LANDSCAPE INDICATORS OF OLD TOWER ROAD ARCHAEOLOGICAL SITE (DbJm-6), THUNDER BAY DISTRICT

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A thesis submitted in partial fulfillment of
the requirements for the degree of Master of Environmental Studies
in Northern Environments and Cultures

Lakehead University

….sacred places where the living may come into contact with the supernatural

(Hamilton et al. 1995:15)

manidoo-minjimendamowin (Ojibwa): spirit memory

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ABSTRACT

This thesis addresses two research objectives. The first investigates landscape factors in the paleo-environment which may have influenced the geographic positioning of an archaeological site near Thunder Bay. The time period under consideration is the Plano, or Late Paleoindian, which spans approximately 6500 to 8500 ^{14}C years BP in northwestern Ontario (Julig 1994). Secondly, an assessment is made of whether a computer-generated landscape model is able to accurately portray real-world conditions at the present time, and whether this process can be applied to future research projects.

Because archaeological sites are often discovered in shoreline environments around Thunder Bay (Hamilton 1996; Phillips 1988), the question arises of whether shorelines may be a major factor in the siting of Plano camps. Field investigations provide evidence that the Old Tower Road site location could have been influenced by its proximity to an ancient shoreline. Other factors that might have also affected the decisions made for that particular site location may never be known. By studying the environs of the Old Tower Road site in detail, landscape indicators may provide important clues (Fry et al. 2004). Put simply, the query is, “Why is it there?”

Weeks of thesis fieldwork permitted a landscape visualization that includes a proglacial lake approximately 2 km north of the study site, one or more debris flows in a high-energy alluvial environment, and the presence of humans who manufactured stone tools at some time period, possibly related to these events. Due to insufficient spatial resolution of the DEM which was created for use in a GIS application, the terrace feature which was discovered during fieldwork is not visible in the final map document. Landscape visual cues may potentially be used in archaeological site prediction (Bellavia 2002; Ebert 2004), although that is not a primary focus of this thesis.

ACKNOWLEDGMENTS

This thesis project came to fruition through the efforts of many people, not only my own. Firstly, archaeological site location data was provided by Robert von Bitter of the Ministry of Tourism, Culture and Sport. Secondly, GIS technical support was afforded freely and generously by Jason Freeburn and Tomislav Sapic, both of Lakehead University. Without these critical inputs, it is doubtful whether I would have been able to complete the mapping component as effectively. To each of these three individuals, I owe my sincere thanks.

My co-supervisors, Adam Cornwell and Scott Hamilton, along with Kamil Zaniewski as committee member, all served as estimable sounding boards for my many issues of concern. Their collective knowledge and experience proved invaluable in areas such as planning, data collection, and interpretation of results. As well, personal visits by all to the study site were much appreciated by me; Scott's visit of July 24, 2013 held additional meaning for both of us. In addition, I recognize Brian Phillips for his willingness to share his extensive knowledge of geoarchaeology in the Thunder Bay area. Mark Puumala's site visit aided in geological interpretation of the valley. Dion Wiseman of Brandon University provided helpful comments and suggestions in his role as external examiner.

I thank my family for their love and encouragement throughout my university career, especially the cheering from the stands by my sons Wolff and Russell. In particular, I owe a great debt to my husband, Blake, for his unstinting support with the fieldwork component of the thesis. We were faced with numerous challenges during twelve weeks of strenuous physical effort, and Blake's optimistic doggedness in the face of difficult odds kept me going a lot longer than I might otherwise have done.

Lastly, I acknowledge the practical bush skills given to me by my parents over the course of my life; it is the greatest gift that can be bestowed.

DEDICATION

This work is dedicated to my parents, who both passed away while I was an undergraduate. They taught me to discover the forest.

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DEFINITION OF TERMS

BP: Before Present (before 1950 A.D.) An indicator of time used in radiocarbon dating, measured in radiocarbon years.

Beringia: Ancient land bridge between Asia and North America.

Cal. BP: Radiocarbon date in years converted to calendar date in years.

Debitage: Flakes produced as a byproduct during the manufacture of stone tools.

DEM: Digital Elevation Model. Three-dimensional representation of a terrain surface.

GIS: Acronym for Geographic Information Systems. Computer software programs developed to display, analyze, store, and manage geographic information databases.

GPS: Acronym for Global Positioning System. Space-based satellite navigation system that provides locational information to a receiver on Earth.

Haplogroup: A genetic population group of people, sharing a common ancestor.

Jasper Taconite: Iron-bearing sedimentary rock in which the iron minerals are interlayered with quartz, chert, or carbonate; fine-grained silica containing varying ratios of magnetite and hematite.

LFH Layer: Soil layer consisting of leaf litter, twigs, and fermenting or humified material.

MTCS: Ontario Ministry of Tourism, Culture and Sport; responsible for administration of the Ontario Heritage Act, and which issues archaeology licenses under the Act.

NTS: National Topographic System. Canadian federal government source of topographic mapping data.

TIN Surface: Triangulated Irregular Network. Terrain model using a set of non-overlapping triangles.

CHAPTER ONE

1.0 Introduction

This thesis is concerned with two objectives: a) an exploration of landscape variables that may suggest, in part, reasons for the location of an archaeological site (Glantz and Todd 2003), and b) an assessment of how well a computer-generated landscape model portrays real-world conditions in the modern day.

Both objectives serve a single purpose: to critically evaluate the approach taken toward archaeological site prediction and research in Ontario, Canada. An examination is made of the assumptions established by earlier academics and by contemporary applied researchers in the cultural resource management field. This test case uses three specific methods of inquiry: map analysis, pedestrian inspection, and subsurface archaeological reconnaissance. These methods highlight issues surrounding our current understanding and interpretation of past human land use patterns, and how limited scientific evidence can influence decisions made regarding which modern landscapes are more likely to yield artifacts than others.

The time period under consideration is the Plano (Late Paleoindian) of approximately 6500 to 8500 ^{14}C years BP in northwestern Ontario (Julig 1994). Such Plano cultural deposits are generally assigned to the Lakehead Complex found throughout an upland zone that occurred between proglacial lakes Agassiz and Minong and the Laurentide Ice Sheet (see Figure 2.4). This thesis utilized one known Lakehead Complex site, Old Tower Road, DbJm-6, as a case study. The study area is contained within the boundaries of National Topographic System Map 52B01, representing Jean Township, 75 km southwest of the city of Thunder Bay (see Appendix A, Maps 1, 8). A brief discussion of the physical characteristics of the region follows.

The Precambrian Shield of northwestern Ontario, with its modern boreal forest mantle, is a dynamic landscape that has undergone significant change over millennia since the Last Glacial Maximum of 21,000 BP (Trenhaile 2007). Isostatic adjustments and their effect on the hydrological system, ongoing erosional processes, climate fluctuations, forest succession dynamics, and human impacts have all contributed to landscape modifications of the territory

(Pinter et al. 2011), and these are reflected in the features that we study today. During the prehistoric interval which encompasses the Plano period, boreal forest was present in the region (Björck 1985; Julig 1984; Kingsmill 2011; Saarnisto 1975). Researchers have uncovered evidence of ancient forests that grew, were drowned by catastrophic floods and eventually flourished once more (Boyd et al. 2010; Yu et al. 2010). Change in the hydrologic system due to climate variation is potentially the greatest factor in the evolution of the landscape over time, and since access to water is an essential consideration in human land use, this transformation has important archaeological implications.

Archaeological sites have been discovered on the shorelines (or former shorelines) of lakes and rivers for decades in the Thunder Bay area (Fox 1975; McLeod 1980; Phillips 1993). Erosion precipitates the discovery of artifacts as they occasionally dislodge from banks or are exposed on beaches. Some researchers believe that the comparative ease of detection in such circumstances may have led to an over-representation of archaeological material associated with shoreline situations (Hamilton 2000; Ross and Wahl 1979); in other words, it is a convenient type of environment for locating artifacts. Sites in areas of modern forest cover tend to be obscured and are usually discovered as a result of chance, rather than of a systematic (deductive) method of prediction or archaeological survey (Fisher 1999). Physical constraints of conducting research in the forest include accessibility, length of frost-free period, cost (both human and monetary), and logistical difficulties, among others. The challenges that the boreal forest offers to explorers can be a deterrent to many programs of inquiry, further predisposing them to focus their attention upon the most readily accessible and visible locations.

In light of the significant geomorphic, hydrological, and ecological transformation during the Holocene, the contemporary landscape might be quite different from that which existed during Plano times. Understanding these transformations is essential in order to model the landscape on a large scale (Phillips and Fralick 1994), in any effort at understanding how, where, and perhaps why Plano people used their environment as they did. A gap exists in the current literature regarding the detail of documentation of past climatic and ecological conditions, since few to no organic remains are preserved in the boreal forest’s acidic soils (Phillips 1993). It is usual for archaeologists working around Thunder Bay to recover only stone tools and debitage from prehistoric sites of 8,000 years ago (Schweitzer 2012). The focus of this research and an overview of the study area of interest are discussed in the following sections.

1.1 Research Focus

The main thrust of this thesis is two-fold. First, detailed examination of the study area seeks to determine whether specific landscape indicators can point to a possible reason, or reasons, for the Old Tower Road site to be located where it is. Such a search aims to identify relevant geomorphic and sedimentary characteristics that might aid in documenting former stream or river courses, beach features, points of high ground, terraces, outcrops of tool stone, and other features that might have been either attractive or unattractive for human use. However, the danger of intellectual bias lurks in such identification exercises of natural landscape features. Are we trying to visualize what an ancient landscape truly resembled, or are we extrapolating modern landscape values into the distant and largely unknown past? Also, what benchmarks can be used to define any feature(s) as attractive or not? These questions highlight critical limitations in such methods of enquiry and suggest the care that must be taken in attempting any type of conclusions.

Second, after identifying the study area, published cartographic data in the form of NTS paper maps were examined. At a scale of 1:50,000, small natural features would not necessarily be visible, and all maps contain some measure of error when compared to the physical world (Slocum et al. 2009). Some such systematic errors are inherent in the means of conventional NTS map production via air photo interpretation. These maps formed the basis of the geospatial data that was assembled for GIS analysis in this thesis, and the limitations associated with the original data are perpetuated throughout this analysis. By ground-truthing within the study areas on a different (larger) scale than that of the map/data, a validity test could be performed to verify which physical features were actually visible, and if so, what positional error was present. Aside from a difference in elevation, the two individual study areas under investigation showed little to differentiate them upon examination of the existing cartography.

Field observations of mapped features, such as breaks in slope, stream location, and other physiographic features within the study areas are compared to the plotted location of the same features using the geospatial data available. The contemporary form and position of these features are represented within these data, and the field-mapped location of the same features will be collected using hand-held GPS and plotted for the purposes of a simple, visual comparison. The amount of divergence related to position, size, and shape between mapped features on the cartographic products compared to field observation of the same features will be recorded and assessed. It is expected that some error will be present through aerial imagery "shadows" caused by the presence of nearby mountains, satellite geometry and vegetative cover. A series of ground control points will be taken with a hand-held GPS unit to determine the amount of error. These points will be added as a layer to the map document, keeping in mind that the GPS unit itself carries an advertised degree of precision of ± 3-4 m.

1.2 Overview of the Study Site Area

The study site area was selected based upon my own selection criteria. These criteria include modern road accessibility, proximity to Thunder Bay, degree of landscape modification, and presence of known archaeological sites of the Plano time period.

Accessibility of the study site area by road was paramount for effective fieldwork. Because the field crew was carrying out research on foot, it was necessary to bring in portable equipment, shared among crew members. This equipment included measuring devices, food, water, raingear, camera, maps, First Aid kit, and bear deterrent, among other miscellaneous personal and professional items. In terms of physical challenge, the boreal forest is an environment which must be taken seriously. It presents numerous potential hazards to any traveler, not the least of which is fatigue. Therefore, the study site area would need to be as close as possible to a traveled road. In this way, the physical demands of the field research would be somewhat mitigated.

NTS Map B5201 displayed an access road to the study area from Highway 588, a hard-surface, two-lane secondary highway. According to Google Earth imagery, this access road was surfaced with gravel and appeared to be free of obstruction to vehicular traffic. It is important to note that the study area was not visited prior to preliminary fieldwork.

Distance of the study site area from Thunder Bay was a factor in terms of both time and money (i.e. fuel cost for vehicles). As well, in case of accident, injury, or illness, medical help would not be too distant to be of timely benefit. The study area is approximately 75 km southwest of Thunder Bay.

Over the past fifty to one hundred years, modification of the natural landscape through infrastructure development has resulted in significant change to the Thunder Bay area. While modern transportation corridors represent a relatively narrow band of landscape modification, they are nonetheless sufficient to affect the landscape. When visualizing an ancient landscape, this must be taken into account. The study area selected had the advantage of containing relatively fewer roads than areas closer to Thunder Bay. As well, gravel extraction by contractors near the city has changed the natural topography to a degree that makes those Plano period site locations less desirable for selection. Choosing an area which contains less anthropogenic modification rather than more is logical.

An archaeological site dating to the Plano period was identified within the study area. This determination is based upon lithic typology and is reflected in data records obtained which form the basis of the thesis dataset. Because sites from the time period of interest are already recorded, this made the study area more attractive for fieldwork purposes.

These four location attributes of accessibility, distance to Thunder Bay, degree of landscape modification, and presence of Plano material made the selected study area the most viable and practical location to carry out the research.

1.3 Chapter Organization

Chapter 1 begins with an introduction, research focus, and overview of the study area. Chapter 2 offers a summary of the Plano period in northwestern Ontario, with information on the paleo-environment, initial peopling of the region, their proposed subsistence strategies, and current archaeological site distributions from that time in prehistory.

Chapter 3 discusses the dataset used in this study, as well as its limitations. Chapter 4 details the methodology in terms of procedures, assumptions and limitations, and the decision-making process for field work.

Chapter 5 describes results, and Chapter 6 provides a discussion of those results in terms of addressing the thesis objectives. To conclude, Chapter 7 assesses the model's performance in broader terms, with suggestions for future approaches in similar studies and the implications of this type of research.

CHAPTER TWO

2.0 The Plano Period in Northwestern Ontario

The Plano period is relatively unknown, particularly when considering the regional history for northwestern Ontario. It is generally accepted that the initial peopling of the Americas occurred in one or more waves of human groups travelling across Beringia during the last glaciation at least 15,000 years ago. While a range of ideas are conjectural and based upon minimal data, it is also believed that some human groups migrated northwards as deglaciation proceeded and colonized the emerging landscape. The following summary presents the current model derived from a variety of sources.

The Plano period is also known as the Late Paleoindian period in North America and is thought to date between approximately 6500 and 8500 ^{14}C years BP (Fagan 2000; Julig 1994). Early researchers categorized people from this time period as Pleistocene big-game hunters, and interpretive parallels were drawn with Upper Paleolithic hunters from Europe (Owen et al. 1967). Plano as an archaeological term derives from characteristic projectile point forms which were used by big game hunters and which were recovered from widely scattered sites across the Great Plains (Dickason and Newbigging 2010). Plano includes a variety of distinctive projectile point forms that are thought to reflect discrete cultural traditions or populations (Jennings 1968). Some names for these traditions include Hell Gap, Agate Basin, and Eden, and there are many others. Plano people, therefore, encompassed a huge geographic and temporal span throughout North American prehistory.

An important detail to remember is that as ice masses melted at the end of the Wisconsinan glacial period, the movements of humans were affected both temporally and geographically. In other words, Plano cultural activity was time-transgressive (Phillips 1988). The spread of people and their culture progressed in a broad front northward from the geographic southern limit of Laurentide ice in Canada (Markham 2013). Their travel extent over any given area from year to year was affected by ice ablation as well as the formation and drainage of proglacial lakes.

2.1 Paleo-environment

The Laurentide Ice Sheet was the single most influential paleo-environment factor affecting northwestern Ontario. Approximately 21,000 years ago, this massive ice lobe covered the entire province during the Last Glacial Maximum of the Late Wisconsinan period. So great was the weight of its 3500-4000 m depth that the continental crust of North America was depressed by more than 800 m (Trenhaile 2007). Climate worldwide was affected by the glaciation event (Broecker 2000). By approximately 18,000 years ago, the ice began to thaw as global temperatures warmed, and vast amounts of meltwater accumulated adjacent to the remaining ice mass (Pettipas 2011). Without the weight of ice bearing down upon it, slow isostatic adjustment of the Earth's crust caused a "springing back" or uplift of the lithosphere, contributing to the formation and the changing configuration of glacial lakes along the margins of melting ice (Teller 1987). Many of these lakes were temporarily restricted in their ability to drain (Braun et al. 2008), such as Lake Agassiz which formed over southern Manitoba (Pettipas 2012). Lake Agassiz existed from approximately 14,000 to 9000 years ago (Trenhaile 2007). As isostatic adjustment continued to occur for millennia (and is still ongoing), regional drainage patterns were affected, including those in northwestern Ontario. Periodically, Lake Agassiz waters bridged the continental divide and entered the glacial Lake Minong basin (Farrand and Drexler 1985; Teller and Thorleifson 1983; Teller and Mahnic 1988) in what is now the Thunder Bay region (see Figure 2.1).

Relict beaches provide evidence of changes in drainage (Baedke et al. 2004), particularly the serial cataclysmic discharges of Lake Agassiz (Leverington and Teller 2003; Phillips and Fralick 1994; Slattery et al. 2007). These beaches were witness to the swift geomorphological changes that occurred over short spans of time, as little as decades, in some cases (Yu and Eicher 1998). As our present boreal forest in the Thunder Bay area appears unchanging in some respects, it is difficult to imagine how rapidly the landscape evolved at the end of the Late Wisconsinan period (Bajc et al. 1997). This volatility has been demonstrated through pollen core data that indicates the species that first colonized the newly ice-freed terrain and those that succeeded them (Björck 1985; Julig et al. 1990; Saarnisto 1975).

Figure 2.1 details a projected sequence of deglaciation in the area northwest of Lake Superior, as determined by Phillips (1993) for the time period under review.

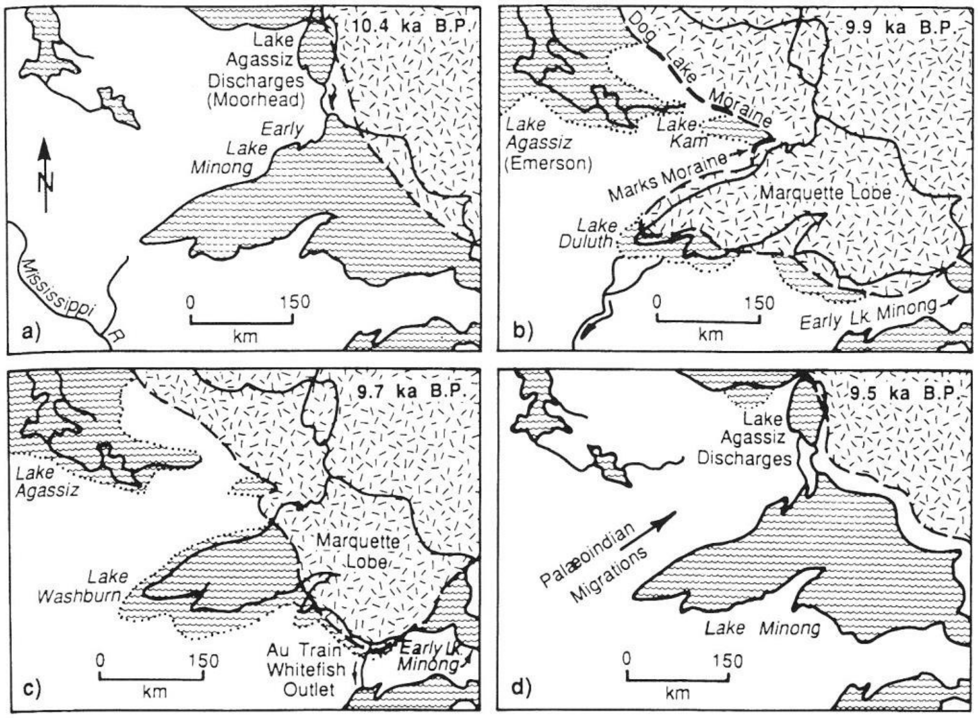

Figure 2.1. Deglaciation sequence for the Thunder Bay region between 10,400 BP and 9500 BP. From Phillips 1993.

Archaeological research in the Thunder Bay area has proposed a timeline of prehistoric environmental change; this will be addressed in the succeeding subsections, beginning with a discussion of the paleo-climate, followed by an examination of both the flora and fauna.

2.1.1 Early Holocene Deglaciation and Climate

The northwestern Ontario region close to the International boundary was ice-free by approximately 10,400 BP (Lowell et al. 2009), before being engulfed with ice again during the Marquette Re-advance at roughly 9900 BP (Teller 1985). Following a relatively brief return of cold, the region was re-opened to species colonization by 9500 BP (Bajc et al. 1997; Phillips and Fralick 1994; Saarnisto 1975).

During this time period, Lake Agassiz continued to exist along the melting ice margin, periodically achieving an elevation sufficient to breach the height of land between the Arctic and Atlantic drainage basins. This allowed catastrophic surges of meltwater to flood out of Lake Agassiz and into both the Lake Nipigon and Glacial Lake Minong drainage basins, causing rapid shifts in the hydrological system and available landscape. Since the western channels were at higher elevations than easterly ones, this offers insight into the rapid retreat of Laurentide glacial ice which opened a succession of drainage channels (Teller and Thorleifson 1983). These are suggested by lag deposits, consisting of laminated silts and clays to sands and gravels that may be identified today in surface cuts (Teller and Mahnic 1988). Similar dynamic patterns of glacial lake formation and drainage also likely affected the Whitefish Lake area, where fieldwork for this thesis was completed.

Figure 2.2 details major meltwater channels between Lake Superior near present-day Thunder Bay and the Nipigon basin. The channels were embayments of the lakes soon after deglaciation (Yu et al. 2010).

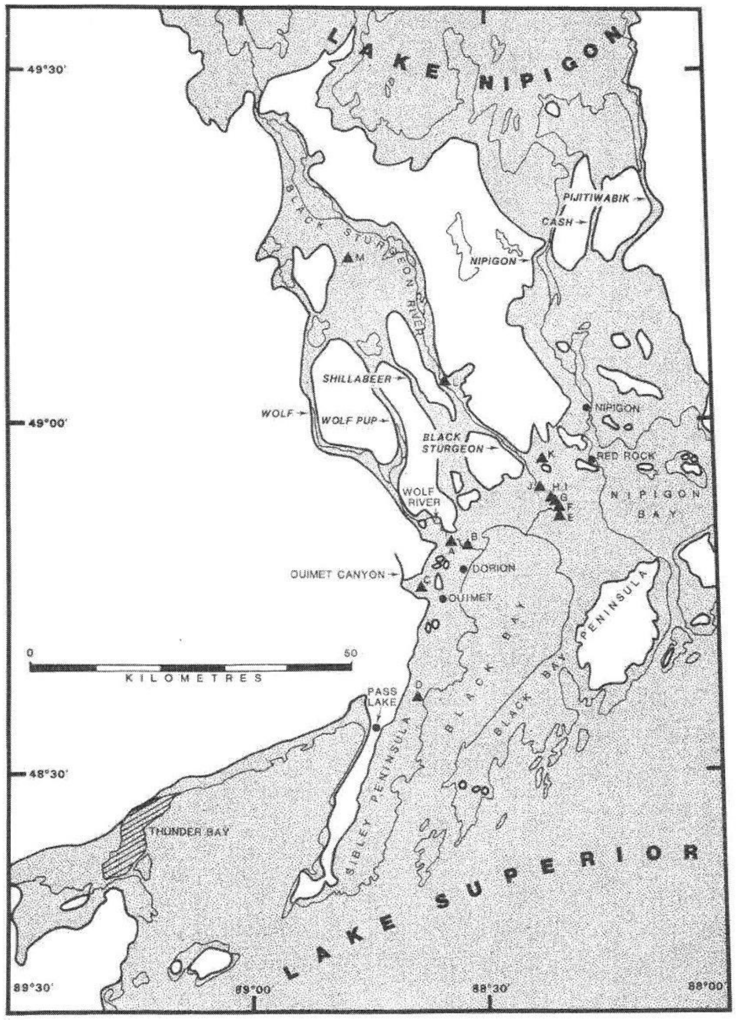

Figure 2.2. Major meltwater channels between the Nipigon basin and Lake Superior. From Teller and Mahnic 1988.

Regional temperatures warmed rapidly as the Laurentide Ice Sheet thawed, and moraines were left behind as evidence of the transition period (Lowell et al. 2009). Changes along the ice front led to ground moraines where ablation was rapid, and terminal moraines formed where stable ice margins allowed rubble to accumulate (Bennett and Glasser 2009). Yu and Eicher (1998) believed that climatic forcing caused by atmospheric circulation was a significant factor in the rate of warming at two lakes in the Niagara Escarpment; this process may have also affected northwestern Ontario, although it has yet to be demonstrated. Whatever the case, a periglacial environment soon developed, characterized by aggrading glacial outwash streams and subarctic conditions, where mean monthly temperatures averaged 0°C for more than half the year. Vegetation was sparse, leading to wind erosion of fine sediment from outwash plains and low annual precipitation rates (Péwé 1969).

