A Geophysical Investigation of the Lower Leibhart Site (36YO170), York County, Pennsylvania

Sara C. Rubino
Indiana University of Pennsylvania

Follow this and additional works at: http://knowledge.library.iup.edu/etd

Recommended Citation
http://knowledge.library.iup.edu/etd/1157

This Thesis is brought to you for free and open access by Knowledge Repository @ IUP. It has been accepted for inclusion in Theses and Dissertations (All) by an authorized administrator of Knowledge Repository @ IUP. For more information, please contact ccloose@iup.edu, sara.parme@iup.edu.
A GEOPHYSICAL INVESTIGATION OF THE LOWER LEIBHART SITE (36YO170),
YORK COUNTY, PENNSYLVANIA

A Thesis
Submitted to the School of Graduate Studies and Research
in Partial Fulfillment of the
Requirements for the Degree
Master of Arts

Sara C. Rubino
Indiana University of Pennsylvania
August 2013
Indiana University of Pennsylvania
School of Graduate Studies and Research
Department of Anthropology

We hereby approve the thesis of

Sara C. Rubino

Candidate for the Degree of Master of Arts

______________________
Beverly Chiarulli, Ph.D.
Associate Professor of Anthropology, Advisor

______________________
Benjamin Ford, Ph.D.
Assistant Professor of Anthropology

______________________
Sarah Neusius, Ph.D.
Professor of Anthropology

ACCEPTED

______________________
Timothy P. Mack, Ph.D.
Dean
School of Graduate Studies and Research
Title: A Geophysical Investigation of the Lower Leibhart Site (36Yo170), York County, Pennsylvania

Author: Sara C. Rubino

Thesis Chair: Dr. Beverly Chiarulli

Thesis Committee Members: Dr. Benjamin Ford
                                 Dr. Sarah Neusius

The Susquehannocks were the dominate Native American group along the Susquehanna River during the 17th to about the 1660s. The Lower Leibhart site (1665-1675) is documented as the last village of occupation by the Susquehannocks as a fully functioning unit. During the occupation of the Lower Leibhart site, the Susquehannocks and the English in Maryland were allies on and off with treaties indicating each switch. Each ally treaty promised assistance in the war effort against the Seneca. Maryland soldiers helped construct defensive structures including bastions at the Strickler site. The bastions found were indicated by post molds in a rectangular shape. It was concluded that the English might have had portable cannons and the bastions were really mounds of earth supported by post. The geophysical survey at the Lower Leibhart site attempted to outline the palisade line and find village and defensive structures.
ACKNOWLEDGEMENTS

I would like to acknowledge many people that have helped complete this project. First and foremost, I would like to thank my friends and family for their continued support throughout the entire process. Secondly, I would like to thank my professors at Indiana University of Pennsylvania whose support and patience have made me a better writer, researcher, and thinker. I have had invaluable experiences, and have met amazing people along the way. Thirdly, I would like to greatly acknowledge and thank the SPA chapter 28 for helping me complete the geophysical surveys. These surveys required many hours of their time and I appreciate everyone who helped, especially Paul Nevin, Barbara Blair, and Dana Shirey, who were there the majority of the time. Fourthly, I would like to thank York County Parks and Recreation for allowing me to conduct the geophysical surveys, and the York County Archaeological Committee that was formed to advise my progress, especially Barry Kent and Kurt Carr, who took the time to help guide my research.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>INTRODUCTION</td>
</tr>
<tr>
<td></td>
<td>Research Questions</td>
</tr>
<tr>
<td></td>
<td>Organization of Research</td>
</tr>
<tr>
<td>2</td>
<td>THE SUSQUEHANNOCKS</td>
</tr>
<tr>
<td></td>
<td>Environmental Setting</td>
</tr>
<tr>
<td></td>
<td>Culture History</td>
</tr>
<tr>
<td>3</td>
<td>HISTORICAL BACKGROUND</td>
</tr>
<tr>
<td></td>
<td>Susquehannock History</td>
</tr>
<tr>
<td>4</td>
<td>PREVIOUS EXCAVATIONS AT THE LOWER LEIBHART SITE</td>
</tr>
<tr>
<td></td>
<td>1970 PHMC Excavations and Results</td>
</tr>
<tr>
<td>5</td>
<td>GEOPHYSICAL SURVEY</td>
</tr>
<tr>
<td></td>
<td>Magnetic Susceptibility (MS) Survey</td>
</tr>
<tr>
<td></td>
<td>Ground Penetrating Radar (GPR) Survey</td>
</tr>
<tr>
<td></td>
<td>Magnetometer/Gradiometer Survey</td>
</tr>
<tr>
<td></td>
<td>Analysis of Geophysical Data</td>
</tr>
<tr>
<td></td>
<td>Magnetic Susceptibility (MS)</td>
</tr>
<tr>
<td></td>
<td>Ground Penetrating Radar</td>
</tr>
<tr>
<td></td>
<td>Magnetometer</td>
</tr>
<tr>
<td>6</td>
<td>CONCLUSIONS AND RECOMMENDATIONS</td>
</tr>
<tr>
<td>REFERENCES CITED</td>
<td>127</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>135</td>
</tr>
<tr>
<td>Appendix A: Grids A-H</td>
<td>135</td>
</tr>
<tr>
<td>Appendix B: Coordinates of Grids</td>
<td>161</td>
</tr>
<tr>
<td>Appendix C: Anomaly Chart for GPR and Magnetometry Data</td>
<td>163</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kent’s Stages/Periods with Site Locations</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Gray Stewart Webster’s Faunal Identifications for the Lower Leibhart Site</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>Anomaly Classification System of Magnetometry Data by Burks</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Magnetometry Anomalies</td>
<td>101</td>
</tr>
<tr>
<td>5</td>
<td>Longhouse Comparisons</td>
<td>111</td>
</tr>
<tr>
<td>6</td>
<td>Coordinates for Grids</td>
<td>161</td>
</tr>
<tr>
<td>7</td>
<td>Anomaly Chart for GPR and Magnetometry Data</td>
<td>163</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1</td>
<td>Map of Susquehanna River Watershed</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Pennsylvania State University (PSU) soil map of the Lower Leibhart site</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>USDA web soil survey map of the Lower Leibhart Site</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Google maps image of the Susquehanna River’s north branch</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Map of main Susquehannock sites from Howard</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>John Smith’s map</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Map of the Susquehanna River</td>
<td>29</td>
</tr>
<tr>
<td>8</td>
<td>Kent’s excavation map</td>
<td>63</td>
</tr>
<tr>
<td>9</td>
<td>Bartington MS2 from ASC Scientific</td>
<td>67</td>
</tr>
<tr>
<td>10</td>
<td>Dr. Beverly Chiarulli and I instructing volunteers</td>
<td>68</td>
</tr>
<tr>
<td>11</td>
<td>Steepness of terrain</td>
<td>69</td>
</tr>
<tr>
<td>12</td>
<td>Demonstrating the Trimble R-8</td>
<td>70</td>
</tr>
<tr>
<td>13</td>
<td>Elevation Scale: red indicates highest points with dark blue indicating</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>lowest points</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Magnetic susceptibility data</td>
<td>72</td>
</tr>
<tr>
<td>15</td>
<td>Interpretation map for magnetic susceptibility survey</td>
<td>73</td>
</tr>
<tr>
<td>16</td>
<td>Map of GPR grids over Kent’s map</td>
<td>76</td>
</tr>
<tr>
<td>17</td>
<td>GPR slice 3 of all GPR grids</td>
<td>78</td>
</tr>
<tr>
<td>18</td>
<td>Grid I GPR slice results</td>
<td>79</td>
</tr>
<tr>
<td>19</td>
<td>Grid I GPR slice 3 with anomalies 1 and 2</td>
<td>80</td>
</tr>
<tr>
<td>20</td>
<td>Grid I at gain 8, 40cm-80cm processed through radan</td>
<td>81</td>
</tr>
<tr>
<td>21</td>
<td>Possible longhouse in Grid I outlined in red (Anomaly 3 repeated from Figure 20)</td>
<td>81</td>
</tr>
<tr>
<td>Page</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Grid F selected radan results ................................................................. 149</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Grid G GPR slice results .............................................................................. 150</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Grid G selected radan results ...................................................................... 151</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>GPR slice 3 &amp; 4 for Grid H ........................................................................... 152</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>GPR slice results for Grid H ......................................................................... 153</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Grid H selected radan results ...................................................................... 154</td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>Grids A-H in radan ....................................................................................... 155</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>GPS points of all grids .................................................................................. 156</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>GPS projection of GPR grids .......................................................................... 157</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>GPS projection of magnetometry grids ............................................................ 158</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>GPS projection of all grids ............................................................................. 159</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 1: INTRODUCTION

Overview

This thesis presents the results of geophysical investigations of the Lower Leibhart or Byrd Leibhart site (Lower Leibhart site will be used throughout the paper because it is more formal), located in Wrightsville, York County Pennsylvania. The Lower Leibhart site was identified through archaeological investigation by Barry Kent in 1970 as a late 17th century Susquehannock village (Kent 1993). The goals of this geophysical investigation were to determine if the western village boundary could be identified and if it was marked by a palisade or stockade line, determine if bastions or defensive structures were present, and to determine if village structures (i.e., residential or daily use structures like drying racks) or other features could be identified. The identification of defensive structures was an important goal because during the last stages of Susquehannock occupation, European style bastions were installed to aid in defense against the Seneca and constant threat of siege at some Susquehannock sites.

One of the two Leibhart sites was occupied during the final assault by the Seneca that forced the Susquehannocks to flee southward toward Virginia (Brown 1887; Kent 1993). This study’s goals will add more information to the archaeological record of the Susquehannocks and add new information to our understanding of where the Lower Leibhart site fits within the Susquehannock chronology.
A Brief Summary of Susquehannocks and Defensive Structures

The Strickler site was occupied from 1645-1665 (Kent 1993) and thought to have been the site occupied just prior to the Upper and Lower Leibhart sites. It was modified with the help of English soldiers from Maryland to include two crude bastions. The archaeological evidence indicates that they consisted of mounds of earth held in place by wooden posts surrounding it and in a rectangle-like shape (Janet Johnson, personal communication 2012; Kent 1993). The artillery obtained by the Susquehannocks was portable, so it is thought that they were dragged into place on the bastions (Eshleman 1909; Janet Johnson, personal communication 2012).

After the final Seneca war with the Susquehannocks in 1674-75, the Susquehannocks occupied an abandoned Piscataway fort in Virginia (Kent 1993). That fort also had bastions, so it is possible that all the villages at this time had bastions (Kent 1993). However, to answer this question completely, both Leibhart sites would have to be investigated further to determine a basic village style during this time period but if both villages had bastions then the answer would be yes.
Research Questions

Three research questions were investigated in this thesis.

1. Can the western boundary of the site be located with the geophysical survey for a better understanding of the size and shape?

   As discussed in Chapter 4, Kent found sections of the palisade line in the 1970 excavations on three sides of the village. No evidence of the palisade was found on the western side and it was assumed by previous archaeologists that erosion had erased all archaeological features on that side. In these earlier excavations, only one trench was excavated on the western side because of the aforementioned assumption (Kent 1993). The missing section of the palisade and the assumption of erosion prompted the testing of the western side of the site with geophysical equipment. The non-invasive instruments were the ideal way to find out if there were any archaeological features still intact without disturbance.

2. Are there defensive structures associated with the palisade at this site? The defensive structures might include bastions or any type of elevated projections along the palisade line.

   The significance of defensive structures located within these sites would suggest the site of a battle, which would possibly help discern the location of the final assault. The historic literature (Thwaities 1959; Browne 1887) contains evidence that during the final battle between the Susquehannocks and the Seneca, the Susquehannock village had bastions along
the palisade line. If the Lower Leibhart site has a bastion/s then it is a candidate for being the village occupied during the final battle.

If one of the Leibhart sites’ contains bastions, it may have been the site of the final battle between the Susquehannocks and the Seneca; however, it is also possible that bastions had become a type of internal structure incorporated into Susquehanna villages as a protective measure after the Strickler occupation. A thorough investigation of both Leibhart sites would determine whether or not this pattern is true and which site was the occupation of the final battle. Investigation of the Leibhart sites is critical in understanding the Susquehannock chronology and where the final battle with the Seneca occurred. This battle pushed most of the remaining Susquehannocks from the Susquehanna Valley (Eshleman 1909; Kent 1993).

3. Can geophysical surveys locate village structures, such as domestic features (longhouses or storage pits) or even less substantial structures like drying racks?

One of Dr. Barry Kent’s (1969; 1993) objectives in his investigations was to estimate the site population. He planned to estimate the population based on longhouse dimensions within the site. Therefore, the focus of the excavations was to find postmolds associated with a palisade that could be used to estimate the limits of the village as well as postmolds from longhouses. He found sections of a palisade on the north, east, and south sides of the village, but not on the west. Kent was unable to determine the village dimensions to determine how many longhouses would fit within. Kent reported that he did locate a partial longhouse, but could not find the entire structure (Kent 1969:2, Kent 1993:375). The attempt to find a longhouse or other village structure was based on his work.
Organization of Research

The chapters are organized as follows:

Chapter 2- Susquehannock Introduction: The chapter introduces the Susquehannocks and the geography of the area. The introduction includes culture characteristics as well as culture changes within each stage or period. Kent developed a chronology for Susquehannock sites based on the site or sites known during his investigations. In his chronology, each stage or period is represented by a single site (Kent 1993). Chapter 2 also addresses the possibility that an update to this chronology is needed to include more recent finds.

Chapter 3- Historical Background: To understand the complex series of relationships between the European colonies and the Native Americans during the 17th century, it is necessary to include a thorough historical background. Admittedly, it is largely based on three main sources: The Maryland Archives Online (Browne 1883-1896), Frank Eshleman’s Lancaster County Indians: Annals of the Susquehannocks and Other Indian tribes of the Susquehanna territory from about the year 1500 to 1763 (Eshleman 1909), and the Jesuit Relations (Thwaites 1959). These accounts demonstrate that conditions were hostile and harsh.

Chapter 4- Previous Excavations at the Lower Leibhart Site: Although there was only one professional excavation conducted at the Lower Leibhart site by the PHMC in 1970 by Barry Kent as the principal investigator, it is important to know that he was not the first to remove artifacts from this property. Throughout the time the
Leibharts owned the land, many graves were removed, some were with the help of David Graham, who was an artifact collector/seller (Kent 1969).

**Chapter 5- Geophysical Survey:** This chapter includes the methodologies and results of the three types of geophysical surveys conducted. They include magnetic susceptibility, ground penetrating radar, and magnetometry. The four most western grids are the focus of this thesis because they include the projection of the western palisade and contain a possible bastion. Information on the other grids are while the rest are covered in Appendix A.

**Chapter 6- Conclusions and Recommendations:** The conclusions of the geophysical surveys are summarized and discussed. Due to the absence of ground testing, all of the most promising anomalies were recommended for future testing to confirm the interpretations of this study. There are also recommendations for more magnetometry to be conducted because the instrument finds prehistoric anomalies better than ground penetrating radar and from those results conduct limited ground truthing (Burks 2010; Peter Leach, personal communication 2012).
Chapter 2: THE SUSQUEHANNOCKS

Environmental Setting: The Susquehanna River valley covers a number of “distinct physiographic and biotic zones” (Kent 1993:9). Figure 1 shows the Susquehanna Watershed. The area includes many hilltops that provided strategic locations for the Susquehannocks’ villages. The area of the Lower Leibhart site is currently listed as “Farmland of Statewide Importance” indicated by the Pennsylvania State University (PSU) Soil Map webpage (Figure 2). This status indicates that the property is still fertile for raising crops.

Figure 1. Map of Susquehanna River Watershed. Courtesy of Mansfield University (2012). (a) North Branch Susquehanna watershed. (b) West Branch Susquehanna watershed. (c) Lower Susquehanna watershed.
The soils present at the Lower Leibhart site are Letort, Pequea, and Conestoga silt loams with the dominant being Pequea (PSU Soil Maps 2012; United States Department of Agriculture Web Soil Survey [USDA WSS] 2012). Figure 3 is a soil map of the Lower Leibhart site from the USDA Web Soil Survey website. The site is on top of a geologic formation called the Conestoga Formation that consists of Ordovician and Cambrian Limestone and Shale (PSU Soil Maps 2012). This formation is important because shale reflects a magnetic signature that can be picked up by the magnetic susceptibility instrument (Heard et al 2008; Integrated Geophysics Corporation 1996; Zambito 2004).
Chosen Homeland

The Susquehannocks are most well known for their occupations in the lower Susquehanna valley in south-eastern Pennsylvania (Kent 1993; Kinsey 1959 Witthoft 1959). The majority of the occupations between 1575 and 1763 are situated along or close to the Susquehanna River. The earliest occupations in Pennsylvania start at the border of Pennsylvania and New York in Bradford County, Pennsylvania and end in York and Lancaster counties on each side of the river (Cadzow 1936; Kent 1993; Kinsey 1959).

The Susquehannocks are described “as a tribe of stone-age agriculturalists who raised fairly large crops of corn, beans, and squash on the fertile floodplains near their generally stockaded and well-situated villages of bark-covered longhouses” (Kent 1993:8). Excavated
middens and storage pits from the villages suggested a varied diet consisting of wild-plant foods, seeds, nuts, insects, reptiles, mollusks, etc. (Kent 1993). In addition, it appeared that most major species of animal were hunted including mammals, birds, and fish with a high preference for white tailed deer (Kent 1993; Webster 1983).

**Susquehanna River Influence:** By 1575, the Susquehannocks had relocated to the Lancaster/York County area along the Susquehanna River and were trading with Europeans and other native groups (Cadzow 1936; Kent 1993; Kinsey 1959). The Susquehanna River allowed the Susquehannocks to have extensive trading relations with many European colonies and other native groups (Cadzow 1936; Kent 1993; Kinsey 1959; Ward 1938; Witthoft 1959). It also provided them with the opportunity to reach different environmental settings, allowing for access to a variety of resources from many animals for food as well as furs. For example, the fur trade had depleted the resources in the lower Susquehanna valley almost to extinction so the Susquehannocks traveled upstream to hunt furs in the Iroquois hunting grounds (Browne 1887; Webster 1983).

**Culture History**

David Cadzow (1936) developed the first cultural chronology of Susquehannock sites located in the lower Susquehanna Valley based on his investigations of the sites in Lancaster County, Pennsylvania, which included what is now York County. Cadzow and two previous researchers (Hanna 1911; Landis 1929) noted connections between the Susquehannocks and the Iroquois both archaeologically and historically that changed the previous misconception of
Lenape origins (Hanna 1911; Landis 1929; Kent 1993). This concept was used to explain the Susquehannock/Lenape occupation areas (Pennsylvania and New Jersey/Delaware) and their Northern Iroquois language (Cadzow 1936).

Kent developed a chronological sequence for Susquehannock cultural history combining all of the known data on sites found and artifacts collected, whether professionally excavated or in private collections (Kent 1993). Each stage is based primarily on a single site and is defined by its attributes such as layout and artifacts. The stages (shown in Table 1) were developed from the works of Cadzow (1936), Witthoft (1959), Kinsey (1959), and Kent (1993). However, since Kent’s work, at least two more sites have been discovered. These sites, the Hershey site and the Lemoyne Site (36Cu194), yielded dates that fit into two of the stages (Washington Boro (1600-1625) and Schultz (1575-1600)), but do not share all of the same attributes. Wyatt et. al. (2011) suggests that there is evidence that the Susquehannocks began to separate into multiple villages around the Schultz stage. Equally important is that there could be more sites that have not been found yet. There is some evidence that we could be missing several village sites in this chronology. Currently, three sites are listed as cemeteries and one of them (Lemoyne Site) recently was found to have an occupation component (Wyatt et al. 2011). The two other known cemetery sites may also have occupation components that have not yet been uncovered.

There are seven chronologically distinct stages or periods of Susquehannock culture and at least three lesser known periods of distinctive Susquehannock pottery (Kent 1993). The lesser known periods are defined by either few or no identified archaeological sites so they are introduced as arbitrary stages (Kent 1993). Prior to AD 1550, the Iroquois and the
Susquehannock lived in close proximity until the Susquehannock branched off and migrated southward making the first few stages similar and associated with the Iroquois (Kent 1993). Kent’s list of stages/periods is outlined in Table 1 in his book (Kent 1993: Table 1).

Table 1. Kent’s Stages/Periods with Site Locations (1993, Table 1).

<table>
<thead>
<tr>
<th>Phase/Period</th>
<th>Time Frame (AD)</th>
<th>Associated Site Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Roots</td>
<td>____ - 1450</td>
<td>See Figure 4</td>
</tr>
<tr>
<td>Proto-Susquehannock</td>
<td>1450-1525</td>
<td>See Figure 4</td>
</tr>
<tr>
<td>Early Schultz</td>
<td>1525-1575</td>
<td>See Figure 4</td>
</tr>
<tr>
<td>Schultz</td>
<td>1575-1600</td>
<td>Lancaster County, PA</td>
</tr>
<tr>
<td>Washington Boro</td>
<td>1600-1625</td>
<td>Lancaster County, PA</td>
</tr>
<tr>
<td>Transitional</td>
<td>1625-1645</td>
<td>York and Lancaster County, PA</td>
</tr>
<tr>
<td>Strickler</td>
<td>1645-1665</td>
<td>Lancaster County, PA</td>
</tr>
<tr>
<td>Leibhart</td>
<td>1665-1680</td>
<td>York County, PA</td>
</tr>
<tr>
<td>The Void</td>
<td>1680-1690</td>
<td>?</td>
</tr>
<tr>
<td>Conestoga</td>
<td>1690-1763</td>
<td>Lancaster County, PA</td>
</tr>
</tbody>
</table>

Common Roots of Susquehannock and Iroquois Culture: The New York State Iroquois and the Susquehannock shared common roots based on linguistic and cultural similarities (Jennings 1978; Kent 1993; Wyatt et al. 2011). The motivation for the migration southward could have been resource exhaustion in the north or the promise of trade opportunities. There are more suggestions of the trade opportunities rather than resource exhaustion, but it was probably both because there were many groups in that area competing for resources (Jennings 1978; Kent 1993).
John Witthoft (1959) was the first archaeologist to conclude a relationship existed between the western Iroquois groups of the Seneca and Cayuga. He based this on his analysis of their similar dialects and a shared pottery type called the Richmond Incised (Kent 1993; Witthoft 1959). Richmond Incised ceramics link the earlier groups to the Susquehannocks in that it is a Proto-Susquehannock ceramic and was found at the earliest sites, where the first Susquehannock material culture was identified suggesting gradual separation. Currently, there are no sites associated with this stage; only pottery (Kinsey 1959; Kent 1993; Witthoft 1959). The author assumes that not enough pottery or other associated materials were found to designate these areas as sites based on earlier research on Susquehannock sites (Cadzow 1936; Kent 1993; Kinsey 1959; Witthoft 1959).

