ABSTRACT

Title of Thesis: THE CLOISTERED INFRASTRUCTURE OF THE OHIO & ERIE CANAL: AN ANALYSIS AND INVENTORY OF THE CANAL WITH A THEORETICAL LANDSCAPE ARCHAEOLOGY AND HISTORICAL GEOGRAPHIC INFORMATION SYSTEMS APPROACH

Mason Richard Waugh, Master of Professional Studies in Cultural and Heritage Resource Management, 2022

Thesis Directed By: Professor, Matthew Palus, Department of Anthropology

The period of the 1820s and 1830s experienced a burst of canal construction across Ohio. The Ohio & Erie Canal connected the Cuyahoga River to Akron, and thence southward to Portsmouth along the Ohio River. The opening of the canal allowed early settlers within Ohio to easily transport products, effectively lowering the costs of goods and increasing the profitability of businesses utilizing the thoroughfare. Towns near the canal flourished as commodities previously difficult to obtain were now brought from long distances. These improvements that the Ohio & Erie Canal brought, as well as the context and significance of the canal, have been thoroughly documented in historical literature. A few intact portions of the Ohio & Erie Canal are currently included on the National Register of Historic Places (NRHP) and listed on the Ohio State Historic Preservation Office (SHPO) online Geographic Information System (GIS)

mapping system. Several Cultural Resource Management (CRM) compliance surveys have also identified and documented canal remnants. However, most portions of the canal are not inventoried or listed on the SHPO online GIS mapping system. Few components of the canal are listed on the NRHP and within Scioto County there are only two locks represented on the NRHP. The general location of the Ohio & Erie Canal is well documented on historical maps; however, the placement of stream crossings and ancillary components (culverts, weirs, bridges) are poorly understood or perhaps cloistered, communicating little to the outside world as they are currently known. A series of plat maps was recorded in the early 1900s by the Canal Commission of the State of Ohio. Plat maps of the Ohio & Erie Canal in Scioto County were obtained for this project and were provided by the Ohio History Connection (2022). No large-scale effort to my knowledge has been made to georeference the plat maps of the Ohio & Erie Canal and analyze archaeological potential using Historical GIS (hGIS), which uses historical documents such as plat maps to answer questions about the past or to inventory canal features based on their location. To address the lack of recorded ancillary structures on the southern descent of the Ohio & Erie Canal, a total of 35 separate portions of the canal plat maps were georeferenced to the modern landscape to identify archaeological potential, ancillary structure locations, and to support recommendations for new contributing resources to the NRHP-listed historic districts. Seven separate categories of ancillary canal components or features which could be extrapolated from the canal plat maps were assigned GPS coordinates. The seven categories consisted of aqueducts, buildings, bridges, culverts, inlets, locks, and waste weirs. These components represent 70 individual features correlating to what was indicated on the canal plat maps through stations 1770-2660 in Scioto County. The inventory of these features breaks down the Ohio & Erie Canal component types and lists coordinates to increase accessibility of the information for future researchers and planners. A cross comparison of the portions of the canal currently listed on the NRHP and the SHPO online GIS mapping system is also completed and contained in this thesis. With the previously inventoried canal components and the newly georeferenced portions of the canal analyzed, this thesis assists further studies in assessing archaeological potential along the canal. Lastly, a recommendation is made suggesting which ancillary components along the canal could be contributing elements to the discontinuous or incomplete NRHP listing. This thesis attempts to provide interested researchers a better understanding of the ancillary components of the canal and how these components should be evaluated for NRHP eligibility. The Ohio & Erie Canal was not simply a historical waterway providing transportation of commodities, but also an early historical engineering feat containing a culmination of various structures whose design was to maintain water levels and one of the first mass engineering attempts in Ohio to manage the landscape and communities around the canal. Culverts along the canal are not only important, but they are also necessary for understanding how the Ohio & Erie Canal operated, how it adapted to certain topographical challenges, and were essential to the functioning of the canal. Removing culverts along the canal would not have allowed the canal to function due to the necessity of proper water levels. The public dissemination of the georeferenced data included in this thesis is intended to be a lasting benefit to gongoozlers, historians, researchers, and planners alike. As such this data will be made available by allowing the georeferenced maps and associated layers available through ArcGIS Pro. The map package in ArcGIS Pro is available upon request by contacting the author of this thesis.