While specific environmental conditions in the Thunder Bay area are not well documented for the early Holocene (10,000 BP), it is known that climate throughout much of North America at this time underwent significant warming (Birks 2003). In comparison with present-day climate, the early Holocene is thought to have had warmer summers and colder winters, as well as lower precipitation rates (Williams et al. 2010). Atmospheric circulation pattern change may have been responsible for the northward movement of the Arctic Cold Front, resulting in geographic locational modification of the boreal forest/Great Lakes - St. Lawrence forest ecotone; it existed further north than it does today. The climate continued to become drier and warmer between 6000 and 4500 BP (Liu 1990). These events are evidenced in the pollen and macrofossil remains of flora, as will be discussed in the following subsection.

2.1.2 Flora

When the landscape in the Thunder Bay area was freed of glacial ice, a comparatively brief time lag ensued before vegetation became established (Björck 1985). Sediments that were previously exposed to constant winds settled in leeward places and weathered, eventually creating stable surfaces for seeds to take root. Over a continuum, soil pH changed due to the addition of organic matter, and this organic matter built up to a sufficient degree to support plant life (Saarnisto 1975). It is believed that open tundra (Birks 2003) formed the first ecological reservoir in the region, populated with low-growing herbs and sedges (Björck 1985; Julig 1994; Julig et al. 1990). Hamilton (1996) states that local environments probably consisted of a fine-grained ecological patchwork, where species more or less tolerant of harsh conditions took hold in specific microhabitats. In the area east of Thunder Bay today, arctic/alpine disjunct plants continue to exist in exposed locations with less sunlight (canyon walls) and consequently lower temperatures.

The tundra phase did not last more than a century before pioneer vegetative species were joined and replaced by arboreal species (Julig 1994; Lowell et al. 2009). Colonization by spruce *(picea)*, larch *(larix)*, and birch *(betula)* is evident in the ancient past's record (Björck 1985). Temperatures continued to climb during this time, marking the beginning of the Hypsithermal warm phase (Julig et al. 1990) and the Houghton low phase of Lake Superior (Boyd et al. 2010). Pine *(pinus)* replaced spruce in areas that became increasingly drier (Björck 1985; Saarnisto 1975), and relative quantities of alder *(alnus)* and birch increased as well (Julig 1994). In time, the Great Lakes – St. Lawrence forest transition zone moved to a projected latitudinal line approximately 140 km north of where it exists today, as determined by Liu (1990) in his research in north central Ontario. New species found in the region included oak *(quercus)*, elm *(ulmus)*, cedar *(thuja)*, and ash *(fraxinus)*. As well, the prairie-forest ecotone shifted eastwards, reaching its maximum position in northeastern Minnesota by between 7000 and 6000 years ago (Williams et al. 2009). Closed forest continued in upland areas and on north-facing slopes, while open woodlands dominated south-facing slopes (Julig et al. 1990).

Table 2.1 lists radiocarbon ages of materials dated to the early Paleoindian and Plano periods from a number of locations at or near Thunder Bay. Geographic locations of samples which were tested are included, as well as the types of material recovered.

Table 2.1. Radiocarbon ages from early postglacial sites in the Thunder Bay area. Modified from Boyd et al. 2010.

	Site name	Lab number	^{14}C years BP	Calibrated 2σ range and mean (cal BP)	Material dated	Context	Modern elevation (m asl)	Latitude (N)	Longitude (W)	Reference
1	Rosslyn Pit	GSC-287	9,380 ± 150	11,094–10,248 (10,671)	Wood	Base of Minong beach	227	48°21.8′	89°27.3′	Dyck et al. (1966)
2	Cummins Pond	TO-547	9,260 ± 170	11,092–9,948 (10,500)	Conifer wood	Basal sand (Minong beach)	230	48°24.3′	89°20.9′	Julig et al. (1990)
3	Old Fort William	UCIAMS-26800	8,135 ± 25	9,127–9,009 (9,070)	Wood	Tree in life position extending into silty clay	186	48°20.7′	89°21.1′	This study
4	Boyd Cut	ETH-31437	8,070 ± 70	9,046–8,658 (8,850)	Charcoal	Base of interlaminated clayey silt and sand	199	48°20.4′	89°21.5′	Loope (2006)
5	Old Fort William	UCIAMS-26801	8,010 ± 25	9,005–8,776 (8,891)	*Picea* sp. cone	Located at base of silty clay in organic laminae	186	48°20.7′	89°21.1′	This study
6	Boyd Cut	ETH-31438	7,995 ± 65	9,014–8,641 (8,828)	Charcoal	Base of interlaminated clayey silt and sand	199	48°20.4′	89°21.5′	Loope (2006)
7	Upstream paleochannel	UCIAMS-61732	7,990 ± 20	8,994–8,774 (8,884)	*Pinus banksiana* cone	Located at base of silty clay in organic laminae	186	48°20.5′	89°21.2′	This study
8	Old Fort William	UCIAMS-26802	7,970 ± 30	8,993–8,659 (8,826)	Wood	Log in silty clay ~2.5 m above base of unit	189	48°20.7′	89°21.1′	This study
9	Old Fort William	UCIAMS-61733	6,420 ± 20	7,421–7,291 (7,356)	*Scirpus* sp. achenes	In upper organic deposit	195	48°20.7′	89°21.1′	This study
10	Surprise Lake	BETA-230960	8,170 ± 40	9,010–9,260 (9,135)	*Betula* leaves and scales	Lake isolation	187	48°20.1′	88°49.3′	Yu et al. (2010)
11	Little Harbor	ETH-32328	8,365 ± 100	9,090–9,540 (9,315)	*Betula* leaves and twigs	Lake isolation	183	46°49.2′	85°21.7′	Yu et al. (2010)

By approximately 4500 BP, conditions returned to a cooler, wetter regime, and species such as spruce *(pices)*, balsam *(abies)*, and jack pine *(pinus banksiana)* recolonized the zones where they had first appeared in the early Holocene (Björck 1985). Figure 2.3 shows a pollen profile for Cummins Pond, which is situated within the city limits of Thunder Bay (Julig 1994). Densities of species common to the current climatic zones are identified, showing when higher concentrations of those species occurred. When examining these diagrams, one must keep in mind that relative percentages of pollens may not accurately represent actual species growing in a particular localized area in all cases. Factors such as fire and wind are capable of transporting pollen outside of their normal growth range (Birks 2003). As well, the issue of pollen preservation under certain conditions must be considered. In other words, species diversity and dominance may be over- or under-represented in the pollen record due to the fact that one species is better preserved while another deteriorates more rapidly (Liu 1990).

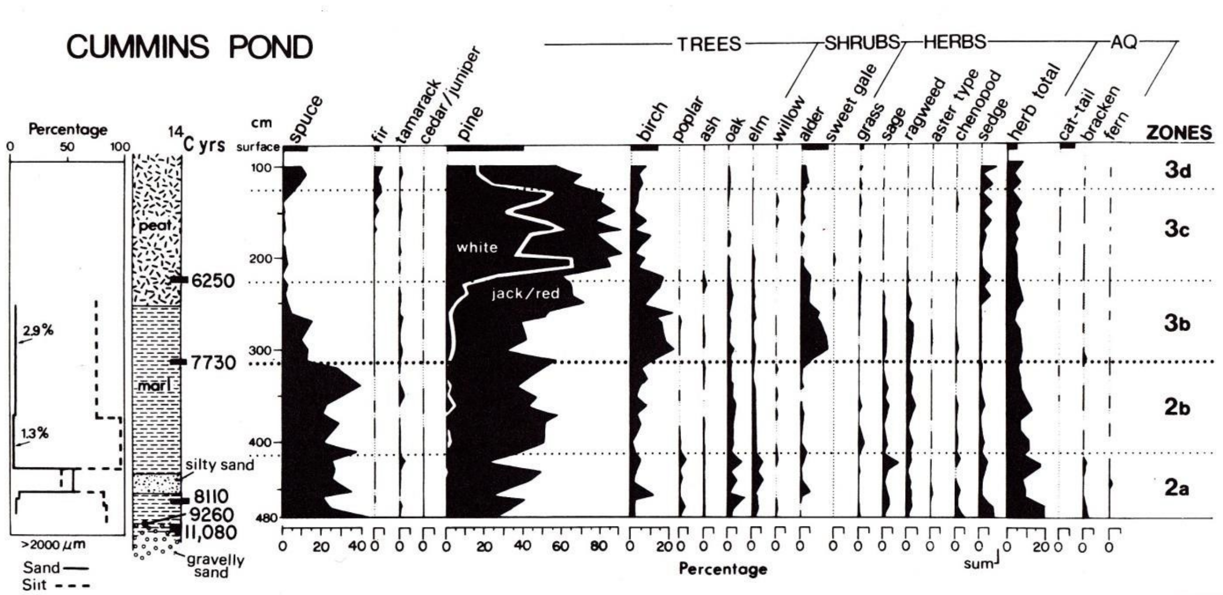

Figure 2.3. Pollen profile for Cummins Pond. From Julig 1994.

The early post-glacial context of northwestern Ontario was ecologically dynamic, with a floral species mix that reflected this diversity of habitat. Climatic change that occurred in abrupt sequences is evidenced by sedimentary records (Yu and Eicher 1998) and by changes in the hydrologic system through the study of lake history (Slattery et al. 2007). One may argue that the region's primary characteristic was that of ever-changing physiographic conditions.

2.1.3 Fauna

Evidence of fauna during the Plano period in northwestern Ontario is sparse at best. The principal reason for this is due to the acidic nature of the soil, which degrades organic material relatively quickly, in years to decades (Hamilton 2000). Another important factor is the fluctuation in water levels when the region was deglaciated. Even in ranges of one to two metres, these fluctuations resulted in the burying of evidence through changes in river mouths and marshy areas over time (Phillips 1993). Given that the Plano period existed 8000 years ago, it is obvious that the archaeological record is currently missing data which would permit more robust interpretation of sites from that time period.

Plano populations have been referred to as hunters, with a primary interest in exploiting caribou *(Rangifer tarandus)* (Dawson 1983; Julig 1984; Krist and Brown 1994; Shott 1986). The Cummins site (DcJi-1) yielded a few bone fragments that were tentatively identified as the proximal end of a caribou radius (Julig 1994). Caribou are tundra dwellers, and because tundra was present when the Thunder Bay area became ice free (Birks 2003), it is reasonable to suggest that the species could have been present then. However, difficulty exists in further determining whether a possible caribou bone from the Cummins site was from the woodland or tundra subspecies, and therefore, any conclusion regarding the presence of this species is provisional at best. Hinshelwood (1990) suggests that caribou may have been utilized at the Bröhm site (DdJe-1) east of Thunder Bay. A confirmed species from the Cummins site is that of the white-tailed deer *(Odocoileus virginianus)*(Julig 1994). McAndrews (1982) reports that Hypsithermal woodland existed in the Kenora area, hosting bison *(bison* spp.*)* as another possible prey resource, although this would be later in time (mid Holocene) than initial Plano presence. Evidence of prehistoric moose *(Alces alces)* was also discovered in northwestern Ontario, radiocarbon dated to 7898 ± 423 cal. BP (Kenyon and Churcher 1965, cited in Pettipas 2011).

Besides these game mammals, other species that perhaps formed part of the Plano diet include the beaver (*Castor canadensis)*, muskrat *(Ondatra zibethicus)*, hare *(Lepus)*, and porcupine *(Erethizon dorsatum)*. Newman and Julig (1989) discovered a range of generalized fauna, both large and small game, represented in their blood residue analysis of Cummins site artifacts; their results have since been challenged on issues of taxonomic specificity and results replicability. Early peoples to the Thunder Bay region may have employed a broad spectrum foraging economy to meet their caloric needs, and this assertion is supported by Newman and Julig's results. Further candidates that are believed to have inhabited northwestern Ontario during the Plano period comprise the turtle *(Chrysemys picta)* and fish such as pike *(Esox Lucius)*, sturgeon *(Acipenserinae fulvescens)*, and lake trout *(Salvilinus namaycush)*. Migratory waterfowl represented by species of geese *(Branta* spp.*)* and ducks such as the Northern pintail *(Anas acuta)* could have also inhabited the type of environment that existed at that time (Julig 1994). However, no evidence of any of these species has been discovered to date in the study site area of this thesis research.

2.2 Initial Peopling of the Region

Before examining how and when humans first arrived in the Thunder Bay area, the study of peopling on a continental scale must be revisited. More information has become available in recent years as efforts continue to determine both the origins and travel routes of the first peoples to enter North America (Anderson and Gillam 2000). One study found that the earliest population of between 70 and 2,000 individuals crossed Beringia in a single migration event approximately 15,000 cal. BP (Mulligan et al. 2008, cited in Peros et al. 2010). Research by Kashani et al. (2012) discussed the possibility of two distinct lineages of humans either travelling together in a single group or in two closely-timed migrations, evidenced by the age and geographic distributions of the two haplogroups (genetic populations sharing a common ancestor) studied. The haplogroup C4 was relatively common in populations which had originated in Siberia and were later manifested in the Great Lakes and Great Plains areas. Haplogroup X2a was brought to Siberia from the Near East and has also been found in North American populations (Goebel et al. 2008).

Research at the Buttermilk Creek Complex in Texas has brought forward new evidence of a pre-Clovis occupation dated between 13.2 and 15.5 thousand years ago (Waters et al. 2011). Two other archaeological sites recognized as potentially pre-Clovis are Monte Verde in Chile (Meltzer et al. 1997), at 14,877 ± 506 cal. BP (Dillehay 2002) and Meadowcroft Rockshelter in Pennsylvania at 20,593 ± 992 cal. BP (Adovasio 1978). The Clovis Paleoindian culture is thought to have appeared approximately 13-13,500 cal. BP in North America. Historically it has been viewed as the first distinctly recognizable culture of human occupation since the melting of the Wisconsinan glacial ice. Regardless of when exact dates place humans in the Americas, it is clear that humans occupied the continents for a substantial period of time before the appearance and geographic spread of Clovis technology.

Debate over the initial peopling of the Americas is ongoing, with a Pacific coastal route also being suggested for travel when glacial ice closed the interior corridor between Alaska and Montana. Humans may have arrived even before the Last Glacial Maximum, as early as 32,000 years ago, but there has been no unequivocal archaeological evidence discovered to date in North America to support this idea (Goebel et al. 2008).

People were unable to enter the Thunder Bay region before approximately 10,400 BP due to the presence of the Laurentide Ice Sheet (Lowell et al. 2009). Once the ice had melted by 9900 BP, however, the periglacial environment was available for colonization, although the landscape may have proved physically challenging in some areas due to local climatic characteristics. The Marquette Re-advance signaled a return to colder conditions once more, until glacial ice melted permanently by 9500 BP (Björck 1985). This process might have obliterated any evidence of earlier human occupation of the area prior to the Marquette Re-advance. It does not appear to have taken the first peoples moving into northwestern Ontario long after that to begin accessing resources. The first groups of migrants are thought to have originated from North Dakota, Minnesota, and Wisconsin (Ross 1997).

Projectile point recoveries in the Boundary Waters and Quetico areas of northwestern Ontario dating to the Paleoindian and Plano periods are detailed in Fox (1977), including the mid-section of one jasper taconite projectile point recovered from the Arrow Lake site (DaJn-7)(see Appendix A, Map 2). An outcrop of jasper taconite was discovered nearby in the 1970's as the result of a geological survey, and this was believed to be one source of flint knapping material for the Plano people. Fox (1975) identified the inhabitants of the area to the west of Glacial Lake Minong as members of the Lakehead Complex. Comparison of tools from this site locale suggested that technological influence was being derived from people occupying warmer locations to the south (Fox

1975). Figure 2.4 details the geographic extent of the Lakehead Complex at approximately 10,000 BP as determined by Fox.

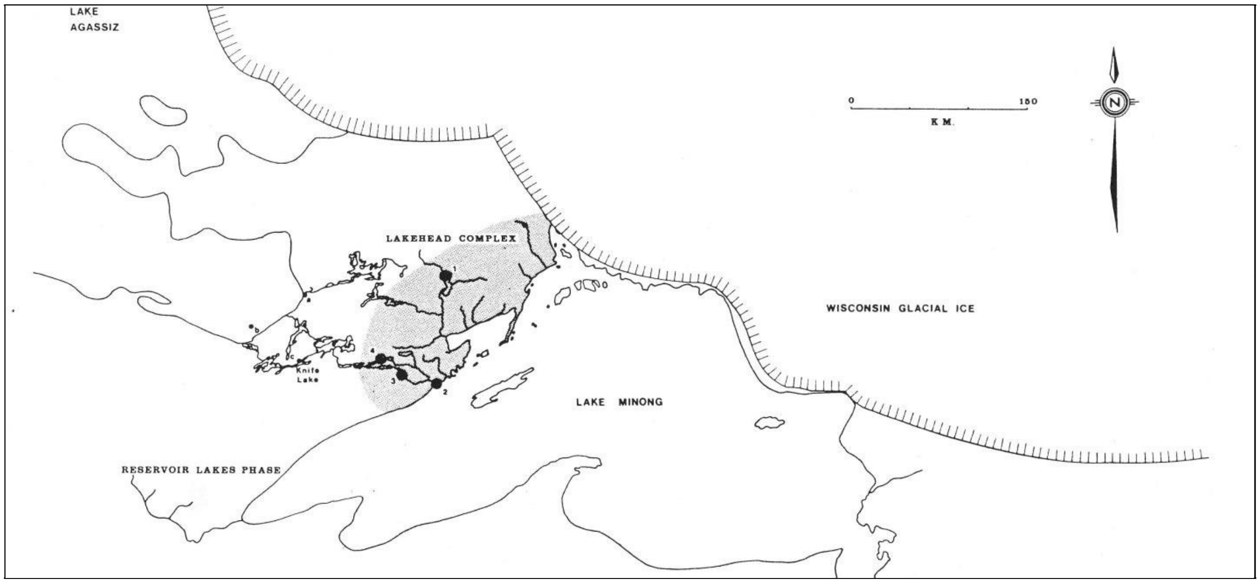

Figure 2.4. Geographic extent of Lakehead Complex at approximately 10,000 BP. Modified from Fox (1977).

Ross (1997) suggested a new definition to explain a number of archaeological complexes in northwestern Ontario, which he termed the Interlakes Composite. One reason for differentiating different cultural groupings was the variety of projectile point styles found in a number of archaeological sites, all of which were assigned Plano affiliation. Another reason was the recognition of cultural phases based upon time sequences, although virtually no control over time is possible in the current archaeological interpretation. Figure 2.5 shows Ross's (1997) interpretation of the geophysical environment of the region, as well as the geographic extent of the Interlakes Composite. Note the location of the Laurentide Ice Sheet and Lake Agassiz relative to the Thunder Bay area.

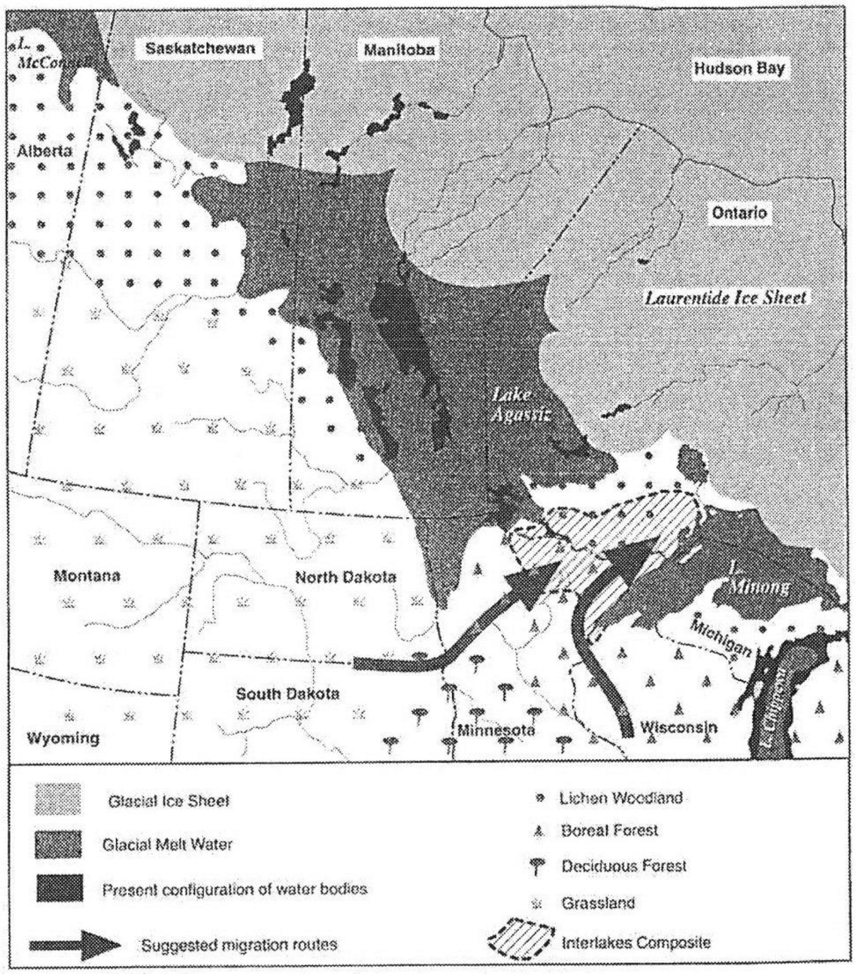

Figure 2.5. The Interlakes Composite. From Ross (1997).

Figure 2.6 displays both site complexes and site locations included by the Interlakes Composite, according to Ross (1997).

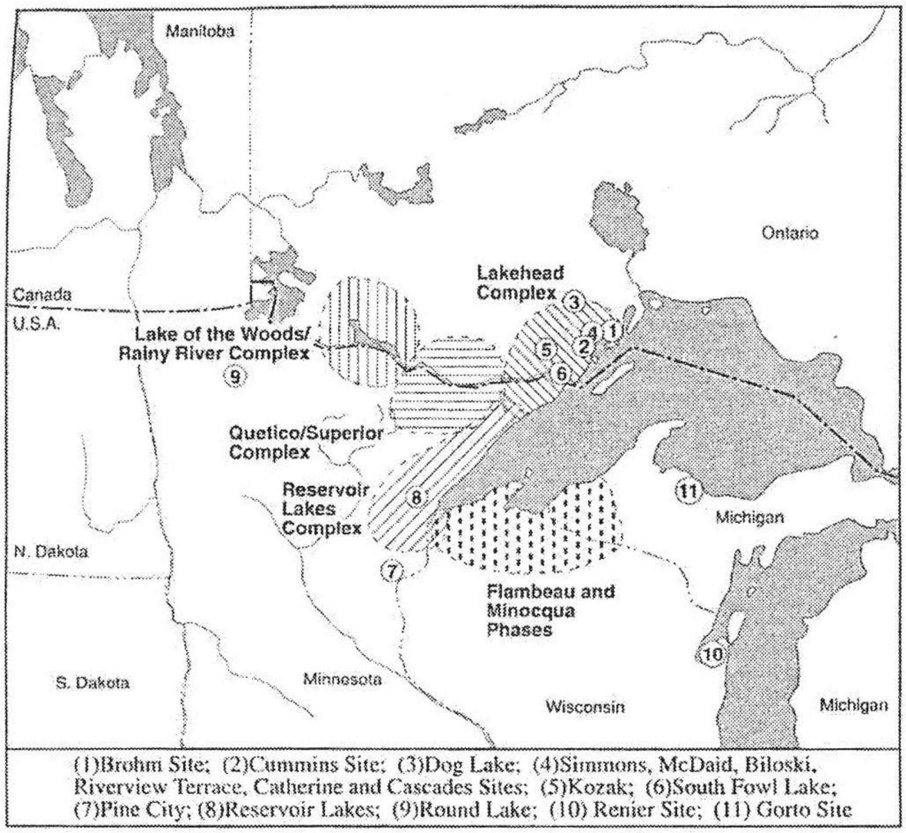

Figure 2.6. Site locations and complexes included in the Interlakes Composite definition. From Ross (1997).

Recent analysis of projectile point assemblage variability at the Mackenzie 1 Paleoindian site east of Thunder Bay has been carried out by Samantha Markham (2013). She notes that a number of specimens share similarities with rather vaguely defined traits of named complexes such as Goshen, Plainview, Cumberland, Scottsbluff, and Eden, among others. However, her perspective is that these similarities were superficial. Characteristic attributes indicate cultural influence from both the east and west, in her view, suggesting skills and knowledge being transferred across geographic space and time. Morphological variation in the assemblage is consistent with characteristics of the Lakehead Complex and the Interlakes Composite as described earlier by Fox and Ross. Lastly, she observed a noteworthy amount of cultural continuity between groups of Plano people that moved into the Thunder Bay region (Markham 2013).