**Proto-Susquehannock Stage (1450-1525):** Witthoft defined the Proto-Susquehannock ceramic type that has not been found in association with European trade goods, which places its context prior to the Schultz site (Kent 1993; Witthoft 1959). The Proto-Susquehannock pottery is thought to be Susquehannock because of its distinct stylistic features such as the high collar and incising patterns (Kent 1993). The Bradford County, Pennsylvania area was among the first occupied by the Susquehannocks when they started to migrate southward from New York and lived in “tiny hamlets” and happens to be where the earliest Susquehannock sites have been found (Witthoft 1959:28). The Proto-Susquehannock stage is not accurately dated at this time because only limited numbers of ceramics have been found (Kent 1993). Currently, there are no sites associated with this stage because archaeological features were not found in association with the pottery.
Early Schultz Stage and the Southward Migration (1525-1575): This stage is better defined because it contains datable artifacts including some European artifacts and more ceramic specimens (Kent 1993). The early Schultz pottery is shell-tempered, unlike the previous stages that were grit tempered, which connects with Iroquoian origins (Kent 1993; Witthoft 1959). The pottery has been “found at various small and scattered sites along the Susquehanna River in Bradford County, Pennsylvania and in adjacent Tioga County, New York” (Kent 1993:15).

The early Schultz sites were abandoned prior to 1570-1575 in the upper Susquehanna (Kent 1993; Witthoft 1959). The known sites in Lancaster/York County on the lower Susquehanna suggest the groups moved south before this period (Cadzow 1936; Kent 1993; Kinsey 1959). Kent (1993:18) proposed that this movement south and the layout of their scattered villages may have been in response to political and economic conflict with the Iroquois starting the long history of tension/rivalry between the two. This movement ends the early Schultz stage (Kent 1993).

Figure 4 contains the approximate locations of areas where early pottery was found. The A and B points connect Kent’s description of the North Branch area of the Susquehanna River from Lake Ostego in Cooperstown, NY to Northumberland, PA. The red dots indicate areas where pottery or other clay artifacts were found and the black dot indicates a possible kiln according to Christopher Wren, who compiled the information (Wren 1914). Living in close proximity and possibly still associated with the local Iroquois, the Susquehannocks’ pottery was still too similar to discern from their counterparts (Wren 1914). Because of this complication,
every area where pottery was found is included in Figure 4 to give an idea of placement and how scattered the areas are. Kent believes that most of these are not directly Susquehannock, but includes a few images of Susquehannock pottery indicating their presence (Kent 1993). Bradford County, PA (black dot) is the first location (in northern Pennsylvania) that contains a decent quantity of early ceramics.

Figure 4. Google maps image of the Susquehanna River’s north branch. Due to the scattered nature of Early Susquehannock pottery finds, it was necessary to create a visual representation rather than listing counties both in New York and Pennsylvania. The red dots indicate areas where pottery was found from the early period and the black dot indicates where a possible early kiln was found. The red arrows indicate areas just next to the map.

_Schultz Stage (1575-1600)_: (Figure 5 contains the major villages starting with this stage)

The Schultz stage in the Lancaster County, Pennsylvania began around 1575 (Kent 1993;
Witthoft 195; Cadzow 1936). The definitive characteristics of this stage as described by Kent are based primarily on material from the Schultz site (36La7) (Kent 1993). A detailed description of the features from Susquehannock sites starting with the Schultz stage are described for comparison with the geophysical data.

**SCHULTZ (36La7):** The Schultz site is located in Lancaster County, Pennsylvania. Forty percent of the village was thoroughly investigated through excavations in 1931, 1968, and 1969 (Cadzow 1936; Kent 1993; Witthoft 1959). A total of 12 complete longhouses and 26 partial longhouses were found (Kent 1993). These ranged in length from 50-70 feet and some 20 feet wide (Kent 1993). Samuel Casselberry reported that the longhouses ranged from 60 to 95 feet long with an average dimension of 80 feet by 20 feet during the 1969 excavation (Casselberry 1971). The palisade was estimated to encompass approximately 132,000 square feet (Kent 1993). The estimation does not include the evidence of three possible extensions of the palisade (Kent 1993). The extensions range to approximately fifty feet increasing the current approximation by about 2,500 square feet (using scale on map). A total of 437 pits were discovered and thirteen burials were investigated (Kent 1993; Kinsey 1959; Witthoft 1959). A pattern of storage pits aligning the inside walls of the longhouses was discovered (Kent 1993; Smith 1970). This pattern is also seen at other sites including Washington Boro, Strickler, and Upper Leibhart. The shapes of the pits were bell, saucer, and silo (U-shaped) (Kent 1993; Kinsey 1959; Smith 1970; Witthoft 1959). The pits were approximately 3 feet in diameter and ranged from shallow to 5 feet in depth (Kent 1993; Smith 1970).
New Interpretation for the Schultz Phase

At the time of Kent’s book, the Schultz site seemed to be the only major village for this stage (Kent 1993). However, the recent discovery of the Lemoyne Site (36Cu194) and other sites, has led to a possible new theory about Susquehannock occupational patterns, which suggests that there were multiple villages in each stage rather than one major village (Wyatt et al. 2011).

In addition to the Schultz site, five sites are now associated with the Schultz stage: Herriot Farm site (46Hm1), Pancake Island site (46Hm73), and Moorehead Village (46Hy89) in West Virginia, the Barton Site (18Ag3) in Maryland, and the newly found Lemoyne site in Cumberland County, Pennsylvania (36Cu194) (Kent 1993; Witthoft 1959; Wyatt et al. 2011). The West Virginian and Maryland sites are located in close proximity to the Potomac River.

The newest Susquehannock site found was the Lemoyne site (36Cu194) during an investigation that started in 2005 in Cumberland County, Pennsylvania (Wyatt et al. 2011). Kent and Witthoft knew of a cemetery site in the vicinity named the Smith site and assumed the railroad and development had destroyed the associated village (Kent 1993; Witthoft 1959). This newly discovered site appears to be the occupation associated with that cemetery based on its close proximity (Wyatt et al. 2011).

With these additional sites in mind, Wyatt et al. (2011:29) believes these finds “necessitate a revision of the migration scenario for the Susquehannocks proposed by Witthoft and Kent (Wyatt et al. 2011:29).” “What the wide spatial disjunct between lower Susquehanna and upper Potomac sites seems to indicate is that the archaeological construct Susquehannock,
based as it is on rather distinctive shell-tempered pottery, might be masking more loosely integrated groups that made decisions of major importance like settlement location in relative independence of each other” (Wyatt et al. 2011:29). The idea that each “stage or period” has multiple sites is becoming more and more evident as more sites are being discovered.

**Figure 5.** Map of main Susquehannock sites from Howard (2003:Figure 1)

**Washington Boro Stage (1600-1625):** Two sites, the Washington Boro site and the Hershey site, date to either this period or the Transitional stage. The Hershey site, found recently is located in Lancaster County between Strickler and Conestoga Town, (Howard 2003;
Schulenberg 2003). The Washington Boro site was investigated in 1931 and 1949 by Cadzow and Witthoft respectively and was estimated to have a maximum of 1700 inhabitants and was established around 1600 in Lancaster County, Pennsylvania (Cadzow 1936; Witthoft 1959; Kent 1993).

The stage is marked with a dramatic increase in European trade goods. These trade goods have been found in graves, pits, and village features from the Washington Boro site, its midden deposit, and its associated cemeteries (Kent 1993; Wyatt et al. 2011). Discussed previously in the Schultz section, a recent study has substantial implications for the chronology of Susquehannock sites making the dates earlier starting with Schultz and affecting this one. “If the initial occupation of Washington Boro is pushed forward to the third decade of the 1600’s as indicated by a revised chronology for Schultz (approx. 1595-1610), the marked increase in European trade items would coincide with Dutch settlements in Manhattan, Fort Orange (now Albany), and on the Delaware River” (Wyatt et al. 2011:30).

Kent (1993) and Cadzow (1936) believed Washington Boro was the village identified as “Sasquesahanough” on Captain John Smith map of 1608. A reexamination of the chronology for the Ontario Iroquoian sites has placed the Cameron site (Hne 29-1) earlier at AD 1595-1610 (Wyatt et al. 2011). The glass beads found at the Cameron site have been linked to precise European suppliers suggesting an earlier date (Wyatt et al. 2011). The Cameron site was used to date Schultz and the new dates would suggest Schultz was Sasquesahanough rather than Washington Boro (Wyatt et al. 2011). These results and implications are worth more investigation.
If these studies are correct, this new interpretation may completely reshape the current interpretation of the Susquehannock migration pattern starting with the Schultz site. The Sasquesahanough occupation is marked on Smith’s map as are several other Susquehannock occupations. Smith’s map is based on what Powhatan told him (Fite 1969). It is important to note that Kent (1993) believed that the other four village markers near the location named Sasquesahanough were a miscommunication so those villages could have actually represented several separate Susquehannock villages (Wyatt et al. 2011). Figure 6 is a section of John Smith’s map showing the area indicated as Sasqueahanough and four surrounding or separate villages outlined in red.

![Figure 6. John Smith’s map. Courtesy of Wyatt et al. (2011: Figure 8) with Susquehannock and possible associated villages circled in red.](image)

**WASHINGTON BORO (36La8):** Several excavations have been conducted at the Washington Boro site (Cadzow 1936; Kent 1993; Kinsey 1959; Witthoft 1959). Several hundred storage pits were uncovered consisting of the same shapes found at Schultz (Cadzow 1936; Kent 1993; Witthoft 1959). In addition to finding artifacts in the storage pits, there were two
large hillside middens that contained large quantities of refuse (Cadzow 1936; Kent 1993). The palisade was estimated to encompass 250,000 square feet with possible evidence of an expansion (Kent 1993). Three partial longhouses were discovered (Kent 1993). The house postmolds were approximately six inches in diameter, eight inches apart, and on average six inches in depth (Cadzow 1936; Kent 1993). In addition, over seventy burials were excavated (Cadzow 1936; Kent 1993; Witthoft 1959).

**Transitional Stage: Billmyer and Roberts (1625-1645):** Around AD 1625 at least two new Susquehannock settlements were established with a possible third (Hershey site) (Cadzow 1936; Kent 1993; Witthoft 1959). Neither of these towns has been thoroughly investigated; at least one has been mostly destroyed (Kent 1993). This stage is characterized with both Washington Boro Incised pottery and European trade goods (Kent 1993).

The first site is called the Billmyer Quarry site which has been (largely destroyed by the quarry). It is located just south of Bainbridge in Lancaster County, Pennsylvania and the limited collection dates it to the late Washington Boro stage (Kent 1993). The second, dated slightly later, was the Roberts site located on Conestoga Creek (Kent 1993). The artifacts suggest a transitional period between the Washington Boro and the next stage called Strickler (Kent 1993). A possible third site is the Frey-Haverstick cemetery, which is adjacent to the Washington Boro village site (Kent 1993). The cemetery appears to be where some Susquehannocks returned from later occupations to bury their dead with their ancestors in this cemetery (Kent 1993).
A third site may also date to the Washington Boro stage. The Hershey site was found in 1998-1999 by Dr. James T. Hatch of The Pennsylvania State University during fieldschools (Howard 2003; Schulenberg et al. 2003; Wyatt et al. 2011). The artifacts suggest the transitional period, but it could part of the Washington Boro stage as well (Schulenberg et al. 2003; Howard 2003; Wyatt et al. 2011). According to Wyatt et al. (2011:32), “The Hershey site supports the idea that the Susquehannock settlement pattern after Washington Boro featured smaller, fissioned communities.”

**Strickler Stage (1646-1665):** Conflict and tension describe the atmosphere of the region during this time period with both European trading partners and Native American allies/enemies engaged in hostilities (Browne 1887; Kent 1993; Thwaities 1959). The stage is named after the Strickler Cord-marked pottery found at the Strickler site in Lancaster County (Cadzow 1936; Kent 1993; Kinsey 1959; Witthoft 1959). This ceramic type has little or no added decoration and has minimal shell-tempering rather than the significant amounts that were typical of Susquehannock pottery (Kent 1993; Kinsey 1959).

The Strickler site is located only about 457 meters south of the Schultz site. It is the largest known Susquehannock village that has been excavated (Kent 1993; Wyatt et al. 2011). “History implies and archaeology confirms that on at least two of its corners it was protected by European-style bastions, and it appears to have been occupied until about 1665 AD” (Kent 1993:23). The bastion information (eg. dimensions and shape) from this site were used for this study to determine if bastions were found during the geophysical survey.
**STRICKLER (36La3):** Salvage archaeology allowed a large portion of the site to be excavated (Kent 1993). A total of 550 pits were uncovered. They were located 13-52 inches below the original surface and ranged from 12-110 inches in diameter. The most common diameter was 12.36 inches. There were 5 different shapes: Saucer (43%; round); U-shaped (25%; round); Bell (5%, round); U-shaped (7%; oblong); Irregular (9%; irregular); and Miscellaneous (11%; -) (Kent 1993: 355). The postmolds outlined more than just longhouses. The postmolds that outlined houses were 1 ½ to 4 inches in diameter with an average depth of 8 inches or 18 inches below the original surface. It was also noted that these postmolds were rarely in a straight line, leading Kent to believe that repairs or extensions had been made (Kent 1993). The houses uncovered (17 total) were approximately 60 feet long and approximately 18-22 feet wide. It was noted that the houses followed a radial pattern with the houses radiating from a central point thought to be the plaza (Kent 1993). The palisade length extended approximately 550,000 square feet and was rectangular with rounded corners. Two bastions were discovered that were 25 by 18 feet (Kent 1993).

**Leibhart Stage: Defeat and Turmoil (1665-1680):** Both the Upper and Lower Leibhart sites (also known as Oscar and Byrd Leibhart Sites, respectively) are similar to Strickler and are almost directly across the Susquehanna River in York County (Kent 1993). The artifacts of both of the Leibhart sites indicate they may have been occupied simultaneously, but the interpretation is based on the minimal assemblages found at both sites (Kent 1993). The artifacts suggest the date range to be in the 1660s, but both sites need more investigation (Kent 1993). One of the sites or both should also represent the occupation that was attacked during the final raid of the Seneca war that resulted in the Susquehannocks’ defeat in 1674-1675 when
they were pushed to the Potomac (Kent 1993; Tooker 1984). The Susquehannocks were pushed to the Potomac because the Seneca wanted control of the extensive trading opportunities and fertile farmland in the lower Susquehanna Valley (Eshleman 1909; Kent 1993).

On the other hand, Jennings (1978) believes the Susquehannocks just moved south rather than a battle. The Susquehannocks occupied an abandoned Piscataway village on the Potomac River opposite George Washington’s Mount Vernon (Eshleman 1909; Kent 1993). Jennings (1978) states that the English invited the Susquehannocks to live in Virginia so that they (the English) could befriend the Iroquois in case the Dutch tried to get revenge. The English had pushed them off of the Delaware River, but arrangements for peace were never carried out. Jennings (1978) said that there were no records that the Iroquois defeated the Susquehannocks and that it was simply a move rather than a removal.

Kent (personal communication, 2012) now believes that the Upper Leibhart site was the occupation during the Seneca War of 1665-1675 and that the Lower Leibhart site is the site the Susquehannocks occupied on their return to Pennsylvania from the brief stay Potomac from 1676-1680. However, since no more excavations have been done since 1970 on either site, the current author is not convinced. More excavation is needed to resolve this question.

**LOWER LEIBHART (36Yo170):** The Lower Leibhart site is located in Wrightsville, York County, Pennsylvania and is across the Susquehanna River from the Schultz site. Both Upper and Lower Leibhart sites are thought to be connected, but the exact relationship is unknown as discussed above. One or both of these sites is the location of the final assault by the Seneca (discussed in Chapter 3) against the Susquehannocks making them very important occupations
(Kent 1993). Similar to the Upper Leibhart site, many graves were removed by the Leibhart family and avocational archaeologists (Kent 1993). The details of the archaeological activity at this site will be discussed in the next chapter. The palisade was estimated to encompass 163,000 square feet. The postmolds were 5-6 inches in diameter and between 4-12 inches apart (Kent 1993). The pits were saucer shaped, but had evidence of previous disturbance (Kent 1993). Based on the partial longhouse Kent found, he concluded that the village layout was also radial with a central plaza (Kent 1993).

**UPPER LEIBHART (36Yo9):** The Upper Leibhart site is located about 4,000 feet above the Lower Leibhart site. More than 130 graves were removed by the Leibhart family and other avocational archaeologists (Kent 1993). Fred Kinsey, former curator at the Pennsylvania Historical Museum and Commission (PHMC) and Susquehannock focused career, was given permission to excavate a single longhouse (Kent 1993; Kinsey 1957). The dimensions were 92 by 24 feet. The postmolds were 2-3 inches in diameter and were pointed at the bottom. Kinsey noted from excavation that there were entrances to the longhouse at the four corners as well as two gaps on either side where the center is located. The other feature found was a fire pit that belonged to the Susquehannock component (Kinsey 1957).

**The Void (Unclear Gap) of 1680 to 1690:** Kent (1993) named this stage the “Void” because he believed the historic documents to be inconclusive. There are some references to scattered Susquehannocks living in different Iroquoian towns to the north (Kent 1993; Benson 1958) during this time. According to Grumet (2009), the Dutch governor Andros, invited the Susquehannocks to move to New York because he learned that the Maryland government was
planning a raid to eliminate them and Andros did not want Maryland to have control of the entire area. The invitation was in 1676 and some Susquehannocks chose to go while some stayed with Delaware groups such as the Lenni Lenape because they refused to leave their homeland. “The Void” may simply be a time where the Susquehannocks were scattered in small communities as opposed to missing.

**Conestoga Stage (1690-1763):** The Susquehannocks are mentioned again in historic documents when a settlement is established at Conestoga Town around 1696 with the Seneca (Browne 1887; Kent 1993). In reality, most of the people living at Conestoga Town were Seneca with some Susquehannocks that had survived the Seneca war and were adopted by the Seneca as prisoners of war (Kent 1993). It is probable the Seneca adopted the surviving Susquehannock to make a stronger unit both economically and politically as there is strength in numbers.

The Susquehannock population (down to a handful) and socio-economic status dwindled over time after their climax period from 1700-1725 (Browne 1887; Kent 1993). “The final curtain of this last stage came abruptly in December, 1763, when the remaining indigent Conestogas were extinguished in the wake of the new and now dominant culture of the Americas” (Kent 1993:24). The Paxton Boys and their comrades were responsible for the final slaughter of the surviving Conestogas (Kent 1993; Pennsylvania State Museum exhibit 2012). It was a time of colonist revolt over tensions with Native American attacks and blaming them for the inability to expand west and it boiled over with these assaults on Native Americans in the area.
Chapter 3: HISTORICAL BACKGROUND

Introduction

In the *Annals of the Susquehannocks and Other Lancaster County, PA Indians*, Henry Frank Eshleman compiled Susquehannock references found in historic documents and maps. The references came from many different sources including the Maryland Archives (Browne 1883-1896), the Jesuit Relations (Thwaities 1959), and Frank Eshleman’s Historiography (Eshleman 1909), etc. These historic documents are useful for understanding the conditions (such as colonization and the fur trade) surrounding the history of the Susquehannocks, but it is important to keep in mind that the documents were written by Europeans. The perceptions and opinions of each source were one-sided and it is certain there were miscommunications throughout history. However, it is clear that Eshleman’s discussion of the documents was sympathetic to the Susquehannocks. The original documents from the Maryland Archives are also referenced in this section as well as research conducted by Kent (1993).

The Susquehannocks were referred to by many names: The Jesuits called them Andastes because the Iroquois referred to them as such; the Dutch called them Minquas and White Minquas (the Erie were possibly the Black Minquas); the English called them Susquehannas or Conestogas (both of various spellings) based on the rivers where they resided. In addition to being referred to by many names there are also variations of the spellings such as Sasquehannoughs and other varieties (Jennings 1978; Kent 1993; Ward 1938).
Susquehannock History

Contact with the New World began as early as the 16th century when the first European fishing vessels reached the shores of North America (Kent 1993). An early expedition was recorded in 1600 when the French and the Dutch purchased Staten Island from the Susquehannocks which may have been incorrect because they were not near that area (Eshleman 1909). Following the purchase, the fur trade began along the Saint Lawrence River between the French and the Iroquois. These early visits provided the Native American’s with the first European trade goods (Kent 1993). Once in hand, these goods were spread among Native American groups long before most even saw Europeans themselves, as evidenced by John Smith’s visit.