THE CLOISTERED INFRASTRUCTURE OF THE OHIO & ERIE CANAL: AN ANALYSIS AND INVENTORY OF THE CANAL WITH A THEORETICAL LANDSCAPE ARCHAEOLOGY AND HISTORICAL GEOGRAPHIC INFORMATION SYSTEMS APPROACH

by

Mason Richard Waugh

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Cultural and
Heritage Resource
Management
2022

Advisory Committee:
Dr. Matthew M. Palus, Chair
Dr. Kathryn L. Samuels
Dr. Paul A. Shackel
Andrew R. Sewell, RPA
Justin P. Zink, RPA

Acknowledgements

First, I would like to thank my advisory committee for the assistance, advice, and contributions in completing this thesis. My chair, Dr. Matthew Palus has been instrumental in both advising and suggesting improvements throughout each portion of this thesis. Dr. Palus provided great feedback, countless ideas, sources, and encouragement which contributed significantly to the ongoing development of this thesis. I would like to thank Dr. Kathryn Samuels for her proposal to take a theoretical landscape approach to this thesis and for guiding the program. The value of the extraordinary experience will be long-lasting in my future career in Cultural Resource Management. Thank you to Dr. Paul Shackel for his help workshopping thesis questions to be answered and his guidance as well as encouragement. Lastly, I cannot underestimate or underscore the countless discussions with my colleagues Justin Zink and Andrew Sewell. These two gentlemen have been great mentors through this process and have done so much to both influence and develop my career path in Cultural Resource Management. Literally countless hours have been invested from them, whether it was reviewing my thesis constantly, or my constant deluge of questions for this and related topics while on long drives to and from work assignments. Both are more than great mentors, but also archaeologists, colleagues, and friends. I cannot conclude without thanking fellow graduate students who were also supportive in this process. We all traversed this project together. When you work alongside each other and conquer similar obstacles, you develop a level of mutual respect and understanding. Finally, I want to thank any of my peers who reviewed sections of this thesis and provided feedback.

It also important to pay tribute to the Ohio History Connection who provided the Ohio & Erie Canal plat maps publicly online. Without this widely available public information I would not have had the foundation from which to build this large undertaking of georeferencing and inventorying the Ohio & Erie Canal plat maps.

My entire family has been incredibly supportive through this process. I want to thank my fiancé Brittany for being patient, encouraging, and supportive through this entire process. My mother and father for all they have done setting the fundamentals leading me up to this point and as always, their love and support. Finally, the many friends that helped through this process. I would like to specifically thank Alex Gajowski for his help building a computer that could run ArcGIS Pro and the programs needed to complete this thesis.

Table of Contents

Acknowledgements ii
Table of Contents iv
List of Tables v
List of Figures vi
List of Illustrations vii
Chapter 1: Introduction 1
Chapter 2: Historical Context of the Ohio & Erie Canal 9
- Constructing the Ohio & Erie Canal 10
- The Rise and Fall of the Ohio & Erie Canal 16
- The Ohio & Erie Canal Through Scioto County 18
- The Ohio & Erie Canal as a Historic Resource 20

Chapter 3: Theoretical Framework Using Landscape Archaeology and Geographic Information Systems 25
- Landscape Archaeology 25
- Geographic Information Systems (GIS) 28
- Historic GIS (hGIS) 29
- GIS and Landscape Archaeology 31

Chapter 4: Georeferencing and Analysis Methodology 33
- Georectification 33
- Historical GIS Information Sources 34
- Analysis of the Cloistered Portions of the Canal 40
- Data Sharing 41

Chapter 5: The Data Along the Canal 42
Chapter 6: Using Historical Geographic Information Systems (hGIS) to Remap and Analyze the Ohio & Erie Canal 55
- Culverts, Remapped and Reimagined 56
- Locks are Already Locked Down 61
- The Distorted Prism 64
- Additional Ancillary Canal Components and Archaeological Potential 67
- NRHP Eligibility 72

Chapter 7: Conclusion 76
Appendices 82
Bibliography 85

List of Tables

Table 1. Canal Ancillary Components within Scioto County 46

List of Figures

Figure 1. Example of a Control Point Being Assigned 37
Figure 2. Aerial View of the Ohio and Erie Canal and its Associated Features within Scioto County 43
Figure 3. Canal Plat Map Aligning with Bridges and Culverts... 45
Figure 4. Area of High Archaeological Potential 51
Figure 5. Two Portions of the Discontinuous NRHP District within Scioto County 53
Figure 6. Lock 48 shown on 1953 ODOT Aerial and OSIP Aerial.. 54
Figure 7. Unrecorded Lock 49 63
Figure 8. Canal Prism Along Stations 2039-2060 Intact 65
Figure 9. Canal Prism Along Stations 1978-2000+93 66