Radiocarbon dates from two Plano sites in the Thunder Bay area are available to place humans in the local environment by approximately 8600 BP. One date is from the Cummins site (DcJi-1) and is recorded as 8480 ± 390 BP (9309 ± 509 cal. BP, Lab No. NMC-1216) (Dawson 1983), and the other is from the Electric Woodpecker site (DdJf-12), recorded as 8680 ± 50 BP (9641 ± 63 cal. BP, Lab No. 323410) (BETA Analytic, cited by Lints 2013; pers. comm.). These two dates closely coincide with the ablation timing of the Marquette Re-advance. With further archaeological work being carried out in the region as a result of future expected natural resource development, more information regarding the first peoples into northwestern Ontario may become available.

2.3 Subsistence Strategies

Plano people have been described as using a generalized foraging strategy as well as large game hunting as the primary means of resource exploitation (Julig 1984; Kuehn 1998; Peros et al. 2010). Even when the Thunder Bay area was very recently deglaciated, bands of hunters may have entered the region in pursuit of caribou on a seasonal basis (Hamilton 1996; Hinshelwood 1990). Old Tower Road (DbJm-6) is located approximately 18 km from another Plano site (Arrow Lake, DaJn-7) that has been described as a possible caribou crossing (Ross 2013; pers. comm.)(see Appendix A, Map 2). McAndrews (1982) identified bison as being present in northwestern Ontario during the Hypsithermal period, suggesting another candidate prey species for prehistoric hunters. In terms of the archaeological record, few examples of biological evidence have been recovered to date as proof of Plano hunting activity at Thunder Bay.

A more confident interpretation of the ecological landscape of the time has been possible due to pollen data interpretation (Björck 1985; Julig 1994). A diverse environment of woodland, closed forest, uplands, and wetlands existed at the time of interest, offering a range of species available for exploitation. This diversity would be manifested by an array of vegetative and animal resources that could have provided a sustained, nutritious diet for much of the year. As the Great Lakes – St. Lawrence forest moved northward by 7500 cal. BP (Liu 1990), northwestern Ontario also received an increase in prairie pollen types (Bernabo and Webb 1977). The result of these changes would be the incursion of animal and bird species into new territories as they accessed their own resources, and in turn, attracted human hunters and foragers. Increasing diet breadth would improve the chances of successful colonization by Plano people, due to the increased predictability of seasonal resources (Jones 2007).

As noted by Yu and Eicher (1998), abrupt climate oscillations were characteristic of the early Holocene. While climatic change may cause increased stress to species, it may also open new windows of adaptation in microhabitats, where species previously not found in particular areas may become commonplace. Food resources that were once unfamiliar can become dietary staples within a short time period (Krist and Brown 1994). First peoples into the Thunder Bay area likely followed a seasonal round of exploitation (Julig 1984) as they travelled in highly mobile groups (Keuhn 1998). Depending upon local climate conditions, Plano people may have extended or shortened their stays in any given area, taking advantage of situations that would support and improve their lifestyle. Hunter-gatherers practiced resource management by using fire to modify vegetation, in order to influence the feeding patterns of animals (Dickason and Newbigging 2010), but it is not known whether Plano people used this economic tool.

Stone tools left from the Plano period continue to be discovered in the Thunder Bay area. Their manufacturing style indicates that they were used for cutting, scraping, chopping, drilling, and sewing, among other things (Dawson 1983). Figure 2.7 shows tools ascribed to this affiliation that were recovered from a number of different sites in the Lakehead region.

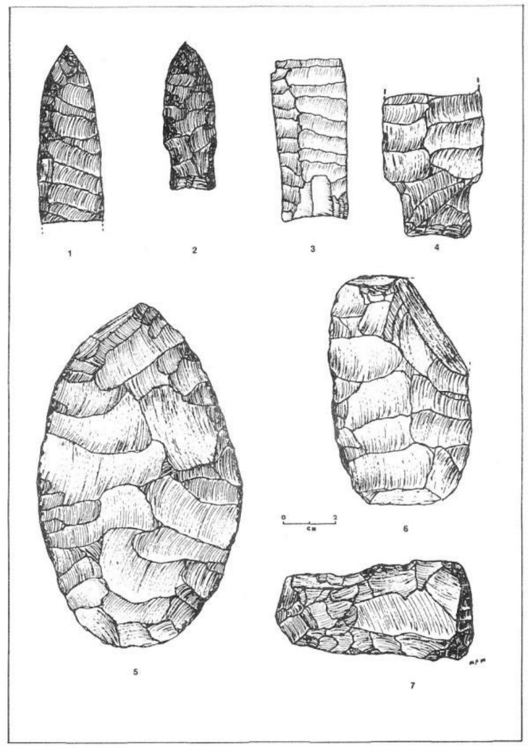

Fig. 3: PALEO-INDIAN ARTIFACTS
1. Lanceolate Projectile Point *Boulevard Lake DcJh-4.* 2. Small Dart Point *Thunder Bay DcJi-1.* 3. Parallel Flaked Projectile Point *DcJi-1.* 4. Scotts Bluff Base *Arrow Lake DaJn-7.* 5. Large Ovoid Biface *Thunder Bay DcJi-1.* 6. Large Biface *Thunder Bay DcJi-1.* 7. End Scraper *Thunder Bay DcJi-1.*

Figure 2.7. Stone tools from the Thunder Bay area. From Dawson 1983.

Tools made for these purposes may be termed ‘general use’ in that they can be adapted to procure any number of prey species, such as birds, fish, or game. Until more is known about specific subsistence strategies at particular Plano archaeological sites (Newman and Julig 1989), one can only surmise that early peoples took advantage of whatever species were available to them, at varying times of the year. The fact that their occupation in the region lasted for millennia indicates that they were highly successful at adapting to changing conditions in their environment.

2.4 Site Distribution

The distribution of Plano sites in the Thunder Bay area is a reflection of ancient land use and/or where archaeologists have looked for them (Hamilton 1996). Shorelines are believed to have influenced patterns of movement and temporary settlement, particularly those that coincided with nearby outcroppings of silica and jasper taconite from the Gunflint Range of northern Minnesota and northwestern Ontario (Phillips 1993). This banded iron-formation rock provided a source of material for tool manufacture and was (and still is) readily available for quarrying. A combination of food resources and the means by which to process them may have been a deciding factor in where Plano people chose to locate encampments. Abundant fresh water in the Lake Superior basin, the presence of trees for fuel and shelter, and lookout points such as local heights, could have tipped the balance in favour of certain locations over others (Jenness 1977).

Anderson and Gillam (2000) assume that individuals are more likely to follow migration routes that require less energy, rather than more, especially when useful resources might be reasonably expected along such routes. This premise appears logical, as it applies to both humans and animals. In hilly terrain, caribou seek paths of least resistance as they cross the landscape (Krist and Brown 1994), favouring ridgelines and valleys. Therefore, ancient hunters could have followed the same or similar routes as their prey at certain times of year (Ross and Wahl 1979). Ergo, evidence of caribou may lead to potential evidence of humans (Julig et al. 1990). In the biologically productive zones of shorelines, such as embayments, marshes and estuaries, one may reasonably expect that Plano people accessed resources there as well (Phillips 1988). The Thunder Bay area is rich is local microhabitats that support a diverse array of species, as was found to be the case thousands of years earlier (Boyd et al. 2010; Saarnisto 1975).

Due to a paucity of scientific evidence, we cannot yet know categorically how Plano people utilized their landscapes. However, ethnographic analogies have been drawn to suggest that they lived in some form of group or band, probably kin-related, and that they almost certainly travelled throughout a territory, rather than remaining sedentary (Dawson 1983; Wright 1994). While these assumptions may eventually be proven correct, there is danger in using this type of approach. To suggest that the lifeways of any group of people remained essentially static over millennia, regardless of significant environmental change, is frankly unbelievable. Generalizations provide convenient explanations for want of hard proof, but it does not necessarily make them valid (Hamilton 2000). Modern perceptions of land use and of the values attached to certain landscapes should be approached with great caution when proselytizing about Plano people. More research into ancient land use patterns will be required before definitive conclusions can be reached.

2.5 Summary

The Plano period forms a unique component of the prehistory of northwestern Ontario. It tells of human movement and adaptation to a changing environment which must have thrown numerous and significant challenges at the individuals and groups who came through this area. By their perseverance and skill, intimate ecological knowledge and endurance, they left behind a legacy for us to discover many centuries later. Fragments of their lives, represented by stone tools, are all we have to go on.

CHAPTER THREE

3.0 Archaeological Dataset Used in the Research

The initial archaeological data used in this project consisted of 171 site locations, all registered in the Thunder Bay region. Because I had no prior knowledge of where Plano sites might be situated in the modern landscape, I sought an overall view to begin my search for a suitable study area. My intent was to explore for potential bias and minimize its impact upon my approach to potential landscape indicators. When the geographic dimensions of the original study area were determined, a table in Microsoft Excel was compiled in order to facilitate the creation of a shapefile to upload into the ArcGIS 10.1 software application. Site data contained all temporal periods, from Paleoindian to Historic. Once a specific study area was selected, only Plano sites were used.

3.1 Archaeological Records

Robert von Bitter of the Ontario Ministry of Tourism, Culture and Sport (MTCS) supplied data for 139 archaeological sites within the wider study area that was originally close to 300 km^2 in size. These site records each contained a Borden number identifier, site name, locational information and notes, collections, and references. They were emailed to me as .pdf attachments in a three-part series dated October 10, October 16, and October 30, 2012.

In addition, another 32 sites were added to the list. These sites were compiled from other sources (Dawson 1983; Fox 1977; Julig 1994; Ross 2013, pers. comm.), and some sites fell outside of the study area. The purpose of this exercise was to amass as complete a set of records as possible in terms of geographic distribution and temporal context, until a suitable study area could be delineated for field research.

3.2. Limitations of the Dataset

Limitations of the dataset included locational accuracy as well as shoreline bias. These two limitations will be discussed in the following subsections.

3.2.1 Locational Accuracy

The site records provided by the MTCS for this research were compiled from decades of research. Earlier reports were recorded by hand and completed on a manual typewriter, before desktop computers were in common use. When determining geographic locations of archaeological sites, researchers often photocopied a section of NTS map and drew on the relevant spot. Occasionally they may have drawn a map location from memory or from a sketch made in their field notes. Cartesian co-ordinates were manually calculated, which might have led to errors in calculation and/or transcription in some cases. As well, hand-held GPS units with reasonable precision were not available during the 1970's-1980's and were not in common use until the late 1990's. As a result, materials were transcribed into a computer database sometimes much later than they were originally recorded, and the accuracy of data often could no longer be checked with the reports' primary authors.

When the research study area for this thesis was selected according to the criteria described in Section 1.2, two Plano sites were chosen for possible further investigation; they were Old Tower Road (DbJm-6) and Arrow Lake (DaJn-7)(see Appendix A, Map 2). I contacted two persons who had visited both sites personally, Diane Delin (an avocational archaeologist) and Bill Ross (a professional archaeologist). The reason for this was to gain first-hand knowledge of and an appreciation for what the sites held.

Based upon these conversations, it became apparent that the geographic location co-ordinates of the Old Tower Road site as provided by the MTCS were inaccurate. In fact, they were inaccurate by roughly 2.5 km, a gross error by the standards of archaeology. The site as indicated by the MTCS was far to the east of the location which both Delin and Ross described to me. After determining the precise location of the Old Tower Road site as provided by Ross's 1986 report (and these personal conversations), the geographic position of the point was changed in the thesis GIS map document. For my research, then, Old Tower Road is located at the location that Ross detailed in his report (Ross 1986) and not at the location in the MTCS dataset. The geographic co-ordinates as provided by the MTCS for Arrow Lake (DaJn-7) were consistent with previously published reports and confirmed by both Delin (2013; pers. comm.) and Ross (2013; pers. comm.).

The inaccuracy of the Old Tower Road site location as within the MTCS database led me to distrust the geographic co-ordinates provided within the provincial database. It must be stated, however, that this does not imply criticism of the diligence of the MTCS in maintaining the database; it was transcribing the information it was given. The process of transcribing many old archaeological reports highlights the problem of errors being propagated any number of times without being identified and corrected.

3.2.2 Shoreline Bias

As noted earlier, archaeological sites of the Plano period are often discovered on shorelines or former shorelines in the Thunder Bay area (Hamilton 1996). According to Phillips (1988), prime site locations are found near taconite sources (for tool manufacturing), close to higher points (for lookouts), and at river mouths or sheltered embayments along the now-abandoned shores of glacial lakes.

Shoreline bias raises a few questions and invites speculation. First, does it reflect a tendency by researchers to look for archaeological material in shoreline areas more often than in other environments? Contemporary shorelines are generally easy to access by road and by water, due to the recreational activities pursued by modern humans. Second, is archaeological material more easily spotted in that type of environment because of the erosion of cut-banks or by wave action? Higher visibility would be an obvious reason for artifacts to be found.

Third, what antiquity of shorelines are we referring to as having archaeological potential; modern, early Holocene, mid or late Holocene? Studies have proven that shorelines have changed and moved since the early Holocene (Baedke et al. 2004; Boyd et. al 2010; Braun et al. 2008). In the boreal forest of northwestern Ontario, therefore, potential exists for ancient shorelines to be invisible on modern maps, due to a lack of paleo-hydrological survey. These same shorelines may not be visible on satellite or aerial imagery due to vegetation cover, and they may also be invisible to the naked eye because of the nature of working in areas of dense tree growth. On the other hand, some ancient shorelines may be evident in surface geological mapping, due to their sedimentary characteristics. Since the entire inland area of the Thunder Bay region has not been systematically surveyed for archaeological potential, can we assume that Plano people preferred shorelines over other types of environments, or that there might be a range of landscape types that were attractive but which have not been systematically examined? It is a logical premise that if Plano people did indeed favour shorelines, then we should be looking for shorelines that date from that time period, and these are the shorelines that occasionally appear to be “missing” in mapped data. In some cases, ancient shorelines now form part of the inland terrain around Thunder Bay, and this is the reason why they are not being identified or recognized as such.

The 2011 *Standards and Guidelines for Consultant Archaeologists* provides guidance in the event of original ground surfaces being deeply buried (Section 2.1.7), noting that “modified survey procedures” are required in such circumstances (MTCS 2011). Complex depositional sequences may lead to ancient and natural features that may be invisible on maps, when they occur inland. Until a much more systematic survey program and thorough inventory can be made of archaeological material in all types of natural terrain in the

Thunder Bay area, and especially at inland locations, this type of situation is likely to reoccur.

The Old Tower Road site was selected for the study site area, in part, because it may have existed on or near a former shoreline of Whitefish Lake, or more likely, on a high point overlooking the lake system. An investigation of the area surrounding this site should indicate whether the desired physical characteristics of a landscape as described by Phillips (1988) were apparent factors in the location decision of the site by Plano people. This would help to address the question of shoreline bias: could a "perfect suite" of indicators (Carleton et al. 2012) be used to predict other site locations in similar circumstances? Limited knowledge currently exists in the literature about the deglaciation history and geomorphology of the Whitefish Lake area, and curiosity about this region was an additional motivation in choosing Old Tower Road over Arrow Lake as the primary site of interest. A practical reason figured largely as well, in that Arrow Lake is within the boundaries of a provincial park and therefore cannot be excavated. Old Tower Road is on Crown land (Hockridge 2013; pers. comm.), where research may be carried out more freely.

3.3 Summary

The dataset used in this research was provided by the Ontario Ministry of Tourism, Culture and Sport. Although it initially appeared to be a complete and accurate record for the study area, this turned out not to be the case. Locational accuracy of the Old Tower Road site was poor to say the least, but it did prompt me to seek out more information on the site as a result. Speaking to researchers who had visited the site produced a comprehensive understanding that might not have existed otherwise. Questions about the nature of shoreline bias helped me to develop ideas related to landscape indicators for further exploration.

CHAPTER FOUR

4.0 Methodology

The research methodology was structured to determine what, if any, landscape features are associated with the Old Tower Road locality. Although I knew that cultural artifacts had already been discovered at the archaeological site itself, my thesis goal was never intended to be a "treasure hunting" expedition for more Plano artifacts. If artifacts were recovered as a result of my fieldwork, they would potentially provide support for and interpretation of specific landscape indicators, although that was not guaranteed. I went into my fieldwork with an open mind and prepared to accept whatever the study area revealed. Perhaps the greatest initial challenge in developing a fieldwork methodology was to determine where to investigate in the vicinity of the documented archaeological site (Ross 1986), and how large of an area to explore. In the winter of 2012/2013, I chose the Old Tower Road location as fitting my criteria for the best candidate for fieldwork purposes; however, I had never visited that particular site before and was not able to seek preliminary insight because the access road was not maintained in winter. This created a problem in not knowing what to expect before beginning fieldwork. In consequence, I purchased a paper map for NTS 52B01 to gain an overview of the landscape study area on a smaller scale than I would be working at. As well, I obtained a copy of Bill Ross's 1986 archaeological site report which contained his own sketch map of the local area at a 30 m scale.

These two documents provided a rudimentary level of understanding for the fieldwork site. The NTS map offered basic information such as 50 ft. (15.2 m) contours, vegetation, and roads, but little else in detail at a larger scale. Ross's report offered his own evaluation of the archaeological site, including the sketch of an area that he suggested may contain cultural material. The Old Tower Road site is situated on the west side of a plateau of a feature called Mt. Edna and also within the valley that separates Mt. Edna from Mt. Marny, to the west of it (see Appendix A, Map 3). Using this information, I decided to explore only as much area as I could reasonably address over the course of a single field season. It was also clear that I could not investigate very close to the archaeological site itself due to the impracticality of transporting equipment up the very steep western slope edge of Mt. Edna.

Choosing a particular area to explore at the site involved making assumptions regarding human land use. Apart from life necessities of food, water, and shelter, I could not personally see a way to effectively predict from the maps what natural feature(s) might have attracted Plano people to either stop or stay at Old Tower Road. There was no stream or river showing on the map, but a beaver pond was represented in the valley, .5 km south of Old Tower Road. I surmised that the pond must have a source of water draining into it, and therefore, some location between the two mountains might be a good place to begin. It may have contained a river at one time in the past. As has been discussed earlier, very little is presently known about land use patterns of Plano people in the Thunder Bay area. What they valued in their environment could be demonstrated if enough data becomes available, but we are not yet at that point. We can suggest that they sought water, food, safety, and perhaps took spiritual needs into consideration, along with any number of other factors, when making site-specific decisions. These types of factors are not generally obvious on paper or digital maps, only in our interpretations of how natural features translate into human land use. Depending upon the scale of map resolution, certain terrain features may be easily identified or may not be visible at all. Some regions of Ontario are mapped in very fine detail while others are not.

In determining how much area as well as where to explore, I used my own life experience in the boreal forest to guide me. Since I do not know how many Plano people may have traveled through or stayed in the site area, I picked an arbitrary number of a dozen individuals and based my size of exploration area on that number. My thought process used a deductive, knowledge-driven approach, in order to establish whether there are any landscape indicators at Old Tower Road that may be interpreted as being relevant. The independent variables represent landscape features, while the dependent variable is defined by the presence, frequency, and distribution of archaeological recoveries. I was fully prepared to find no indicators at all and chose instead to carry out exploration in the area that would have best suited me personally, should I have desired to be at that location in the present day. I chose an area which is sheltered from northwest winds, down on the valley floor on the west side, and extending along part of the southwest slope of Mt. Edna on the east side. Test pits would be dug in a grid pattern over a limited geographic area that would permit detailed information to be gained from what lay beneath the ground surface in two different locations. It was necessary to dig pits because the time period under consideration might have been long buried by geomorphological activity. In this regard, the grid pattern and test pits were done according to regulations set by the Ministry of Tourism, Culture and Sport (MTCS 2011) for carrying out research under the terms of my archaeological research license. I acquired a fieldwork permit for this reason.

Once fieldwork data were available in the form of landscape and hydrological conditions, it could then be mapped in GIS, and an assessment could be made as to the accuracy and detail of the geospatial data that is widely available. This process would address the second thesis objective, which compared the accuracy of existing digital map data with real-world conditions.

Limitations and assumptions, procedures, and the decision-making process for field work design are discussed in the following subsections.

4.1 Limitations and Assumptions

There are two primary limitations and assumptions that must be taken into account when formulating a GIS-based model for archaeological interpretation. They will be examined here, not necessarily in order of importance.

First, accuracy of geospatial data is an important consideration when producing valid maps for modelling the natural landscape. It is generally assumed that the data is as correct as it can be, given the vagaries of human input and interpretation, while recognizing the limitation that the data is not likely to be completely error-free. The vector data in this research project originated as paper map representations derived from aerial photography using photogrammetric techniques by one or more individuals. At the outset, once these data layers were added to the map document, inconsistencies became apparent. For example, one section of railroad track "disappeared" for some distance before continuing later on. Also, roads layers from different sources did not perfectly match in all cases, occasionally containing differences of 100 m or more. This fact may be more important at some map scales than others; it depends upon the purpose of the map and the enquiry which it seeks to address.

NTS paper maps are widely available for the northwestern Ontario region and have been used for decades by individuals in government, research, and industry who seek a comprehensive understanding of the natural geographic landscape. Earlier maps are derived from air photo interpretations, and they carry a number of concerns regarding their accuracy and detail (Hamilton 2013; pers. comm.). Techniques relating to aerial photography and photogrammetry must take into account issues such as relief displacement, parallax, determination of heights and the sun's angular elevation, among others (Avery 1962). Contemporary soft-copy photogrammetric techniques address these issues through the use of modern technology (Wolf et al. 2014).

Discrepancies in digital data do not imply that the data cannot be used for research purposes, but rather that a healthy amount of critical evaluation is required. The process points to the importance of ground-truthing in an effort to improve the quality of information that becomes part of a landscape model. Accepting erroneous data as correct (at certain map scales) negates the purpose of scientific enquiry, and so researchers are encouraged to make improvements to the system whenever and wherever possible. One focus of this research is to measure the amount of error between the modelled landscape according to the GIS map document versus landscape interpretation based upon ground inspection.

A second assumption affecting this research is the theory that landscape characteristics at one or more Plano sites in the Thunder Bay region may serve as reliable indicators of site location or activity at any other Plano site in the same area. Generalizations should be treated with caution, since they may lead one to overlook subtle clues that are unique to any one site. The concept of human agency at the group level is an important contributing factor, perhaps the most important factor in site selection by ancient people. Cognitive processes by humans responding to change in the natural environment cannot be ignored (Brown 2008).

4.2 Digital Map Preparation

When the archaeological site dataset was provided by the MTCS, it was transcribed one entry at a time into a Microsoft Excel table. An additional site list was added, as previously detailed in Section 3.1, resulting in an initial database of 171 sites. This table was uploaded into the ESRI (Environmental Systems Research Institute) ArcCatalog 10.1 application and converted to shapefile format; following this procedure, the shapefile was added to an ArcMap document, where the data could be displayed and queried. Base map information was added in the form of digital vector data, representing roads, lakes, rivers, contours, etc. via the Natural Resources Canada website. These map layers were all georeferenced to UTM Zone 16, NAD83.

At this stage of map production, the archaeological site points overlaying the base maps were given a cursory evaluation for potential field work areas to consider. The data were queried to identify sites assigned Plano affiliation. A number of these were found either within, or very close to, the city of Thunder Bay, as well as two rural areas, Dog Lake and Whitefish Lake.

Dog Lake contains many archaeological sites, some without cultural affiliation as received in the original MTCS data. It was noted that there are many privately-owned properties around the lake, as well as a limited number of access roads. According to the study area selection criteria, this made the Dog Lake area less attractive for field work. Sites around the lake often corresponded to private property, so that I was concerned both with access to the sites and the possible difficulty of obtaining permission to carry out research on privately-owned land.

Whitefish Lake and Arrow Lake showed one Plano site located at each. When it was noted that the Arrow Lake site (DaJn-7) is located within the boundaries of a provincial park, and Old Tower Road (DbJm-6) is located on Crown land, Old Tower Road was selected as the candidate for fieldwork because it satisfied the study area criteria in all four categories.

A meeting was held with Bill Ross, a Thunder Bay archaeologist who knows the local area intimately. He discussed the Old Tower Road site at length because he had been there personally and indicated on a map where the site was located. Bill's recollection of the location did not match the MTCS site location (Ross 2013; pers. comm.). A 1986 report he had filed for the then Ministry of Citizenship and Culture was obtained (Ross 1986), and this confirmed the error in the MTCS data. Ross's report gave different grid co-ordinates and also contained a detailed sketch map. The star marking the site location is based upon Bill Ross's information and not upon the MTCS data (see Appendix A, Map 3). It was evident that the site point location in the provincial inventory requires correction.

I decided to edit the site point location in the map document by using the Edit tool in ArcMap and correcting the geographic co-ordinates which had originally been provided by the MTCS. The Old Tower Road site was moved to its proper geographic location.

A DEM was accessed with a preset 15.2 m resolution, consistent with a 50 ft. contour interval as in the NTS (1994) topographic map for the same location. I was unable to ascertain exactly when and how this particular DEM was created by Natural Resources Canada. My own belief is that the geospatial data was derived from an existing NTS map, explaining the somewhat unusual spatial resolution. Nonetheless, I used the DEM to create a slope layer in 3D Analyst and reclassified this layer into nine slope classes, reflecting slope degree values between 0° (flat) and 90° (steep), resulting in a more "natural" look to the mapped landscape (Llobera 2003). Contour lines were created and labelled at 15 m intervals.