John Smith, of English descent, came to North America in 1607-1608 as part of the Jamestown settlement (Eshleman 1909; Kent 1993). He learned of the Susquehannocks from the Tockwocks or Tockwhogh (Nanticokes) that had acquired iron hatchets from the Susquehannocks who had obtained them originally from the French (Cadzow 1936; Eshleman 1909; Kent 1993). Smith’s map of the New World showed where various native groups were located (Fite 1969). This map was based on information given to him by Powhatan, the Indian chief of the Powhatans, who had befriended Smith (Eshleman 1909; Fite 1969). During the early 17th century, the Susquehannocks controlled the area from the Susquehanna River up to at least the Hudson River (Figure 7) (Eshleman 1909).
John Smith’s map labeled five Susquehannock towns Sasquesahanough, Attaock, Quadroque, Testnigh, and Utchowig (Kent 1993, see Figure 6 in Chapter 2). Cadzow adds a sixth town and spells one differently: Sasquesahanough, Quadroque, Attaock, Tesinigh, Utchowig, and Cepowig (Cadzow 1936). It is not clear on Smith’s map whether each town had equal ranking, which would be helpful in determining size. This incomplete information explains why they are difficult to locate. Kent believes the extra towns, other than Sasquesahanough, represent a miscommunication between Smith and Powhatan because archaeological sites have not been found matching the layout on the map (north of Lancaster County) (Kent 1993). However, we should not be quick to dismiss the other towns on Smith’s map as miscommunications because they could be sites that we simply have not yet discovered.
Powhatan and other rival tribes described the Susquehannocks as a fierce, gruesome, and mighty people (Eshleman 1909). J. I. Mombert (1869), in his book on Lancaster County mentioned a story of the Susquehannocks leaving one of their clubs next to anyone they murdered to intimidate other tribes (Eshleman 1909). However, the relationship between the Susquehannocks and the Swedes shows a different, more peaceful image because of an alliance (Eshleman 1909; Ward 1938). Based on the evidence, both European groups and Native American groups described their enemies as gruesome and their allies as friendly so the perspective is very important.

The image of the Susquehannocks as a violent people might have been heightened by the acquisition of firearms. John Smith wrote in 1623, that the Dutch provided firearms and instruction on how to use them to the Susquehannocks. However, the Dutch, settled in 1598, had supplied fire arms to the Susquehannocks as early as 1608 (Eshleman 1909). Smith interpreted these actions by the Dutch as encouragement to expel the English when they tried to inhabit the area near the Delaware River (Eshleman 1909). Guns were not the first metal weapon the Susquehannocks assimilated. They already had incorporated other weapons such as axes, copper darts, and hollow cones into their toolkit (Eshleman 1909).

The guns were, in fact, not used to harm the English, who settled successfully into the area during the 1620s. Around 1631, the first English trading posts near the Delaware Bay were established by William Claiborne (or Clayborne) (Eshleman 1909; Land 1981). In less than a year the trading posts were taken over by Lord Baltimore (or Calvert) who founded the new colony of Maryland in 1632 (Eshleman 1909; Jennings 1978; Kent 1993; Land 1981).
Kent and Palmer’s Islands at the mouth of the Delaware River were sold to Claiborne by the Yoacomacoes to spite the Susquehannocks because they had ravaged their lands constantly (Eshleman 1909). There were small wars between other Native Americans and the Susquehannocks from 1633 to 1644. Because of the Susquehannocks dominance and ambition, Lord Baltimore had declared the Susquehannocks public enemies’ several times between peace treaties (Eshleman 1909). The relationship between the Susquehannocks and the Maryland colony was complicated and would waver constantly once the English were the only European colony in the area (1665). The nature of the relationship was dependent on Iroquois attacks, trade networks, and relative positions of power.

In 1635, the Jesuit Relations claim there were twenty Algonquian towns consisting of 30,000 people (Thwaities VIII: 115). It seemed the term Algonquian referred to Native American groups further south from the New York/Canada area although it is unclear how many different groups are included in the figure of twenty towns. The other names listed along with Andastoerrhonons (Susquehannocks) were described as Algonquian so this could have referred to many different groups, but not all are in the Algonquian language family (Thwaities LXXIII: Index). The list of nations given in the Jesuit Relations for this reference are Conkhandeenrhonons, khionontaterrhonons, Atiouandaronks, Sonontoerrhonons, Onontaerrhonons, Oüioenrhonons, Onoiochrhonons, Agnierrhonons, Andastoerrhonons, Scahentoarrhonons, Rhierrhonons, and Ahouenrockrhonons (Thwaities 1959 VIII:115). The first encounter with the Susquehannocks mentioned in the Jesuit Relations is around 1640 when a Susquehannock captive was baptized before he was burned (Thwaities 1959 XXX:85). There are many more references to the Jesuits trying to convince the Iroquois that they needed to baptize
the captives before they were killed although they were not in favor of the killings either (Thwaities 1959).

In 1638-39, the Susquehannocks were accused of killing some of the Maryland colonists; naturally the English settlers were initially against their presence. The word accused is used because the Susquehannocks were frequently blamed even if there was no direct evidence of guilt (Eshleman 1909). It is known that there were misunderstandings of which group actually carried out the killings at any point during the 17th century (Eshleman 1909). This was a frequent occurrence throughout the Susquehannocks’ history. It is also important to note that the English frequently referred to all the Iroquois as Seneca so it is safe to assume they were constantly unsure as to with whom they were dealing (Kent 1993).

In 1626, first European and single occupation (later they will occupy another fort) in the Delaware River area by the Dutch was Fort Nassau and it was a temporary trading post. It was placed along the Delaware because of the variety of Native American groups who lived in the area (Ward 1938). It was not successful enough to stay until the Swedes and the English settled (Ward 1938). Rival European settlements would bring the Dutch back even though they had abandoned the area for years. In 1638, the Swedes established their settlement (Eshleman 1909; Kent 1993; Ward 1938). The Swedes started trading with the Susquehannocks as soon as their settlement was established. Both the Susquehannocks and the Swedes would take turns traveling to each others’ towns to trade (Eshleman 1909; Kent 1993; Ward 1938). Cadzow reproduced Thomas Campanius’s (who wrote the first History of New Sweden) account of the Swedes going to the current Susquehannock occupation:
“...the way to their land was very bad, being stony, full of sharp grey stones, with hills and morasses, so that the Swedes, when they went to them which happened generally, once or twice a year, had to walk in the water up to their armpits. They went thither with cloth, kettles, axes, hatchets, knives, mirrors, and coral beads. They live on a high mountain, very steep and difficult to climb, there they have a fort or square building surrounded with palisades in which they reside. There they have guns and small iron cannon with which they shoot and defend themselves and take with them when they go to war...” (Cadzow 1936:21).

The Roberts site is thought to be the occupation in question since it dates to this period and it is on the other side of the Conestoga Creek, although Roberts has not been thoroughly investigated (Cadzow 1936; Kent 1993). Based on this description, Kent (1993) believed the occupation was on the west side of a river if the Swedes had to walk in water up to their armpits. The problem with claiming the description belongs to the Roberts site is that there are not many known sites that date to this period and it seemed that Cadzow and Kent were trying to place known sites into the ones indicated by historical evidence. The two criteria of being located on a high mountain and across a river can describe many locations so there can be no definitive identification of known sites as being the village the Susquehannocks occupied at this time.

The Dutch and the Swedes also traded liquors like rum. The Susquehannocks did not like the effects that the alcohol caused such as regrettable acts of violence, but they could not resist having more according to some accounts of traders (Eshleman 1909). The year 1638 also marked the departure of Claiborne back to England because he gave up fighting Lord Baltimore for control of his islands (Kent 1993). Claiborne leaving is significant because historical evidence
indicated he tried to encourage the Susquehannocks to attack Maryland several times to get his islands/trading posts back and his departure eliminated major tension.

In 1642, Maryland declared war on the Susquehannocks (Browne 1887 III: 102-103). It is suggested that Claiborne was successful in instigating war between Maryland and the Susquehannocks (Kent 1993). In 1643, two expeditions were organized and sent against the Susquehannocks. The first expedition managed to make the Susquehannocks retreat while the second expedition ended with a Susquehannock victory (Kent 1993). The Susquehannocks had dealt a serious blow both physically and mentally. The physical blow included casualties, fifteen prisoners and the acquisition of two pieces of artillery (Browne 1887 III:149; Kent 1993).

A letter from Robert Evelyn to the Queen of Sweden reported that there were 800 Susquehannocks and twenty-three kings (Eshleman 1909). The Europeans used their own term of king to refer to chiefs and it was also understood from the text that each village had more than one chief (Eshleman 1909). It was also mentioned in this letter that the Susquehannocks settled in their “New Town” on the Susquehanna River, which is either one of the transitional occupations or the Strickler site because the Strickler occupation began around 1645.

The occupation from 1646 (Strickler probably) was reported, by Thomas Campanius (who wrote the first history of New Sweden), to have “small cannon placed upon it” (Eshleman 1909:36-37). Campanius (1834) stated that the English improved the village by means of European features such as mounted iron cannon and the best guns available. These improvements are what drove the Iroquois to retreat before attacking. However, the same document also states that this abortive Iroquois attack occurred in 1664, which means it could
also date to the one of the Leibhart sites (Eshleman 1909). It is unclear if this is an error, given the ease of transposing numbers- 1646 and 1664, or that there is a possibility that one or both of the Leibhart sites may have also been equipped with artillery. The reference of the “almost Iroquoian attack” from the Jesuit source (Thwaities 1959 XLVIII:77) mentions a planned surprise Iroquoian attack on the Susquehannock, but the attack was halted when they saw the mounted artillery according to Axelrod (1993). To complicate matters even further, there was more than one surprise attack during this period that also ended with retreat before any fighting (Eshleman 1909).

There is a Jesuit account from 1647 (Thwaities 1959 XXXIII:129; Eshleman 1909), that describes the Susquehannocks (Andastes) and where they lived:

“Andastoé is a country beyond the Neutral Nation, distant from the Huron country about one hundred and fifty leagues in a straight line to the Southeast, a quarter South, from the Huron country,—that is, Southward, a little toward the East; but the distance that has to be traveled to reach there is nearly two hundred leagues, owing to detours in the route. Those people speak the Huron language, and have always been the allies of our Hurons. They are very warlike, and in a single village they county thirteen hundred men capable of bearing arms.” (Kent 1993:37)

Kent (1993) believes that the reference to a single village does not necessarily mean that only one village was inhabited during this period. Kent (1993) and Jennings (1975) both used the approximate number given by the Jesuits, of 1,300 men, to extrapolate total population. Using Kent’s equation of one warrior equaling 3.33 people to account for women and children, the population would be equal to 4,329 people (Kent 1993). Jennings concludes that 1,300 warriors equals between 5,200 to 6,500 people (Jennings 1975). The Strickler site, which is the best known village of the period, is also the only village that has been found that could have accommodated that many people (Kent 1993). For comparison of population, John
Smith said they had 600 warriors when he visited their area in 1608 as compared to the 1300 warriors in 1647 (Kent 1993).

According to Jennings (1978) the Iroquois were well supplied with firearms from both the English and the Dutch. The firearms allowed the Iroquois to dominate the beaver trade in the northern region from 1649-1656 (Jennings 1978). In 1651, the small pox epidemic severely crippled both the Susquehannock and the Iroquois populations (Eshleman 1909). Disease and continuous warfare caused the population of native groups to decrease from this point on.

The year 1651 also marked the beginning of the Iroquois’ massacre of tribes to the north and south of Lake Erie (Thwaities 1959 XXXVII:97, 105; Eshleman 1909). A Jesuit account claims that the Iroquois were becoming more ambitious and confident with each victory and thus continued their conquest. Eventually, the French even feared for their lives because of the weapons and other items of value they possessed (Eshleman 1909).

In 1655, the English became a new trading partner with the Mohawk after defeating the Dutch, who had previously held the trading rights (Axelrod 1993). Because the area near the English was depleted of furs, the Mohawk joined forces with the other nations of the Iroquois to attack the Huron territory to gain more land to obtain access to furs. Before the Huron were defeated, they asked the Susquehannocks for help by sending ambassadors (Axelrod 1993). After a series of battles, the Iroquois forced the remaining Huron to flee. A total of fifteen Huron towns were abandoned at the end of the struggle (Axelrod 1993).

The Huron never received help from the Susquehannocks and there is no documentation to explain why (Eshleman 1909). Three possibilities could explain their inaction:
the Susquehannocks did not reach the Huron in time, something delayed their departure, or
the ambassador was murdered before reaching the Susquehannocks. The latter is the likely
scenario because it happened previously to an ambassador and his nephew in 1669-70 when
the Susquehannocks tried to make peace (Thwaities 1959 LIV:75). One could say the
Susquehannocks may have decided not to help, but the Susquehannocks would not have passed
up the opportunity to fight a common enemy which was gaining strength. The Iroquois feared a
united force of the Huron and the Susquehannocks, which may have spurred the extra
precaution of attacking the Huron before the Susquehannocks could provide assistance
(Eshleman 1909). In addition, the Iroquois were also interested in acquiring the fertile, rich
lands of the lower Susquehanna Valley (Eshleman 1909). The desire for the land and to defeat
their only remaining competition prompted them to attack the Susquehannocks next and this
ambition would start the twenty-four year long war between the two groups (Eshleman 1909).

The Susquehannocks, after learning of the Huron defeat, realized an alliance with the
Maryland was a necessity (Eshleman 1909). In 1652, the Susquehannocks went before the
Maryland General Assembly to ask for assistance and peace (Browne 1887 III:278; Eshleman
1909). In exchange for an alliance, the Susquehannocks “ceded to Maryland all of their
territory from the Pauxtent River to Palmers Island and from the Choptank River to the
northeast branch, north of the Elk River” (Cadzow 1936:22). The English devised a peace treaty
with the Susquehannocks:

“Articles of Peace and friendship treated and agreed upon the 5th day of July 1652 Between the
English Nation in the Province of Maryland on the one party, And the Indian Nation of
Sasquesahanogh, on the other partie as followeth:
1. First that the English Nation shall have hould and enjoy to them their heires and Assigns for Ever, all the land lying from Patuxent River unto Palmers (Palmer’s) Island on the Wester Side of the Baye of Chesapiake (Chesapeake), And from Choptanke (Choptank) river to the North East Branch which Iyes to the Northward of Elke (Elk) River. On the Easter Side of the Said Bay with all the Islands, Rivers, Creekes Trees, ffish fflowle Deere, Elke and whatsoever else to the same belonging Excepting the Isle of kent, and Palmers Islands which belongs to Captaine Clayborne. But Nevertheless it shalbe lawfull for the aforesaid English, or Indians to build a Howse or ffort for trade or any such like use or Occasion at any tyme upon Palmers Island.

2. That if any Damage or Injury be done on either Side at any tyme hereafter, either by the English or Indians aforesaid, or by any other Allyes, Confederats Tributaries or Servants, that Reparation be made and satisfaction given from each to other from tyme to tyme as the Case requires, and as in Reason should be done betweene those that are freinds, and that desire soe to Continue.

3. That if any people or Servants belonging to the English or to the Indians shall goe away or Run away from either side, they shall not be concealed or kept away from each other, But shall with all Convenient speede be retourned back and brought home, And satisfaction to be made in a Reasonable way for transportation by land or water to those that bring them in.

4. That upon any occasion of business to the English, or any Messadge or the like, the Indians shall come by Water and not by land, That there shall not be aboue Eight or ten at the most at one tyme, And that they bring with them the tokes given them by the English for that purpose, by which they may be knowen and entertained, As also that the English on their parts when they send to the Indians, the Messenger shall Carry the token which wee have receiued from them.
5. And Lastly that these Articles and every particular of them shalbe really and inviolably observed kept and performed by the two Nations before named, and by all the people belonging to them, or that are in amity with them for Ever, to the End of the World And that all former Injuries being buried and forgotten, from henceforward they doe promise and agree to walke together and Carry one towards another in all things as freinds, and to assist one another accordingly But if it should soe happen at any tyme hereafter that either party is weary of Peace, and Intends warr then that the Same shalbe signified and made knowne each to other by Sending in and delivering up this writing before any Acts of Hostility or Enmity be done or attempted, and that twenty dayes warneing thereof be given before hand” (Browne 1887, III:277-78).

This would be the first of several treaties between Maryland and the Susquehannocks. The treaty is interesting because the English agree to share the land with the Susquehannocks and also because of the last part where they agree to giving twenty days warning before attacking if the peace is dissolved. The latter revealed the paranoia of the Maryland Assembly of Native American attacks. The native style of warfare consisted of surprise and guerilla attacks that caught the English off guard. Eventually, Maryland did not adhere to the term of waiting twenty days before attacking. However, the alliance with Maryland would hold until 1667 providing the Susquehannocks with assistance in manpower, ammunition, and cannon against the Iroquois (Cadzow 1936).

By 1654, Maryland was tired of Native American groups killing colonists with guns. The Maryland government passed a declaration to ban guns from all Native Americans groups except the Susquehannocks because of the peace treaty. The declaration read as follows:
...That is shall be Lawfull for any person or persons within the Province to take away from any Indian or Indians, That shall Come within the Libertys and bounds of the said persons Lands, their Gunns power & Shott, and that none shall Entertaine Indians into their houses except they Come upon the publique Treaty, which is meant only of the Susquehannars and the Emperor of the Pascataways (Piscataways) and that as far as may be, the Indians have Notice of the Act (Browne 1883 I:348).

As of 1655, the ongoing fur trade war was between Maryland who was assisting the Susquehannocks versus all of the Iroquois tribes except the Mohawk because they also had peace with Maryland (Jennings 1978; Kent 1993). The Dutch, at this time, wanted to start trade relations with the Seneca now that they acquired the New Sweden territory (Kent 1993). This deal is critical because agreeing to trade with the Dutch meant that the Seneca would have to travel through Susquehannock territory to reach them (Kent 1993). The invasion of Susquehannock fur territory might have heightened the tension between the Susquehannocks and the Seneca, thus continuing the ongoing conflict.

Meanwhile, in 1656, there is an account that the Susquehannocks continued to hunt for furs near Lake Ontario even while at war with the Iroquois (Thwaities 1959 XLIII:143; Eshleman 1909). The writer of the account related that even though the French were allies of the Iroquois, they did not take any Susquehannock as prisoners (Thwaities 1959 XLIII:143; Eshleman 1909). Surprisingly, the French allowed the Susquehannocks to hunt and take some supplies in their territory to preserve the status quo of equal fighting prowess between the Susquehannock and the Iroquois because the continued fur trade would preserve the English alliance. The aid of the English was what had been keeping the Iroquois at bay making the alliance crucial for the Susquehannocks to be a threat to Iroquois power. This status quo was
desired because the French feared the growing strength of the Iroquois (Thwaites XLIII:143; Eshleman 1909). The Iroquois had frequently told the French that the Susquehannocks were their only competition so it was assumed that if they defeated the Susquehannocks that they would be dominant with no more threats to their power (Eshleman 1909).

After a few colonists were murdered, in 1661, Maryland declared war on the Susquehannocks forcing the Susquehannocks into two conflicts, one with the Seneca and one with Maryland (Browne 1883 I:406-407; Eshleman 1909). Historical documents indicate that the Susquehannocks were attacked many times through the 1650s and 1660s by the Iroquois (mostly Seneca) (Kent 1993). However, Maryland did not carry out any form of aggression probably for fear of retaliation and because they realized they could not be neutral during the ongoing war between the Iroquois and the Susquehannocks (Eshleman 1909). Shortly after, the Maryland government decided to respect the treaty and help the Susquehannocks with their ongoing war with the Iroquois (Browne 1883 III: 417; Kent 1993; Eshleman 1909). The sudden change of heart was because the Susquehannocks had decided to cede more territory, this time, on both shores of the Chesapeake Bay for assistance and defense (Jennings 1978). In 1661, the Maryland government sent a commission to John Odber:

“...appoynt you Captaine of fifty Souldiers raysed this our Province of Maryland, ... to the Sasquesahannough Forte, to the resistance of all Ennemies declared and to be declared and Defence the said Forte against all attempts from any enemy to the said Sasquesahannoughs or of this Province according to such Instrucccons as you shall receive from us or our Leiuetennant Generall from tyme to tyme, them to vanquish and putt to death and all or any other thinges ...
Given under our lesser Seale of our said Province of Maryland this Eighteenth day of May 1661
Witness our Deare brother Philip Calvert Esquire our Leiuetennant of our said Province of Maryland” (Browne 1883 Ill:417).

The date of this commission matches the Strickler stage according to the chronology given by Kent (1993). This is the only time that Maryland would send men to help defend the Susquehannocks based on historic documents (Eshleman 1909). After this assistance, only supplies like ammunition would be sent to help with the war effort. In addition, another document from this year mentions another Susquehannock fort near the mouth of the Octorara River that was protected by a small stockade for harboring hunting parties, but that the main fort was further up the river about three miles from the mouth of the Conestoga Creek, this location description could include the Strickler site (Eshelman 1909).

There were also acts in 1661 made by the General Assembly associated with relations with the Susquehannocks (Eshleman 1909). The first went as follows:

“An Acte impowering the Governor and Council to rayse forces and mayntayne a warre without the province and to ayde the Susquehannough Indians. ... It is enacted and be it enacted (by) the Lord Proprietary of this Province by and with the advice and consent of the Upper and Lower House of this present General Assembly that the governor ... have power to leavy and rayse by presse or otherwise fifty able men with armes and Provisions and all things necessary for them to be sent to the Susquehannough Forte for the ends aforesaid...and for the paye of the officers and souldiers to be proportioned as followeth until the souldiers returne- to the Commander in Chief 600 pounds of tobacco in caske per month; to the interpreter 600 pounds per month; to the lieutenant 400 pounds per month; to the sergeant, 300 pounds per month and to the Chirurgeon foure hundred per month and to every private souldier 250 pounds per month” (Eshleman 1909:46-47).