List of Illustrations

Illustration 1. A New Map of Ohio with the Canals Roads and Distances 12
Illustration 2. Terminus of the Ohio & Erie Canal 20
Illustration 3. Bridge, Nine Miles North of Portsmouth... 69
Illustration 4. Scioto Distillery, 2 ½ Miles from Portsmouth 71
Illustration 5. Davis Distillery, North of Portsmouth 72

Chapter 1: Introduction

This thesis is focused on the Ohio & Erie Canal and how few of its components are included on the NRHP even though it is one of the largest historic infrastructure resources built throughout Ohio garnering much interest from the public. Currently portions of the Ohio & Erie Canal in southern Ohio are listed on the NRHP as the *Ohio and Erie Canal Southern Descent Historic District (Discontiguous)* (United States Department of the Interior 2018). This NRHP listing is a great resource and is a great step in addressing the historical significance of the Ohio & Erie Canal. However, the NRHP district components largely consist of canal locks; ten of the fourteen canal components in the nomination form for the southern descent of the Ohio & Erie Canal consist of locks. This suggests a disproportionate amount of canal features such as culverts, bridges, watered prisms (the watered portion of the canal that allowed boats to traverse), aqueducts, weirs, and other ancillary components of the Ohio & Erie Canal have possibly been overlooked as significant contributing resources. Further, little archaeological interest has been focused on these “ancillary” components, which should be done for the broader public in Ohio interested in canal history, engineering, and its function. By largely focusing on just locks along the canal there are many ancillary components that are underrepresented in Ohio. Many of these ancillary components along the Ohio & Erie Canal likely have further potential as contributing resources. To address this problem this thesis draws on archaeology of the landscape combined with historical Geographic Information Systems (hGIS), which takes geographic as well spatial information from resources such as historical maps, satellite imagery, and other historical information and allows them to be viewed simultaneously as overlays. These can be combined into a new interactive and dynamic map that allows further research to be conducted on the canal resources. The main question of this thesis is can hGIS be used to perform a landscape analysis of select portions of the southern descent, to identify and record locations of ancillary components of the Ohio & Erie Canal system and support their assessment as contributing resources to the NRHP-listed historic district? This question and the use of hGIS then allows additional questions to be simultaneously proposed, and possibly answered, such as, why were ancillary components of the Ohio & Erie Canal placed where they were on the landscape, and can hGIS identify areas of high archaeological potential? Further building on this question, can hGIS then be used to demonstrate components that are on the contemporary spatial landscape? What role can hGIS play in the evaluation of resources for contributing status or can it assess integrity? Should these ancillary components be further recommended to the NRHP as contributing resources? This thesis was envisioned to help the public in understanding the path the canal took and where its components were, so that they can be rediscovered and preserved for public uses such as the creation of trails and education. With so much attention canals garner from the public it is unequivocal to say how addressing the lack of ancillary Ohio & Erie Canal components on the southern descent NRHP filing should be important. The recordation, documentation, and expansion on what is currently known about the canal is thus extremely important. Cultural Resource Management (CRM) also sometimes lacks robust public involvement and much of what consultants do within CRM is “intangible,” something that the public never sees. Thus, for the continuation of cultural heritage and preservation it is essential to involve the public, which this thesis intends to do by creating maps for public use and data for researchers to use in the future. The interactable map created for this project can be immensely helpful in understanding this thesis.