4.3 Decision-making Process for Fieldwork Design

The fieldwork design was based upon the research goals of identifying landscape features and of comparing real-world physical observations with a GIS map model. To begin, a visit was made to the Old Tower Road site location on May 14, 2013 in an effort to determine how closely the natural landscape appeared to match that of the geospatial data assembled in GIS which had been collected for comparison with fieldwork data. Due to the delayed arrival of spring in the Thunder Bay region, it was decided not to return for one more week. Patches of snow remained in shaded locations, and ground frost was not yet released. On May 21, 2013, the site was visited again. A few trees that had fallen were cleared from the access road, and large pools of water from snow melt were ditched, to enable the water to drain from the roadway. Small-scale physical characteristics of the land did correspond to the geospatial data layers (see Appendix A, Map 3). The access road bisected the valley between Mt. Edna and Mt. Marny, and the beaver pond was present. An ascent was made of Mt. Edna, and numerous GPS readings were taken with a hand-held GPS unit from the plateau at its peak. These readings were recorded as ground control points, to later assess the accuracy of both the GPS unit itself and of the geospatial data layers. Photographs were also taken from these locations, creating a record of the 270° panoramic view, supporting the belief that the site (Old Tower Road) may have been a lookout point. The valley to the north and Whitefish Lake to the south were clearly visible from that elevation. Figures 4.1 and 4.2 illustrate views taken from the point of the registered location of Old Tower Road, according to Ross's 1986 report, at compass bearings 240° and 340° respectively.

Figure 4.1. View from Mt. Edna plateau, bearing 240°. Photo by M. Schweitzer.

Figure 4.2. View from Mt. Edna plateau, bearing 340°. Photo by M. Schweitzer.

Reconnaissance of the immediate vicinity of the Old Tower Road site revealed a relatively recent cut-over adjacent to the west of the access road (since 2010, based on a comparison of Google Earth images). Slash from birch (*Betula papyrifera)* trees was present on the ground, as well as wood chips. Cedar *(Thuja occidentalis* L.*)* trees were left standing, and red pine *(Pinus resinosa)* seedlings had been planted in open areas. This portion of land formed part of the study site area which my permit was valid for, and its disturbance by wood harvesting activities was seen as a detriment to fieldwork. The reason is that any artifacts that may be present, particularly those near the ground surface, could be damaged or destroyed by harvesting machinery, or else moved from their original location of deposition. If I was able to discover any artifacts, ideally they should be found *in situ* to be relevant to my inquiry. Ground disturbance may reveal cultural artifacts in some cases, but my thesis objective was to locate landscape features, if any, not to search for artifacts per se. The cut-over was extensive in size, and I could not see the boundaries of it from the access road. From my vantage point, the land appeared relatively flat and featureless, being part of the valley floor, and not an optimal location to discover obvious landscape features. Figure 4.3 illustrates the disturbance created by the cut-over. Therefore, I decided not to survey or excavate test pits in that specific location but to carry out these activities to the north, some 150 m further up the road where there was no disturbance. This decision resulted in the splitting of my original, permitted research site area into two geographically separated blocks, now designated as Study Area 1 and Study Area 2 (see Appendix A, Map 4). This moving of part of the study site location remained consistent with my desire to explore an area that was both in the valley and also on part of the mountainside. Study Area 1 would be west of the archaeological site, and Study Area 2 would be southwest of it, on the opposite (east) side of the access road. This would permit comparison between the conditions found at each of the study areas, since one was farther away from Old Tower Road than the other, and each had a different elevation.

Figure 4.3. Disturbance in study area. Photo by M. Schweitzer.

I decided that a comprehensive test pit survey using the systematic sampling method would provide the most complete record for data collection and mapping purposes. Because I had no prior knowledge of the landscape in either of the two study areas, and in fact was unable to see into them from the access road due to tree cover, I did not want to introduce bias to any part of the sampling locations. The systematic sampling method was chosen over selected sampling since it more closely approximated a random sampling method, giving equal probability to the results from any test pit excavated. In this way, I would locate test pits on any natural feature and not choose one spot over another due to ease of movement or perceived likelihood of discovery of a landscape feature. It was my intent to treat both study areas as homogeneous physical landscapes, trusting that the systematic sampling method could reveal subtle environmental clues that could address the first thesis objective. Other than looking at the NTS map and its digital counterpart (the GIS map document) prior to visiting Old Tower Road for the first time, I had no other landscape information from which to base decisions. The sketch map in Ross's 1986 report was beyond the boundaries of the areas I would be exploring. I considered this to be another benefit in terms of lack of personal bias.

Study Area 1, measuring 100 m by 90 m, was located north of the cut-over, as previously explained. This size of sampling block was, in my opinion, an area that may have been used by a small group of Plano people; this is how I define the human scale of landscape utilization. As well, since I would be excavating a total of 120 test pits from the two study areas over the course of the summer, this amount of work could be accomplished in the twelve weeks that I had set aside for fieldwork.

To begin the exploration, a series of six transect lines were identified in Study Area 1. While standing in the middle of the access road, a compass bearing of 310° was taken, using a Silva Prospector compass. This bearing was judged to be 90° perpendicular to the road. A wooden stake was hammered into the ground at a distance of 1m from the west road edge and a GPS reading taken for the stake, using a hand-held Garmin GPSmap 76CSx GPS unit; accuracy of the unit was advertised as ± 3-4 m. This reading would function as a ground control point in the finished map document (along with more points from all transect stakes). Next, a 50 m roll-tape was used to measure into the study area, with one person holding the compass and tape, calling out 10 m intervals, and a second person walking ahead and planting a metal marker pin at each designated location, sighting on tall trees that were visible in the distance. Transects were 15 m apart. In this way, a total of 60 test pits were available for survey and excavation, according to the 100 m x 90 m size of the study area (see Appendix B, Sketch 1). The sixth and last transect was located approximately 10 m north of the cut-over boundary, where the ground was still undisturbed by tree harvesting activity.

Study Area 1 contains numerous challenges to accurate mapping. Firstly, large numbers of poplar (*Populus tremuloides)* trees had blown down and blocked the natural walking path of many transects. As a result, the person placing marker pins was required to move either to the left or right of the projected path as conditions necessitated. Secondly, a modern stream ran north to south, crossing transects at right angles, at approximately 40 m distance from the road. A few marker pins were placed in shallow water in consequence.

As a point of interest, physical conditions in the entire study area are believed to be the result of a severe weather system which passed through the area on July 4, 1999 (NOAA 1999). This particular storm is likely to have produced the high number of blow- down trees due to the age of the secondary growth of poplar, which measured approximately 3-4 m in height on average, consistent with the timing of the storm. The study area also contained a few standing birch trees, as well as a small number of standing, mature white spruce *(Picea glauca)* and balsam fir *(Abies galsamea* L.*)* trees.

Test pits were opened two at a time at the beginning of each transect. After the first pit was excavated to an approximate depth of 15-20 cm by my co-worker, he would move on to the next consecutive pit, and I would complete the first pit to a depth of 50 cm, if possible. This method allowed us to keep up an acceptable working pace. As well, because of my previous archaeological field experience and his lack of it, I was able to determine which pits warranted more intensive exploration. I field-trained him to recognize certain characteristics, which he brought to my attention as necessary; in this situation, he would usually stop working with a shovel, and I would take over with a trowel. This system proved to be the most efficient use of time and effort during fieldwork. Each pit had a GPS reading taken and written notes completed in a spiral field notebook. Weather observations, recoveries, excavation depths, unusual occurrences, etc. were all recorded. A minimum of one photograph of each test pit was taken using a Nikon D3100 DSLR camera. In addition, visits to the site by committee members and other interested persons resulted in written notes being kept of conversations, particularly regarding site observations and interpretations. Visitors were also photographed. After each week of work was completed, field data were entered into a MS Excel table, for later addition to the GIS map document which had previously been created. GPS readings were used as the positional geographic locations for test pits (the reading taken at each pit).

Study Area 2 was located approximately 100 m south of Study Area 1 and was on the opposite (east) side of the access road (see Appendix B, Sketch 2). A block the same size as previous would be explored, that is, 100 m by 90 m. This area contained relatively fewer blow-down trees than in the first study area; however, the forest undergrowth was significantly denser. As a result, a slightly different method was used to set in the six transect lines; the person carrying the marker pins would also take the compass. A bearing of 119° was taken as representing right-angles from the road initially, and a wooden stake hammered into the ground as before.

In some cases, visibility was severely limited as the line was set in. Vegetation had to be brushed aside from the body and logs climbed over in order to advance. A compass bearing was taken at each consecutive pin, in an effort to reduce directional error in the transect. In contrast to Study Area 1, there was no stream present, and by the fourth pin marker, the land grew noticeably steeper as it went up the southwest slope of Mt. Edna. Once lines were prepared, a trail was cleared between each test pit using clippers and a bucksaw. This would facilitate travel between the lines for the fieldworkers.

Test pits in both study areas were dug at 50 cm x 50 cm size, and 50 cm deep whenever possible. A wooden frame template was placed on the ground at each pin marker location, in order not to compromise pit size and right-angles of the pit corners. Occasionally pit locations were moved by 10 cm or more, depending upon the ground characteristics at any specific location, such as a rock just below the surface being in the way. Pits were excavated with a metal spade to remove the organic layer and to dig into the sediment layers below. If an artifact or some other interesting feature or characteristic were found, the excavation was completed with a trowel. Numerous times, conferences were taken to decide on best practices, given fieldwork conditions. As the license holder, my decisions were deemed final. Sediment profiles were noted and photographed as part of regular record keeping. Screening of material with a ¼" mesh screen was attempted in both study areas but was found to be impractical. In Study Area 1, proximity of the modern stream to test pits resulted in very wet soil and sediment conditions, made worse by regular rainfalls. Clay material clogged the mesh often, or else the high number of clasts discovered made the use of the screen impossible. In Study Area 2, apparent earlier debris flows down the mountainside resulted in clay and boulder material being found in many of the pits, rendering the screen as generally useless.

Overall, decisions regarding fieldwork design were implemented as originally planned, subject to actual conditions on the ground. Other than the challenge of entering territory which had not previously been studied, no significant obstacles were encountered.

4.4 Summary

There were several advantages to the methodology developed for this project. The size of the two study areas enabled visualization to be made of landscape features even before fieldwork was completed. By employing a systematic approach to data collection, the number of test pits excavated permitted some preliminary observations to be made, which helped with landscape interpretation while I was still in the field.

In keeping with the second objective of the thesis, to compare real-world current physical conditions to geospatial data of the same area, it was possible to make immediate comparison of the map document with the actual study areas, at different map scales (see Appendix A, Maps 3 and 4). Exploring the study areas at a human scale of potential landscape use was paramount in terms of assessment value. Ground control points taken with the hand-held GPS unit could be later verified for locational accuracy when uploaded to the GIS map document, as a validity test.

A comprehensive fieldwork design, while keeping limitations in mind, afforded me a greater level of confidence in the outcome of the final map document versions.

CHAPTER FIVE

5.0 Results

This section will discuss results in terms of fieldwork methodology, recording of test pit information, and how the data relating to that process were entered into the GIS format. Next, products of fieldwork are presented, followed by data analysis and interpretation. Photographs have been included to enhance explanation.

5.1 Fieldwork

The thesis objectives for this enquiry are twofold: to investigate potential landscape indicators for a known archaeological site, and to assess the accuracy of a computer-generated landscape model (a digital map) when compared to real-world conditions in the study areas. The overall goal of the project is to evaluate the present approach taken towards physical archaeological site prediction in Ontario. A single case study of one research area highlights issues that affect the validity of geospatial data, as well as the perceived visibility of landscape features at certain map resolutions and scales. These results cast doubt upon whether relevant natural features are visible in readily available mapping products (both digital and paper) and how that may impact site prediction. When one understands how map products are produced, drawbacks are uncovered. These drawbacks may serve to initiate discussion of more effective ways of predicting possible locations of landscapes where prehistoric cultural material exists in Ontario.

Procedures to carry out the thesis fieldwork were executed in accordance with the decision-making process described in Section 4.3. The methodological framework undertaken permitted relevant data to be acquired that answered both of the thesis objectives unequivocally. A landscape feature was discovered that is not visible on either a digital or paper map at 1:50,000 scale, and the computer-generated landscape model approximates real-world conditions only at smaller scales than were used in this thesis. The following paragraphs detail fieldwork observations.

5.1.1 GPS Test Pit Data Collection

One issue became apparent very soon after beginning fieldwork in Study Area 1. This was regarding the accuracy of the readings from the hand-held GPS unit. Because the transects had originally been laid out with a compass and measuring tape, relative distances between test pits were both known and visible prior to using the GPS unit. I was confident in taking ground control point readings on the access road because there was a break in tree cover at that location, keeping in mind that the road was hemmed on both east and west sides by mountains, creating a possible masking effect. However, once in the forested area, some GPS readings at test pits were apparently erroneous, when compared to distances as measured with the tape. It was the Easting reading especially which lacked accuracy.

For example, after the test pin markers were in place, a GPS reading was not taken until that test pit was going to be opened. Theoretically, I could have taken all GPS readings for each transect in a single day, before beginning any excavations. I did not wish to introduce positional bias for any portion of the study areas in terms of satellite configurations or any other factor which might influence readings. I believed that by taking readings on different days and in different conditions, the GPS readings would average out to be as accurate as they could be under the circumstances, perhaps by randomizing the positional error.

Despite taking readings in what I considered to be the most optimal locations that were still within 1-2 m of test pits, results were disappointing at times. I would record each reading in my field notes, sometimes writing down a GPS distance of 1-5 m from the next adjacent pit, when in reality, I knew that the pit was a measured 10 m away, even allowing for a 1-2 m error in the tape measurement (see Appendix B, Sketches 8,9). On two occasions in Study Area 1, GPS readings placed test pits directly atop one another, co-ordinates which I could not use in the GIS application. When this happened, I wrote down an Easting distance 1 m away from the given reading and made note of it (see Appendix A, Map 6). One way I attempted to mitigate this situation was to leave the GPS unit active for up to 10 minutes at a time, waiting for a "better" reading to appear; sometimes it was successful. Generally, though, the reading would not change after 4-6 minutes, and that is what I would record. It was my decision not to spend inordinate amounts of time trying to gain superior positional accuracy according to the GPS unit but rather to simply record the unit's reading at any given test pit and move on. I accepted that the readings were not going to be accurate at the level of detail which I required. I also realized that this inaccuracy was going to be manifested later in the map document, by not allowing the test pits to be recorded in their true positions on the ground (see Appendix A, Maps 6, 7).

In Study Area 1, some tall trees were present and could not be avoided entirely when taking GPS readings. All of the area was affected by blow-down and there was not heavy forest cover. As well, since fieldwork began just as the leaves were opening in spring, there was not a lot of vegetative interference overhead, in my opinion. In Study Area 2, forest cover was heavy, and the trails between transects were cut wider by approximately 1 m, so that improved positional readings could be taken. Once the transect elevations began going up the mountainside, Easting readings appeared more accurate when compared to the locations of the test pits. In both study areas, elevation readings could be more than 25-30 m different at distances of 20 m along the ground. I did not see how errors that large could provide reliable information when comparing GPS elevations with previously mapped elevations in the data.

5.1.2 Landscape Interpretation

As had been discovered when the transect lines were set in, Study Area 1 formed a complex natural environment. A gentle slope from the access road led down to a modern stream that varied in width between approximately 3 m and 5 m, depending upon the character of the stream bed. Boulders and large platy rocks were visible at the surface in some areas, while other areas were smoother in appearance and more level. Snow melt from the late spring weather made for fast flowing water. A few metres beyond the stream, (travelling in a westerly direction), a short, steep-sided slope rose quickly for a linear distance of 4-5 m before leveling off. This possible alluvial terrace feature was identified by its characteristic steep sides and by the flat-topped appearance of the plateau (Charlton 2008). Broken and downed trees littered the landscape. Back home, I checked the paper map (NTS B5201) as well as my GIS map document, to ascertain whether the abrupt slope changes were apparent, but they and the stream were not visible in either format at that level of detail (see Appendix A, Map 6). Figure 5.1 shows a typical view of the working conditions in Study Area 1.

Figure 5.1. Third transect line, Test Pit 25. Photo by M. Schweitzer.

Numerous boulders were strewn about the landscape where the transect lines were cut, especially in the first three transects (see Appendix B, Sketch 3). By the sixth transect, surface boulders were largely absent. My initial interpretation was that a high energy alluvial environment may have deposited them, possibly as the result of a debris flow. I believed that that type of process would contain sufficient energy to move such clasts. The landscape elevation appeared to increase to the north of Study Area 1, although I could not see through the trees to verify it. A debris flow would also explain the quantity of smaller clasts visible both at the ground surface and in many test pits. Figure 5.2 illustrates an assemblage of rock removed from Test Pit 14; the measuring card is marked in centimetres. Figure 5.3 shows one large boulder near Test Pit 26 (see Appendix B, Sketch 5). My backpack is shown for size comparison.

Figure 5.2. Rocks removed from Test Pit 14. Photo by M. Schweitzer.

Figure 5.3. Glacial boulder. Photo by M. Schweitzer.

Clasts were unsorted in every test pit. Sediments ranged in size from clay to boulder (Wentworth scale), and in many instances, were found within very short distances (i.e. between test pits) or even occasionally in the same test pit. As before, I suspected a debris flow as the cause for this evidence. Distinct gravel layers were discovered in many of the pits, at a common depth of 30 cm below the modern ground surface (see Appendix B, Sketch 5). Preliminary interpretation identifies them as being lag deposits or melt-out streams from former glacial activity (Bennett and Glasser 2009). Figure 5.4 depicts the west wall profile view of Test Pit 50. Gravel and sediment layers are visible from the surface down to the 50 cm depth. Clasts removed are at the left and right hand sides of the pit in the photograph. The lack of fining upwards characteristics in the sediment suggest that a stable, long-term river flow did not exist at the time that these sediments were laid down, and that they are more likely to represent glacial outwash deposits.

Figure 5.4. West wall profile view of Test Pit 50. Photo by M. Schweitzer.

Soils in Study Area 1 are very young in age, meaning that they are thin in nature. They are classified in that particular geographic locale as belonging to the subgroup Orthic Eutric Brunisol, O. EB. Brunisols are common in the Thunder Bay region and are formed beneath forest cover, mainly on parent material with a pH at or above 5.5. They lack the degree of horizon development found in other soil orders (Agriculture and Agri-Food Canada 2013). Fieldwork confirmed that below the surface litter layer, the organic layer was generally 10 cm thick or less, although this layer was found to be up to 20 cm thick in a few test pits, likely the result of added material from upturned trees over time.

A second potential terrace feature was less visible east of the modern stream (see Appendix B, Sketch 3). It also displayed a flat-topped appearance and sloping sides but was truncated by the edge of the access road, where the transect lines began. This truncation was caused by the construction of the access road decades earlier, when material had been bulldozed and leveled to create the roadbed.

Ample amounts of naturally occurring jasper taconite were found everywhere throughout the Study Area 1 block, and I declared a buffer zone of 25 m from the apparent edge of earlier road activity. This zone would separate taconite material which might have been moved by road building, as opposed to material which may not have been moved by such means. A single, angular block of pure jasper taconite with a mass of approximately 2.5 kg was found on the ground surface near Test Pit 47, well away from the access road. Instances of smaller pieces of raw taconite being found at the ground surface or in the roots of upturned trees were relatively common. Figures 5.5 and 5.6 depict natural occurrences of taconite from Study Area 1.

Figure 5.5. Jasper taconite. Photo by M. Schweitzer.

Figure 5.6. Taconite in tree throw. Photo by M. Schweitzer.

The physical character of Study Area 2 resembled that of Study Area 1, with some exceptions. First, the organic layer was of similar thickness as both areas, although fewer trees were blown down in Study Area 2. Vegetation was noticeably denser in Study Area 2. Second, sediments were largely unsorted as before, except in an area encompassing the northwest corner of the first few transects numbering 7, 8, and 9 (see Appendix B, Sketch 6). Third, soil formed a shallower layer in Study Area 2 than in Study Area 1, and I suggest that the main factor in explaining this phenomenon is the gradient of the landscape. Considerable unsorted sediment was found in Study Area 1 in the vicinity of the modern stream and on the sides of the terrace feature. However, the flat top of the terrace west of the stream appeared to present a more stable environment for soil to develop, and there was more depth of soil in that area. I noted more size sorting of sediments with more clearly defined boundaries between sediment layers on the flat top, suggesting that it was an older surface than either the stream to the east or the mountain slope in Study Area 2. Figure 5.7 illustrates the north wall profile view of Test Pit 102, in Study Area 2. This type of stratigraphy was common in that area of the slope.

Figure 5.7. North wall profile view of Test Pit 102. Photo by M. Schweitzer.

Similarly, in Study Area 2, transects that began on flatter surfaces had more soil depth and fewer large sediment sizes (fewer clasts but more silts and clays).

When transects began to climb in elevation up the mountainside, soil was thin to almost absent, replaced by a mix of very large clasts and clay. This represented colluvium (Trenhaile 2007), in my opinion, that had flowed off the mountain top (see Appendix B, Sketch 4). When I originally scaled Mt. Edna at the beginning of the fieldwork, I noted that there was generally a complete lack of soil on top of the plateau. A few pockets of soil supported vegetation, but much of the plateau consisted of either bare or lichen-covered rock. Therefore, more soil development was possible in the flat valley floor where eroding fine sediment has accumulated. Soil characteristics in Study Area 2 matched those in Study Area 1.

Study Area 2 carried one major difference from Study Area 1: the presence of subsurface organic material. Four seed cone scales were discovered in three separate test pits, at various depths below the surface: at 12 cm, and also at 45 cm. Test Pit 73 contained a large quantity of jasper taconite (approximately 2.5 kg in total), both natural and worked. The gravel layer as noted in Study Area 1 at 30 cm depth was also present (see Appendix B, Sketch 6), and a single seed cone scale was unearthed well below the beginning of this layer, at 45 cm depth. This particular cone scale may prove to be at least as old as the material at the level where the taconite was found, and possibly older, due to its provenience. When Test Pit 73 was excavated, I noted that the culturally manipulated material was at or near the edge of an apparent river or stream, as evidenced by sediments in a fining upward characteristic; this depositional layer was absent within 20 m to the east. The taconite pieces were the largest in size found in either of the two study areas and were much less modified in nature, in terms of flint knapping. They resembled taconite cores or blanks that had primary reduction flakes only taken off of them. Figure 5.8 shows one of the pieces of taconite *in situ*, later assigned to the Cultural category.

Fig. 5.8. Culturally manipulated jasper taconite *in situ*, Test Pit 73. Photo by M. Schweitzer.

By the time all test pits had been excavated and the data collected, I was well acquainted with the landscape in the two study areas. As stated earlier, I was interested in exploring a physical area of what could be termed human-landscape size. Human landscapes may encompass small site areas such as campsites, or they may represent much larger areas when travel routes and seasonal resource exploitation are taken into account. For my thesis project, I sought to explain what may have happened in the ancient past in the location where my focus was concentrated. Of course, I explored a very small area and do not have enough data to make definitive conclusions about a larger geographic area; however, I am confident in making certain observations based upon the evidence I found.

Early on in the fieldwork, I was intrigued by the presence of various pieces of jasper taconite that turned up together in the same test pits. The reason for this is that some pieces were clearly culturally modified, yet others were just as clearly natural. In many cases, these pieces were found at or near the same depth in pits. I had also noted that the numerous unsorted clasts were also part of the same mix. In my view, this evidence illustrates that the study areas (particularly Study Area 1) were part of a dynamic, alluvial-dominated environment. Natural taconite is readily available in the valley, and taphonomic processes over a long time span can account for its presence and redistribution in test pits. Still, there seemed to be more to the story than this.

I developed a theory that one or more series of debris flows had taken place at some point in the past, and this flow had moved a large quantity of material from farther north up the valley (Phillips 2013; pers. comm.). My impression from the taconite material in test pits was that sometimes the material was under water and other times on dry land; this would offer at least partial explanation as to the water-tumbled pieces being found together with sharp-edge cultural material. My idea was that the entire area in Study Area 1 that contained the terrace feature could have been submerged at one time, and that eventually the water flow decreased, resulting in the formation of the terrace.

To test my idea, I walked approximately 1 km further north of Study Area 1, along the access road. This led to the narrowest east-west gap between Mt. Edna and Mt. Marny, perhaps some 300 m distance, although not measured by me (see Appendix B, Sketch 7). At that location, there was visual evidence of a debris flow of significant magnitude, in the form of massive boulders and small pockets of sand and clay where material had settled out. Blocks the sizes of vehicles were strewn about the landscape as if thrown with great force, perhaps a force caused by the sudden release of an ice dam that hindered outflow from a proglacial lake. Although I did not survey this area, I speculated that some of the tumbled or rounded taconite in Study Area 1 may have originated from here, and I wondered whether any debitage might have been present as well. Could it be possible that Plano people were there very close to the timing of the debris flow(s)? I was not able to answer this question.