The act shows the promise of help from the English to help the Susquehannocks when they are threatened. There are also references in the text above of actually sending soldiers to assist in battle including what they would be paid.
Based on another treaty from 1661, it appears the Maryland soldiers that were with the Susquehannocks had left for some reason (Eshleman 1909). The only clue is one document that states the Susquehannocks acted ungrateful for the help they were receiving by killing English colonists and demanding tobacco from them (Eshleman 1909). The English continued to blame the murders of colonists on the Susquehannocks without evidence. The Susquehannocks were viewed as “ungrateful” because they were not willing to be “servants” since the jobs consisted of errands such as fetching timber or preparing food or sending letters. Nevertheless, a new treaty was devised, because although to this point the Susquehannocks were holding their own against the Seneca single-handedly, it was soon realized that they would need further assistance (Eshleman 1909). Maryland had to care about the Susquehannock-Seneca status quo because the Seneca would also attack the colonists. This peace treaty is dated to May 16, 1661 by the Susquehannocks and Maryland:

“(1) It is mutually agreed that wee shall according to our former agreements mutually assist one the other against the Enemies of either nacon (nation) upon timely notice given to each other respectively. (2) That such Indian men Prisoners as shall happen to be taken in warre, shall be Delivered to the English as well such as have killd (killed) any English as others. (3) That the English shall send up to the Sasquesahannough Forte fifty men to helpe to defend the forte. (4) That the Sasquesahannough shall permit the Captaine of the English Souldiers to choose a place either within or without the forte to fortifye himselfe in and that the Sasquesahannoughs shall helpe them to fetch loggs or other tymber or nessaryes for his fortificacon. (5) That the Sasquesahannoughs shall finde the English Souldiers with sufficient fish and flesh, and bread ready beaten. (6) That there shall be six Indians appoynted by the Sasquesahannoughs to be ready to carry letters betweene the Captain of the English at the forte, and Collonell Utyes howse, and from thence to the forte againe, to which End two of them shall alwayes be upon Palmers Hand (Palmer’s Island). (7) That for prevencon (prevention) of mischief that too often happens by misunderstanding and not distinguishing Sasquesahannoughs from other Indians, the Sasquesahannoughs shall not come ordinarily to any other howse, but the howse of Captaine Thomas Stockett or of Jacob Clauson from whence they shall have tickets if they have occasion to come further among the English plantacons (plantations) And if by Ennemies they be driven downe amongst the English they shall be bound to hollowe before they come neere any
English howse, and upon the appearance of any English they shall immediately lay downe their Arms and suffer their Armes to be in the English posson (possession) till their Departure. (8) That the Sasquesahannoughs shall send all Runawayes of the English Downe to Captaine Thomas Stockett, imediately after their arrival at the Forte…” (Browne 1883 III:420-421; Eshleman 1909: 50-51 (Translations of old English).

Even though this treaty sounds very similar to the previous ones, the way it is worded makes it sound like the English were still trying to make the Susquehannocks their servants by adding in clauses about helping to fetch wood and to make sure the soldiers were well fed. The English sense of superiority could be why there were problems because the next document shows that the Susquehannocks did not comply with all the duties mentioned in the treaty (Eshleman 1909). Jennings (1978) also adds that Maryland was hoping to use the Susquehannocks to secure control over governments in the Delaware Bay. Captain Obder sent a report back to Maryland and his sentiment was that the Susquehannocks were not grateful for the help because the Susquehannocks did not want to fetch provisions for the soldiers (Eshleman 1909). The main complaint in one of the letters is that the Susquehannocks became violent after consuming alcohol, which is ironic when the English were the ones trading them the alcohol (Eshleman 1909). They could have traded other items if they wanted the violence to stop. This year of 1661 demonstrated the complicated relationship between Maryland and the Susquehannocks; they were allies and enemies several times in the same year.

The English soon after devised a set of instructions that seemed to be a compromise because the soldiers did not wish to stay with the Susquehannocks yet they needed to assist so it was decided to construct helpful structures and lend artillery weapons. The next document is the instructions to Captain Obder sent to assist the Susquehannocks most likely at the Strickler site.
The instructions are dated to May 18, 1661 to Captain Obder:

“(1.) You are to choose some fitt place, either within or without the Forte (Susquehanna Fort) which you are to fortifie for your owne Security and to demand the assistance of the Sasquesahannoughs to fetch tymber and other necessaryes for the fortificacions according to the Articles now concluded between us, and further to cause some Spurrs or flankers to be layd out for the Defence of the Indian Forte whome you are upon all occasions to assist against the Assaults of their Ennemies. (2.) Upon your arrivall at the Forte imediately press them to appoynt some one or more of their greate men, to whome you shall make your applicacons in all occasions, that is either of demanding assistance to helpe fortifie, or of provisions or upon any orders received from us & c. (3.) Procure that the certaine persons be appoynted whoe are to be Messengers Betweene you and us according to the Articles And be sure to advize us of every accident of Importance, that shall befall you or the Sasquesahannoughs, and of the proceedings of the affaires. ... (5.) You are carefully to avoyd all Quarrells with the Indians (Susquehannocks) and therefore permit not the Souldiers, to sitt drinking or Gameing with them, but keepe them to exact military discipline and to avoyde Idleness often exercise them. ... (7.) Lastly you are to have a very wary Eye upon all Dutch that come to the Forte (Susquehannock Fort), observing their Actions, and treatyes with the Indians, but shew not any animosity against them, if you find any close Contrivances to our prejudice give us speedy notice and oppose with discrecon any open actions that may tend to our Losse” (Browne 1883 III:417-418).

This set of instructions reveals that modifications, designed by the Maryland forces, were to be constructed on the existing Susquehannock fort and the Maryland forces possibly constructed their own fort within the palisade as well. The modifications helped the Susquehannocks keep the Seneca at bay and the Jesuits were relieved to see that status quo was maintained. The last part of the instructions, about the Dutch, was in reference to their forced retreat by the English (Eshleman 1909). There was a lingering fear that the Dutch would enact revenge because they had controlled a large amount of southeastern Pennsylvania until the English interfered (Eshleman 1909). The only problem with this document is that there is no supplement to provide details as to what was definitely built because Kent mentioned that the initial instructions were not carried out, but at some point the English eventually helped
because archaeological evidence did find bastions at Strickler (Kent, personal communication 2012).

The difficulty mentioned previously with the Iroquois having to cross Susquehannock territory required cautious measures. The Jesuit Relations recount that the Iroquois were forced to travel in a pack of six hundred to trade with the Dutch because the Susquehannocks would attempt to ambush them on their way through (Thwaities 1959 XLVII:111). It is possible to see how tensions slowly grew over time.

In 1663, a Seneca and Cayuga force of approximately 800 tried to attack the Susquehannocks (Axelrod 1993; Cadzow 1936; Eshleman 1909; Thwaities XLVIII:77). There are different accounts of how many warriors each side had, one reported similar numbers and another has the Seneca having 1600 and the Susquehannocks having only one hundred resulting in the numbers that are unclear (Hanna 1911; Eshleman 1909; Kent 1993). The Susquehannocks were able to make them flee (Eshleman 1909; Kent 1993). The Seneca noted that the Susquehannock village was “defended on one side by the stream, on whose banks it was situated, and on the opposite by a double curtain of large trees, flanked by two bastions erected in some European manner, and even supplied with some pieces of Artillery” (Thwaities XLVIII:77). With these defensive measures and supplies from the English, Dutch, and Swedes they were well defended (Axelrod 1993; Leder 1956).

The siege lasted a week (Axelrod 1993). After the Seneca retreat, they decided to plan a surprise attack by means of a trick because of the unexpectedly well-defended fort (Cadzow 1936; Eshleman 1909). The Seneca decided to trick the Susquehannocks by sending a party of
twenty-five men to “negotiate” peace and to buy provisions for the return home. The men were allowed inside the fort, but the Susquehannocks suspected trickery so they burned the prisoners alive in front of the rest of the Seneca army waiting outside the fort (Cadzow 1936; Eshleman 1909). This display of power humiliated the Seneca and they went home to plan their defense after a warning from the Susquehannocks that they were going to come (Thwaities 1959 XLVIII:77-79). Kent believes these references refer to events that took place at the Strickler site because bastions have been found there, but it could have been part of the village setup after Strickler, especially when Obder did not follow his orders from 1661 (Kent, personal communication 2012).

After the retreat by the Seneca, both groups were hit hard again by small pox, with large population declines (Eshleman 1909; Grumet 2009; Thwaities 1959 XLVIII:77-79). The Susquehannocks asked the English for more ammunition to make up for the loss of men (Eshleman 1909). The English voted to renew their treaty to help the Susquehannocks (Eshleman 1909). Meanwhile, the Iroquois (not stated which nation) asked the French (Jesuits) to assist them, most likely because it would increase their numbers (more men for fighting) and supplies (guns and ammunition) (Eshleman 1909; Thwaities 1959 XLIIX:141). However, the French (Jesuits) thought it was out of desperation and did not take it sincerely and probably secretly did not want the Iroquois to win (Eshleman 1909). For the second time in 1663, the Iroquois (mostly Seneca) left for the Susquehannock territory from New York for another raid (Eshleman 1909).
A witness named Harman Reiders, who was near the Susquehannock fort, reported that there were 1600 Iroquois including men, women and children that were heading for the Susquehannock fort (Eshleman 1909). During this same time, the English tried again to make the Susquehannocks errand runners and again they refused. The English decided to attempt a peace treaty with the Seneca after the Susquehannocks did not comply with the list of demeaning demands from the treaty (Eshleman 1909). However, the English continued to supply ammunition and powder to the Susquehannocks (Browne 1883 III:486-487; Eshleman 1909). In 1663, the Susquehannocks reported that the Seneca had 1460 men and that they had 700 men (Eshleman 1909).

In 1664, the Seneca-Susquehannock War started its ten-year climax period (Eshleman 1909). The first war tactic used by both sides was guerilla warfare. This tactic would continue to be used throughout the ten-year period in addition to actual raids (Eshleman 1909). The killings from the guerilla warfare affected both Native American groups and English colonists. Most likely because of the continued killings of English colonists by the Seneca, a new treaty with the Susquehannocks was negotiated that contains conditions to help aid in the war against the Seneca (Eshleman 1909):

“To the end that peace and amity with the Sasquehannaugh Indians accordinge to certaine articles made with that Nation may bee kept and continued. ... shall thinck fit and toward the aydinge (aiding) and assistinge the sasquahanna Indians when desired by them for continuinge the said articles and preservinge peace and amity with them as aforesaid and not otherwise ...” (Browne 1883 I:539-540).

Even though the treaty states that soldiers will be raised, the Susquehannocks never received infantrymen from the English when the final battle occurs (Eshleman 1909). Later in 1667, there was another call for soldiers by the Susquehannocks to the English, but the result
was the same: material supplies only (Eshleman 1909). In 1664, the Onedia joined the Seneca against the combined force of the Susquehannocks and the English (Eshleman 1909).

Before an attempt at peace in 1666, the Susquehannocks defeated an Onondaga army (Thwaities 1959 L:205). The Munsee Indians joined the Susquehannocks against the Five Nations, this allowed them within Susquehannock territory for the fur trade (Grumet 2009). There was a brief peace period from 1667-1668 and the Jesuits took the opportunity to bring Native Americans to France and this group included one Susquehannock (Thwaities 1959 LII:173). There was also mention of more baptisms of Susquehannock captives (Thwaities LII:167).

In 1670, the Susquehannocks attempted peace talks with the Seneca by sending an ambassador and his nephew with wampum belts as gifts of peace, but after the Seneca had a successful raid, the two were murdered out of feeling superior (Cadzow 1936; Thwaities LVI: 75). Eventually, in 1673 the Susquehannocks were defeated by the Seneca after years of warfare, disease, and little help from allies with manpower (Eshleman 1909). However, the Seneca were not satisfied with just defeat; they pushed the remaining Susquehannocks back until they were down to the Potomac (Eshleman 1909). This exertion gave the Seneca access to the rich lands and trade connections that the Susquehannocks had established (Eshleman 1909).

Jennings (1968) believes that the Susquehannocks were invited to Maryland by Lord Baltimore for political reasons rather than by war (Kent 1993). He said the battle was a rumor providing Maryland an opportunity to make peace with the Iroquois (mostly Seneca); with the
Susquehannocks moved away, it was thought peace could be more easily achieved (Kent 1993). The reason for the move could be debatable because the historic documents mention the war after it is over rather than updates as it was happening. Although, it is now generally accepted that there was a battle and that the Susquehannocks lost (Kent 1993; Tooker 1982).

In 1674, the Maryland government acknowledged the Seneca as the victors (Browne 1883 II: 378; Eshleman 1909):

“In Pursuance of the Vote for a Peace to be made with the Cynicoes Indians (Senecas) passed at a Conference of both houses this day the Upper House have Voted That a Peace be by the Government made with the said Cynicoes Indians & forasmuch as that Peace may bring a Warre with the Susquahannoughs This house for the Securitie of the Province doe Vote that an Act of Assembly be drawne up to Impower the Goveror & Councell to make Warre even without the Province & to Leavie the Charges of the said Warre by an Equall Assessment upon the Persons & Estates of the ffreemen of this Province anie former Act or Law to the Contrarie hereof notwithstanding & doe desire the Concurrence of the Lower house to this Vote”(Browne 1883 II:378).

The Susquehannocks were disgusted with the English for recognizing the Seneca as the victors so early (the final assault had started less than a year before at this point) and they retaliated with murders and raids (Eshleman 1909). Even though the English feared retaliation, it was more important to be allies with the strongest Native American force for more overall protection (now the Seneca).

Meanwhile, the Jesuits wrote that the victory over the Susquehannocks had the Iroquois drunk constantly and that caused unnecessary hostilities (Eshleman 1909). In the Jesuit Relations (Thwaities LIX: 251, LX: 173) it is noted the Seneca now thought they were invincible. Also, now that the Susquehannocks had been defeated, the Iroquois adopted captives rather
than killing because they needed the extra people because disease and war diminished their numbers (Brown 1883; Eshleman 1909).

In Virginia, the Susquehannocks occupied an abandoned Piscataway Indian fort that was located across the river from Mount Vernon, which was owned by George Washington (Grumet 2009; Kent 1993; Cadzow 1936; Eshleman 1909). The population of the Susquehannocks had decreased dramatically after the war and small pox continued to claim lives (Cadzow 1936; Eshleman 1909). S. F. Streeter (1857:17), in 1675, claimed that there were 100 Susquehannocks living in the Piscataway fort (Cadzow 1936). The occupation of this abandoned fort would not last long because, once again, they would be blamed for more colonist murders.

The Susquehannocks had been asked to move to another location several times by the people of Virginia (Cadzow 1936). Their refusal caused a force of 1,000 Virginia and Maryland colonists to lay siege to the fort (Cadzow 1936). Killings were committed by both sides as the siege lasted for six weeks (Cadzow 1936; Grumet 2009). Somehow, the 75 remaining Susquehannocks managed to light the whole fort on fire to burn the supplies and escaped during the night (Cadzow 1936; Eshleman 1909). While escaping, they killed enough sleeping people to avenge their chiefs (10 people for every chief to equal the ranks) (Cadzow 1936). The revenge did not end here; they killed 60 more settlers (Cadzow 1936). One of these killed, was an overseer on Nathaniel Bacon’s farm (Cadzow 1936). This particular killing would inspire Nathaniel Bacon desire to destroy the Susquehannocks because this overseer was part of his family’s farm for years and they were great friends.
With an English interpreter, the Susquehannocks compiled a list of grievances and asked for peace with Virginia (Cadzow 1936). The letter basically asked why they were being attacked and claimed innocence against the charges of murdering colonists while living in the Piscataway fort (Cadow 1936). The letter also included a condition that if peace was not achieved then the recent killings would continue; after there was no reply they made true to their promise and started raiding again (Cadzow 1936).

Meanwhile in Pennsylvania, the Seneca were noted to have occupied an abandoned fort, but it is unknown which village they occupied (Eshleman 1909). In addition, their numbers declined to about 300 after the war with the help of small pox, but the reference did not make it clear whether the number represents the number of men or the entire population (Thwaities LVI: 57; Eshleman 1909). Another document states that the Seneca were committing many murders of English colonists, but the Susquehannocks were being blamed for the attacks (Eshleman 1909). In 1675, the Susquehannocks asked the Maryland government if there was an area that could be given to them to live on in peace back in their homeland of the lower Susquehanna Valley. The list of concerns from the Maryland Assembly if the Susquehannocks can return states:

“1. That their living among them may Corrupt Our Indians (Seneca and possibly the Delaware) and Mould them So to their own future Designs as it will inevitably prove prejudicial to this Province in Generall.

2. This house hath reason to Suspect that the Designs of the Susquehannahs in coming among the English and Claiming Protection may be out of Design Purposely to Discover the Strength of the Province and the Advantages they may for the future take should they be evily inclined which will be of very Dangerous Consequence should they be Admitted to remain this Year among the Neighbor Indian Nations.
3. We have reason further to Suspect that the Susquehannahs & Seneca? have private Correspondence together Notwithstanding the Seeming Warr between them which may be of Dangerous Consequence to this Province should they be permitted among the Neighbor Indians.

4. If they are Absolute Enemies of the Senecas yet it will so Exasperate the Senecas for us to Entertain them that should a Warr this ensuing Year happen between the Senecas and them, the whole Province in Generall must of Necessity Suffer and therefore this house is of the Opinion it will be safe that the Governor to appoint a Place above the falls of Potomak (Potomac) there being time enough if immediately Laid hold on, to Clear Ground enough to Plant Corn this year which is the only thing they Seem to desire to live among the Neighbour Indians for” (Browne 1883 II:429).

The document shows the apparent English concern about the Susquehannocks enacting revenge against them. Because of their paranoia, the Susquehannocks were given permission to live along the Potomac (Eshleman 1909). Similar treatment from the English followed the Susquehannocks to Virginia because they continued to be accused of killings (Browne 1883 II:462).

Maryland attempted a raid while the Susquehannocks were in Virginia (Eshleman 1909). The hostilities, however, were in vain because the expedition proved it was not worth the investment (Eshleman 1909). The cost of the army was high and the English lost many horses to only kill a few Susquehannocks. Because of the heavy loss of both financially and material assets, some of leaders of the expedition were sentenced to impeachment proceedings by the Maryland government since no punishment was actually given (Eshleman 1909).

Also in 1675, the Virginia government, the Maryland government, and the Mattawomen Indians all joined forces for another raid (Eshleman 1909). The Virginian government wanted to attack the Susquehannocks from some accused murders and the Mattawomen just wanted to gain favor with Maryland. The Susquehannocks only numbered about 200 at this point in time
The siege continued for about six weeks from September to November (Cadzow 1936; Eshleman 1909). Being outnumbered, the Susquehannocks lost this battle (Eshleman 1909).

They fled to the frontier in Virginia near Ocaneechi Island in the Roanoke River to two forts. Bacon’s Rebellion took place during their stay (Grumet 2009; Jennings 1978). Nathaniel Bacon gathered a troop and followed the Susquehannocks (Jennings 1978; Jordan 1987). Bacon attacked any Native Americans he saw while he tried to find the Susquehannocks, whom were his primary target (Cadow 1936). Eventually he found out that the remaining Susquehannocks were living amongst two forts (Cadzow 1936).

Bacon recruited the Ocaneechi chief to help attack the two Susquehannock forts that contained about thirty to forty persons (Jennings 1978). Luckily for the Susquehannocks, there was a disagreement between the chief and Bacon that led to a massacre of the chief’s people. This allowed time for most of the Susquehannocks to escape (Jennings 1978). Bacon had demanded the Manikin Indians, Ocaneechi’s Native American allies, to become slaves and to relinquish all the pelts they currently had in their possession (Axelrod 1993). When the Ocannechi chief refused, Bacon’s men attacked them and took off with as many pelts as they could (Axelrod 1993).

The Maryland government decided for security reasons to make peace with the Susquehannocks (Eshleman 1909). Another motivation was that the Dutch governor Sir Edmund Andros offered refuge to the Susquehannocks and Maryland did not want to lose their authority over them or lose them as a trading partner (Axelrod 1993). There was a letter from
August 6, 1676 from Maryland’s Deputy Governor Notley to the Governor of Virginia about the Susquehannocks’ return:

“Wee have lately received intelligence from the Head of the Bay that the Susquehanough Indians have resided at their Old fort about sixty miles above Palmers Island for so many months that they have now Corne fitt to roast. That they shortly expect the remainder of their troopes, and as many of the Western Indians neer or beyond the Mountaines as they have been able to perswade to come and live with them. Wee are further informed that by the means of Collonel Andrewes with the Governor of New Yorke a peace was made last Summer betweenee them & their old Enemye the Cinigo’s (Senecas) so that now they are at Ease and out of Our reach. This notwithstanding they have applyed themselves to Captain Edward Cantwell the Deputy Governor of Newcastle upon the Delaware and requested a peace and trade as formerly with the English and in order to come down with Captain Cantwell formerly with the English and in Order to it came with him and Jacob Young Our old Interpreter… Wee have given them a months time to come downe in Wherefore Sir if you have any particular matter to offer them to them in relation to the future security of the people in your Government Wee humbly desire you will by some way or Other within that time lett us Know …”

(Brown XV:122-123)

The English hoped this time that both the Seneca and the Susquehannocks would not harm any more colonists. Andros was able to convince the Susquehannocks to live amongst the Iroquois in New York or with the Munsee/Minisink people so that the Dutch could secure the Delaware Bay area (Grumet 2009). At any cost, Andros did not want Maryland to control more land nor to have the Susquehannocks there to eliminate (Grumet 2009). He wanted Maryland to get into trouble with England for being aggressive over no reason (if the Susquehannocks were not there when the army arrived) (Grumet 2009).

The “old Fort,” mentioned in the above block quote about the Susquehannocks returning to the lower Susquehanna Valley, is now thought to be what the Lower Leibhart represents, having been inhabited previously (Kent, personal communication 2012). However,
the Maryland Archives has an entry that states they occupied two towns when they returned (Browne 1896 15: 239). It is possible that both Leibhart sites were being occupied at this time.