In Chapter 2 of this thesis, I shall present the general historical context of the Ohio & Erie Canal and address what type of components existed, continue to exist, and discuss the Ohio & Erie Canal on the NRHP in addition to the NRHP criterion. The Ohio & Erie Canal had a total of 146 locks that helped boats navigate a total 1,206 feet in elevation change, which would fall or rise depending on the section of the canal. The canal also had 56 guard locks, 153 stone culverts, 50 wood culverts, eight dams for waterway crossings, 12 toll collector offices, and 14 aqueducts (United States Department of the Interior 2018:5). Many of the ancillary components along the canal such as culverts, aqueducts, inlets, and weirs would be built with dry-laid sandstone from the readily available bedrock in Ohio. The general vicinity of the Ohio & Erie Canal is well documented on historical maps; however, the placement of stream crossings and ancillary components (culverts, weirs, bridges) are poorly understood. The Ohio & Erie Canal went from Lake Erie at Cleveland all the way south to Portsmouth on the Ohio River for a total of 308 miles and opened in 1832. An effort was consciously made to avoid certain topography while also maximizing the water supply. Two of its largest water sources were Buckeye Lake and Portage Lake (United States Department of the Interior 2018:5). It should be noted that the engineering of the canal not only encompassed planning how to address where the canal would go in the landscape, but also the critical process of maintaining appropriate water levels. Too little and boats could not properly travel along the canal, while too much would damage locks and other components of the canal. A record of the plat maps was recorded in the late nineteenth to early twentieth century by the Canal Commission of the State of Ohio, under the direction of the Department of Public Works (Ohio History Connection 2022). These canal plat maps were provided for the current project courtesy of the Ohio History Connection (2022) and are digitized on the Ohio History Connection Canal Plat Map Collection (Appendix 1). These plat maps also represent ancillary components, roads, railroads, and buildings near the canal. These plat maps are a wealth of historical information; however, are functionally limited because they do not show exactly where the canal was placed on the landscape and its surrounding topography. No greater contextual information can be gleaned from them. To my knowledge these have never been fully georeferenced at a large scale to obtain the most accurate placement of the canal.

The theoretical chapter, Chapter 3 of this thesis, elaborates on how landscape archaeology has developed to allow archaeologists to investigate cultural activities that can span large areas. Adams proposed that a better term for landscape archaeology is “landscape history” (2008:92). This is because landscape archaeology is not just limited to soils, distance to water, and slope factors, instead one should not separate the built environment from the natural as natural forces dictates the built environment and eventually cause it to decay. Adams proposed landscape archaeology could then be used to ask questions like when were forests cleared, how does diversification of land use vary though time, and when were fences and roads built (2008:93)? Landscape archaeology, he then proposes, must be used with historical documents coupled with the power of observation to establish larger context (Adams 2008:101). Landscape archaeology can then be used to analyze entire regional landscapes and offers analysis outside the traditional archaeological technique of excavation of stratigraphic layers and the subsequent analysis of material culture from the artifacts (Skolnik 2019:48). This contrasts with viewing sites as independent entities with limited investigation of wider connections and relationships. The phenomenological approach to landscape archaeology focuses on social practices that create a certain individual or group's experience of the past landscape. A phenomenological approach to landscape archaeology should rely on subjective experience (Johnson 2012: 274). Current approaches of landscape archaeology recognize the faults of traditional landscape archaeology and phenomenological approaches. To overcome both criticisms there needs to be a middle ground to approaching landscape archaeology. Marcos Llobera (2012:504–505) believes we can bridge the gap and overcome criticisms in GIS and landscape archaeology by creating a middle ground between these two approaches. Richards-Rissetto introduces structuration, as middle ground between the two approaches that uses GIS to analyze social spaces on the landscape, which can give meaning to past human experiences and practices (Richards-Rissetto 2017:12).

The theoretical landscape archaeology approach is useful but when coupled with GIS it allows for analysis of particularly large regions. In Chapter 3 of this thesis, I explore GIS as one of the fastest growing specializations in archaeology and how it is vital to conducting work on cultural resources as part of CRM (Ebert 2004; González-Tennant 2016). The application of georeferencing specifically has been used to answer broader questions about people and their landscape (Armstrong 2009; Skolnik 2019; Willems et al. 2017). Skolnik demonstrated the usefulness of hGIS techniques through his work on answering questions such as the structure of plantation landscapes during the middle half of the nineteenth century and what they look like today in Talbot County, Maryland, as well as using hGIS to identify archaeological features and remapping plantations from the perspective of those enslaved (Skolnik 2019). Maps created through hGIS then provide a perfect opportunity for analyzing large spanning infrastructure such as canals.