Another observation I made is that the subsurface gravel layer found in both study areas may well represent a braided stream network, resulting from glacio-fluvial outwash from the north (see Appendix B, Sketches 5,6). I cannot prove this scenario, but the only location where sediments fined upwards in both study areas was at the base of Mt. Edna, at a shallower depth than this gravel layer. For me, this evidence points to a more stable river flow being established at a later time than the braided stream deposits. The fact that a small modern stream is established in Study Area 1 may indicate a down-cutting erosional process in the ancient channel that may have been in place for millennia, or it might represent seasonal precipitation and snow melt only, draining through the lowest elevation in the valley. It is impossible to know without further study.

These conjectures as to the geomorphological prehistory of the Old Tower Road site point to potentially great physical change in the natural landscape. It is important to note that none of the landscape features investigated is visible in the maps used for my fieldwork. The aerial imagery with 40 cm resolution that I experimented with later still does not reveal the terrace feature in Study Area 1 or any evidence of an ancient river (see Appendix B, Sketches 1, 2). This is not surprising, given that aerial imagery is unable to penetrate vegetation canopy mantling the ground surface.

5.1.3 Interpretation of Cultural Material

My last fieldwork observation was the apparent correlation between landscape variables and human occupation. The terrace feature west of the modern stream in Study Area 1 contained most of the cultural material found in that location. The terrace feature east of the modern stream in Study Area 1 contained some of the cultural material (see Appendix B, Sketch 3). In Study Area 2, the cultural material was found at the edge of what I interpret as a former river bank at the base of the southwest slope of Mt. Edna (see Appendix B, Sketch 4).

Further note is made of the west terrace feature in Study Area 1, since cultural material there was found *in situ*: Test Pit 38 contained 158 taconite flakes, 1 expedient tool, and 3 pieces of water-tumbled taconite (see Appendix B, Sketch 3). These artifacts were recovered in a single concentration, from the surface level to a depth of approximately 22 cm. The smallest flakes were less than 2 mm in diameter, indicating that they had not been moved to any degree following initial deposition. I believe that this test pit represents a location where a Plano person performed flint knapping on a piece of jasper taconite. No finished tool was found in association with the debitage. Figure 5.9 shows me holding a bag of debitage recovered from Test Pit 38.

Figure 5.9. Flint knapping station at Test Pit 38. Photo by B. Schweitzer.

5.2 Description of Fieldwork Data Entry

A total of 117 test pit locations were investigated in the two study areas. During fieldwork, detailed notes were kept (by hand) in a spiral notebook, which provided the raw data for later analysis and interpretation. In order to create a file that would be available for upload into the GIS application, it was necessary to first develop a database.

This process was carried out in Microsoft Excel, by transcribing raw fieldwork data into a table format. I chose to do this once each week, at the half-way mark of each study area transect, and at the completion of each transect line; in other words, after five test pits had been completed and recorded.

In terms of shapefile requirements, the most critical values are those of the UTM co-ordinates for each test pit, recorded as "X" and "Y" columns in the table, corresponding to eastings and northings measured in metres. These co-ordinates permit the visual display of test pit locations through spatial identification within the GIS map document. Numeric codes were chosen arbitrarily to identify specific attributes, such as the presence of the gravel layer and of jasper taconite. Actual depths of relevant material were recorded, as well as descriptions of sediment sizes and soil texture. Divisions between the organic soil layer and what lay beneath it were assigned levels under the heading "Horizon." Entries were added under the heading "Error" to assess the stated accuracy of the hand-held GPS unit. Each row in the table corresponded to a numbered test pit.

A second, smaller table was also created. This one contained information on ground control points (GCP's) that were taken at each transect stake along the road edge. These points were not assigned characteristic attributes as in the first table; as a result, no other analysis could be carried out or displayed from this data in a GIS map document, only the locations of the points. This is also why the second table was assembled separately from the first table. The purpose of the GCP table was to permit a visual assessment of the accuracy of the GPS readings when compared to the vector data which had been downloaded from Natural Resources Canada, in particular the location of the access road to the site. Readings for this were taken in the middle of the road, in a cleared area in order to permit minimal instrument error. This assessment process was successful in that, once the GCP table was converted to shapefile format, digitizing error in the range of 0-50 m was found in the vector roads layer that had been downloaded originally. In other words, the error occurred in the data prior to my using it for my map document. As a consequence, this error was identified and mitigated as explained in Section 6.2.

These two tables formed a comprehensive dataset from the fieldwork results which could then be uploaded to the GIS software application.

5.3 Excel Tables Converted to Shapefile

As with the original dataset on archaeological site locations, the two fieldwork tables were uploaded into ArcCatalog as previously described in Section 4.2. Once available in shapefile format, they were added to the existing GIS map document which had been created prior to fieldwork, where they were displayed as data points and symbolized differently for ease of interpretation. No changes or corrections were required once the data was displayed in the map document.

5.4 Products of Fieldwork

The thesis fieldwork produced a geospatial map document that permitted display and analysis of field data from the study areas at different scales and with different data layers visible (see Appendix A, Maps 2-7). As well, 433 individual pieces of jasper taconite were recovered from the test pits at the site, and these were kept for analysis and curation. These pieces permitted valuable insight into the physical landscape and conditions of the Old Tower Road location area in the ancient past. Lastly, 269 digital photographs were taken at the site over the course of the fieldwork.

5.5 Data Analysis and Interpretation

A total of 60 test pit locations were investigated in Study Area 1 (the valley), with 57 of those pits being excavated to either a maximum depth of 50 cm below the ground's surface, or as deep as was possible to dig. Three test pits were not excavated since their measured locations along the relevant transects were under water within the modern stream environment (see Appendix B, Sketch 3).

A total of 60 test pit locations were investigated in Study Area 2 (the mountainside), with 60 of those pits being excavated to either a maximum depth of 50 cm below the ground's surface, or as deep as was possible to dig (see Appendix B, Sketch 4).

Tables 5.1 and 5.2 summarize the number of jasper taconite pieces and the categories which I assigned them to in Study Area 1, and Tables 5.3 and 5.4 provide the same information for Study Area 2. These four summaries are portrayed visually in Sketches 3 and 4 (Appendix B), using pie diagrams to represent relative proportions of taconite material recovered in each test pit.

Table 5.1. Results of Fieldwork, Study Area 1, Test Pits 1-30.

Study Area 1	**Jasper Taconite Source Material (individual pieces)**			
Test Pit No.	**Natural**	**Cultural**	**Uncertain**	**Absent**
1	0	0	0	X
2	0	0	0	X
3	0	0	0	X
4	0	0	0	X
5	0	0	0	X
6	0	0	0	X
7	0	0	0	X
8	0	0	0	X
9	0	0	0	X
10	1	3	0	0
11	1	0	0	0
12	0	0	0	X
13	0	0	0	X
14	0	1	0	0
15	1	0	0	0
16	1	0	0	0
17	2	0	0	0
18	0	53	0	0
19	1	2	0	0
20	2	0	0	0
21	0	0	0	X
22	0	1	1	0
23	7	2	1	0
24	3	0	3	0
25	4	0	0	0
26	6	0	0	0
27	1	1	0	0
28	1	1	0	0
29	0	0	0	X
30	1	0	0	0
TOTAL	32	64	5	13

Table 5.2. Results of Fieldwork, Study Area 1, Test Pits 31-60.

Study Area 1	**Jasper Taconite Source Material (individual pieces)**			
Test Pit No.	**Natural**	**Cultural**	**Uncertain**	**Absent**
31	2	2	0	0
32	0	0	1	0
33	2	0	0	0
34	0	0	0	X
35	0	0	0	X
36	2	0	0	0
37	4	1	0	0
38	3	159	0	0
39	5	0	0	0
40	2	0	0	0
41	0	1	4	0
42	0	0	0	X
43	0	0	0	X
44	0	0	0	X
45	0	0	1	0
46	12	0	0	0
47	8	2	0	0
48	13	0	4	0
49	10	1	1	0
50	7	0	0	0
51	10	0	0	0
52	0	0	0	X
53	0	0	0	X
54	0	0	0	X
55	0	0	0	X
56	0	0	0	X
57	26	0	2	0
58	12	0	0	0
59	25	0	2	0
60	8	0	0	0
TOTAL	151	166	15	10

Study Area 1 contained a total of 433 individual pieces of jasper taconite material which I assigned to three different categories for cataloging purposes: Natural, Cultural, and Uncertain. From the 433 pieces, I determined 230 pieces as being culturally derived. Of these, 23% were found in Test Pit 18, and 69% were found in Test Pit 38. Together, the quantities in these two pits account for 92% of the total cultural recoveries in Study Area 1. My interpretation of the geographic position of these artifacts when related to landscape features is that they were located on a former river terrace (see Appendix B, Sketch 3).

When making determinations for which category to assign the above material into, I used the following criteria. First, a culturally derived piece of debitage must have a) a distinct bulb of percussion and percussion ripples on the ventral side, and b) percussion flake scars on the dorsal side. Pressure flaking on a tool form was present on the biface found in TP 22. The following figures of examples from the study area illustrate these traits.

Fig. 5.10. Debitage recovered from Test Pit 18. Piece measures 5 cm in length. Photo by M. Schweitzer.

Fig. 5.11. Bifacially flaked tool from Test Pit 22. Piece measures 10.5 cm in length. Photo by M. Schweitzer.

Taconite pieces that fell into the Natural category had no visible evidence of human manipulation. They were blocky or rounded in appearance, suggesting that they were tumbled in a water-based environment. Figure 5.12 illustrates a taconite piece assessed as being Natural.

Fig. 5.12. Naturally occurring piece of jasper taconite from Test Pit 15. Photo by M. Schweitzer.

Taconite pieces assigned to the Uncertain category possessed possible characteristics of cultural modification but without positive identification. Some of these pieces appeared to have percussion flakes, yet their edges appeared more natural than cultural. Shown below is an example of a piece assessed as being Uncertain.

Fig. 5.13. Piece of taconite assigned to Uncertain category, from TP 24. Photo by M. Schweitzer.

A conservative approach was taken when assessing which category a piece of jasper taconite belonged to. Because ample amounts of the material were naturally available in the two study areas, it was necessary to make conclusions of Cultural affiliation only when the physical evidence was unequivocal.

Table 5.3. Results of Fieldwork, Study Area 2, Test Pits 61-90.

Study Area 2	Jasper Taconite Source Material (individual pieces)			
Test Pit No.	**Natural**	**Cultural**	**Uncertain**	**Absent**
61	3	1	0	0
62	5	1	0	0
63	2	2	2	0
64	0	0	0	X
65	6	0	0	0
66	0	0	0	X
67	2	0	0	0
68	0	0	0	X
69	0	0	0	X
70	0	0	0	X
71	0	0	1	0
72	1	0	1	0
73	11	5	1	0
74	11	1	0	0
75	13	0	0	0
76	0	0	0	X
77	0	0	0	X
78	0	0	0	X
79	0	0	0	X
80	0	0	0	X
81	1	1	13	0
82	9	0	2	0
83	5	0	0	0
84	0	0	0	X
85	0	0	0	X
86	0	0	0	X
87	0	0	0	X
88	0	0	0	X
89	0	0	0	X
90	0	0	0	X
TOTAL	69	11	20	17

Table 5.4. Results of Fieldwork, Study Area 2, Test Pits 91-120.

Study Area 2	Jasper Taconite Source Material (individual pieces)			
Test Pit No.	**Natural**	**Cultural**	**Uncertain**	**Absent**
91	3	0	0	0
92	0	0	0	X
93	0	0	0	X
94	0	0	0	X
95	2	0	0	0
96	0	0	0	X
97	0	0	0	X
98	1	0	0	0
99	0	0	0	X
100	2	0	0	0
101	0	0	0	X
102	3	0	0	0
103	3	0	0	0
104	5	0	0	0
105	0	0	0	X
106	1	0	0	0
107	2	0	0	0
108	0	0	0	X
109	0	0	0	X
110	0	0	0	X
111	0	0	0	X
112	5	0	0	0
113	16	0	1	0
114	6	0	0	0
115	0	0	0	X
116	1	0	0	0
117	2	0	0	0
118	0	0	0	X
119	1	0	0	0
120	1	0	0	0
TOTAL	54	0	1	14

Study Area 2 contained a total of 155 individual pieces of jasper taconite material which were assigned to the same three categories for cataloging purposes as with Study Area 1. From the 155 pieces, I determined 11 pieces as being culturally derived. Of these, 45% were found in Test Pit 73. Test Pits 61, 62, 63, 73, 74, and 81 contained 100% of the culturally derived material in Study Area 2. My interpretation of the geographic position of these artifacts when related to landscape features is that they were located on a former river or stream bank (see Appendix B, Sketch 4).

5.6 Summary

The fieldwork component of the thesis went very well, other than the difficulty in obtaining accurate GPS readings for test pit locations. There were no significant problems encountered with either the sampling design or equipment; wet weather and biting insects provided ongoing inconveniences which were accommodated accordingly.

Creation of the two tables was carried out in a methodical fashion, and these were successfully uploaded into the ArcGIS 10.1 application. No changes or corrections were required once the data were displayed in the map document.

In terms of addressing the two thesis objectives, the methodology was successful in identifying landscape variables that appear to contribute to Plano site location at Old Tower Road, and in assessing whether the map products employed in the project are useful for locating these types of natural features at a large scale.

CHAPTER SIX

6.0 Discussion of Results

This section will address the results of the fieldwork by evaluating landscape features as they apply to the study area, and by comparing the modelled map landscape to actual conditions encountered. Additional observations will be included.

6.1 Assessment of Outcomes: Landscape Indicators

The methodology developed for this thesis proved to be successful in achieving in the thesis's two main objectives. Landscape indicators will be examined first, followed by an assessment of map performance.

Determining landscape factors that may have accounted for the site situation of Old Tower Road was one of the thesis objectives. Exploration into Old Tower Road included personal interviews with archaeologists, site visits by persons well qualified to speak to issues concerning archaeology, geoarchaeology, geomorphology, and geology, and by surface reconnaissance as well as GPS mapping of cultural and natural features. This type of integrated approach permitted a comprehensive picture to be drawn of the site area at different spatial scales, and a visualization to be made in an attempt to recreate a small part of the prehistory of the region surrounding the site. By excavating a series of test pits in two separate study areas, data were collected to ascertain what the natural environment contained that may have proved beneficial to Plano people who were there in the ancient past. A number of factors that may have influenced or contributed to their presence will be discussed.

One result from the fieldwork was the discovery of ample amounts of naturally occurring jasper taconite, for use in tool manufacture. A potential local source of this material is listed in the Mount Edna prospect of Gunflint Range Occurrences in Jean Township (OGS 2005). This prospect identifies a Gunflint iron formation located on part of the east slope of Mt. Edna and the west part of Divide Ridge in Jean and Strange Townships (see Appendix A, Map 8). While the formation is not identified on the map (as the bulk of it is underground), the ore body is estimated to comprise approximately 270 million tons in an area measuring roughly 0.8 km², averaging 26.3% iron content, with chert and jasper ore (Flint Rock Mines Ltd. 1962). As the material is within walking distance of the study areas, one may reasonably predict that this formation could have been a convenient source for the Plano people to manufacture tools. However, it must be stated that samples from this prospect were not taken to determine whether it was an actual source of material found in the culturally modified pieces from the test pits.

Samples of jasper taconite were found on the surface of the ground in both study areas, and at all excavation depths down to 50 cm below the surface of the test pits. In this case, Plano people may not have needed to access taconite from the nearby iron formation at all, since it was readily available to be picked up and used. Fieldwork notes indicate that it was unusual to excavate more than 3-5 test pits in a row in Study Area 1 without finding any taconite within them; hundreds of samples were found within a relatively small area. A few of the pieces identified as being culturally modified appear to be of the silica-rich variety of taconite, while many more natural pieces appear to be of the heavier, less desirable variety for tool manufacturing. Alternatively, it could also be the case that material for the purpose of flint knapping was brought to the site from elsewhere.

A second landscape factor that may have contributed to the location of Old Tower Road is the presence of water. Three of the test pits in Study Area 1 were impossible to excavate, since they were in a modern stream environment. Test pits adjacent to the stream also contained water on a number of occasions, where excavation to 50 cm depth below the ground surface was unworkable. As described in Section 5.1, sediments in Study Area 1 suggest a high-energy, alluvial environment with fluctuating flow and water level changes over time. This observation, together with the evidence of fining-upward graded sediments in a number of test pits in Study Area 2, imply that a river existed in the valley for a long period of time, and remnants of that earlier flow may still exist today in the form of the catchment stream.

A third possible landscape factor is that the site location of Old Tower Road is, in fact, a plateau some 50 m above the valley, on the west side of Mt. Edna, according to Ross (1986). He reported that a small number of artifacts were discovered there. My trip to the plateau confirmed that it could have served as an excellent lookout location, although I found no evidence of site occupation at the location which Ross had drawn on his sketch map. The question of whether the newly discovered artifacts in the valley below form part of the original documented site is yet to be determined, but that is beyond the scope of this thesis. Nonetheless, a lookout may be used for more than one activity: scouting game, weather watching, communicating between distances, and/or taking part in rituals of spiritual significance. Plano people at Old Tower Road may have participated in any or all of these events atop the plateau, or none at all.

The most telling landscape indicator at the site is the presence of the terrace feature(s) in Study Area 1. There can be no mistake that all of the culturally derived material found west of the modern stream was located on the terrace itself. This fact seems to be more than a coincidence, especially when Test Pit 38 yielded a flint knapping station *in situ*. My interpretation is that Plano people appear to have preferred that feature, which was more stable and flatter than any other location examined in Study Area 1. Is it possible to state this definitively? Perhaps not, yet that is what the fieldwork evidence points to. At a human scale of land use, I suggest that this is indeed true.

Cultural material in Study Area 2 was discovered on what I interpret as the edge of a stream or river environment. It is possible that the river extended further into the study area and that I found no evidence of it due to my sampling design. As well, evidence of colluvium over much of Study Area 2 may have covered up artifacts due to slope failure. Both of these scenarios are plausible; however, the fact is that the culturally modified pieces of taconite were all found in an area that contained fining-upward sediments.

Archaeologists have a limited understanding of what humans valued in their natural landscapes long ago. Few studies have been done in the boreal forest of northwestern Ontario to uncover clues to the ancient past, leading to conjecture and perhaps occasionally misguided, though well-intentioned, ideas. Scientific evidence is required to either prove or disprove theories. Great physical change to the landscape occurred at and after the timing of the Wisconsinan deglaciation event. How can we make predictive statements about events which we have so little knowledge of? Earlier human geography is tied to the natural world in ways that we currently have only glimpses of. Post-hoc rationalization of inductively collected data seems to be the best that we can do at this stage. Each study that is carried out adds to our understanding.

6.2 Assessment of Outcomes: Map Performance

The second objective of this thesis was to examine how well a computer-generated model could approximate current natural landscape conditions in the physical world. The scale of interest for this project is the human scale of landscape interpretation, which necessarily is much larger than most map scales; in effect, where we may find small evidences of humanity on the ground. I wanted to explore potentially how much territory in geographic area that a group of Plano people might utilize for any particular purpose, and whether that size of space could be modelled in a map format. One may temper that statement with obvious parameters, such as the size of the group, the purpose of the land use, and the time of year (seasonality). Other important factors include the accuracy and precision of cartographic data which is reasonably achievable in a study such as this, where a particular map scale is required.

The GIS map displayed at a 1:7,500 scale (see Appendix A, Map 4) portrayed landscape features quite accurately at that scale. Broadly defined features such as the beaver pond, access road, and sloped sides of the two mountains were visible and in their correct positions relative to one another. However, it became apparent early on that resolution (grid cell size) between the map document and what I found "on the ground" created a problem at the human scale. For example, as soon as the stream and terraces in Study Area 1 were noted as being present during fieldwork, I saw that they did not appear on either the paper map or in the GIS map. This issue is particularly important in regards to the slope values layer that I had produced. The slope values layer was critical to observing whether specific landscape features were visible as heights above the surrounding terrain, namely, the west terrace where the flint knapping station was located. The test pit sampling grid had been designed to match a human scale of landscape use, which was necessarily larger than the map scale. I learned that it was only with ground inspection and subsurface testing that I could determine what landscape features the study areas held, not from viewing those areas on an NTS map at its 1:50,000 scale or in the GIS map at 15.2 m resolution.

Two primary differences became apparent when the modelled map was compared to real-world conditions; one regarding raster data, and the other regarding vector data. The west terrace feature that was discovered in Study Area 1contained sufficient archaeological evidence in the form of taconite debitage and expedient tools to suggest an association between that type of landform and the presence of Plano people. This natural terrace measured no more than 30 m maximum width and approximately 2-3 m in elevation above the modern stream at its highest point. I did not actually survey it with a transit. The feature is too small to be discernible in the map, due to the coarseness of the DEM resolution.

The DEM (raster) data layer was collected at a preset 15.2 m resolution. Because I was not able to access the metadata file for this layer, I cannot identify how accurately its data reflect the actual contours of the land as they would be derived from stereo-photography. In times past, scattered elevation points were sometimes employed to estimate changes in elevation on the natural landscape, since it is impossible to know the exact continuous slope gradient between any two contour lines. Occasionally this estimation method would be used when actual survey data were sparse, depending upon the region being mapped in Canada. Areas that contained economically valuable natural resources were often mapped with greater precision than areas that were perhaps viewed as less important for development (Hamilton 2013; pers. comm.). As previously stated, the use of paper maps created from old aerial photographs can affect map accuracy in some cases.

DEM's are created in the GIS application by inputting shapefile vector data for topographic contours, rivers, and lakes, which is then interpolated to a new file containing these elements in raster format. Therefore, every raster grid cell in the interpolated data layer, coloured green to red according to slope values, ideally represents a 15.2 m square of land in the real-world in this case (see Appendix A, Map 7). DEM's may be created at different resolution values, depending upon the quality of the data that was used to create the contour lines. However, it is critical to state at this juncture that creating a DEM at higher resolution than is available in an original digitized contour layer (when it is known) is not going to create a valid higher resolution dataset. Output resolution is based upon the interval of the input contour lines. If this fact is disregarded, in essence the GIS operator is asking the software to create elevation values where none exist in the original data. The software will indeed create a new resolution map layer through interpolation between known values, but it should not and cannot be used when making comparison to real-world values, because unknown values are shown as fact in the resulting map. This type of practice is completely unacceptable in cartographic practice and brings to mind the adage: garbage in, garbage out.

In this thesis, a DEM resolution of 15.2 m proves ineffective at displaying the subtle terrace feature in Study Area 1, since that feature is physically smaller than the DEM resolution. Visual comparison with the map during fieldwork, and after the fieldwork data were uploaded into GIS, confirmed this fact. Because terraces have sloped sides and flat tops, these characteristics should ideally have been visible in the slope raster of the map. Sloped sides may be displayed at a layer value range of 31-40°, for example, and the flat top displayed at a layer value range of 0-10°. When comparing the area where the terrace in Study Area 1 was known to be with the map at 1:1,000 scale; see Appendix A, Map 6), the flat top of the terrace is displayed at 21-30° slope value. This is incorrect since the terrace definitely had a flat top and therefore, should have had a low slope value range of 0-10° in the map (compare with Appendix B, Sketch 3). Another example is the geographic position of the west slope of Mt. Edna, where fieldwork was being carried out on the 11^{th} and 12^{th} transects particularly. In the map, slope values in these specific areas indicate up to 70°, when in reality, the slope was considerably less than that (see Appendix A, Map 4). My estimate is that the slopes along transects 11 and 12 were no more than 35-40° at their steepest, although I did not survey them.

The only way to rectify this situation would be to obtain digital elevation data derived from imagery with higher resolution, and without assurance beforehand that a small-size feature such as the terrace would be visible even then. The presence of tree cover in the study area could easily affect vertical resolution (see Appendix B, Sketch 1). The aerial imagery used in Sketch 1 originated from the Ontario Ministry of Natural Resources Forest Resource Inventory and has a 40 cm resolution, yet the terrace feature is still invisible to the naked eye. This image shows the vegetative cover over the study area, not the bare ground features beneath it.

Remote sensing methods are able to detect actual ground surface details by effectively penetrating the vegetation canopy. One option is LiDAR (Light Detection and Ranging), a system that employs remote sensing technology to measure distance by illuminating a target with laser light, then analyzing the light that reflects back to the airborne device. This system may be able to provide a resolution that does permit identification of the terrace; however, this technology is very expensive, and very little of Canada's geography has been subjected to such survey. What LiDAR data is available has generally been commissioned by governments or proponents of development, where resultant information is proprietary.

Another difference became apparent when comparing the map and the physical features in the study areas. According to the vector data downloaded from Natural Resources Canada, the access road to the study area was positioned in a particular location. Ground control points were taken as GPS readings in twelve locations along the road, at the beginning of each transect line. These points were deemed to be as accurate as possible (given as ±3-4 m error by the unit itself) because they were taken on the road without tree cover overhead. However, once the data points were uploaded into the GIS application as a shapefile, there was clearly a discrepancy between where they were showing on the map and where the road actually was. By using the GIS software, the GCP data were transferred to Google Earth imagery and a separate shapefile created of the road as depicted there. When this new shapefile was added to the GIS map, the fact became clear that the vector data itself was incorrect in terms of the position of the access road (see Appendix A, Map 5). When the original road location was digitized, some error was incorporated into the process.