Due to the low numbers of Susquehannocks, different groups of the Iroquois tried to capture some to increase their numbers by adopting them (Eshleman 1909). After the Maryland government interfered with the capturing, the Seneca resorted to killing Susquehannocks since they could not adopt (Eshleman 1909). There were now two separate sections of Susquehannocks, one in New York with the Iroquois and another at their Old Susquehannock Fort in the lower Susquehanna Valley (Eshleman 1909).

In 1680, plans were being devised for a new Indian town named Conestoga in which the Seneca would live with the remaining Susquehannocks in the area (Eshleman 1909). In 1697 there is an account by Steelman who claims there were only forty men left at Conestoga from both the Seneca and the Susquehannock (Eshleman 1909). These numbers do not include the unknowable amount of Susquehannocks that were captured to live with the Iroquois in the north (Jennings 1978).

Meanwhile in 1682, the Jesuits began to help Native American groups that had been very depleted by the Iroquois. They helped the Algonquins (Algonquians), Andastaz (Susquehannocks), Loups, Abénaquis, and others (Thwaities 1959 LXII:161). All of the groups mentioned were defined in the index of the Jesuit Relations as Algonquian so it is unclear if there was an actual group the called Algonquian too or if they did define groups by their culture or Algonquain language of (Thwaities 1959 LXXIII). The remnants of the groups mentioned were in towns called Sillery, Laurrette, Lake Champlain, and other areas where the Jesuits lived
Lake Champlain was referenced like this so it is unclear whether it was the name of a town or meaning along the lake itself.

In 1693, the Susquehannocks in New York that had been adopted by the Iroquois asked the Maryland government if they could return because their population had been so reduced (Browne 1890 8: 518; Jennings 1985). The Maryland colony extended somewhat into Pennsylvania, so permission and warning was necessary so that they would not be attacked heading south (Browne 1883). Some Seneca went with the Susquehannocks to establish Conestoga (Jennings 1985).

In 1701, the Susquehannocks and a group of Shawnees signed a peace alliance with William Penn (Jennings 1978). By the time of Conestoga, the Susquehanna Valley had been inhabited by a mixture of Native American tribes: Iroquois, Shawnees, Conoys, Nanticokes, Delawares, Tuscaroras, and Tutelos (Jennings 1978). Some of these groups intermingled with the Susquehannock-Conestoga inhabitants already living in Conestoga meaning there was possibly no longer any full-blooded Susquehannock living in the Susquehanna Valley (Jennings 1978).

In 1718, the Conestogas (Seneca and the remaining Susquehannocks) wanted a few traders to be removed from the town because they were spreading false rumors about the Conestogas to get them in trouble with the government (Eshleman 1909). There were many migrations to Ohio after continued land conflicts with the Europeans (Jennings 1978). In 1755, the Seven Years’ War caused huge conflicts in America and only a handful of Native Americans remained at or near Conestoga Town (Jennings 1978).
The last mention in a primary source of the Susquehannocks was in 1763 that related the unfortunate news that they were murdered in two raids; the last one lead by the Paxton Boys who murdered the remaining residents of Conestoga Town (Eshleman 1909; Jennings 1978; Kent 1993). There were seven men, five women, and eight children that perished from the raid (Jennings 1978). There were many outrages against this massacre within Pennsylvania and abroad (like Benjamin Franklin), but nothing was done about it (Jennings 1978).

The story of the Susquehannocks is one of tragedy because of many factors leading to their decline including disease, warfare, trading relations (allies and enemies), fur trade (danger in physically get furs from other territories), and the European colonies (raids and desire to expand). The Europeans also encouraged Native American groups to eliminate each other also for the fur trade. From small pox, warfare, and greed, many groups either faced extinction or were left with very few survivors. Luckily, archaeology has prevented their culture from becoming extinct. Archaeologists are learning more and more about the Susquehannocks with each study conducted at a site, whether it was previously known or newly discovered through CRM (Cultural Resource Management) projects, as in the case of 36CU194, a village that is associated with a known cemetery discussed previously in Chapter 2.
Chapter 4: PREVIOUS EXCAVATIONS AT THE LOWER LEIBHART SITE

The Lower Leibhart site sits on a terrace of the Susquehanna River. The entire area of the site and surrounding open areas have been used as farmland and as an orchard since the 1860s (Bob Leibhart, personal communication, 2012; Paul Nevin, personal communication 2012). Currently, it is used to grow hay by farmers who contract with York County Parks (Paul Nevin, personal communication 2012). To date, known components of the site are the village and four cemeteries. The layout of the site is the village in the center with two cemeteries above on the higher hilltop and two cemeteries below on the flattest terrace and together resembling the four corners of a square with the village in the center. The Lower Leibhart site has been known by local archaeologists and collectors for almost a century and has been non-systematically excavated by the Leibhart family over many years (Kent 1969; Kent 1993; Paul Nevin, personal communication 2012).

As early as 1929, artifacts were being sold from the site (Kent 1969). Charles Leibhart, Byrd’s father, and David Graham, an artifact collector/seller, partnered. A deal was struck between both Leibharts’ that Graham would investigate the Leibharts’ property and any profits from the sale of the artifacts would be split (Kent, personal communication 2012). In 1932, two graves were found and unsystematically removed (Kent 1969). A year later, Byrd Leibhart uncovered human remains while plowing near the southwest corner of another cemetery sparking renewed interest in finding artifacts. Byrd and Graham removed ninety graves (Kent 1969).
The artifacts that belonged to Graham ultimately ended up at the York Historical Society, which is now the York County Heritage Trust while other parts of the collection were sold to specialized collectors (Kent 1969). However, the pieces that arrived at the Historical Society were mixed with artifacts from the Upper Leibhart site located 4,000 feet away (Kent 1969). The mixed collections is a problem for archaeologists because it is impossible to tell which artifacts came from which site and because they are so close in occupation periods, the artifacts are very similar. The similarity of artifacts is the reason the chronology of the two Leibhart sites is unclear.

George Keller, who lived near the site, also removed many graves and pits in the village component (Kent 1969; Kent 1993). The artifacts he accumulated were recorded and partially photographed by Barry Kent (Kent 1993). In 1970, Barry Kent, of the Pennsylvania Historical and Museum Commission (PHMC), was the first to conduct professional excavations at the site as stated in the Lower Leibhart National Register Nomination Form (Kent 1969; Kent 1993).

1970 PHMC Excavations and Results

The PHMC excavations were conducted from July-August in 1970. Kent tested three of the four cemeteries and some of the village component (Kent 1969). He did not excavate much in the village component fearing that there was too much disturbance that had already taken place between the unsystematic digging for artifacts and the extensive use of the field for agriculture (Nevin, personal communication 2012). Kent explains this dilemma in his National Register Nomination form for the site: “Few undisturbed features were located within the village area, and only one longhouse was noted from excavation” (Kent 1969:2).
Kent’s excavation methodology at this site was to strip the plow zone with a bulldozer to expose the features underneath (Kent 1969; Nevin, personal communication 2012). The selected areas were then flat shoveled and then excavated by trowel with the features being mapped along the way (Kent 1969). Kent’s excavation notes identified pits and burials as features, but not postmolds (Kent n.d.). The postmold dimensions are given in his book (1993), but not exactly how many postmolds he found associated with the palisade. The information concerning the postmolds is important for conducting geophysical surveys to help focus the results. Postmolds have been found at various depths at the other Susquehannock sites. At the Strickler site, posts were from 8-18 inches below the surface and about 6 inches in diameter depending upon their function (Kent 1993).

Kent was also trying to find the dimensions of at least one longhouse, which he could then use to estimate the population size based on how many houses may have been in the village (Kent 1993). The sizes of the longhouses vary depending on the site and the population at the time. The shortest longhouses/structures found at any of the Susquehanna sites were around 50 feet and the longest were 92 feet based on archaeological evidence (Kent 1993).

A 97 foot longhouse was recorded historically by John Bartram, who lived amongst the Onondaga. The equation for determining the number of compartments: \textbf{length of house divided by 7ft} (median of 6.7 and 8.08) \textbf{multiplied by two} (each side of the longhouse) (Kent 1993, 362). Then the number of compartments is subtracted by four to account for the storage compartments and that number is used to calculate the number of persons living in the longhouse (Kent 1993). The equation for determining the number of persons per house: \textbf{two}
multiplied by length minus 4 (storage areas) multiplied by seven (compartment size) / by 7
then multiplied by 2.5 (estimated number of people living in each compartment) (Kent 1993, 363). Kent used four sources to come up with his average numbers and equations: Morgan 1881; Bartram 1751; O’Callaghan 1849; and Weiser 1854.

Excavation Results

Palisade line posts were found on three sides of the village, except for the western where it was thought that sheet erosion may have disturbed the soil (Kent 1993). Kent excavated thirteen trenches which uncovered palisade postmolds (Kent 1969). Based on the palisade posts Kent found that the village was an oval shape and estimated the stockade’s approximate location (Figure 8) (Kent 1969; Kent 1993). It is understandable with the time constraints, that Kent did not have the ability to search for more palisade postmolds. Additionally, no defensive structures were found archaeologically, except the palisade itself.
Figure 8. Kent’s excavation map (1993:373). The dashed circle represents Kent’s estimated palisade. The red squares indicate the three cemeteries he investigated. All other shapes except for blue square (trees) represent his excavation units. The yellow square outlines the units that contained the partial longhouse. The units along the palisade that have dashes through them represent units that yielded postmolds.

Overall, the PHMC excavations yielded the most information on the burials from the three cemeteries investigated. Additional information came from the many pits uncovered in the village component and an idea of the site’s size and shape:

*Burials:* The burials were thoroughly investigated. Each grave shape and skeletal remains were carefully drawn by the field crew. The dimensions of the pit, type of pit, direction of
skeleton, skeletal position (fetal or otherwise), and comparisons were all recorded. In addition, it was also recorded which burials contained grave goods and special attention was paid to those buried with pottery because the pots were included in the drawings. The grave goods were heavily documented and these artifacts are very important because it is known that they came from the Lower Leibhart site.

**Pits:** The pits helped date the site from the artifacts inside and revealed information about diet patterns (Kent 1969). The excavation of the pits allowed for more artifacts to be obtained from the Lower Leibhart site, but unfortunately they did not contain anything to differentiate it from the Upper Leibhart site. However, learning more about diets helped understand the Susquehannocks’ subsistence at the Lower Leibhart site. Based on Gray Stewart Webster’s (1981) analysis of the faunal remains from the Lower Leibhart site, it is apparent that the Susquehannocks used a variety of resources for their diet including mammals, birds, fish, and even reptiles (Table 2). It is not surprising that the highest number of specimens is from the white-tailed deer because of their abundance in the area. Faunal analysis could be the key to differentiating the two Leibhart sites if a certain species is not present at a certain time of year, for instance when the war took place the summer. Even though the diet and faunal information was not the focus of this thesis, it is important to understand the investigations that have been done and what can be learned from those studies.
Table 2. Gray Stewart Webster’s Faunal Identifications for the Lower Leibhart Site.

<table>
<thead>
<tr>
<th>Type</th>
<th>Specific Fauna</th>
<th>Quantity</th>
<th>Types</th>
<th>Specific Fauna</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black Bear</td>
<td>9</td>
<td></td>
<td></td>
<td>Map Turtle</td>
<td>3</td>
</tr>
<tr>
<td>Domestic Dog</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elk</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gray Fox</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rabbit</td>
<td>1</td>
<td></td>
<td></td>
<td>Fish</td>
<td></td>
</tr>
<tr>
<td>Raccoon</td>
<td>1</td>
<td></td>
<td></td>
<td>Longnose Gar</td>
<td>1</td>
</tr>
<tr>
<td>Whitetailed Deer</td>
<td>97</td>
<td></td>
<td></td>
<td>Catfish</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td></td>
<td></td>
<td>Sea/Striped Bass</td>
<td>1</td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallard/Black Duck</td>
<td>1</td>
<td></td>
<td></td>
<td>Overall Total</td>
<td>129</td>
</tr>
<tr>
<td>Wild Turkey</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 5: GEOPHYSICAL SURVEY

The Geophysical Survey consisted of surveys using three instruments conducted in this order: magnetic susceptibility (MS), ground penetrating radar (GPR), and magnetometer/gradiometer surveys. The first survey was performed from January 16, 2012 to January 20, 2012. The second was performed at intervals from March 10 to June 15, 2012. The third was conducted July 6-8, 2012.

Magnetic Susceptibility Survey

A magnetic susceptibility survey was the first geophysical investigation of the property. Magnetic susceptibility is a rapid survey method that can identify areas of intense occupation in soils. In this survey, data was collected at approximately 5 meter intervals.

The Bartington MS2 (Figure 9), was used for the magnetic susceptibility survey. It consists of sensors and a probe that takes readings from the placement of the probe on the ground surface. It measures the “magnetic susceptibility of many types of materials including soils, rocks, powders, and liquids” (Bartington 2012).”Nearly all sediments contain minerals that react (magnetically) when a magnetic field is present-some more so than others. This reaction is called magnetic susceptibility…” (Burks 2009:5). In other words, “magnetic susceptibility provides a measure of a material’s ability to be magnetized” (Dalan 2006:161).
Generally, the darker, organic-rich sediments are located on or close to the surface making A horizons more magnetically susceptible (Burks 2009). This happens because “of natural oxidation and reduction cycles in iron oxide-rich sediments and by bacteria that feed off of organic-rich sediments and produce tiny magnetic particles as a by-product” (Burks and Pecora 2007: 94). This process in the development of soils makes the surface much different by comparison with the subsoil horizons (Dalan 2006). The surface soil magnetic susceptibility can be increased with human activity, which is how this instrument can help us understand where humans had occupations (Burks 2009). For example, a charcoal pit buried in the subsoil that has ashes will provide a reflective effect on the surface that the instrument can detect (Dalan 2006). The Trimble R8 GPS system was used to collect UTM coordinates and elevations for each of the magnetic susceptibility data collection points as will be discussed further.
The survey was started on January 16, 2012 and the equipment was tested for workability and to show the volunteers how to use the equipment. Dr. Beverly Chiarulli assisted in demonstrating how to use and set up the equipment (Figure 10). The volunteers consisted of members from the local SPA (Society for Pennsylvania Archaeology) Chapter 28, local residents, and other stakeholders from York County including a representative from the York County Parks department that allowed the surveys to be conducted. For practice, two transects, one going west to east and the other north to south, were recorded.

Figure 10. Dr. Beverly Chiarulli and I instructing volunteers.

The second day started the real survey. Paul Nevin, president of the local SPA Chapter 28, helped by placing cones for the start, middle, and end points for attempts at straight lines. The site is large and was flattest at the center with slopes on every side except to the north, thus keeping straight lines going down these hills was challenging. At certain parts, the top of
the hill was not visible from the bottom because of the steep and bumpy terrain (Figure 11).

With the help of volunteers, twelve transects were recorded that started from the eastern side of the site, which were about 135-185 meters long.

![Figure 11. Steepness of terrain. The steepness and vastness of the site made human targets mandatory. Photo by Dana Shirey.](image)

The final day of work for the Magnetic Susceptibility survey was January 20th. On this day the methodology changed. The transects were laid ten meters apart for the middle of the village because the boundaries were the focus and each transect was about fifty meters longer in length. When the middle was completed, the methodology of five meter transects was
continued. Fourteen transects were recorded to finish surveying the village for a total of twenty-eight including the two practice transects.

While measuring the magnetic susceptibility GPS data points were mapped with the Trimble R8 (Figure 12). The R-8 collects GPS data as UTM Northing, Easting, and elevations. The R-8 works with GNSS (Global Navigation Satellite System) and provides “unmatched power, accuracy and performance.” (Trimble 2012). At each collection point, the magnetic susceptibility value was entered into the GPS data so in addition to elevation contour maps, contours of the magnetic susceptibility values could also be mapped. This data can be visualized through GPR Slice to produce images that can then be imported into Google Earth (Figure 13).

Figure 12. Demonstrating the Trimble R-8. Photo by volunteer.
Figure 13. Elevation Scale. Red indicates highest points with dark blue indicating lowest points.
Image from Google Earth and GPR Slice.

The resulting image was produced by importing the R-8 and magnetic susceptibility data into GPR Slice (Goodman 2011). In this analysis, the magnetic susceptibility readings were used as the Z variable, which the Northing and Easting UTM were the X and Y variables (Figure 14). The dots in the background are the actual points of the magnetic susceptibility readings. The contours interpolate the magnetic susceptibility values by averaging the adjacent values to create an overall contour map of the values. The data (Figure 15) shows some of the physical
features visible on the landscape such as the sinkhole/quarry (A), and also shows areas of high magnetic susceptibility readings that are not readily visible on the landscape such as the area in front of the trees (B) and another on the west side of the site (C). Area D is most likely a geologic formation.

Figure 14. Magnetic susceptibility data. Scale: red indicates highest values and dark blue indicates lowest values. (Google Earth backdrop)

Interpretation: Area C and E in Figure 15 are located on the western side of the site. Based on location and size, Area E may be a prehistoric earth oven or fire pit that the
magnetometer results also found or something like a series of internal longhouse fire pits. Dearing (1999) and Burks (2009; 2010) both conclusively say that magnetic susceptibility can detect burned/disturbed soil in features like a prehistoric earth oven or fire pit. A future project should investigate this area to confirm that it is an earth oven or some version of a fire pit. I believe A and B are part of a geologic formation that contains shale, allowing the magnetic susceptibility to detect higher values because of its magnetic properties (Integrated Geophysics Corporation 1996, Heard et al 2008, Zambito 2004). Area D is now thought to also be geologic because the location contained bedrock at its surface layer.

Figure 15. Interpretation map for magnetic susceptibility survey. Scale: red indicates highest values and dark blue indicates lowest values.
The Magnetic Susceptibility survey was supposed to indicate areas of occupation based on the human activities having a potentially magnetic effect on the soil. The information would have allowed clues as to where the palisade line should be if it would encircle the area of the village. Unfortunately, the geologic features such as the potential sink hole/geologic formation and the exposed bedrock appear to have made it difficult to detect archaeological features unless this site was not structured the same as the previous ones based on its topography. The PSU’s soil map (2012), reveals that, the sinkhole area is a geologic formation called the Conestoga Formation that is comprised of limestone, which is negative for magnetic susceptibility, but also shale that does have a magnetic property. This formation could be why the area is giving higher values, or it could be that it had been filled in previously and/or could have been filled with something that has magnetic properties.

The first documentation of the depression (sinkhole/quarry) was in the 1940s by Bob Leibhart, who said his family had plowed around it (Bob Leibhart, personal communication 2012). He also mentioned that it was approximately one hundred feet across and half as wide meaning it was just as extensive back then (Bob Leibhart, personal communication 2012). It had also been filled in once, but he was absent during the filling so he does not know what it was filled in with. It could have high potential for magnetic susceptibility both because it was filled relatively recently. Depending on what it was filled with, it could have had magnetic properties. On the other hand, the data does contain valuable information in that it revealed just how extensive the sink hole/geologic formation really is. The data also showed three areas that were not apparently geologic, in that there was no physical explanation on the surface, located in Area B in front of the trees and an area on the western end of the village where after examining
all the data could have been a row of residential hearths in Areas C and E. This possibility will be discussed later in the chapter in the magnetometer section.

**Ground Penetrating Radar (GPR) Survey**

Ground penetrating radar surveys involve making a plan with grids to cover the desired area. It was difficult trying to plan where the grids were going to go and how many to do because of the site’s odd shape and the wooded areas that now surround the site. Also, the site slopes in every direction off the main village location except to the north so the terrain was difficult. Due to the steep sloping, the bottom of the hill is not visible from the top of the hill in certain areas as was shown in Figure 11.

The GPR investigation covered 14,055 square meters by means of twelve survey grids that consisted of four measuring 30x42 m in green (Grids A, C, D, & E), one 23x61 m in purple (Grid F), one 30x32 m in red (Grid B), five 30x35 m in orange (Grids G, H, I, J, & K), and one 35x40 m in brown (Grid L) all collected with a GSSI Sir 3000 (Figure 16). All grids were collected in 0.25 meter intervals in a zig-zag pattern (bi-directional). Grids A-E and G-H were collected so that transects alternated between north-south and south-north. Grids F and I-L transects were collected west-east then east-west in the same fashion. These five grids were collected in this fashion so the data could be collected perpendicular to the projected stockade line which should make it more visible. The primary focus was to find the western boundary of the village and possibly identify village features. The grids were intended to be placed strategically in order to cover the area investigated by Kent in 1970.
In the end, a few grids probably showed Kent’s trenches (Grids A, F, G, H, & J). After the survey was completed, it was discovered that Kent’s grid was aligned 34° off magnetic north because his 0‘0 point was based on Elizabeth Dritt’s headstone. Dritt’s headstone is located northeast of the map below and was chosen because of its location. The grids in this survey are aligned to magnetic north explaining why they do not align with Kent’s trenches.

Figure 16. Map of GPR grids over Kent’s Map.

“Ground penetrating radar operates by sending an electromagnetic wave pulse into the ground that reflects off materials with contrasting properties (Waselkov 2005:7).” The waves are reflected back to the data collector on the GPR. They may be reflected with materials of different
permeability like changes in moisture content or by objects like metal rods or rocks. These will cause differences in the time that it takes the wave to be reflected. The GPR does not work well with saturated ground or with high salinity soils (Waselkov 2005). “Features as diverse as Mayan house platforms and plazas, burial tombs, historic cellars, privies, and graves, camp sites, and pit dwellings have been discovered and mapped using this method” (Conyers 2006:131).

All of the GPR data was processed with both GPR Slice and Radan, which is the program that comes with the GSSI SIR 3000. Both GPR Slice and Radan work in similar ways, but the filtering processes are visually carried out differently. GPR Slice filters one transect at a time no matter how many transects are in a grid. Radan, on the other hand, filters them all together in one continuous line as if they were all one transect. This ensures that all of the transects were filtered in the same way; meaning using the same highs and lows to filter all of the transects. Radan was processed using different gains. Gains help enhance anomalies that would not have been visible otherwise or make visible anomalies even more visible. It is necessary to try to different gains because patterns emerge that may not have been easily visible such as subtle patterns. The scale of activity in black represents the highly reflective anomalies and white indicates the low reflective anomalies.