The methodology and data interpretation chapter of this thesis first outlines georeferencing methods which creates two types of data, raster and vector data. Vector data creates the boundary of a certain area and then the raster data fills the area in with the pixels or cells to project the image. The process of aligning raster data with control points requires that coordinates be assigned to locations that can be accurately identified within spatially referenced data. This requires real-world-coordinates associated with identifiable natural features in the landscape with more control points creating a spatially correct projection of the landscape (ArcGIS 2021; 2022). Then appropriate aerial imagery is chosen to combine multiple layers of data to answer the questions proposed by this thesis including modern highly detailed orthoimagery available on the Ohio Geographically Referenced Information Program (OGRIP), 1940s and 1950s aerial photographs which were obtained from the Ohio Department of Transportation (ODOT), and USGS (United States Geological Survey) topographic maps (ODOT 2022; OGRIP 2022). These multiple layers of historical evidence and Ohio & Erie Canal plat maps were combined allowing hGIS for further analysis. Global Positioning System (GPS) coordinates can then be assigned to components indicated on the canal plat maps against the landscape.

These methods outlined create a new interactable and dynamic map created through hGIS that provides a dataset to identify components that once existed on the Ohio & Erie Canal along the landscape in Scioto County, Ohio. To address the lack of recorded ancillary structures on the southern descent of the Ohio & Erie Canal, a total of 35 separate portions of the canal plat maps were georeferenced to the modern landscape to identify archaeological potential, ancillary structure locations, and to support recommendations for new contributing resources to the NRHP-listed historic districts. This dataset revealed 70 ancillary components along the Ohio & Erie Canal within Scioto County, Ohio. These components are recorded by their GPS location on the landscape, and by what type of resource they were, such as a lock, culvert, weir, etc. The components are also broken down by their station number along the canal and comments address whether these resources are viewable on aerials, their dimensions, and if other landscape features can be attached to them.

Analyzing the historical maps from the early nineteenth century along the Ohio & Erie Canal show a high probability and high potential of revealing intact canal components on the contemporary spatial landscape. Historical GIS has limitations when identifying smaller components on the contemporary landscape. However, larger canal components that still exist can be identified with ease and without field verification. Historical GIS can also answer why ancillary components along the Ohio & Erie Canal are located where they are. Culverts in Scioto County were essential to the operation of the canal and were an engineering feat separating the water of the canal and the water of streams. As revealed through hGIS there are so many culverts within Scioto County because of the topography, and likely a lack of inlets because these streams could not be relied on to maintain a consistent water level in the canal. Culverts were also assessed if they should possibly contribute to the current canal NRHP listing within Scioto County. If they are found to have a high level of integrity, likely culverts would be a contributing resource to that district.

In conclusion, the data recorded by this project will be of tremendous use to researchers in future analyses of the canal. There is a growing interest in cultural heritage management and creating large trails for the public to understand historical resources like canals. This data could be incorporated in the Digital Guide to the Ohio River by the Ohio River Recreation Trail. The Ohio River Recreation Trail is creating a multi-layer database that can be used for trip planning and project development (like bike trails), in which knowing the extant features of the Ohio & Erie Canal and its alignment is extremely valuable. In Cultural Resource Management, this data could also provide a template for conducting surveys along canals and allowing for more refined survey areas to be created that focus on where canal components are mapped. It is a hope that this thesis has revealed new ways of understanding the canal along the landscape in Scioto County and the role that the “ancillary” components played on the canal.

Chapter 2: Historical Context of the Ohio & Erie Canal

Before the canal, Ohio was still very much undeveloped and had few transportation routes. Ohio was covered in vast forests and bore little resemblance to the landscape now. This is largely due to the wide-scale nineteenth century settlement throughout Ohio which introduced non-native species, drainage systems for wetlands and low-lying areas, and habitat loss and change. Large infrastructure projects such as the Ohio & Erie Canal have changed how we view the landscape, and the Ohio & Erie Canal was the first such large infrastructure-related project, with a groundbreaking event occurring near Newark, Licking County, at about the center of the canal. Much of the process of building the canal was recorded in public documents and published out of *Civil Engineer and Herald of Internal Improvement*. John Kilbourn would compile many of these documents into one compendium seeing that the canal would be "contemplated by future generations" and he did not want them to fall into obscurity like other "ancient improvements" such as the canals in older civilizations like Rome and Egypt (1828:Preface). Governor Brown during his first inaugural address on December 14th, 1818, gave the justification for the largest infrastructure ever proposed in Ohio: "If we would raise the character of our state by increasing industry and our resources it seems necessary to improve the internal communications, and open a cheaper way to market for the surplus produce of a large portion of our fertile country" (Kilbourn 1828:3). Governor Brown was a large proponent of building the canal and he pulled on the success of other states such as Virginia, Massachusetts, North and South Carolina, as well as New York on how they proved the usefulness of artificial navigation. He also compared canals to arteries and veins that distribute supplies, health animation, and vigor to the whole system (Kilbourn 1828:3). On the 23rd of February 1820, the General Assembly of Ohio resolved an act to appoint three commissioners to employ engineers for surveying the route of the canal (Kilbourn 1828:13). Thereon, the state started the process and would employ engineers for surveying the best route from Lake Erie to the Ohio River, from which they decided the best routes to build the canal.