These two elements of comparison highlight differences between the map model and real-world landscape conditions in the study area. Discrepancies found illustrate the limitations of certain types of geospatial data and the fact that digitized data is only as accurate as the information from which it is derived.

6.3 Summary

Results from fieldwork were successful in addressing the two thesis objectives. Human-scale landscape use can be explored when using a sampling grid that supports that level of cultural resolution in a natural environment. Features may be visible to the naked eye by a researcher who is on the ground, but those same features may not be visible on maps at certain resolutions. Accuracy is related to map scale, and the geospatial data used in this project were not of an appropriate quality to render landscape features as accurately as possible. The process highlights a limitation of using this type of data in archaeological enquiries.

Perhaps more importantly, my results cast a critical look at the approach taken in cultural resource management and archaeological site prediction in Ontario. First, where there is limited literature that discusses archaeology in the boreal forest region of the province, one must question how archaeologists approach the potential identification of natural features or cues that may be useful in predicting typical landscapes where cultural material may be found. There has been great change in the physical landscape of the region since the Wisconsinan deglaciation, and as this thesis demonstrates, late Holocene landscape modelling does not necessarily equate with early Holocene landscapes. Plano people were present in the north, yet much of the knowledge about their lifestyle is derived from different geographic areas such as the Great Plains of the west-central United States. This and other areas that supported Plano people are not the same as the boreal forest. We must be very careful when drawing analogies between different natural environments that existed in prehistory, or when drawing conclusions from earlier studies that may not speak directly to northwestern Ontario. Humans both adapt to and modify their natural environments to maximize resource sustainability, and a strong note of caution is advised in theorizing land use patterns when very little data is available.

My overall interpretation of the Old Tower Road site area is that it represents a valley scoured by glacial ice before being exposed to geomorphological change of great energy and magnitude over time. Walking along the quiet access road, one might never guess what had taken place there in the distant past; a tiny stream gurgles through thick vegetation today. This type of landscape may share few similarities with other locations in North America which were never glaciated, and by extension, share few similarities with how early peoples utilized their environments in other geographic regions. Cultural artifacts were discovered on a terrace and also on a river bank in the two study areas in this thesis. Does this mean that archaeologists can safely predict that Plano people utilized landscapes beside rivers in northwestern Ontario on a regular basis or over time? At present, there is not enough data to make meaningful comparisons.

I also addressed the possibility of shoreline bias in Subsection 3.2.2. The area which I explored for fieldwork is now on dry land, some 2 km north of the present-day Whitefish Lake. My evidence did not uncover a former lakeshore, but it did reveal an ancient river terrace containing culturally modified jasper taconite. I suggest that this find supports the fact that cultural material is found in shoreline environments (Hamilton 2000; Hamilton 1996; Phillips 1988), at least in my study area. A range of shoreline contexts may have been attractive to humans, but again, how do we find those features today when they may be inland and invisible on maps? And are they reliable predictors of human presence?

Once I uploaded the shapefile containing the test pit data, my earlier concern with the locational precision of the test pits provided by the GPS unit was fully justified. It was disappointing to see how scattered some of the points were when displayed in the map document (see Appendix A, Maps 6, 7); I knew that the compass and tape measure had created a grid that I was confident would show actual locations of test pits with minimal error. Comparisons are made in the two study areas between the GPS points and compass/tape measure points (see Appendix B, Sketches 8, 9). A practical feature of this result was that I chose to use AutoCAD drawings to illustrate the natural characteristics of the study areas, as well as recoveries. For me, the amount of error from all sources combined in the digital map is too great to make that form of visual communication a valid interpretation of real-world conditions.

There are numerous standards for assessing the quality of geospatial data. The quality of these data is typically described in terms of accuracy, precision/resolution, consistency, and completeness. Within each of these categories listed, three properties of geospatial data are also considered: spatial, thematic, and temporal. When evaluating the quality of data using these measures, one must take into account the intended use of the data (NCGIA 2014).

The issue of geospatial data quality and its limitation in this thesis identifies what could be termed a serious drawback in cultural resource management. When archaeologists are exploring geographic areas that are new to them, they logically turn to whatever maps are readily available, at least at the beginning of the research, i.e. Stage 1 and Stage 2 Assessments (MTCS 2011). If we understand that there is potential inaccuracy in those maps, should we be looking at a different approach in geographically profiling any particular area? If the data cannot be trusted as being accurate or comprehensive for its intended use, where do we turn?

A final point to consider is the transference of landscape indicators between different geographic areas and different time periods. Because the terrace found in Study Area 1 contained cultural artifacts, it does not mean that all terraces found in similar conditions and circumstances will contain artifacts. River terraces may have been favoured environments for any length of time; there is not enough data to make conclusions. We must exercise restraint in declaring that whenever an ancient terrace is found, there is an increased likelihood of finding artifacts as well, even though that may be the case. The study areas for this thesis involved a few thousand square metres of ground, in a single environment. Archaeologists in Ontario must use other means than previous studies from different areas and modern, potentially inaccurate site maps that do not represent the time period which they are interested in. If no other resources are available for the purpose of site prediction, a re-think of methods is in order.

CHAPTER SEVEN

7.0 Conclusion

The research undertaken for this thesis project provided very useful data and achieved the two stated objectives: to discover what (if any) landscape factors may have contributed to the siting of Old Tower Road, and to assess the accuracy of readily accessible and published geospatial data at one desired scale (the human scale). Assessment of the model's performance, suggestions for future modelling using a similar approach, and the implications of this type of work in a broader research sphere will be discussed in the following subsections.

7.1 Assessment of Model Performance

The modelled landscape created using ESRI's ArcGIS 10.1 software afforded a reasonable approximation of landscape conditions in the study area at the geospatial data's 15.2 m resolution. This level of resolution is appropriate when taking a broader view of real-world conditions in terms of drainage patterns, elevations, and the geomorphological diversity of any particular area. However, at what is called the human scale, the model is not accurate enough to delineate subtle changes in the natural environment that are (or were) important for human land use. As discussed in Section 6.2, differences encountered in both the raster and vector data available as downloaded material, when compared to the study area during fieldwork, render the model as little more than a general guide. Map resolution is defined as the accuracy with which the location and shape of map features are depicted at a given map scale. Map scale is the ratio between distance on the map and corresponding distance on the ground. While map scale changes the amount of detail visible in a landscape, map resolution does not change with scale.

While this fact may discourage some researchers from using geospatial data in similar work, it serves to highlight the necessity of maintaining a critical eye when using map products, and when selecting map data of suitable quality for its intended use. What level of error is acceptable to any given project or researcher depends upon what the purpose of the enquiry serves. For this thesis, the geospatial data was relatively inaccurate but also appropriate for some research questions.

7.2 Suggestions for Future Modelling

This thesis focused upon a study area in the boreal forest of northwestern Ontario. Traditionally, there have not been as many published papers on archaeological topics from this particular region, when compared to other regions in North America. Hamilton (2000) highlights some critical issues with regard to working in the boreal forest, especially the visibility of archaeological material, or more specifically, the visibility of those landscapes that may have an increased likelihood for the presence of artifacts. In the Thunder Bay region, many areas have been exposed to both mining activity and logging for over a century. Many of these areas were historically crisscrossed by privately owned roads which were not accessible by the general public or by scientists. From an outside researcher's point of view, then, the boreal forest could be viewed as impossible to access in a practical sense, impossible to get through (i.e. mature tree stands), or else impossible to explore due to disturbance.

And yet, we know that archaeological material continues to be found in places where it is perhaps not always expected. Some inland areas today may have once been shoreline environments, and some ancient lookout points may have been dynamited during highway construction. Potentially many factors (and features) in the natural environment influenced human land use by Plano people, but we do not yet know definitively what those factors were, or how they worked together to address the human geography of culture long ago. This study uncovered evidence that suggests that Plano people may have preferred to be on a river terrace in a single environment, given the complex nature of their surroundings. These results shed light on a tiny portion of a very small area in the province, which may be argued as being unrecognizable to what it once was. A few pieces of culturally modified tool stone might seem insignificant to the bigger picture, and yet it is exactly this type of research that will eventually fit together the pieces of a puzzle that will reveal ancient lifestyles that we can currently only guess at. Moreover, this important human-scale land use clue is not visible on even the highest resolution imagery used in the thesis. The question is: where do we go from here?

The great change to the physical landscape in parts of northwestern Ontario throughout history provides a significant challenge to both archaeologists and researchers in other disciplines. It is an exciting time of discovery, with new tools available that did not exist decades ago. The ease of use and accessibility of products such as GIS may lull some into believing that answers to longstanding questions are just around the corner. The fallacy of this type of thinking soon brings disappointment to workers in the boreal forest. Therefore, accepting the fact that not all areas are currently accessible on the ground, we must employ modelling as best we can to help us to visualize what is unknown, while keeping limitations and assumptions firmly in the forefront.

In an ideal world, generous amounts of funding would be available from various agencies and governments to permit institutions such as universities to carry out a mandate of archaeological site prediction in a systematic manner. Unfortunately, this is not the case now and it is not likely to be the case in the future. No matter how important a research line of enquiry may be, it must be supported by many different interests before it can proceed. In the meantime, we must use the tools at hand to at least make a start.

As new areas of northern Ontario are becoming economically attractive for natural resource development, more attention is being paid to places that were perhaps formerly thought of as being "in the middle of nowhere". And as this thesis discovered, some of these areas may have only NTS map data available to portray their geographic characteristics, and this data cannot be viewed as accurate and valid at large resolutions in every case. Therefore, a developer examining an area of economic interest is probably using another method to learn about that area, such as LiDAR imagery. This imagery is normally not shared with outside interests, especially when sensitive information is involved.

There is a possible solution to the issue of archaeological site prediction based upon landscape indicators. If high resolution imagery has been accessed and a report filed to an agency as part of a regulatory requirement, then perhaps this imagery could be shared with other interests after a certain period of time has elapsed. Potentially, an agreement could be drafted between government agencies (as regulatory bodies) and consultant archaeologists, whereby archaeologists may gain access to sensitive data with a focus on protecting cultural heritage material that may be under threat if economic development proceeds. This process would need to be tightly controlled for obvious reasons. As with the ideal world scenario, this system may be unworkable if put into practice. Shareholder interests and confidentiality are strongly held principles by many.

In my view, if map data is not readily available at high enough spatial resolution to render small landscape features visible, there is no other option than pedestrian survey to investigate potentially sensitive natural areas. The point is, sensitive areas must first be identified through other means than simply looking at NTS map data, especially in northern Ontario. Archaeological prediction must follow landscape identification. If researchers do not have programs in place to do this on their own, they must rely on others to effectively point out the areas that beg further investigation.

For this thesis enquiry, a landscape indicator containing cultural material that cannot be seen remotely due to a particular scale of map resolution should give us pause to reconsider our options, and also to decide what types of oversight we are prepared to accept as archaeologists. Predictive landscape modelling in northern Ontario, should it become more prevalent in the future, requires a serious overhaul. Hypothetically, Study Area 1 could be compromised in a number of ways in the modern world, without anyone ever knowing that Plano people once inhabited the valley. As will be discussed in the following subsection, there is some urgency involved in this prediction process, due to potential natural resource development and the vulnerability of undiscovered archaeological sites.

7.3 Implications of Results in Broader Context

This thesis produced interesting and worthwhile results. It demonstrates that landscape indicators do have some association with the siting of encampments from the Plano time period in the Thunder Bay area. It also highlights the fact that digital imagery resolution can have a considerable influence on the perception of landscape characteristics. This second result holds implications for future modelling done in a GIS format. Continued natural resource development is becoming increasingly visible in the region, in the form of hydro-electric utilities, gas and oil pipelines, and the Ring of Fire mining advancement through road and rail access. Each of these proposed activities involves great cost and potentially great social change to the First Nations people who live in the affected areas.

Part of the negotiation process between First Nations, governments, and resource developers is the designation of natural areas that are deemed to be more sensitive than others, either culturally or ecologically. These areas should (or must) be identified and protected early on in the process, so that negotiations can proceed smoothly and expenses kept under control. One can imagine a scenario where a road is being constructed during the short frost-free season in the North, when it inadvertently runs into an ancient, undisturbed burial ground. First and foremost, archaeological site prediction in the North requires a better understanding of ancient land use patterns. In addition, the production and distribution of accurate maps is essential to the identification of sensitive sites. As Kitchin and Dodge so adroitly explain, maps are events of process, not representations of science. By their very nature, maps are insecure and subject to continual change (Kitchin and Dodge 2007). This was never more true than it is today.

If terrace features are one of the factors that may predict the presence of prehistoric archaeological material, then these features need to be identified through paleo-hydrological reconstruction. Terraces may, in fact, be only one indicator, highlighting the importance of recognizing and appreciating ancient land use patterns when planning archaeological site excavations. This is where the resolution issue between digital imagery and actual fieldwork observation identified in this thesis becomes critical. Unless finer resolution imagery is accessible on a cost-effective basis, modelling will not serve its intended purpose. The only way to determine what is potentially in the landscape will be to send field crews to previously identified areas of interest, so that they may conduct surveys. Without a province-wide inventory database available, area of interest will have to be identified by First Nations people as part of their cultural heritage, or by developers with scientific data. Field-based studies are expensive and time-consuming when compared to simpler map analysis.

Multi-national and international firms that specialize in natural resource development may have the resources to carry out mapping at ground level, but First Nations communities in the remote northern parts of the province do not. They are at a distinct disadvantage as they seek to protect natural and heritage values that are important to their continued way of life and to their longstanding relationship with their traditional lands. Anecdotal evidence suggests that tools such as GIS are currently available to only a limited number of remote First Nations, with even fewer people being trained there to use them effectively. Co-operative agreements should be considered and implemented between resource developers, researchers, and persons trained in the use of certain types of technology, in order to facilitate a leveling of the playing field. Agreements can be struck where researchers may travel to remote communities to learn about human landscape use from those skilled in boreal forest living (Hamilton 2013), and where they in turn may train First Nations people to use modern technology to their best advantage. Perhaps most importantly, relationships of significant trust must be developed over time. First Nations cultural values and traditional ecological knowledge are not normally shared freely with outsiders.

Perhaps through the natural resource development that is expected to continue in the region, archaeologists may be granted opportunities to answer some of the persistent questions regarding ancient populations in this land. Better still, they may ask new questions.

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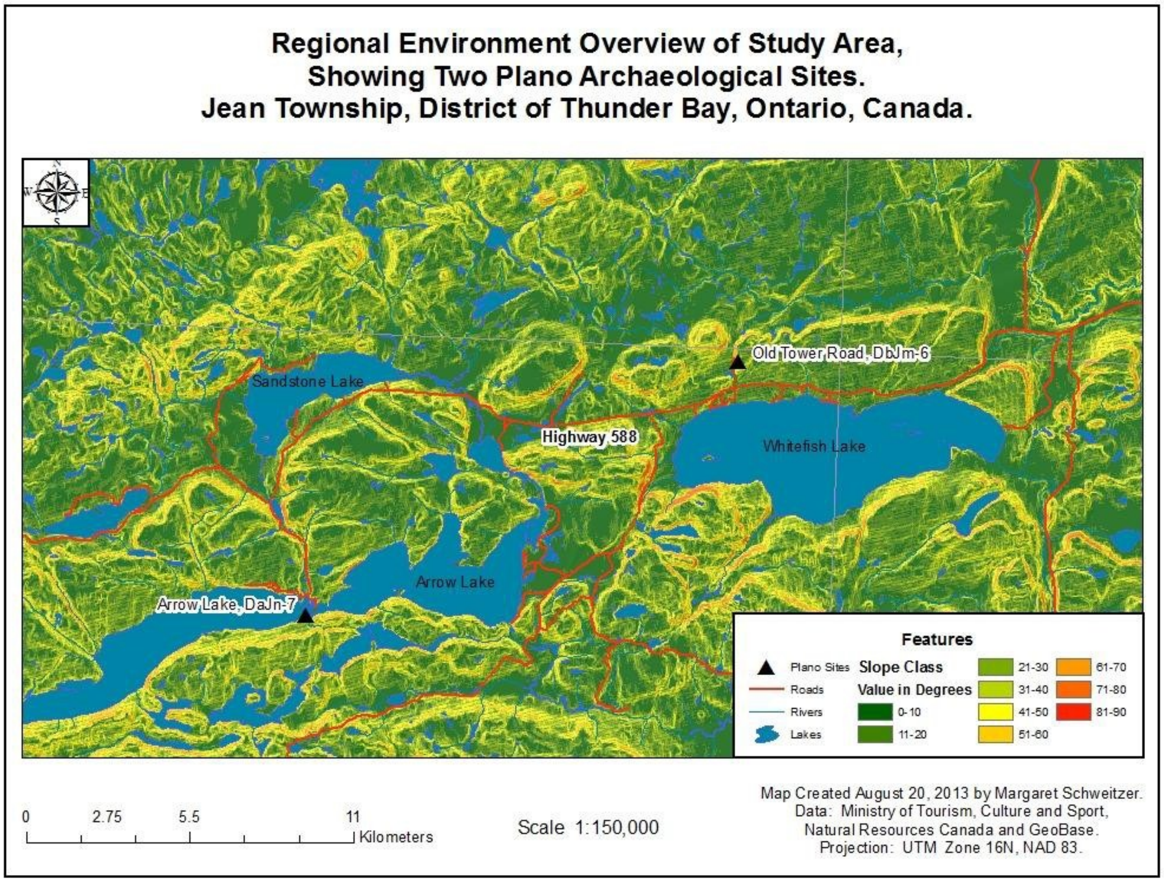
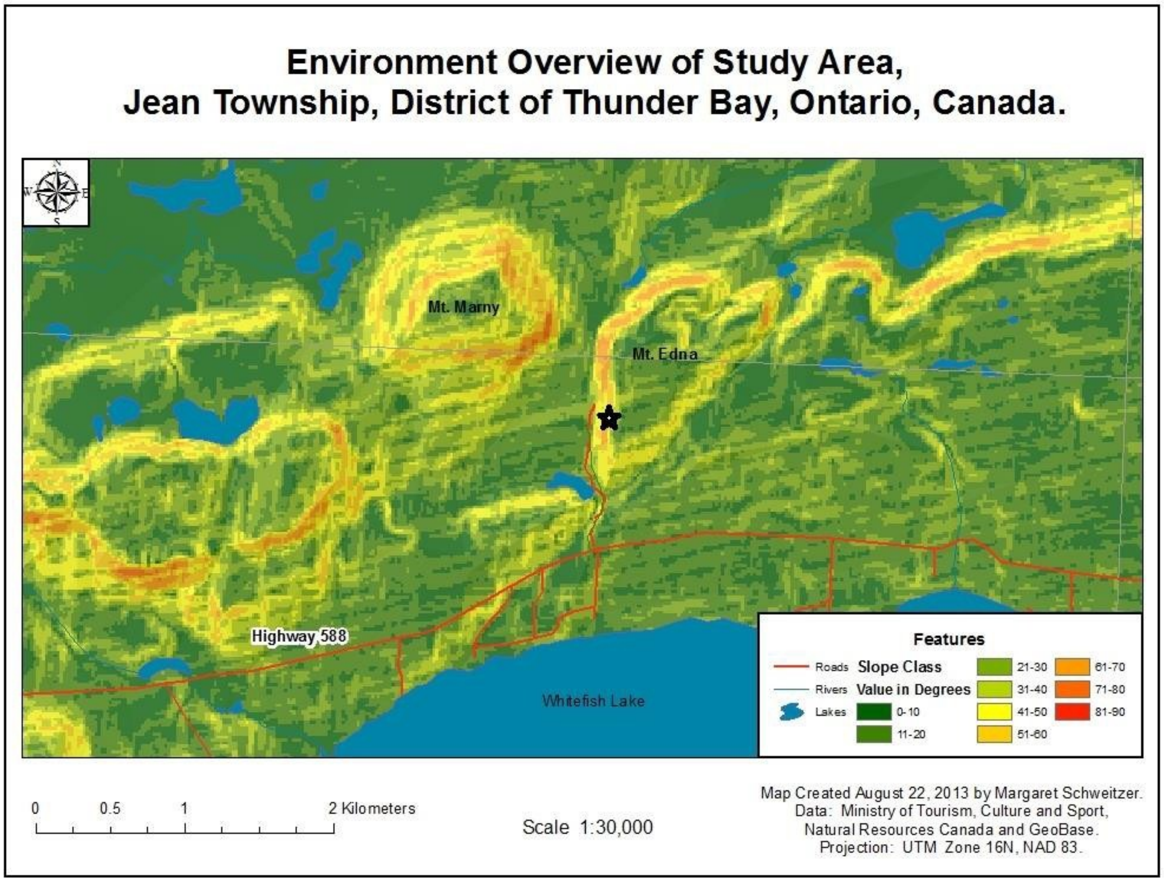
APPENDIX A

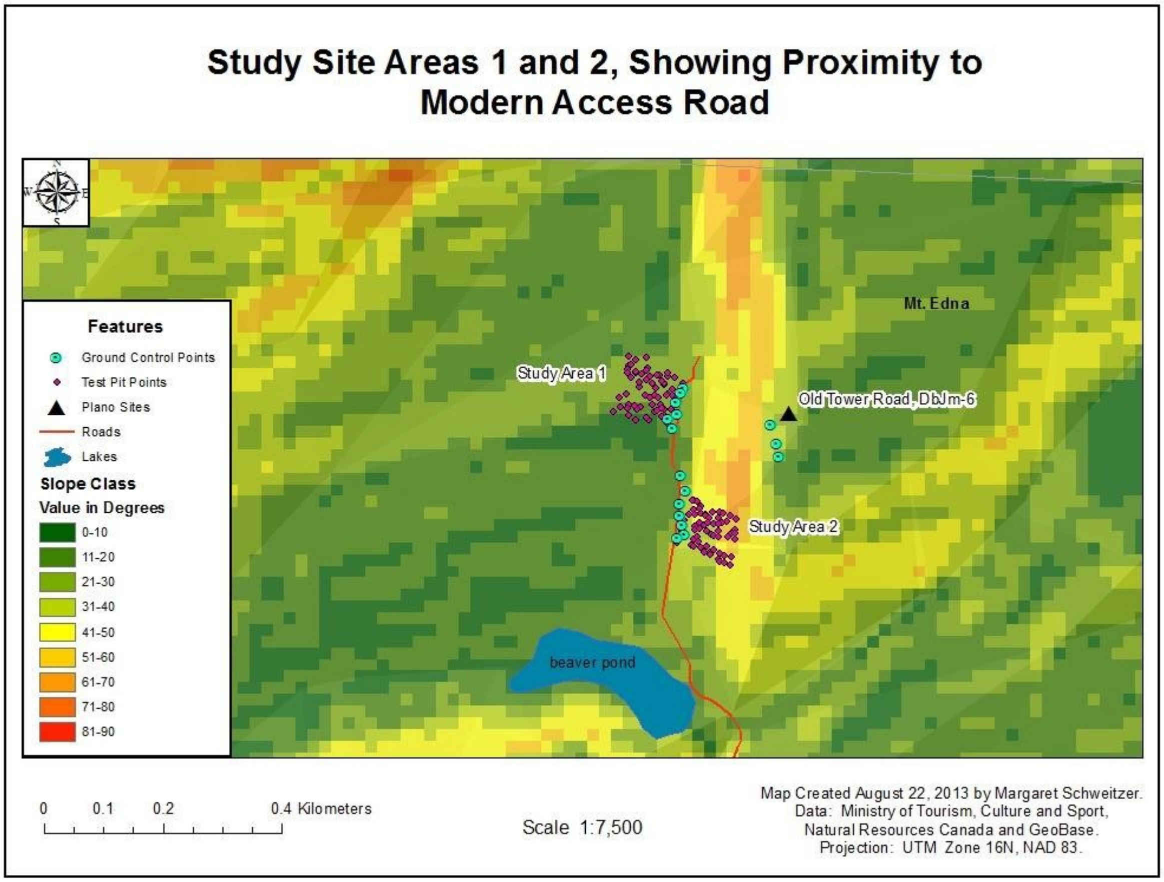
Map 1. Location of Old Tower Road (DbJm-6) relative to Great Lakes. Google Earth image.