GPR collection started June 8, 2012 and ended June 15, 2012. Grids A-H will be discussed only in Appendix A except a couple of anomalies because the focus for interpretation in this thesis is the western side of the site. The western side was projected to include the western palisade and the MS data suggested possible residential features. Grids I-L cover the western side and will be discussed. The GPR and Magnetometry anomalies mentioned throughout the study are numbered for increased clarity and are listed in Appendix C. Figure 17
shows Slice 3 of all the GPR grids at 32-49 cm deep with many anomalies that could be both geological and cultural.

Grid I

Grid I is located on the northwestern corner of the site and was not recorded properly in the middle because the GSSI needs to be rebooted after recording two grids or collecting 60 transects. The aforementioned fact was learned after recording Grid I. Figure 18 shows the GPR Slice images for Grid I. All of the GPR Slice results are portrayed in depths of centimeters, the x and y lines are in meters, and the scales indicate reflective values. This grid was projected to have the palisade according to Kent’s estimation.
The line going through the middle of the image represents the reboot of the system, which was necessary because the GSSI stopped recording data. The particular depth that was focused on for the GPR Slice data was the third image at 32-49 cm below the surface. The grid in particular did not offer any significant evidence of archaeological features, however, there is a high reflective anomaly on the left side (Anomaly 1) and there seems to be a light blue square anomaly (Anomaly 2) outlined in black (Figure 19). If Slices 8 and 9 were closer to the surface it looks like a semi circular anomaly that should continue into Grid L.
Figure 19. Grid I GPR slice 3 with anomalies 1 and 2. Scale in meters.

Figure 20 shows Grid I from 40 cm-80 cm in Gain 8. Figure 21 shows Grid I from 40 cm-70 cm in Gain 16. The significant patterns in the Radan images show many elongated oval shaped anomalies that may be additional subtle longhouses, but Anomaly 3 is the most promising (Figure 21) (discussed later is the possible finding of a longhouse spread over three grids). Another interesting anomaly is the circular anomaly in the first image of the Gain 16 in Figure 22 located near the bottom right corner. It looks like a “bulls-eye” with a dot within a circle and is enlarged in Figure 22. The shape is similar to a fire pit and is Anomaly 4.
Figure 20. Grid I at gain 8, 40cm-80cm processed through Radan. Anomaly 3 in red.

Figure 21. Possible longhouse in Grid I. Anomaly 3 outlined in red, repeated from Figure 20. Gain 16 shows more contrast and makes Anomaly 3 more visible.
Figure 22. A close up of Anomaly 4. It is a circular (“bulls-eye”) anomaly in Grid I (Gain 16 40cm).

Grid J

The location of Grid J should have included the trajectory of the palisade line as it curved toward the bottom of Grid L. Figure 23 shows the GPR Slice results for Grid J and Figure 24 has the Radan results. Based on the shape of the highly reflective areas in the Slice images (red), Anomaly 5 is either the trench from Kent’s excavations that extended westward or it could be an archaeological or geologic feature.
Figure 23. Grid J GPR Slice results. Anomaly 5 outlined in black.
In Figure 24, there seems to be some types of patterns or formations that are either geologic or archaeological. The 30cm image has a geometric pattern with a line pattern extending northward (Anomaly 6). Anomaly 6 is still visible in the 40cm image and the line pattern is wider to reveal the shape. The 50cm image shows a different pattern (Anomaly 7) with the highest reflective area confined to the lower left of the grid and is an odd shape. Grid J’s location could have been the start of the village plaza explaining the large geometric pattern with some type of village structure in the middle whether it is a pit or something else. Further work could include magnetometry over this area.
Figure 24. Grid J selected Radan results. Top: Raw images. Bottom: 30 cm and 40 cm image shows Anomaly 6 and the 50 cm image shows Anomaly 7.

Grid K

Grid K is located in the southwestern corner of the site below Grid L. Figure 25 shows the GPR Slice results of Grid K. Grid K has a pattern of a broken up line of features (Anomaly 8) that runs north-south down the center. Anomaly 8 should contain the palisade line and it is possible one of the lines in this continuing pattern is the palisade.
Figure 25. Grid K GPR Slice results. Slice 3 shows Anomaly 8 in the middle in red and yellow. Scale in meters.
Figure 26 shows the selected results from Radan that show a circular feature (Anomaly 9) that resembles part of a palisade curving in a different direction away from the Lower Leibhart site that is visible in both images showing different depths and gains. Finding other sites and/or components is very common when conducting archaeology whether its ground testing or geophysical surveys and could be a separate component to the site. Additionally, Anomaly 53 also appears to be another separate component with a circular anomaly internally. The depths are short because the area indicated in the image is where the grid starts to slope downward and it is possible erosion erased the top layers. A circular anomaly with small appendage (Anomaly 10) is outlined in orange that is most visible in the 20cm slice with a Gain of 8. Based on the strength and well-defined shape it could be an archaeological feature. The length of Anomaly 10 is approximately eight meters, which is fairly large and it is within the possible extra palisade line.
Figure 26. Grid K selected results from Radan. The red, curved indicates the extra palisade line (Anomaly 9). The orange circle outlines a circular anomaly that shows promise of an archaeological feature (Anomaly 10). In green is Anomaly 53 that was noticed later.

If Anomaly 9 in Figure 26 is a palisade line then it could be to a different village or if there were multiple areas of occupation during the time of the site. It was noted from a nearby resident, Dana Shirey (personal communication 2010), that during Kent’s excavation he found a Late Woodland site located further down the hill, but because the Susquehannock site was the
focus, he chose to set it aside for the time-being. It could also indicate another village within the site because, as mentioned in the historical background chapter, the Susquehannocks occupied two towns when they returned from Virginia. The author proposed that possibly both Leibhart sites were occupied at that time, but it could possibly be two towns at one location.

**Grid L**

Grid L (Figure 27) was the most important because it was expected to contain the palisade based on its location on Kent’s map. There are a few circular features in Grid L. Because the documentation on this site is limited, it was not known if the village was burned or if their palisades were built with ditches. If neither of these apply, the palisade should show up as a subtle feature. If the village had been burned, the palisade would be highly reflective and show up in red or yellow in GPR Slice or black in Radan. If there were ditches built alongside the palisade, then the palisade line would appear wider because the ditches would be detected as well. In Figure 28, Slice 3 (Anomaly 11) and 4 (Anomaly 12) were the focus and both have two circular anomalies that could be archaeological features. Both Slice 3 and 4 have many circular and semi-circular looking features. It is difficult to tell which segments are connected and are part of the same anomaly. Both slices have a circular anomaly (combination of both Anomaly 11 and 12) that could equate to a structure, but not a longhouse. The radius indicates that Anomaly 11 and 12 are not part of the palisade line, but this anomaly could be located internally adjacent to the palisade line. Illustrations of Susquehannock villages show that many structures were located just inside the palisade to allow for a central plaza (Herman 1720; Kent
1993). Anomaly 12 also contains what appears to be a linear anomaly to the left of the circular anomaly.

Figure 27. Grid L GPR Slice results. Scale in meters.
Figure 28. Grid L GPR slices 3 and 4. There appear to be several circular and semi-circular anomalies. It is difficult to tell which segments are connected and which are not. Anomaly 11 in Slice 3 and Anomaly 12 in Slice 4 has a different shape. Scale in meters.

The results in Radan (Figure 28-33) revealed that there are many interesting anomalies in Grid L. The images chosen to show all the anomalies in Grid L are the Gain 4 Radan images from 20cm to 50cm. Figure 29 is Grid L with Gain 4 at 20 cm and it shows three possible plow scars or something related to the property’s past agriculture uses. They appear to extend from west to east across the entire grid outlined in yellow although the degree to which they can be seen changes with depth. The anomaly in orange had some well defined corners and a visible geometric shape (Anomaly 13). Anomaly 54, noticed later, has a square shape that could also
be a bastion or some defensive structure. Anomaly 13 and 54 could be bastions or other defensive structures if Anomaly 14 is the palisade line in red.

![Figure 29. Grid L anomalies 13 and 14 in Radan: Gain 4; 20cm. Left: Raw Data; Right: Interpretation. The yellow lines indicate possible plow scars. The red line outlines the possible palisade line (Anomaly 13). The orange anomaly outlines a possible bastion/feature along the palisade line (Anomaly 14). Outlined in green is Anomaly 54 that has a square shape and could be a bastion.](image)

The Figure 30 images at 30 cm also have possible plow scars or agriculture remnants with an addition of another one. Anomaly 15 reveals an end portion of an extended oval shape that resembles the Susquehannock longhouse layout in green. However, the same shape could also form a box from the bottom left corner appearing to be a right angle in maroon (Anomaly 16). The straight bottom could also reflect a plow scar or agriculture remnant because the lines do not appear to be consistent widths apart. Anomaly 13 is still visible. At first glance Anomaly 15 looked rounded like the end of a longhouse, then it appeared to be a square shaped
Anomaly 16. Either shape could indicate a village feature. Anomaly 15 in Figure 30 is 49.21 feet long and 26.25 at its widest. When combined with Grid K, the seemly connected feature turns into 75.46 feet long.

Figure 30. Grid L anomalies 13-16 in Radan: Gain 4; 30cm. Left: Raw Data. Right: Interpretation. The yellow lines are possible plow scars. Anomaly 13-16. Anomaly 16 and Anomaly 15 both relate to one feature that appears to have two possible patterns.

Figure 31 shows Grid L with Gain 4 at 40cm. The plow scars or agriculture remnants are still very visible. The longhouse end is also still very apparent (Anomaly 15), but the square shaped Anomaly 16 is no longer visible. Anomaly 17 in blue has the appearance of a three dimensional point or spike. As will be shown later, it has the appearance of a postmold reflection in a radargram that are also created with the GPR data.
Figure 31. Grid L anomalies 15 and 17 in Radan: Gain 4; 40cm. Left: Raw Data. Right: Interpretation. The yellow lines indicate possible plow scars and the green outline is Anomaly 15. The new anomaly in blue is Anomaly 17. It is similar in shape to Anomaly 10 found within the extra palisade line from Grid K.

Figure 32 shows Grid L with Gain 4 at 50cm. At this depth the possible plow scars may be agriculture remnants instead since they are still visible. Anomaly 18 in purple is a semi-circle appearing at the bottom of the grid as well as many other circular features. There appear to be multiple circular anomalies occurring on the right side of the grid in red and orange (Anomalies 19 and 20). Hopefully a future project will investigate this grid because most of the geophysical evidence has shown that there is much activity in this area.
Figure 32. Grid L anomalies 14, 19, and 20 in Radan: Gain 4; 50cm. Left: Raw Data. Right: Interpretation. The yellow lines are the possible plow scars and the rest are circular or semi-circular with the potential to be archaeological village features and a separate component (purple= Anomaly 18) (red= Anomaly 19 and orange= Anomaly 20). The green line indicates Anomaly 14.

The conclusion for Grid L is that there are many anomalies that may represent archaeological features. The current interpretation of the curved anomaly being part of a longhouse will be explained further in the interpretation section as the other three adjacent grids are added. The curved anomaly and the other anomalies outlined in the previous images would need to be tested further for confirmation of being archaeological features.

**Magnetometer/Gradiometer Survey**

Magnetometry has been used to successfully to find stockade lines on similar sites (Horsley and Wall 2010) making it an ideal instrument for this site. The magnetometry survey covered a total of 3,100 square meters divided into five grids. The five grids consisted of two
measuring 30x30m (Grids 2 and 4), one measuring 20x30m (Grid 5), one measuring 20x20m (Grid 3), and 10x30m measuring (Grid 1). Each grid was collected in a north-south, south-north zig-zag at a 0.25 meter interval. The instrument was set up to take a reading every 0.125 meters or eight readings per meter. Two grids were collected on July 6, 2012 and the last three were collected July 8, 2012.

The magnetometer is used to identify areas of disturbed soils (Geoscan Research 2012). The Geoscan FM256 Fluxgate Gradiometer was used in the survey. It is used to find archaeological features like “fired structures such as kilns, furnaces, hearths and ovens, and structures with an enhanced magnetic susceptibility such as pits, ditches, enclosures, field systems, barrows, etc” (Geoscan Research 2012:28). The instrument works by measuring subtle changes in soil based on the magnetic field (Burks 2009). Because the focus is magnetic, the magnetometer detects metal very easily. The magnetometer’s highly sensitive sensors separate it from metal detectors because it can “detect very subtle changes in the sediments and can detect large iron objects at some distance” (Burks 2010:3). “It is a rare passive method of remote sensing because it employs the earth’s magnetic field, rather than generating its own artificial one (the active technologies of radar, resistivity, and electromagnetic induction all introduce artificial fields to measure responses in the ground” (Kvamme 2006:206).

The areas chosen for testing were based on a comparison of the GPR data and Kent’s map (Figure 33). It was essential to survey the two areas where the stockade was already identified by Kent. Grid 1 was chosen to test the two highly reflective anomalies from the GPR survey located in Grids L and K. The size and high reflection of the anomalies suggested that
these could be middens. Many Susquehannock sites have had at least one large midden outside the stockade line (Kent 1993.) In Grid 3 the GPR survey data revealed a number of highly reflective lines radiating from a central origin that had not been included during the GPR survey. This could be a house. Thus, the grid was placed over the origin. Grid 4 was placed in an area where Kent found the stockade line on the south side of the site. Previous studies have shown that stockade lines/fort enclosures look ditch-like and are more subtle in color than other high anomalies as in shown in the analysis section (Horsley and Wall 2010; Geoscan Research 2012 (Example survey results: http://www.geoscan-research.co.uk/page18.html). Grid 5, located on the eastern side of the site was placed to investigate an area which may contain evidence of the stockade.

Figure 33. GPR grids A-L (in black) and magnetometer grids 1-5 (in red).
The results were not as clear as expected, but every grid contained at least one positive peak (Figure 34 and Figure 35). According to Burks, “Medium gray colored regions in the data indicate areas where there are no unusual, or anomalous, magnetic signatures. Lighter, white colored areas denote lower magnetic gradient readings (negative anomalies) and darker, black colored areas are higher readings (positive anomalies)” (Burks 2010:6). A description of the major types of anomalies defined by Burks (2009: 6-8) is summarized in Table 3. Grid 3 may contain a fire-pit based on the characteristics of other fire-pits that have been found. Burks (2010) calls it a dipolar simple (DP): negative and positive peaks adjacent to each other (Figure 36). Burks says “Most archaeological features of interest, such as pit features, earth ovens, hearths, wells, foundations, cellars, and the like, produce fairly consistent kinds of anomalies that are comparable all across the Midwest US and at similar latitudes around the globe where soils are formed into alluvium and glacial tills” (Burks 2010:12). The other class of magnetometer anomalies present is the monopolar positive (MP): “localized areas of soil with increased magnetic susceptibility” that could be things like pit features or large tree roots (Burks 2010: 8). Table 4 contains a chart of the magnetometry anomalies. Figure 34 shows the magnetometry data over the GPR grids on Google Earth.
Figure 34. Magnetometry data over GPR Slice data. The grids are numbered 1-5 from left to right. Anomaly 32 is circled in red.
Table 3. Anomaly Classification System of Magnetometry Data by Burks (2010:7-10).

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Possible Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monopolar Positive (MP)</td>
<td>Localized positive peaks; appear as dark gray to black areas</td>
<td>i.e.: Pit Features or Large Tree Roots</td>
</tr>
<tr>
<td>Dipolar Simple (DS)</td>
<td>Negative and Positive peaks; appear as one negative and one positive peak</td>
<td>i.e.: Iron Objects or Large Rocks</td>
</tr>
<tr>
<td>Dipolar Complex (DC)</td>
<td>Multiple negative and positive peaks of varying intensities that are clustered together</td>
<td>i.e.: Burned/Disturbed areas; in-filled cellars, foundations, etc</td>
</tr>
<tr>
<td>Multi-Monopolar Positive (MMP)</td>
<td>Clusters or groups of Monopolar Positives</td>
<td>i.e.: Prehistoric structures or historic fences</td>
</tr>
<tr>
<td>Monopolar Positive and Dipolar Simple (MP/DS)</td>
<td>If difficult to discern if an anomaly is monopolar positive or just a portion of a dipolar simple</td>
<td>Unknown category since the unknown anomalies are placed here</td>
</tr>
</tbody>
</table>
Table 4. Magnetometry Anomalies.

<table>
<thead>
<tr>
<th>Anomaly #</th>
<th>Grid</th>
<th>Magnetometry Anomalies</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>1</td>
<td>Dipolar Simple Anomaly</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>Dipolar Simple Anomaly</td>
</tr>
<tr>
<td>23</td>
<td>1</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>26</td>
<td>2</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>27</td>
<td>4</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>29</td>
<td>4</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
<td>Dipolar Simple Anomaly</td>
</tr>
<tr>
<td>31</td>
<td>3</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>32</td>
<td>3</td>
<td>Dipolar Simple Anomaly; Fire Pit/Earth Oven</td>
</tr>
<tr>
<td>33</td>
<td>5</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>34</td>
<td>5</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>35</td>
<td>5</td>
<td>Monopolar Positive Anomaly; Pit</td>
</tr>
<tr>
<td>36</td>
<td>5</td>
<td>Dipolar Simple Anomaly</td>
</tr>
</tbody>
</table>
Figure 35. Magnetometry data. Top Row: Grid 2 (in Grids’ G & J) and Grid 4 (in Grid A). Middle: Grid 5 (in Grid F). Bottom Grid 3 and Grid 1. North is facing up. Anomalies 21-36 (Table 4).

In Figure 35 the dark anomalies are monopolar positive anomalies (circled in blue) and represent possible pit features. The black & white anomaly in Grid 3 is a dipolar simple circled in yellow (DS) could indicate an iron object or a large rock. The different form of dipolar simple anomalies is represented in red in Grid 3 (the black encircled in white) is likely a prehistoric earth oven or some form of a fire pit based on its unique signature.
Figure 36. Anomaly 32 comparison with Burks anomaly (2010:7): Left: Burks image of fire-pit in a magnetometry survey in Ohio. Right: Magnetometry data from Grid 3 showing Anomaly 32. The scale is for 5m.

At least one anomaly type was present in each grid (Figure 37 is a close up of each grid). These were most commonly monopolar positive and dipolar simple anomalies. Horsley and Wall (2010) and Kvamme (2009) label monopolar anomalies as very strong anomalies. Horsley and Wall identifies many examples of this type of anomaly, but does not speculate on their function. Kvamme (2009) (Figure 38) labels them as storage pits as does Burks (2010). The Anomaly 32 in Figure 36 appears irregular compared to Burk’s image probably because the magnetometer’s balance and alignment may have been compromised during collection. Grid 3 was taken in the afternoon after another grid had already been collected. It was noted in the manual that as the temperature increases the alignment could be altered and the magnetometer had been set up in the morning.
The conclusions are that these anomalies provide multiple indications of possible pit features and one earth oven. These findings suggest that geophysical surveys can add to our understanding of the village structure at the Lower Leibhart site. A future project should investigate the anomalies.
Figure 38. Horsley and Wall data (2010, Figures 10 & 11). Top: magnetometer data with the red circles indicated the pit features. Bottom: Kvamme (2009, Figure 2) also has Monopolar Positive anomalies identified as strong anomalies and confirming them as storage pits.
Analysis of Geophysical Data

The geophysical surveys identified a large number of anomalies that may represent cultural features. Most of these cannot be investigated further in this project which is concentrated on the western edge of the village. Interpretation was focused on the primary objective of finding the western boundary; however, each geophysical test offered new information on the overall layout of the site. Despite the many years of farming and excavation, it appears that much of the site contains intact cultural features.

Magnetic Susceptibility (MS)

Area C and E in Figure 39 (Figure 14 recopied) are located on the western side of the site. Based on location and size, Area E may contain the prehistoric earth oven or fire pit that the magnetometer results also found. It is also possible others were missed because Areas C and E seem to contain a series of similar anomalies. Dearing (1999) and Burks (2009; 2010) both conclusively say that magnetic susceptibility can detect burned/disturbed soil and this coincides with a prehistoric earth oven or fire pit. A future project should investigate this area to confirm that it is an earth oven or some version of a fire pit.

The anomalies in Area C also had high valued circular areas seen in Grids’ L and K. All three geophysical surveys found anomalies in this area, which suggest that this represents a residential area.
Figure 39. (Figure 14 recopied) MS results: A-sinkhole/quarry; B-high area in front of trees; C-high spot on western side; D-geologic formation; and E which corresponds to an “earth oven” or hearth found by the magnetometer (white spots represent magnetic susceptibility collection points).

**Ground Penetrating Radar**

*Western Grids (I, J, K, L)*

The GPR surveys of the four western grids together suggest that significant cultural features are present in this part of the site related to a possible palisade line, bastions, and even residential or longhouse features (Figure 40). Anomalies 15 and 6 appear to be the shape
and size of a long longhouse in Grid L and a second partial longhouse in Grid J (Anomaly 6). Grid I was not recorded correctly in the middle and it disrupted the shallow depth data. The most visible possible longhouse (mentioned above) is approximately 23 meters long, which is equivalent to 75.46 feet. The middle of the possible longhouse may not be visible because of plowing.

The purple line indicates Anomaly 14 which is the possible palisade line that is located outside from Kent’s estimation. The orange outline is Anomaly 9 and could possibly be another palisade as mentioned previously or could also be part of the palisade if the layout is similar to the Upper Leibhart site (Oscar Leibhart site) as depicted by Augustine Herman (Figure 41). The extended palisade line would make the placement of the longhouses more sensible when
viewing Kent’s map based on the contours. His map shows elevation contour lines and the possible longhouse is located between two contour lines meaning it would have been on less of a slope. This consideration would have had to be utilized on this site because of the way it slopes in every direction except north, assuming a central plaza was present on the flat portion of the site. The map showing this concept will be shown later in Figure 47 because it is part of the conclusion.