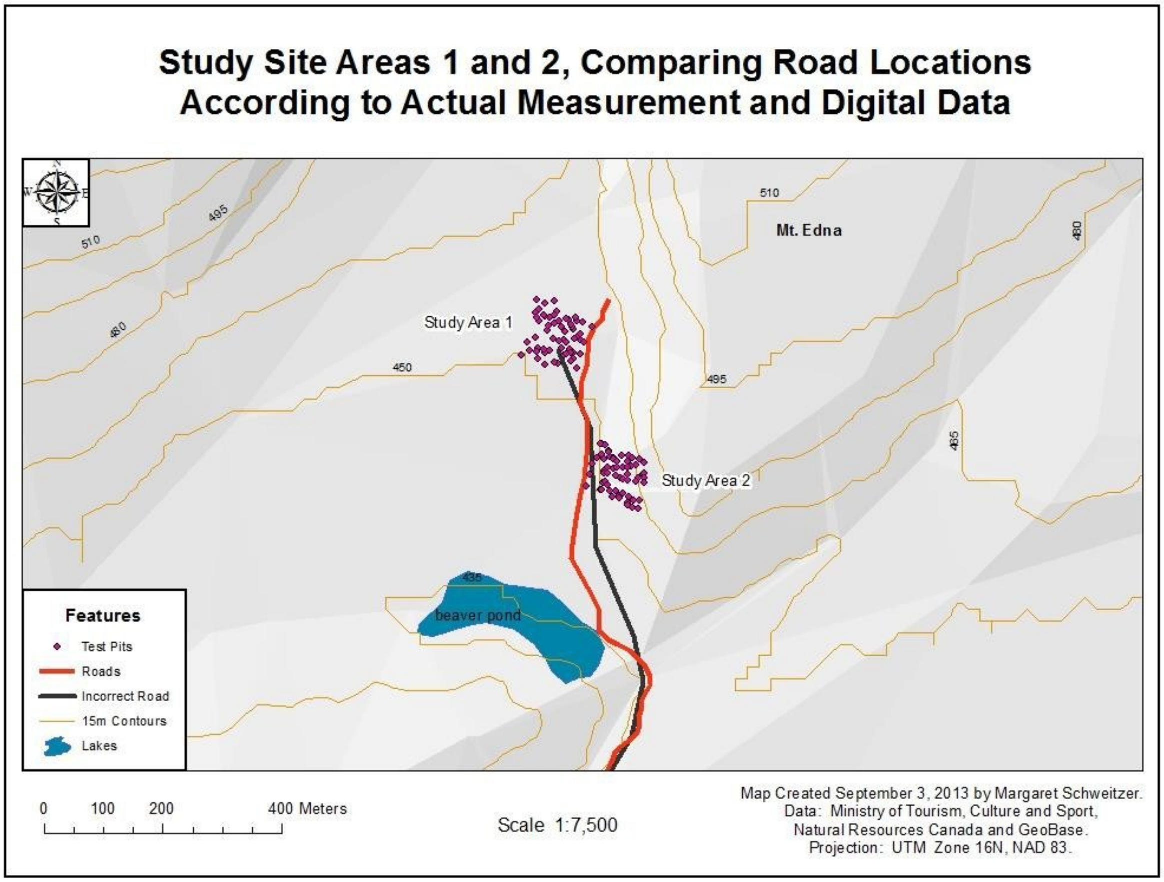
Map 2. Regional Environment Overview of Study Area. Archaeological site locations are as described by Delin (2013; pers. comm.) and Ross (2013; pers. comm.).



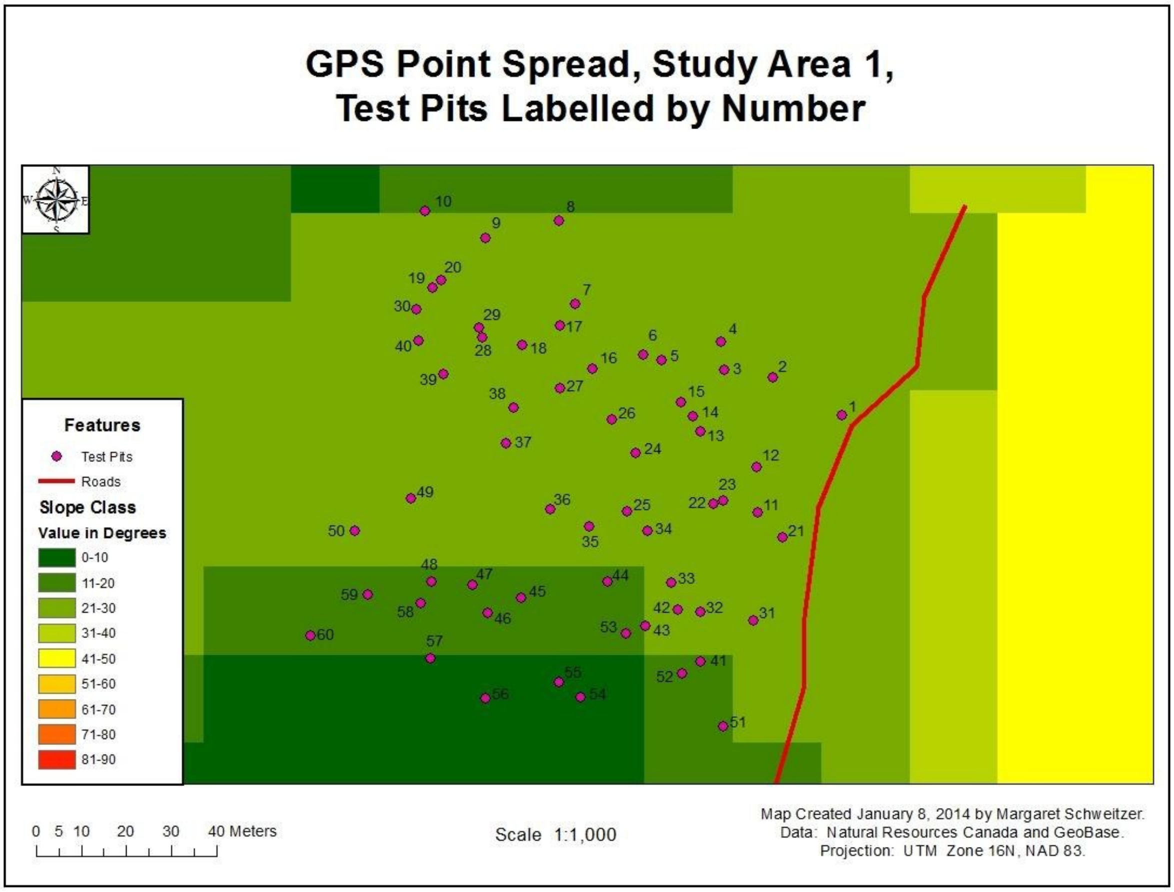
Map 3. Environment Overview of Study Area. Old Tower Road site position marked by black star, as described by Ross (2013; pers. comm.).



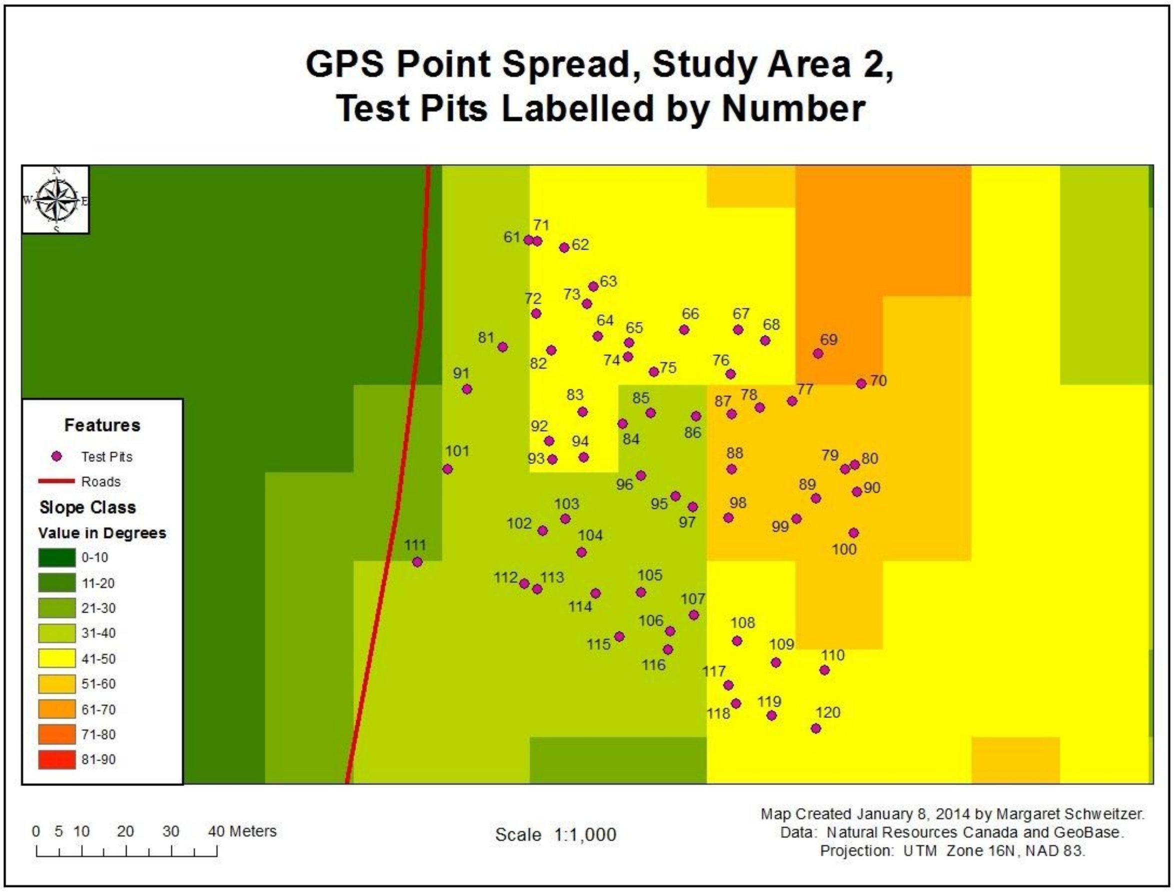
Map 4. Study Areas 1 and 2, showing proximity to access road. Old Tower Road site location is as described by Ross (2013; pers. comm.).



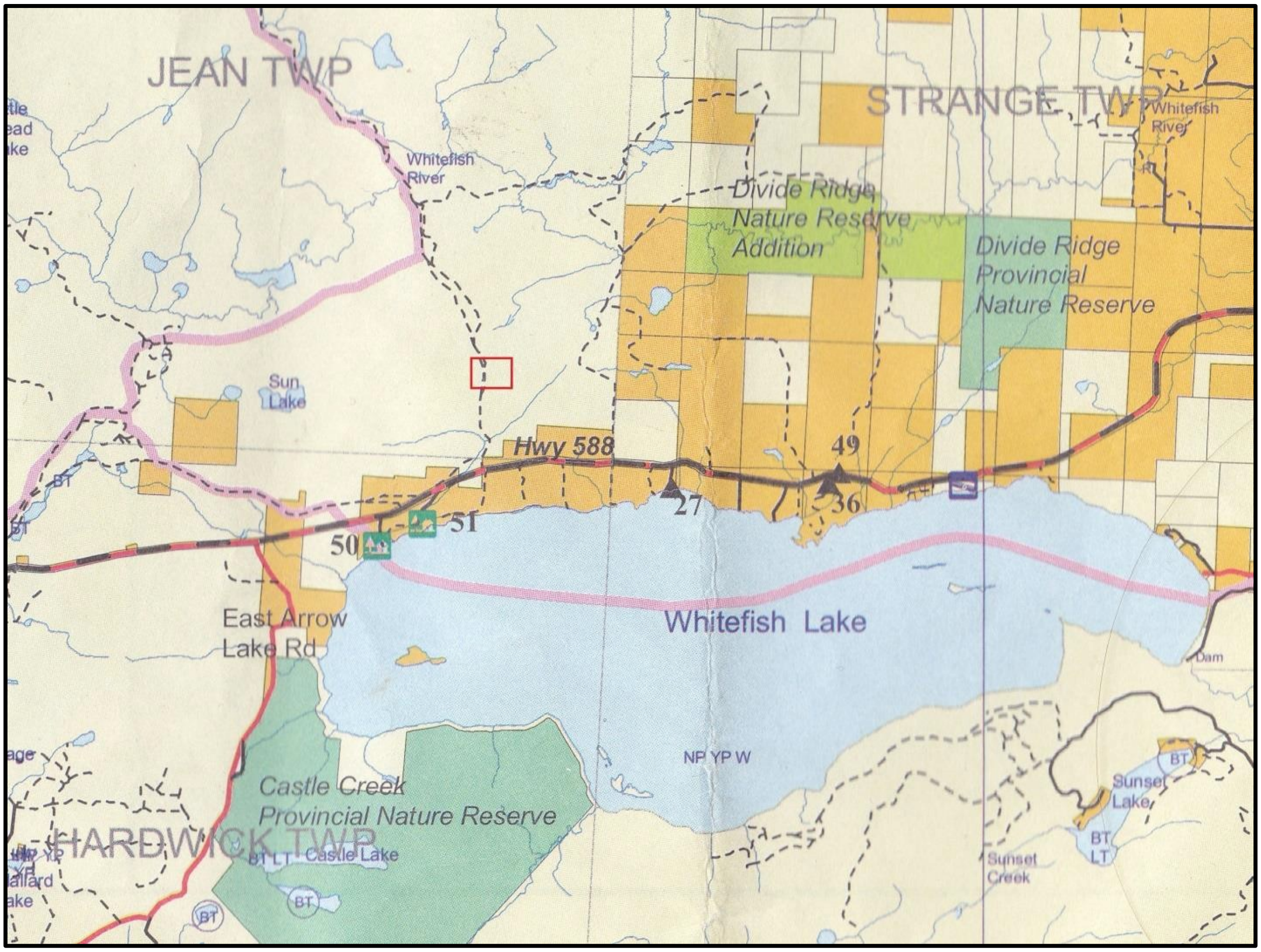
Map 5. Study Areas 1 and 2, comparing actual location of access road (red line) with map data (black line).
Grey-shade background graphic is a TIN surface.



Map 6. GPS Point Spread, Study Area 1.



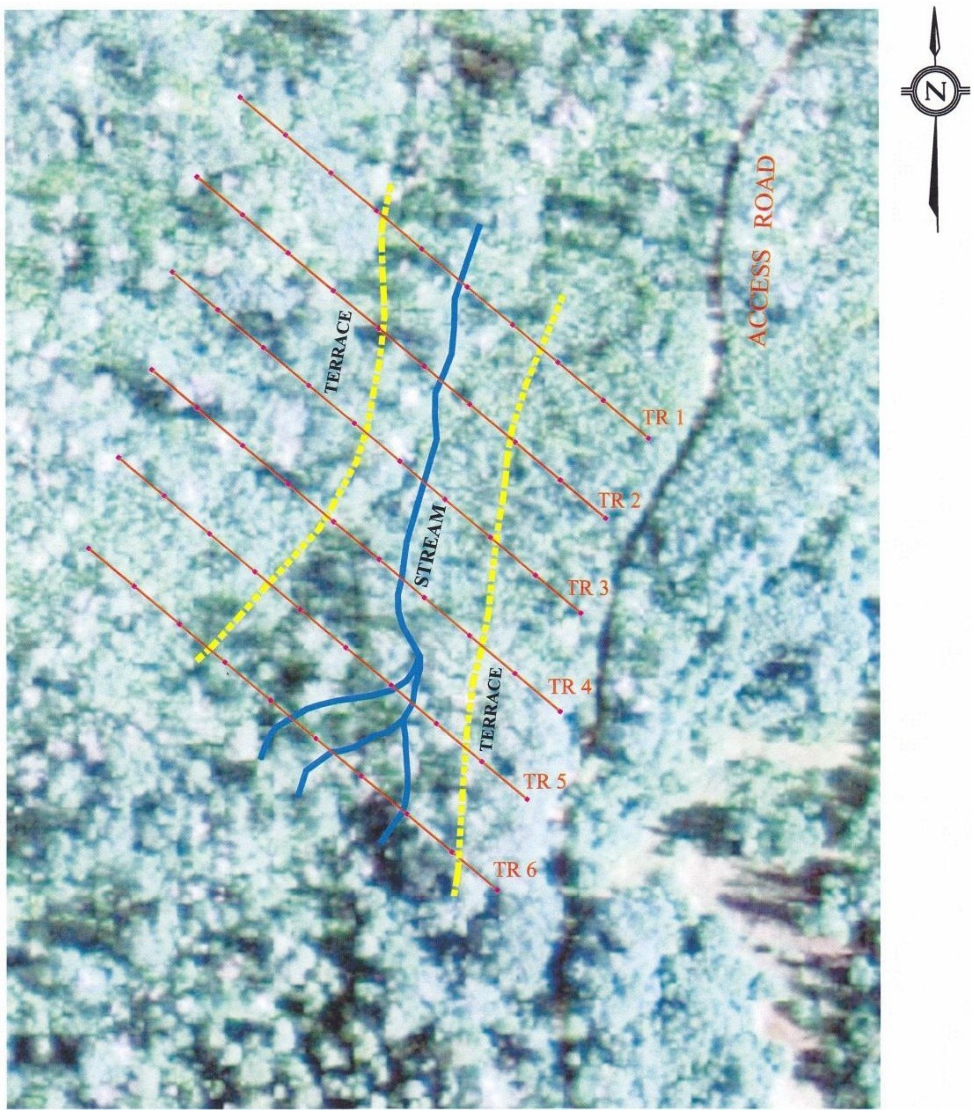
Map 7. GPS Point Spread, Study Area 2.



Map 8. Location of Divide Ridge relative to study area (marked by red hollow rectangle), where Mt. Edna prospect was identified. Exact boundary of prospect is not mapped. Map source: North of Superior Explorer Map Series. Scale: 1 cm = 1.3 km.

APPENDIXB

SKETCH 1
POSITION OF STUDY AREA 1
RELATIVE TO AERIAL IMAGERY



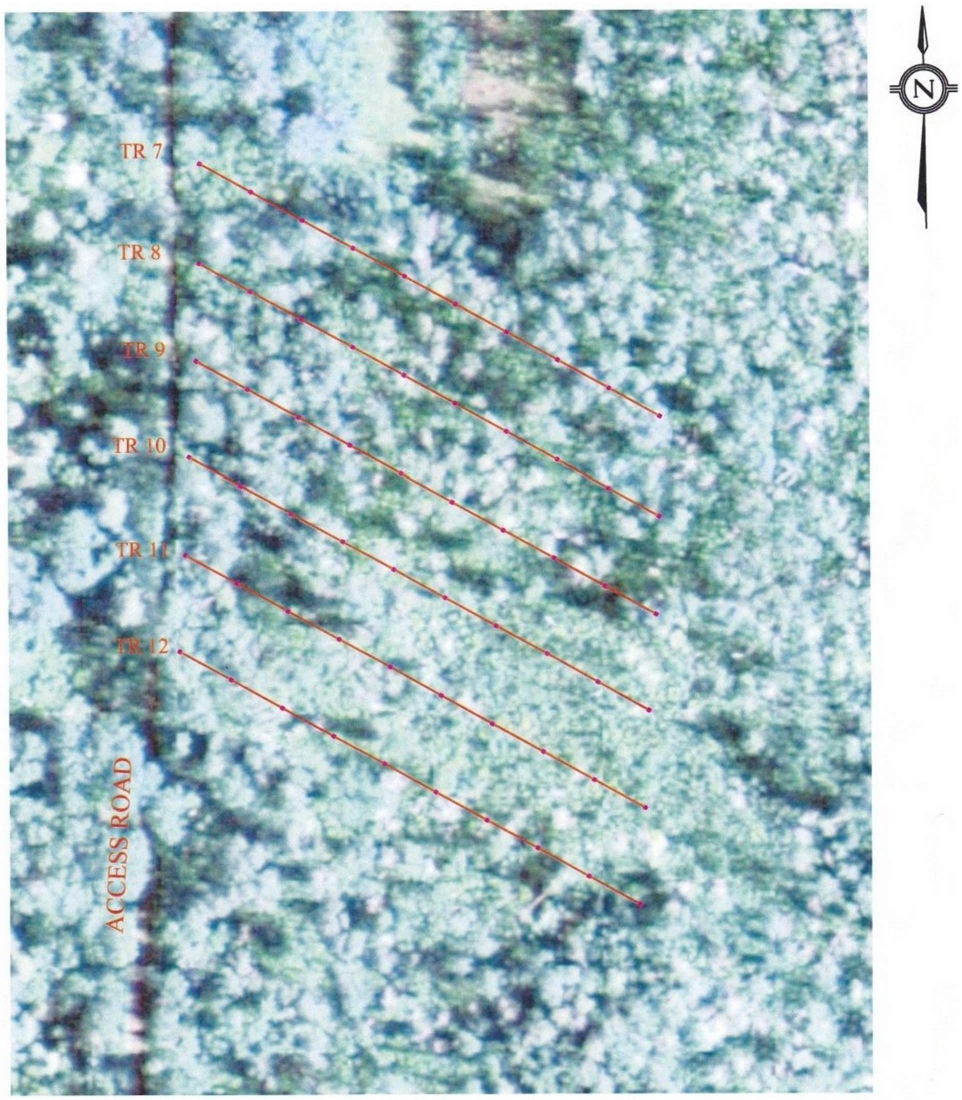
LEGEND
TESTPITS
TR (TRANSECT)
STREAM
TERRACE

Imagery: Forest Resource Inventory, Block W
(40em resolution)
Ontario Mioisty of Natural Resources
Source: ScholarsGeoPortal
Downloaded December 18, 2013

10m 0 1O 20m
SCALE: 1:1000

Drawing by: BLAKE SCHWEITZER, January 6, 2014

SKETCH2
POSITION OF STUDY AREA 2
RELATIVE TO AERIAL IMAGERY

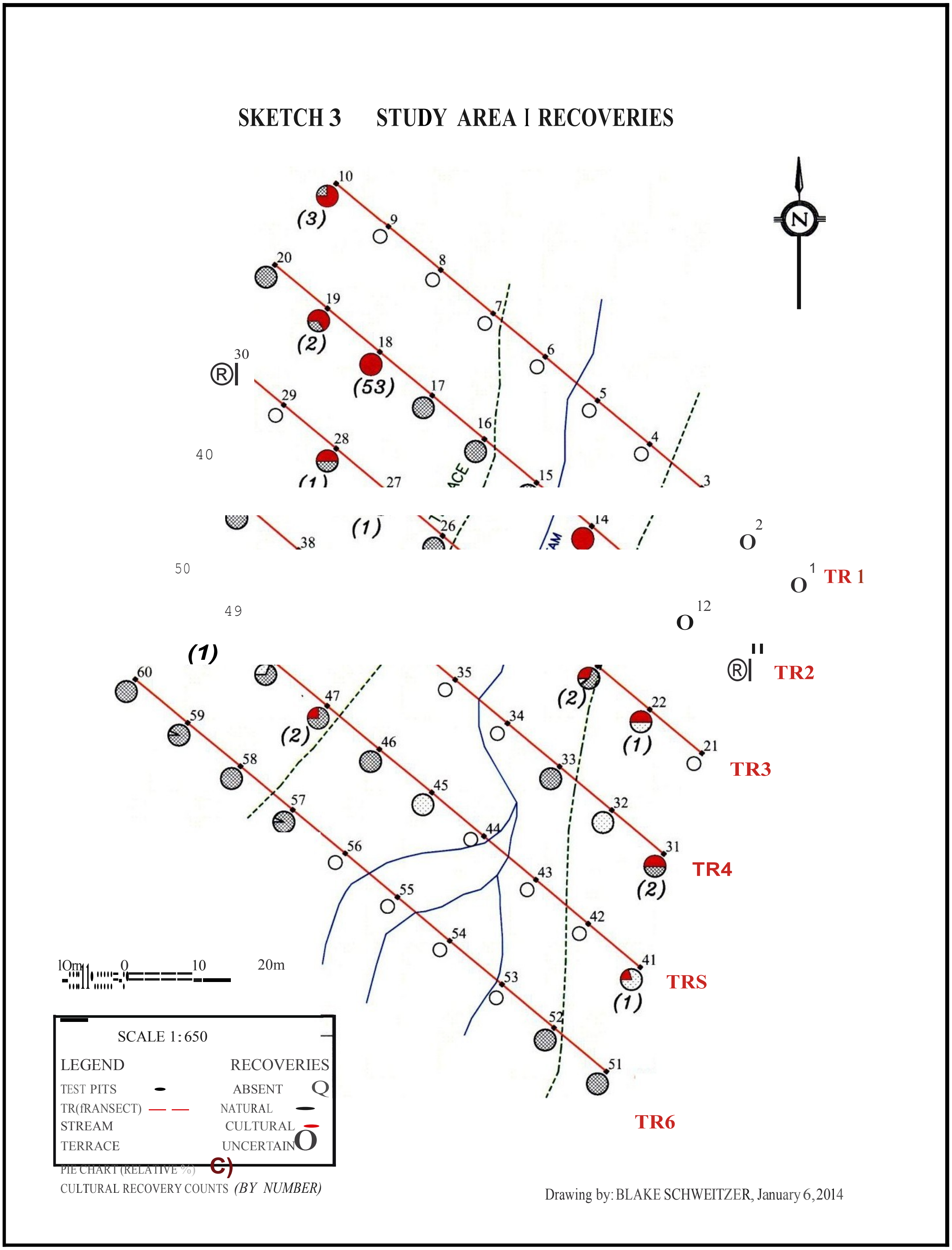


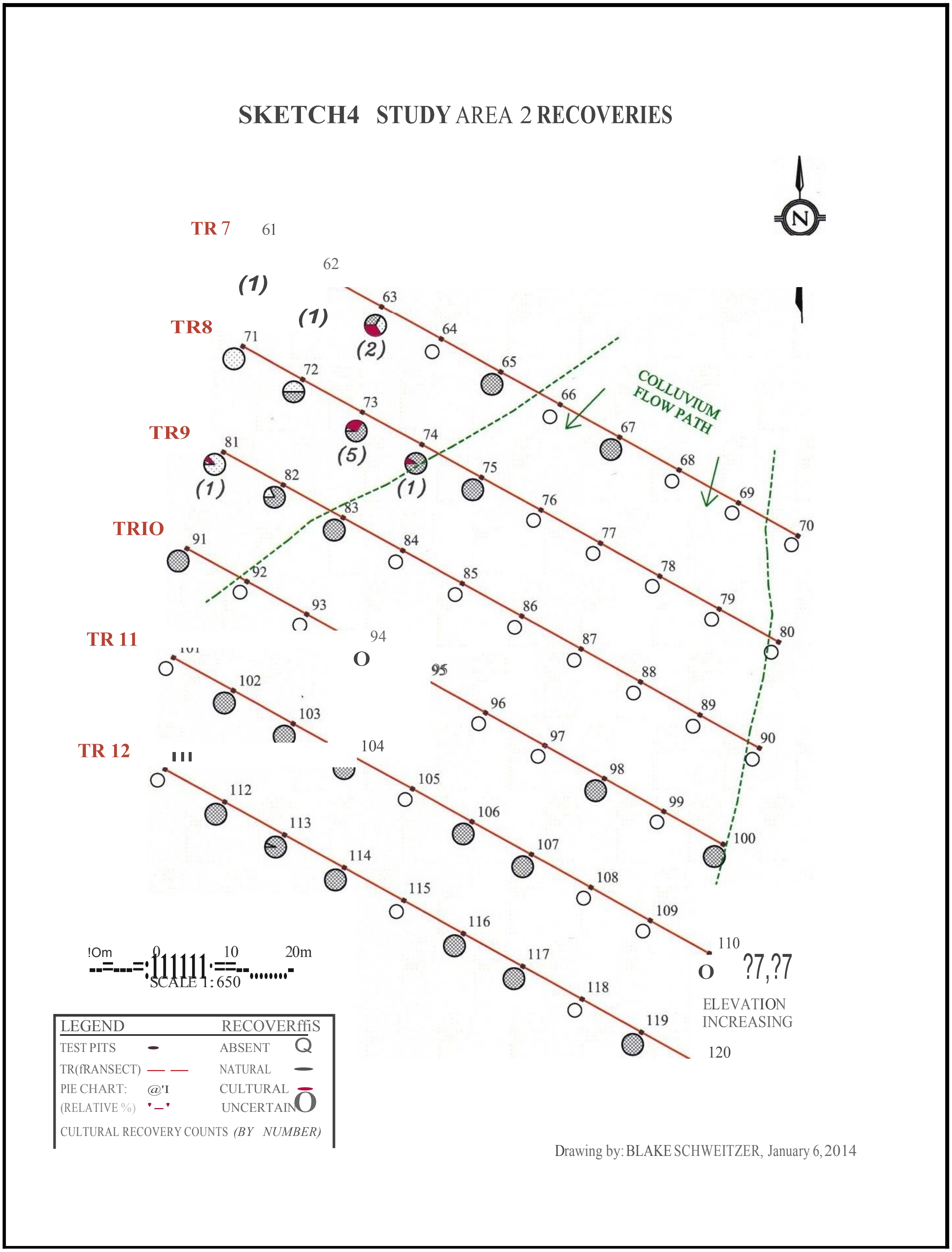
LEGEND
TESTPITS
TR (TRA'ISECT)

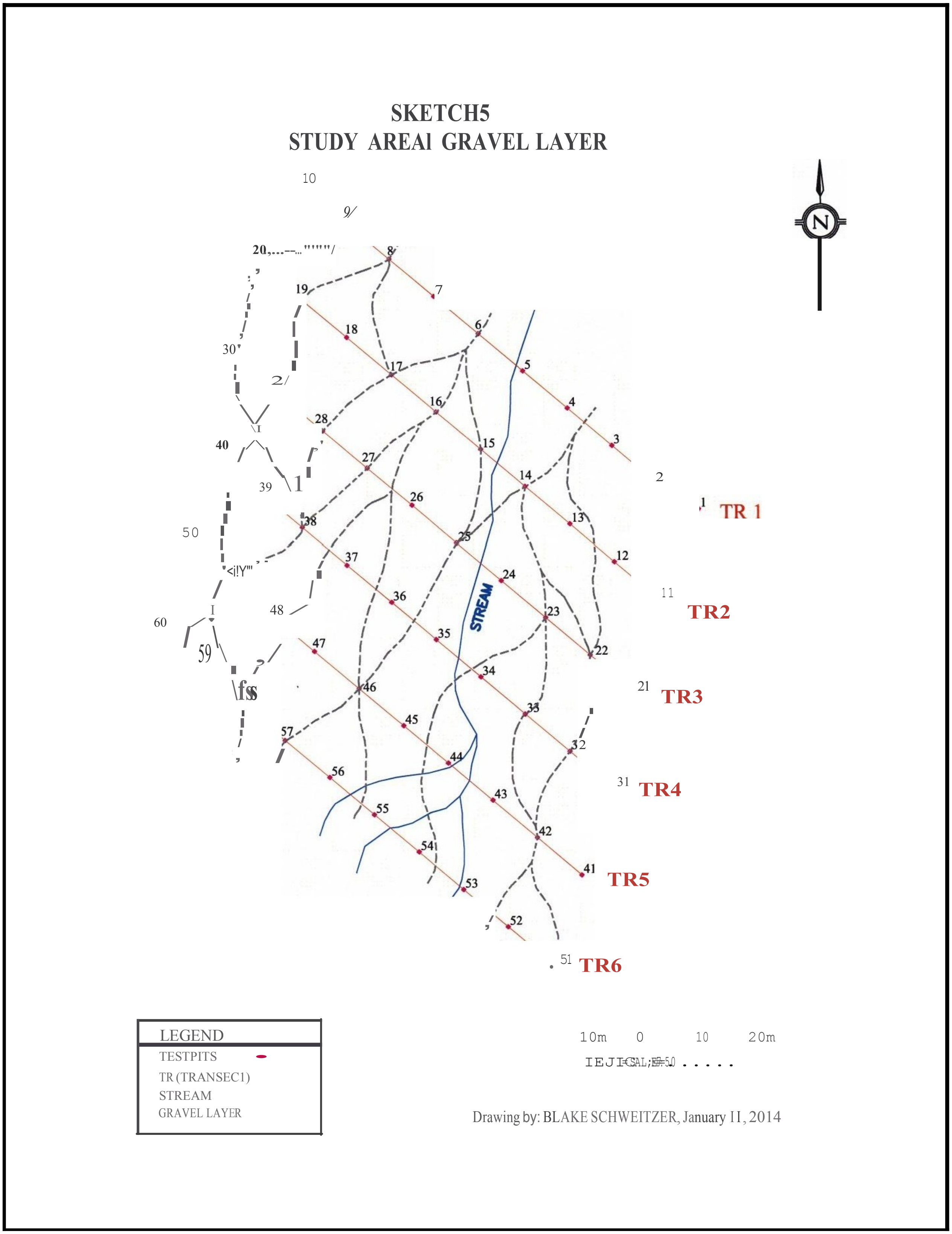
Imagery: Forest Resource Inventory, Block IV
(40 em resolution)
Ontario Ministry of Natural Resources
Source: ScholarsGeoPortal
Downloaded Docembcr \8,2013

IOrn 0 10 20m
SCALE: 1:1000

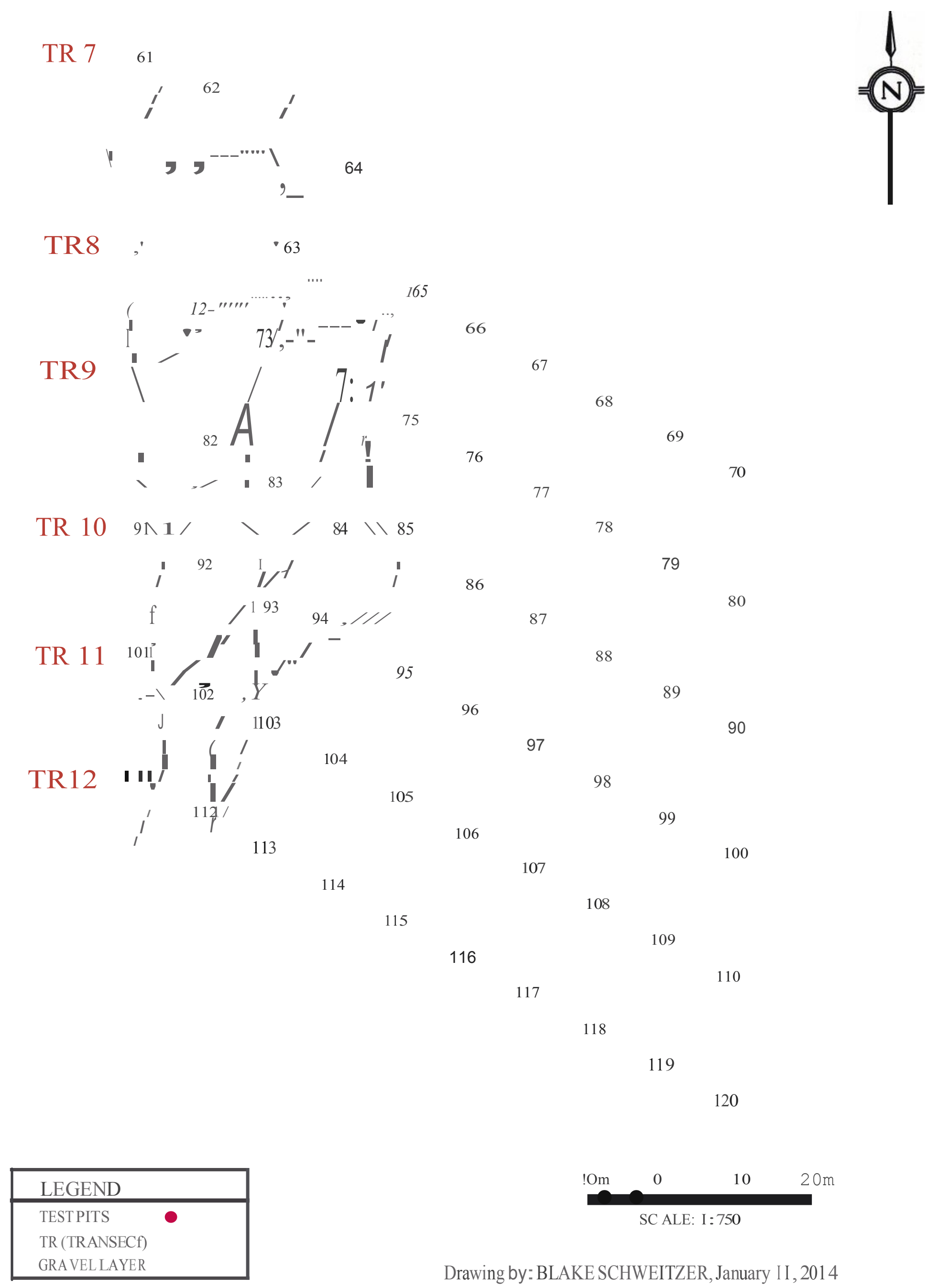
Drawing by: BLAKE SCHWEITZER, January 6, 2014


SKETCH 3 STUDY AREA I RECOVERIES
N
TR 1
TR2
TR3
TR4
TRS
TR6
(3)
(2)
(53)
(1)
(2)
(2)
(1)
(2)
(1)
10m 0 10 20m
SCALE 1:650
LEGEND
TEST PITS
TR(fRANSECT)
STREAM
TERRACE
RECOVERIES
ABSENT
NATURAL
CULTURAL
UNCERTAIN
PIE CHART (RELATIVE %)
CULTURAL RECOVERY COUNTS (BY NUMBER)
Drawing by: BLAKE SCHWEITZER, January 6, 2014


SKETCH4 STUDY AREA 2 RECOVERIES
TR 7
TR8
TR9
TRIO
TR 11
TR 12
(1)
(1)
(2)
(5)
(1)
(1)
COLLUVIUM FLOW PATH
!Om 0 10 20m
SCALE 1: 650
ELEVATION INCREASING
LEGEND
RECOVERffiS
TEST PITS
ABSENT
TR(fRANSECT)
NATURAL
PIE CHART:
CULTURAL
(RELATIVE %)
UNCERTAIN
CULTURAL RECOVERY COUNTS (BY NUMBER)
Drawing by: BLAKE SCHWEITZER, January 6, 2014

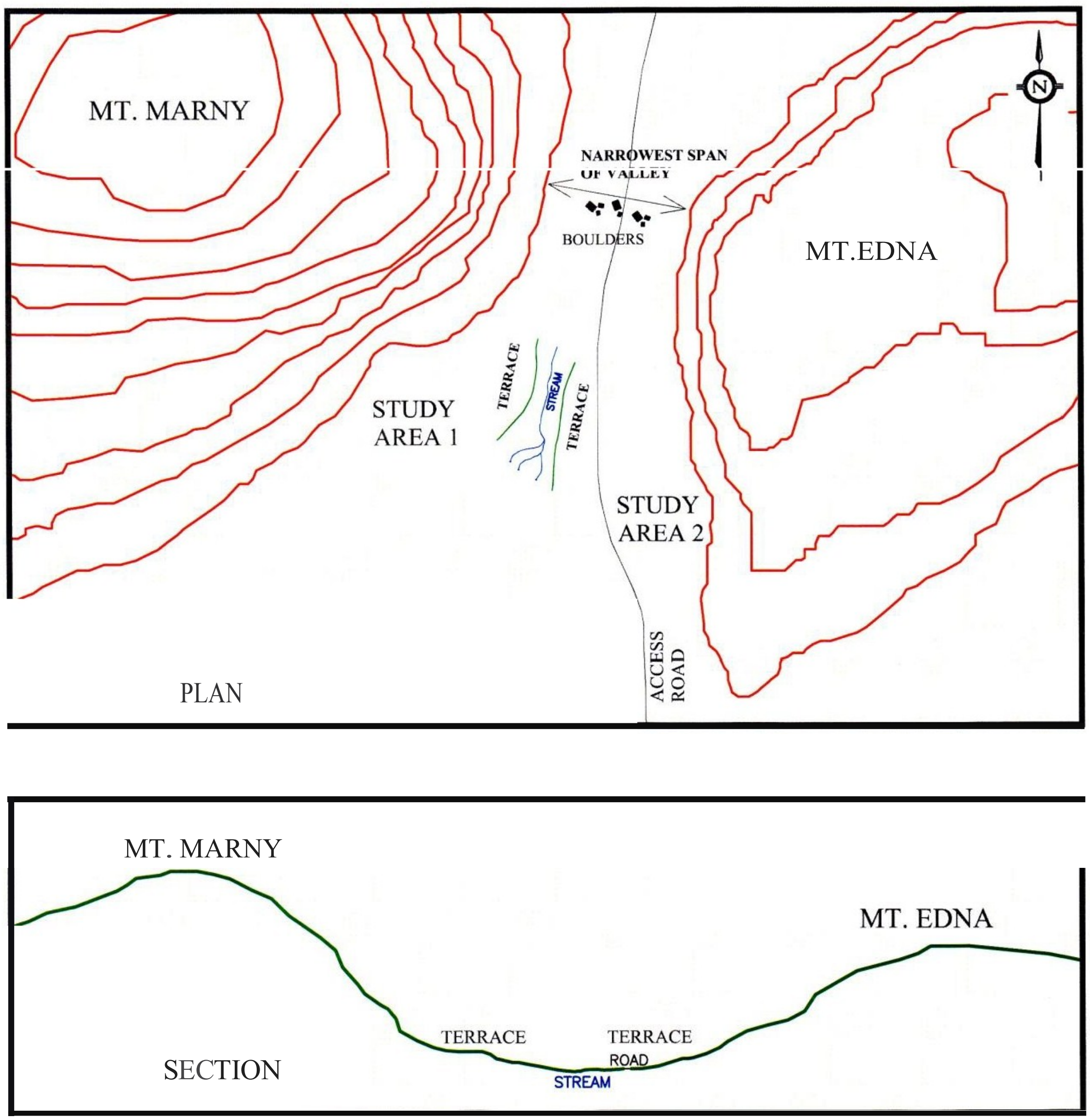

SKETCH5
STUDY AREAI GRAVEL LAYER
N
TR 1
TR2
TR3
TR4
TR5
TR6
STREAM
LEGEND
TESTPITS
TR (TRANSEC1)
STREAM
GRAVEL LAYER
10m 0 10 20m
Drawing by: BLAKE SCHWEITZER, January II, 2014

SKETCH6
STUDY AREA 2 GRAVEL LAYER



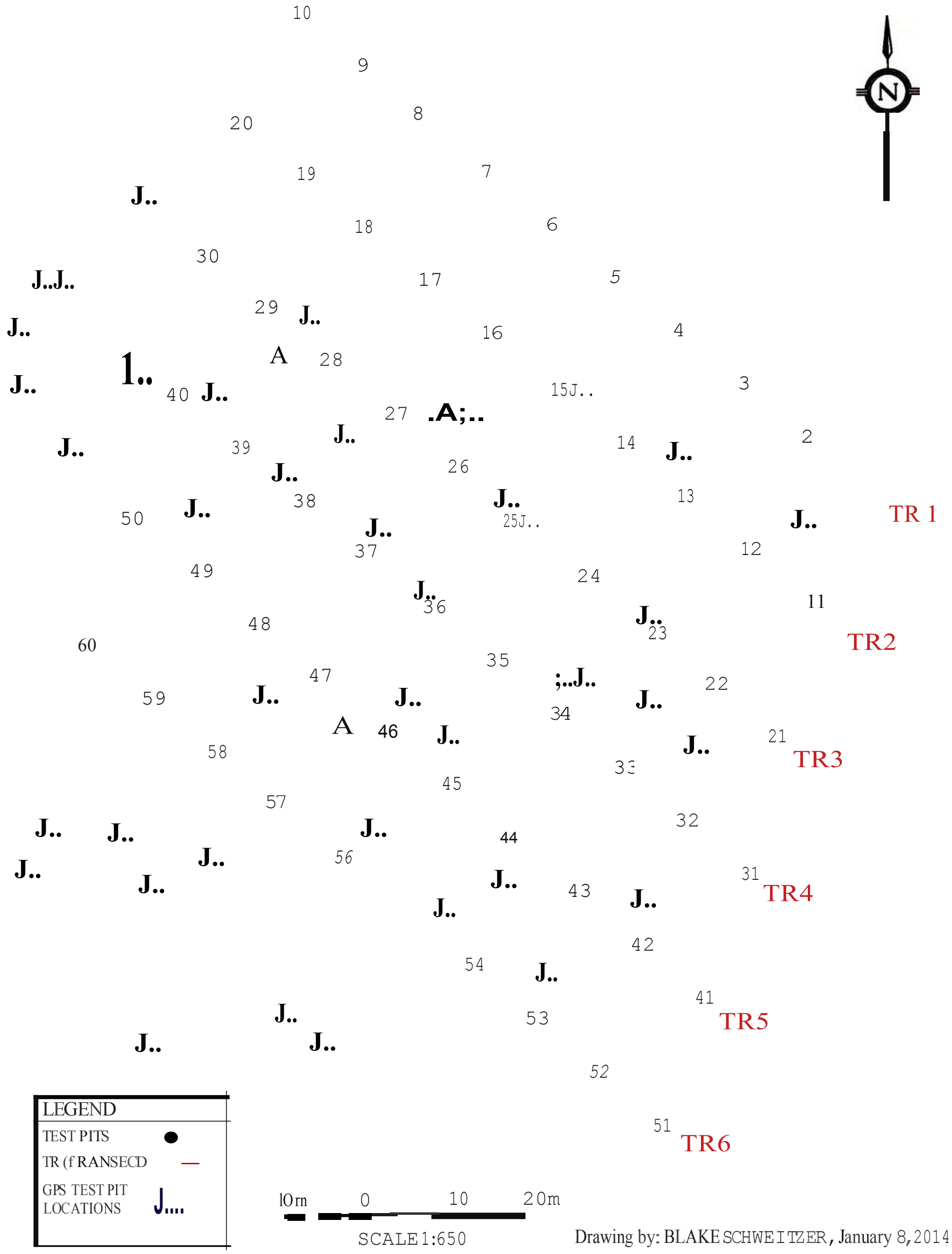
SKETCH 7 PLAN AND SECTION VIEWS OF STUDY AREAS

(NOT TO SCALE)



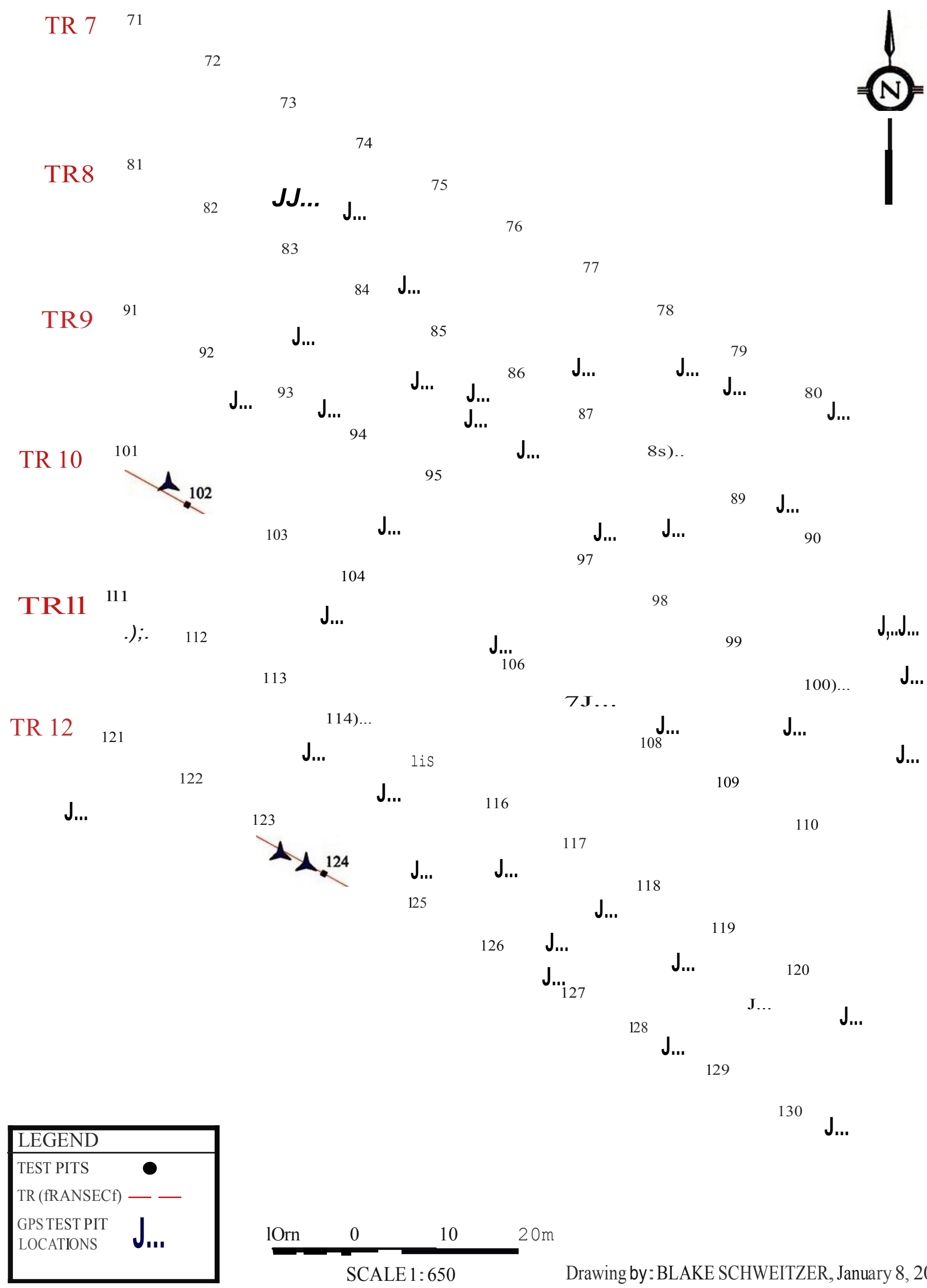
Drawing by: BLAKE SCHWEITZER, January 12, 2014

SKETCH 8 COMPARISON OF GPS POINTS TO FIELD MEASUREMENT POINTS, STUDY AREA 1



Drawing by: BLAKE SCHWEITZER, January 8, 2014

SKETCH9 COMPARISON OF GPS POINTS
TO FIELD MEASUREMENT POINTS, STUDY AREA 2



Drawing by: BLAKE SCHWEITZER, January 8, 2014