Figure 41. Augustine Herman Moll’s 1720 map of the Upper Leibhart Site. Courtesy of York County Heritage Trust.
Figure 42. Longhouses found at other Susquehannock sites courtesy of Kent (1993: 325, 350, 369). Upper Leibhart site (a), Schultz site (b), and the Strickler site (c) all have at least one example of a longhouse discovered during excavation. All sites are drawn at a similar scale.

Figure 42 shows the shapes and sizes of longhouses found at the other known and tested Susquehannock sites. If the anomalies at the Lower Leibhart site are, in fact, longhouses then it would be a major discovery because an entire longhouse has not been found at the Lower Leibhart site and it would help provide some difference with the Upper Leibhart site. A longhouse has been the only archaeological feature excavated at the Upper Leibhart site. That particular longhouse (a) was recorded to be 92 feet and it is the longest one found so far (Kent 1993, Kurt Carr, personal communication 2012). The Schultz (b) longhouse used for the population estimate was 80 feet. The average length of the longhouses at Strickler (c) is 60 feet.
long with some being about 70-80 (Kent 1993). The longhouse size may have decreased at the Lower Leibhart site if the population had declined due to war and disease. Table 5 shows the numbers in grid form and the numbers fit with the average numbers from other Susquehannock sites.

Table 5. Longhouse Comparisons.

<table>
<thead>
<tr>
<th>Site</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schultz (1575-1600)</td>
<td>80ft (average)</td>
<td>20ft</td>
</tr>
<tr>
<td>Strickler (1645-1665)</td>
<td>60ft (average)</td>
<td>17ft</td>
</tr>
<tr>
<td>Upper Leibhart (1665-1675)</td>
<td>some 70-80ft</td>
<td></td>
</tr>
<tr>
<td>Lower Leibhart (current study)</td>
<td>approx. 73 ft</td>
<td>approx. 26ft</td>
</tr>
</tbody>
</table>

Excavations conducted at known Susquehannock sites to date suggest that they lived in longhouses that resemble the Iroquoian-style (Custer 1996; Kent 1984). Longhouses have been found to be at most 95 feet in length (Custer 1996). The average length at the Schultz site was 77.5 feet long (Kent 1993), but this site was occupied in the early stages of Susquehannock occupation and it is assumed that the style had changed since then with contact from other Native American groups as well as the Europeans. Conestoga Town, occupied after Lower Leibhart, had log cabin residences like the Europeans suggesting acculturation was a gradual factor in social organization (Nevin, personal communication 2012).
Grid L Possible Stockade line

Figure 43. Anomaly 37 in Radan. Grid L at 20-25 cm depth. Top: The black areas indicate the higher reflections while white shows the low reflections allowing for better visibility. Bottom: Anomaly 14 is the possible palisade line with the blue line being another possible ending for the grid (Anomaly 37).

The primary goal of finding the palisade line with the GPR survey required focus on Grids I-L. Grid L has promising evidence of the palisade line forming an ark shown in red starting toward the NW/central area of the unit (Figure 43). The blue line indicates Anomaly 37 that could be another possible direction that extends from Anomaly 14. This particular route was also seen in Figure 29 in pink. The Radan image of this line looks remarkably similar to the stockade lines found by Horsley and Wall (2010). The stockade lines in Horsley and Wall’s image look ditch-like.
and are remarkably subtle compared to other features in the image (Figure 44). As shown in Horsley and Wall’s data, the stockades were associated with trenches given it the ditch-like appearance. There is no evidence of trenches associated with the Lower Leibhart stockade line.

Figure 44. Horsley and Wall (2010, Figure 9) Magnetometry data. They located multiple stockade lines.

Figure 45 and 46 show radargrams (or profiles of the GPR data) that may show evidence of postmolds along the palisade. Figure 45 has a profile view along the possible stockade line at the 24.75 and 24.5 transect lines (top of the grid started at 35). Both radargrams contain evidence of possible features. The first one, at the depth of 15 to 20 nanoseconds (ns), shows much activity in the red circles where the stockade line should occur. The second band has a range of 20-40 ns. The black circles indicate another interesting set of what appear to be postmold hyperbolas, however, they are much too deep to be Lower Leibhart postmolds. The two radargrams are symmetrical because they were two transects taken in succession using the
zig-zag method. Also the depths may not be exactly as shown here because the “depth” was taken using time (nanoseconds) rather than distance (cm).

The objective to find the western palisade appears to be successful, but conducting ground tests is necessary to be conclusive. The palisade line feature would extend Kent’s initial
estimation by 40ft to the west at its widest and increases the size of the palisade as it rejoins the projection further south in Grid K (Figure 47). Figure 47 also shows an approximate placement of the most intact possible longhouse feature. Both of these finds contribute significant data to the archaeological record because little of the village layout was previously known either from archaeological or historical evidence.

Figure 47. Kent’s map of projected palisade line and longhouse (approximate placement based on the time slices). Red dotted lines indicate extended palisade line and blue elongated oval represents the longhouse. The projected features are approximate and based on the Anomaly 13 and 15
Magnetometer

A large number of features were found in the magnetometer survey. Because the transects were orientated north-south and the plow scars going west-east, it is possible to determine how straight the transects were. Each magnetometer grid contains at least one discernible strong anomaly. Most grids had at least one monopolar positive anomaly, which indicates a strong anomaly and Grid 3 has Anomaly 32 that is the class of dipolar simples that are interpreted as earth ovens or some version of a fire pit according to previous studies (Burks 2009; 2010; Kvamme 2009). The results of the magnetometer and the other geophysics instrument surveys indicate that geophysics can locate archaeological features to add to our understanding of the site structure. The anomalies of monopolar positives and dipolar simple correlate with pit features and an earth oven and hopefully in the future they will be investigated.
CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

This thesis presented the geophysical investigations conducted at the Lower Leibhart site in Wrightsville, York County, Pennsylvania. The three types of geophysical surveys included magnetic susceptibility, magnetometry, and ground penetrating radar. The location of the Lower Leibhart site is presently in a York County Park named the Native Lands Park that resides along the Susquehanna River.

The Lower Leibhart site was inhabited by the Susquehannocks and is currently believed to have been occupied approximately between 1676 and 1680 (Kent 1993). The Leibhart stage within the Susquehannock chronology includes both the Upper and Lower Liebhart sites.

The series of geophysical surveys conducted (grids in Figure 48) was an attempt to find the western palisade, village features, and possible defensive structures. The objective was to add to the archaeological record with the actual boundaries since the western side was the only one missing and if any structures were found to know something of the village layout. The secondary objective, using the features found, would be to add more factors in determining the difference between the Upper and Leibhart sites. Currently, it is difficult to know the chronology of these two sites within the Susquehannock sequence because their artifacts were very similar (Kent 1993). They are also 4,000 feet away from each other, making any type of physical description non-conclusive because they would match or be very similar.
The geophysical surveys did identify many anomalies which might be cultural features. The magnetic susceptibility located two fire pits on the western side of the site which were also identified in the magnetometry data. The ground penetrating radar may have found three longhouses (Grid C (Anomaly 45), Grid I (Anomaly 3), Grid K+L (Anomaly 15)), the western palisade (Grid L), and a possible bastion (in either L or F). The magnetometry survey an additional fire pit in Grid 3 as well as nine pit features throughout the five grids tested.
A future project should include testing area B of the magnetic susceptibility data because the area is highly reflective which may indicate that it is an archaeological feature. Areas C and E contain the possible residential area because the most probable longhouse was located in this area as well as the fire pit found by the magnetometer.

The ground penetrating radar (GPR) survey possibly found three longhouses, a western palisade, and two possible bastions. These selected features are overlaid on Kent’s map in Figure 49.

Figure 49. The most prominent GPR anomalies: longhouses (blue), bastions (green), and extended palisade in red on western side.
The difficulty in interpreting my sets of GPR data is that I used two programs in different ways and it seemed to show different results. The GPR Slice program can portray multiple centimeters at a time where Radan needs to be focused on a particular depth. Ground testing is the best way to determine the real nature of the features. Figure 50 (Figure 40 recopied) shows the most likely longhouse features. They repeat some previous Susquehannock patterns of having a radiating formation, an elongated oval shape, and fitting the typical length range. Anomaly 5 in GPR Slice from Grid J could be the firepits interpreted from the MS data suggesting they were outside the residential structures.

Figure 50 (Figure 40 recopied). All western-most grids together in Radan. Top left is Grid L; Bottom left is Grid K; Top right is Grid I; and Bottom right is Grid J. Each set is 30cm with the different gains. Anomaly 15 is in red, Anomaly 9 is in orange and Anomaly 37 is in purple.
Evidence for the western palisade or boundary was likely found in Grid L. There is visible ditch-like anomaly show in this grid. This is the pattern that would be expected by a palisade feature associated with a ditch. Figure 51 (Figure 30 recopied) shows the possible palisade line. This particular line is most visible around this depth of 20cm, however, erosion may have kept this feature at a constant low depth and filtered the plow zone. The other possible lines do not match the palisade line as projected by Kent.

Figure 51 (Figure 30 recopied). Anomalies 13 and 14 in Radan, Grid L: Gain 4; 20cm. Left: Raw Data; Right: Interpretation. Anomalies 13 (orange), 14 (red), 54 in green, and possible plow scars.

There were two locations associated with the possible palisade where square features were found that could indicate bastions. Anomaly 13 is located in Grid L. The second (Anomaly 50) was found in Grid F. Figure 52 shows the application of three different gain settings for the 40cm level Radan slices. Consistently on the right side is a square anomaly. Both Anomaly 50 in
Grid F and Anomaly 13 in Grid L have very strategic lookout positions where bastions would have been placed with excellent vantage points.

The magnetometer survey located several pits and a possible fire pit anomaly. Figure 53 (Figure 35 recopied) shows the results for the magnetometry grids. All the blue circles indicate possible pit features (monopolar positive anomalies: black). The yellow circles may indicate either iron objects or large rocks (dipolar simple anomalies: black adjacent to white). The red circle indicates Anomaly 32, the other form of dipolar simple anomalies where black anomalies (negatives) are encircled by white anomalies (positives) and these types of anomalies have
been found to be some version of a fire pit (Burks 2010; Leach, personal communication 2013). These anomaly terms and possible interpretations are from Burks (2010).

The concentration of the majority of features being towards the middle and the two sides of the site is a pattern that suggests most of the activities took place in those areas. It appears the Susquehannocks utilized the entirety of the space assuming there is a plaza like other Susquehannock sites (Kent 1993). The two pits in Grid 5 (Anomalies 34 & 35) are actually located in the space where the possible bastion is located, which would add more evidence to the possibility of there being something in that area.

![Magnetometry data](image)

Figure 53 (Figure 35 recopied) Magnetometry data. *Top Row:* Upper left corner is Grid 2 (in Grids’ G & J) and Lower Right is Grid 4 (in Grid A). *Middle:* Grid 5 (in Grid F). *Bottom Left:* Grid 3 and *Bottom Right:* Grid 1. North is facing up.
Research Questions

There were three main research questions investigated in this study:

1. Can the western boundary be located with the geophysical survey?

   The previous 1970 excavations at the Lower Leibhart site did not uncover the palisade line on the western side (Kent 1993). Kent believed it was due to erosion on the western edge. Anomaly 14 in Grid L resembles the estimated path of the palisade published by Kent (1993). Although the anomaly only shows up at the low depth of approximately 20-25cm, it is possible that the constant erosion processes have kept the site at a low depth on the western side. Many of the other anomalies also start showing up at the same low depth possibly suggesting the site is still shallow on the sloped areas. Further investigations would need to be conducted to confirm if that anomaly is actually the palisade line.

2. Can any village structures be located?

   Kent (1993) located a partial longhouse in his previous excavations and it was the only village structure he found, however, he did locate many pit features. Many anomalies resembled longhouse shapes, but further testing would need to be conducted to confirm this interpretation. There were also several anomalies that resembled circular structures like those found in Grid G and Anomaly 51 in Grid H (in Appendix A). All of the anomalies require further investigation to make more definitive conclusions.

3. Are there any defensive structures at this site?

   There were also three square anomalies (Anomaly 16 (Figures 29), Anomaly 49 (Figure 50), and Anomaly 53 (Figure 26)). The only structures found at other Susquehannock sites that
were square were bastions at the Strickler site other than the log cabins at Conestoga. Evidence at Piscataway and the Leibhart sites thus far do not suggest log cabins were used before Conestoga. Two bastions were found at the Strickler site that was occupied just before the Leibhart stage (Kent 1993). Further investigation would need to be conducted to make more definite conclusions. Based upon the dimensions at Strickler, Anomaly 16 in Grid L in orange (Figure 30) is a closer match than Anomaly 49 or Anomaly 53.

**Recommendations**

Finally, the geophysical survey and research on Susquehannock villages suggest that additional investigations of the Lower Leibhart site should be undertaken through additional geophysical survey and limited ground testing. The entire site should be investigated through a magnetometer survey since it has been proven to successfully find prehistoric features in numerous previous studies (Burks 2010; Horsley and Wall 2010). The magnetometer should be able to successfully determine if the palisade line is present at the site and identify other features including storage pits and fire pits.

Based on what has been found with this project, the anomalies in Grid L and Anomaly 50 in Grid F with Anomalies 34 and 35 in Grid 3 should be tested first. Both of these testing areas would test the magnetometry results and the ground penetrating radar results. Other areas recommended for further investigation include the fire pit (Anomaly 32) in Grid 3 and the possible trenches from Grid A in Anomalies 38-41.
Hopefully, in the future, more investigations of any type will be conducted at the Lower Leibhart site. There are still many questions that need to be answered and it is still not conclusively known where the Lower Leibhart site fits within the Susquehannock chronology.

**Significance**

Much of the Susquehannock history is documented and known to the archaeological community. However, the period of the Leibhart stage is one of the least understood. It is ironic that there is little or no historical documentation of the battle that almost annihilated the Susquehannock culture. There were a couple of cannon balls found at the Lower Leibhart site, but it does not conclusively confirm that this was the site of the battle (Kent 1993).

Geophysical surveys are a non-destructive method for investigating archaeological sites. The technology is used more frequently now than in the past, but it is still in its beginning stages in archaeology. This project was an attempt to add information to the archaeological record about the Lower Leibhart site. It is the author’s belief that the difficult terrain revealed a weakness in the current progress of using geophysics at certain archaeological sites. During most of the geophysical surveys, the hay (current use) interfered with the data collection by making it difficult to push. There were moments during the collection that the GSSI had to be physically lifted to keep going and this affected the results. Overall, the geophysical technology has the potential to become an important method in Phase II archaeological investigations.
References Cited

ASC Scientific
2012 MS2/MS3 Magnetic Susceptibility System. Electronic document,

Axelrod, Alan

Bartington Instruments
2012 MS2/MS3 Magnetic Susceptibility Equipment. Electronic document,

Benson, Evelyn
1958 The Story of the Susquehannocks. Society for Pennsylvania Archaeology. Conestoga
Chapter No. 4, May.

Browne, William Hand (editor)
Maryland Historical Society. Electronic document,

1890 Proceedings of the Council of Maryland 1687/8-1693. Vol. 8, Maryland Historical
Society, Electronic document,
http://aomol.net/megafile/msa/speccol/sc2900/sc2908/000001/000008/html/,

Society. Electronic document,

1887 Judicial and Testamentary Business of the Provincial Court 1637-1650. Vol. 4, Maryland
Historical Society. Electronic document,


Historical Society. Electronic document,

127

Burks, Jarrod
2010 Geophysical Survey Results at 33BU1110 and 33BU1112, Two Multicomponent Prehistoric Native American Sites in Butler County, Ohio. OVAI Contract Ct Report #2009-56.

Cadzow, Donald A.

Carr, Kurt

Conyers, Lawrence

Custer, Jay

Dalan, Rinita A.

Dearing, John
Dragoo, Don

Eshleman, Henry Frank
1909 *Lancaster County Indians: Annals on the Susquehannocks and other Indian tribes of the Susquehanna territory from about the year 1500 to 1763*. Express Print Co., Lancaster, Pennsylvania.

Fite, Emerson David

Geoscan

Goodman, Dean
2011 GPR-SLICE V7.0 Geophysical Archaeometry Laboratory, Inc, Santa Barbara, California.

Google Earth
2011 Wrightsville imagery. Lower Leibhart site. Wrightsville, Pennsylvania

Gordon, Thomas F.

Grumet, Robert Steven

Hanna, Charles A.
Herman, Charles, Esq.

Horsley, Timothy, and Robert Wall
2010 *Archaeological Evaluation of Alluvial Landscapes in Western Maryland*. Submitted to the Maryland Historical Trust.

How Stuff Works

Howard, J. Smoker

Integrated Geophysics Corporation

Jennings, Francis P.

Johnson, Janet

Jordan, David W.

Kent, Barry
1969 National Register Nomination Form for 36Yo170. Manuscript on file at the Pennsylvania and Historical Museum Commission, Harrisburg, Pennsylvania

130

Kinsey, W. Fred III

Kvamme, Kenneth

Land, Aubrey C.

Landis, David H.
1929 A brief description of Indian life and Indian trade of the Susquehannock Indians. *Intelligence-Journal* (June 22), Lancaster, Pennsylvania

Leach, Peter

Leder, Lawrence H., (editor)
1956 *Pennsylvania History: The Livingston Indian Records 1666-1723*. The Pennsylvania Historical Association, Gettysburg, Pennsylvania

Leibhart, Bob
2012 Personal Communication. Previous owner of Lower Leibhart Site. Wrightsville, Pennsylvania

Mansfield University

Mereness, Newton D.
Mombert, Jacob Isidor
1869 *An authentic history of Lancaster County, in the state of Pennsylvania*. J.E. Barr, Lancaster, Pennsylvania.

Nevin, Paul
2011 Personal Communication. President of SPA Chapter 28.

Pecora, Albert M., and Jarrod Burks
2007 *Phase III Archaeological Data Recovery of Site 33DL1837, Delaware County, Ohio*. Ohio Valley Archaeology, Inc, Columbus, Ohio.

Pennsylvania Historical and Museum Commission/State Museum

Pennsylvania Spatial Data Access (PASDA)

Pennsylvania State University Soil Maps

Sempowski, Martha L.

Schulenberg, Janet, Jaimin Weets, and Peter Van Rossum

Shirey, Dana

Streeter, S. F.
Thwaites, Reuben Gold, (editor)

Tooker, Elizabeth

Trimble Instruments

Waselkov, Gregory A.
2005 *Application of Complementary Geophysical Survey Techniques in the Search for Fort Louis at Old Mobile: A Comparative Case Study*. Friends of Old Mobile, Inc., and the Center for Archaeological Studies, University of South Alabama. Submitted to the Department of the Interior, NPS.

Ward, Christopher

Web Soil Survey

Webster, Gary Stewart

Witthoft, John

Wren, Christopher

Wyatt, Andrew, et al.
2011 *Phase III Archaeological Data Recovery Investigations at 36CU194 Proposed Norfolk Southern Railway Company Rail Connector Project, Memorial Park, Borough of*

Zambito, James J. IV
APPENDIX A: GRIDS A-H

The following grids were not involved in finding the western palisade, however, there were still intriguing features within them including possible longhouse features and a possible bastion. The order will be alphabetical and will cover both processing programs of GPR Slice and Radan.

Grid A

Grid A was placed over where the palisade was previously found at the southern end of the complex. This location also incorporates three of Kent’s trenches in the hopes of finding them for comparative and orientation purposes. A couple of the features, believed to be Kent’s trenches, were found. Figure 54 shows the GPR Slice data for Grid A.

The third slice was focused on (Figure 55) because the site should be around that depth. The four bottom right squares, outlined in black, contain evidence of two of Kent’s trenches that appear to be approximately 20 meters in length (Anomaly 38). The top feature also outlined in black is believed to be the extensions of the sinkhole/Conestoga Formation geologic formation (Anomaly 39).
Figure 54. Grid A results in GPR Slice. Scale in meters.
Figure 55 shows selected images from the Radan processing program for Grid A. The 40cm images show Anomaly 40 and the 60cm images show Anomaly 41 that should be Kent’s trenches. Anomalies 38, 40, and 41 are all Kent’s trenches and received different numbers because there is something unique about how each anomaly appears.
Figure 56. Grid A selected Radan results. Left to Right of each depth has an increase in gain to enhance the anomalies. The circled anomalies are 40 (red) and 41 (black).

Grid B

Grid B was placed to find the partial longhouse that Kent discovered during his 1970 excavations for the PHMC. Figure 56 shows the GPR Slice results for Grid B. The southern highly reflective anomaly in Grid B reflects the large sinkhole which has formed in the underlying limestone (Anomaly 42). When orienting the grid to match Kent’s orientation, 34° off of north,
it is possible that the northern highly reflective anomaly could be one of Kent’s trenches that uncovered a partial longhouse (Anomaly 43).

Unfortunately, the only clear anomaly in Grid B in the Radan images is a set of plow scars (Figure 58). The other darker patterns visible could be geologic formations.

Figure 57. Grid B GPR Slice results. Anomalies 42 (bottom red anomaly) and 43 (top red anomaly) are in Slice 3. Scale is meters.
Figure 58. Grid B selected Radan results. The top images are structured like a pyramid with the top being the lowest gain of 2 down to 16 and also ordered from left to right based on depth so that it is easier to see the gain progression.
**Grid C**

Grid C was placed in what is believed to be the middle of the village; it also should overlay more of Kent’s trenches. Figure 59 shows the GPR Slice image results for Grid C. The highly reflective (red) anomaly at the top could be one of Kent’s trenches (Anomaly 44).

![Grid C GPR Slice results. Anomaly 44 is in Slice 3 at the bottom. Scale in meters.](image-url)
Figure 60 shows the selected images from the Radan processing. For the majority of Grid C, the images were either very plain or very busy with geologic patterns as portrayed by the Gain 16 40cm image. However, Gain 16 70cm does possibly show another longhouse-like shaped anomaly named Anomaly 45. Further investigation would be needed to test this longhouse-like anomaly to help determine what these anomalies actually represent.

**Grid D**

Grid D was also placed to detect Kent’s trenches for orientation purposes. Figure 61 shows the GPR Slice results for Grid D. It appears that there is the start of an anomaly at the top of the grid. Further investigation would have to be conducted to complete the bigger picture for that particular anomaly.
Figure 61. Grid D GPR Slice results. Scale in meters.
Figure 62 shows selected images from Radan that contained the most significant data. Grid D probably would not contain much if it was the location of the plaza because it would have been clear for walking space or isolated activities. It is interesting how the Radan images do not show evidence of the highly reflective anomaly in the GPR Slice data.

Grid E

Grid E was placed between Grid G and B so that it would possibly pick up the rest of the longhouse that Kent believed he found in 1970. Figure 63 shows the GPR Slice data for Grid E and Slice 3 is believed to be showing more of Kent’s trenches although the reflections may be off in orientation (Anomaly 46). The reflections could also be showing more of the geologic
formation. Grid E is just to the north of the sinkhole.

Figure 63. Grid E GPR Slice results. Scale in meters.
Figure 64. Grid E selected Radan results. Anomaly 46 is the evidence of a trench.

Figure 65 shows selected Radan images from Grid E that show a plow scar, but there an interesting black circle along the right line of the plow scar. Further testing would have to determine the nature of the dark circular anomaly (Anomaly 47). The three different gains at the 70cm depth reveal interesting patterns that might be geologic. There is one spot in particular that stands out and it is circled in red (Anomaly 48). It appears to be a series of two pointed anomalies. Further investigation would have to occur to determine what those anomalies are.
Figure 65. Grid E 70cm Radan results. Circled in red is Anomaly 47 and the dark mass on the left is Anomaly 48.

**Grid F**

Grid F was placed to uncover the palisade line on the eastern side of the village, as well as, the Kent trenches that found the palisade line. Kent had chosen this area because he believed that if the site had bastions this would have been the ideal spot. This location gives commanding views of the river and also the western and northern lines of sight. Figure 66 has the GPR Slice results for Grid F. It is difficult to tell from the GPR Slice results if the palisade line runs through the grid. It is supposed to be on the right side of the image, but that is where the bulk of the “noise” is located (in red and named Anomaly 49). Based on the irregular shapes of the red anomalies, it is concluded that those anomalies are geologic.
Figure 66. Grid F GPR Slice results. Anomaly 49 is the high reflective anomaly on the right side of Slice 3.

The Radan images from Grid F (Figure 67) also show numerous anomalies that could be geologic. There is also a faint square anomaly that is visible in the 40cm images on the far right side. It is possible that this could be a bastion (Anomaly 50), but further testing would be necessary before stating anything conclusive. As stated earlier, this would be an ideal location for a bastion if one were to exist at this site. It was expected to find the eastern palisade in this grid, but it does not appear to present in the following images. It is possible that erosion may have erased them because like the western side, the eastern side is also sloped.
Grid F selected Radan results. Anomaly 50 is the square anomaly on the right side of each image.

Grid G

Grid G was also placed over some of Kent’s trenches from 1970. Figure 68 shows the GPR Slice results for Grid G. It appears that the grid caught the end of a feature because, like Grid D, the origin or the main anomaly is not present in the image. From the Magnetometry data (Grid 3), it was learned that a fire pit was located adjacent to this grid so it is possible this could be a residential area or the location of cooking activities.
Figure 68. Grid G GPR Slice results. Scale in meters.
Figure 69 shows selected images from Radan for Grid G. There are some very interesting patterns in this grid. At first glance, the most visible characteristic are the five decent sized circular anomalies that seem to be connected in some way (Grouped as Anomaly 51). It is difficult to determine if the anomalies are geological or archaeological just by these images. Regular circular shapes could indicate man-made features. It is possible that this represents an activity area or some type of structure. Further investigation would be needed to determine what these anomalies are.
Grid H

Grid H was also placed to detect Kent’s trenches and also to possibly uncover village structures (near middle of village). One particular shape that stood out is outlined in Figure 70. It appears to be a polygonal shape with an appendage with a reflective spot in the center that could indicate a fire pit (Anomaly 52). If this is a village residence, its set up is similar to the Monongahela style that included a side appendage for storage (Dragoo 1955). Further investigations would need to be done to be more definitive. The GPR Slice results for Grid H are in Figure 71.

Figure 70. Grid H GPR slices 3 and 4. Close up of Anomaly 52. Scale in meters.
Figure 71. Grid H GPR Slice results. Scale in meters.
Figure 72. Grid H selected Radan results.

Figure 72 shows the 40cm depth in four different gains for Grid H. They indicate some activity on the right side of the grid. Without further investigation, the activity being observed is believed to be geologic.

**Compiled Grids**

Figure 73 shows the grids placed together. Grids A and B are approximately where they should be in relation to each other. In reality, Grids A and B are ten meters apart. Grids E and C are slightly lower than they should be. The depth of 40cm and gain 4 were chosen because of the depth of the site and gain 4 was the medium range used. The majority of the image shows the mosaic-like pattern of plowing and geologic activities. The square anomaly is still visible in Grid F as well as the circular anomalies in Grid G. With these sweeps it was expected to find more village features, but it appears the many years of plowing and geologic activities have drowned out most of the archaeological features.
Figures 74-77 show the grids on Google Earth based on the actual GPS coordinates taken by the R-8. Figure 74 shows all the points taken for the grids all together. Figure 75 shows the GPR Grids and Figure 76 shows the Magnetometry Grids. Figure 77 includes all of the grids on it together. It is visible from Figure 75 that the southwest corner of Grid H was not properly aligned, but thankfully the other grids were not affected because their corners were based on Grid H’s points. It is also apparent that some sides were extended past their points on the map and that is because some of the confusion of collecting the points resulted in wrong stakes being recorded. Unfortunately, this step of recording the grid coordinates was completed last. The area from Grid J to Grid E was difficult to determine which stakes belonged to the Magnetometry grids and which belonged to the GPR grids. The lesson learned was to record the grids as they are laid out to avoid confusion later, especially with the grids and site being so large. Appendix B contains the chart to match the numbers with their coordinates.
Figure 74. GPS points of all grids.
Figure 75. GPS projection of GPR grids.
Figure 76. GPS projection of magnetometry grids. The number 1 represents the datum. Grid 3 had to be manually put in for the most part because some of the stakes had been plowed over.
Conclusions:

One of the most interesting aspects of this research, other than identifying anomalies themselves was processing the GPR data. The data displays for Radan and GPR Slice were so different even though the same data was used for both. The differences could possibly be the result of differing filtering processes or that the Slice images show multiple centimeters at one
time while Radan can be focused at any particular depth. It would have been an educational test to use excavation to determine how accurate both programs are.

Overall, the twelve GPR grids contained many anomalies, both geological and archaeological. It appears that there are quite a few archaeological anomalies that should be investigated further. There were also possible longhouses and village structures that were located as well as a possible bastion. For future research, the top priority for ground testing would be the right side of Grid F and the possible longhouse features as well as Anomaly 32 in Grid 3. Those areas are guaranteed to have some interesting features.

Even though ground testing was not conducted, it is the author’s belief that much was learned about the village set up based on the anomalies that resembled longhouse shapes. These shapes were not always at a consistent orientation and not concentrated on any particular side, which means it remains unknown how many longhouses were at this site and a proper estimation cannot be made. These conclusions are based on the assumption that all the possible longhouse anomalies are longhouses. It would be ideal for ground testing to occur at some point in the future before erosion erases all there is to discover.
APPENDIX B-Coordinates of Grids

The following chart (Table 6) shows the coordinates for all the grids completed in the geophysical survey. The corresponding maps were found in Chapter 5 in Figures 74-77. The coordinates conclude that some the grids were not completely accurate, but some inaccuracy was expected due terrain difficulty. The first column in Table 6 is the name of the point, second is the Northing, third is Easting, and fourth is the elevation.

Table 6. Coordinates for Grids.

<table>
<thead>
<tr>
<th></th>
<th>Point</th>
<th>Northing</th>
<th>Easting</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>datum</td>
<td>4426260</td>
<td>372037.3</td>
<td>72.395</td>
</tr>
<tr>
<td>2</td>
<td>F NE</td>
<td>4426269</td>
<td>372154.7</td>
<td>61.776</td>
</tr>
<tr>
<td>3</td>
<td>Mag F NW</td>
<td>4426265</td>
<td>372135.4</td>
<td>64.928</td>
</tr>
<tr>
<td>4</td>
<td>F NW</td>
<td>4426258</td>
<td>372095.3</td>
<td>69.093</td>
</tr>
<tr>
<td>5</td>
<td>F SW</td>
<td>4426235</td>
<td>372099.6</td>
<td>69.587</td>
</tr>
<tr>
<td>6</td>
<td>Mag F SW</td>
<td>4426236</td>
<td>372140.7</td>
<td>63.856</td>
</tr>
<tr>
<td>7</td>
<td>F SE</td>
<td>4426246</td>
<td>372158.7</td>
<td>60.449</td>
</tr>
<tr>
<td>8</td>
<td>Mag F SE</td>
<td>4426239</td>
<td>372159.9</td>
<td>59.907</td>
</tr>
<tr>
<td>9</td>
<td>D SW</td>
<td>4426230</td>
<td>372070.2</td>
<td>71.564</td>
</tr>
<tr>
<td>10</td>
<td>D NW</td>
<td>4426271</td>
<td>372062.4</td>
<td>70.414</td>
</tr>
<tr>
<td>11</td>
<td>D NE</td>
<td>4426276</td>
<td>372091.7</td>
<td>67.34</td>
</tr>
<tr>
<td>12</td>
<td>B NE</td>
<td>4426210</td>
<td>372104.6</td>
<td>68.395</td>
</tr>
<tr>
<td>13</td>
<td>B NW</td>
<td>4426204</td>
<td>372075.3</td>
<td>69.969</td>
</tr>
<tr>
<td>14</td>
<td>B SW</td>
<td>4426173</td>
<td>372081.4</td>
<td>66.426</td>
</tr>
<tr>
<td>15</td>
<td>B SE</td>
<td>4426179</td>
<td>372110.8</td>
<td>65.813</td>
</tr>
<tr>
<td>16</td>
<td>A NE</td>
<td>4426169</td>
<td>372112.9</td>
<td>65.962</td>
</tr>
<tr>
<td>17</td>
<td>Mag A NE</td>
<td>4426159</td>
<td>372125.7</td>
<td>64.409</td>
</tr>
<tr>
<td>18</td>
<td>Mag A SE</td>
<td>4426130</td>
<td>372131.4</td>
<td>62.99</td>
</tr>
<tr>
<td>19</td>
<td>A SE</td>
<td>4426128</td>
<td>372121.3</td>
<td>63.75</td>
</tr>
<tr>
<td>20</td>
<td>Mag A SW</td>
<td>4426124</td>
<td>372102</td>
<td>63.015</td>
</tr>
<tr>
<td>21</td>
<td>A SW</td>
<td>4426122</td>
<td>372091.6</td>
<td>62.05</td>
</tr>
<tr>
<td>22</td>
<td>Mag A NW</td>
<td>4426154</td>
<td>372096.1</td>
<td>64.183</td>
</tr>
<tr>
<td>23</td>
<td>A NW</td>
<td>4426163</td>
<td>372083.3</td>
<td>64.698</td>
</tr>
<tr>
<td>24</td>
<td>E SE</td>
<td>4426189</td>
<td>372078.1</td>
<td>68.487</td>
</tr>
<tr>
<td>25</td>
<td>E SW</td>
<td>4426183</td>
<td>372048.7</td>
<td>67.47</td>
</tr>
<tr>
<td>26</td>
<td>Mag E SE</td>
<td>4426184</td>
<td>372053.5</td>
<td>67.653</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------</td>
<td>----------</td>
<td>----------</td>
<td>------</td>
</tr>
<tr>
<td>27.</td>
<td>Mag E NE</td>
<td>4426203</td>
<td>372049.2</td>
<td>70.005</td>
</tr>
<tr>
<td>28.</td>
<td>Mag E NW</td>
<td>4426199</td>
<td>372029.7</td>
<td>69.12</td>
</tr>
<tr>
<td>29.</td>
<td>Mag E SW</td>
<td>4426180</td>
<td>372034.1</td>
<td>66.571</td>
</tr>
<tr>
<td>30.</td>
<td>G SE</td>
<td>4426197</td>
<td>372045.5</td>
<td>69.22</td>
</tr>
<tr>
<td>31.</td>
<td>G NE</td>
<td>4426224</td>
<td>372040.8</td>
<td>71.974</td>
</tr>
<tr>
<td>32.</td>
<td>C SW</td>
<td>4426231</td>
<td>372039.3</td>
<td>72.319</td>
</tr>
<tr>
<td>33.</td>
<td>C NW</td>
<td>4426265</td>
<td>372033.1</td>
<td>72.466</td>
</tr>
<tr>
<td>34.</td>
<td>H NW</td>
<td>4426260</td>
<td>372003.6</td>
<td>72.054</td>
</tr>
<tr>
<td>35.</td>
<td>H SW</td>
<td>4426226</td>
<td>372009.9</td>
<td>70.633</td>
</tr>
<tr>
<td>36.</td>
<td>Mag G NE</td>
<td>4426228</td>
<td>372024.5</td>
<td>71.797</td>
</tr>
<tr>
<td>37.</td>
<td>Mag G SE</td>
<td>4426199</td>
<td>372029.8</td>
<td>69.113</td>
</tr>
<tr>
<td>38.</td>
<td>G SW</td>
<td>4426191</td>
<td>372016.1</td>
<td>67.738</td>
</tr>
<tr>
<td>39.</td>
<td>Mag G SW</td>
<td>4426194</td>
<td>372000.4</td>
<td>67.327</td>
</tr>
<tr>
<td>40.</td>
<td>Mag G NW</td>
<td>4426223</td>
<td>371995.2</td>
<td>69.154</td>
</tr>
<tr>
<td>41.</td>
<td>J NW</td>
<td>4426221</td>
<td>371980.6</td>
<td>67.065</td>
</tr>
<tr>
<td>42.</td>
<td>J SW</td>
<td>4426186</td>
<td>371986.7</td>
<td>65.59</td>
</tr>
<tr>
<td>43.</td>
<td>K SW</td>
<td>4426181</td>
<td>371957.5</td>
<td>61.615</td>
</tr>
<tr>
<td>44.</td>
<td>Mag K SW</td>
<td>4426196</td>
<td>371957.5</td>
<td>63.965</td>
</tr>
<tr>
<td>45.</td>
<td>Mag K SE</td>
<td>4426198</td>
<td>371967.2</td>
<td>65.166</td>
</tr>
<tr>
<td>46.</td>
<td>Mag L NE</td>
<td>4426227</td>
<td>371962.6</td>
<td>64.196</td>
</tr>
<tr>
<td>47.</td>
<td>Mag L NW</td>
<td>4426226</td>
<td>371952.9</td>
<td>62.665</td>
</tr>
<tr>
<td>48.</td>
<td>K NW</td>
<td>4426215</td>
<td>371951.4</td>
<td>63.08</td>
</tr>
<tr>
<td>49.</td>
<td>L SW</td>
<td>4426214</td>
<td>371941.5</td>
<td>61.613</td>
</tr>
<tr>
<td>50.</td>
<td>L NW</td>
<td>4426248</td>
<td>371935.9</td>
<td>60.248</td>
</tr>
<tr>
<td>51.</td>
<td>L NE</td>
<td>4426255</td>
<td>371974.4</td>
<td>68.152</td>
</tr>
</tbody>
</table>
## Appendix C: Anomaly Chart for GPR and Magnetometry Data

Table 7. Anomaly Chart for GPR and Magnetometry Data

<table>
<thead>
<tr>
<th>Program</th>
<th>Depth</th>
<th>Description</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPR</td>
<td>42-49cm</td>
<td>Highly Reflective Anomaly</td>
<td>19</td>
</tr>
<tr>
<td>GPR</td>
<td>42-49cm</td>
<td>Light Blue Square Anomaly</td>
<td>19</td>
</tr>
<tr>
<td>Radan</td>
<td>60cm</td>
<td>Gain 8, 16; Possible Longhouse</td>
<td>21, 22</td>
</tr>
<tr>
<td>Radan</td>
<td>40cm</td>
<td>Gain 16; Bullseye Anomaly</td>
<td>23</td>
</tr>
<tr>
<td>GPR</td>
<td>31-49cm</td>
<td>Highly Reflective Possible Trench</td>
<td>24</td>
</tr>
<tr>
<td>Radan</td>
<td>30-40cm</td>
<td>Gain 4; Geometric Pattern Extending North</td>
<td>25</td>
</tr>
<tr>
<td>Radan</td>
<td>50cm</td>
<td>Gain 8; Odd Shaped Anomaly</td>
<td>25</td>
</tr>
<tr>
<td>GPR</td>
<td>31-49cm</td>
<td>Broken up line of Anomalies</td>
<td>26</td>
</tr>
<tr>
<td>Radan</td>
<td>20 &amp; 40cm</td>
<td>Circular Features Resembling Extra Palisade</td>
<td>27, 40, 50</td>
</tr>
<tr>
<td>Radan</td>
<td>20 &amp; 40cm</td>
<td>Circular Anomaly with Small Appendage</td>
<td>27</td>
</tr>
<tr>
<td>GPR</td>
<td>31-63cm</td>
<td>Slice 3 &amp; 4; Circular Anomaly</td>
<td>29</td>
</tr>
<tr>
<td>GPR</td>
<td>47-63cm</td>
<td>Slice 4; Linear Anomaly on Left</td>
<td>29</td>
</tr>
<tr>
<td>Radan</td>
<td>20cm</td>
<td>Gain 4; Possible Bastion</td>
<td>30, 31, 46, 51</td>
</tr>
<tr>
<td>Radan</td>
<td>20cm</td>
<td>Gain 4; Possible Palisade Line</td>
<td>30, 40, 43, 45, 51</td>
</tr>
<tr>
<td>Radan</td>
<td>30cm</td>
<td>Gain 4; End Portion of a Possible Longhouse</td>
<td>31, 40, 50</td>
</tr>
<tr>
<td>Radan</td>
<td>30cm</td>
<td>Gain 4; Possible Square Anomaly</td>
<td>31</td>
</tr>
<tr>
<td>Radan</td>
<td>40cm</td>
<td>Gain 4; Spike Shaped Anomaly</td>
<td>32</td>
</tr>
<tr>
<td>Radan</td>
<td>50cm</td>
<td>Gain 4; Semi-Circle Anomaly</td>
<td>33</td>
</tr>
<tr>
<td>Radan</td>
<td>50cm</td>
<td>Gain 4; Circular Anomaly</td>
<td>33</td>
</tr>
<tr>
<td>Radan</td>
<td>50cm</td>
<td>Gain 4; Circular Anomaly</td>
<td>33</td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Dipolar Simple Anomaly</td>
<td>35, 52</td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Dipolar Simple Anomaly</td>
<td>35, 52</td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td>35, 52</td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td>35, 52</td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td>35, 52</td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td>35, 52</td>
</tr>
<tr>
<td>Instrument</td>
<td>Depth</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Dipolar Simple Anomaly</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Dipolar Simple Anomaly; Fire Pit/Earth Oven</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Monopolar Positive Anomaly; Pit</td>
<td></td>
</tr>
<tr>
<td>Geoplot</td>
<td>N/A</td>
<td>Dipolar Simple Anomaly</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>20-25cm</td>
<td>Other Possible Palisade Ending</td>
<td></td>
</tr>
<tr>
<td>GPR Slice</td>
<td>31-47cm</td>
<td>Slice 3; Kent's Trenches</td>
<td></td>
</tr>
<tr>
<td>GPR Slice</td>
<td>31-47cm</td>
<td>Slice 3; Conestoga Formation Anomaly</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>40cm</td>
<td>Gain 4, 8, 16; Trench with Bullseye Anomaly</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>60cm</td>
<td>Gain 4, 8, 16; Trenches</td>
<td></td>
</tr>
<tr>
<td>GPR Slice</td>
<td>31-47cm</td>
<td>Slice 3; Sinkhole Anomaly</td>
<td></td>
</tr>
<tr>
<td>GPR Slice</td>
<td>31-47cm</td>
<td>Slice 3; Trenches with Partial Palisade</td>
<td></td>
</tr>
<tr>
<td>GPR Slice</td>
<td>31-47cm</td>
<td>Slice 3; Top of Kent Trench</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>70cm</td>
<td>Gain 16; Possible Partial Longhouse</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>30 &amp; 50cm</td>
<td>Gain 2, 4, 8, 16; Trenches</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>70cm</td>
<td>Gain 2, 4, 8; Dark Circular Anomalies</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>70cm</td>
<td>Geologic Pattern</td>
<td></td>
</tr>
<tr>
<td>GPR Slice</td>
<td>31-47cm</td>
<td>High Reflective Anomaly on Right Side</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>40-60cm</td>
<td>Gain 2, 4, 8; Possible Bastion</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>30-40cm</td>
<td>Five Circular Anomalies</td>
<td></td>
</tr>
<tr>
<td>GPR Slice</td>
<td>32-64cm</td>
<td>Structure Anomaly</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>20cm</td>
<td>Circular Anomaly with Internal Circular Anomaly</td>
<td></td>
</tr>
<tr>
<td>Radan</td>
<td>20cm</td>
<td>Square Shaped Anomaly, Possible Bastion</td>
<td></td>
</tr>
</tbody>
</table>