Constructing the Ohio & Erie Canal

Instead of building the canal all at once, or from start to finish, it was built in sections depending on when funding would become available, or when labor was more "convenient." This "convenience" could even be the forced labor of convicts. On January 30th, 1827, the General Assembly of the state of Ohio created an act in which convicts could commute the punishment of the crimes by laboring on the Columbus feeder of the Ohio & Erie Canal (Kilbourn 1828). As stated in section one of the act:

> Be it enacted by the General Assembly of the state of Ohio, That so soon as that part of the Columbus feeder, designed to supply the Ohio canal which leads from the Scioto River, in a southern direction, towards the main line of said canal shall be prepared for excavation, it shall be lawful for the Governor to commute the punishment of such convicts as he may deem advisable, from close confinement in the penitentiary, to hard labor on the said Columbus feeder, or any other public work, according to the provisions herein contained (Kilbourn 1828:266).

That is not to say that the entirety of the canal was built by prisoners, in fact most portions of the canal would be contracted out. There was a proposal process in which contractors would need to plan and specify how they would do the work. Forty-three miles of canal between Licking Summit and Circleville consisting of twenty-eight to thirty locks, two aqueducts, and a dam had to bid out to contractors, and the contractors had to specify their work details by the 14th of November 1828 at Lancaster (Kilbourn 1828:290). A similar process would be conducted by any contractors commencing work along the canal. Economic factors also had a considerable influence on when certain sections would be built or contracted out, thus, with Cleveland being such an economic powerhouse at the time, most sections started in northeastern Ohio. One of these sections was the Cleveland and Portage Summit, consisting of 38 miles. The first canal boat traversed this section on July 3, 1827. Environmental factors also played a huge part in the building, as well as the delays, in the Ohio & Erie Canal construction. In the winter and spring of 1827 rain fell at a much higher than expected rate. This suspended work on some portions of the canal as it was made impossible, by normal means at the time, to prepare and fix foundations of aqueducts, culverts, and locks during these wet seasons (Kilbourn 1828:323).

After the first canal boat had traversed the Ohio & Erie Canal, goods across long distances could now be shipped in a much lesser time. Typically, the types of commodities received in the northern section of the canal were more agricultural consisting of flour, beef, cheeses, tobacco, as well as whiskey. The southern portion of the Ohio & Erie Canal received more general merchandise, such as salt or fish. Within the next year goods such as wood, coal, stone, and cloth became the primary goods being shipped back and forth. The canal correlated with the early industrialization in Ohio. The early success of the canal helped prove the worth of building the entirety of the Ohio & Erie Canal (Gieck 1988; Unrau and Scrattish 1984).

The entirety of the canal route that went from Lake Erie at Cleveland all the way south to Portsmouth on the Ohio River totaled 308 miles and opened in 1832. The route of the canal can be seen in *A New Map of Ohio with Canals Roads and Distances* starting in Cuyahoga County and moving southwesterly until reaching Pickaway County, which from there it moves largely south to Portsmouth in Scioto County and the Ohio River (***Illustration I***; Chabot 2022).

Illustration 1. A New Map of Ohio with the Canals Roads and Distances

Image provided by Gina Gadot, Portsmouth, Ohio. Image in the public domain.

The Ohio & Erie Canal Components

Many of the components such as the aqueducts, feeder inlets, and locks were made from dry-laid sandstone, the readily available bedrock that could be pulled from the landscape in Ohio. An effort was consciously made to avoid certain topography while also maximizing the water supply. The Ohio & Erie Canal had a total of 146 locks, which helped boats navigate a total 1,206 feet in elevation change, which would fall or rise depending on the section of the canal. Two of its largest water sources were Buckeye Lake and Portage Lake. The canal also had 56 guard locks, 153 stone culverts, 50 wood culverts, eight dams for waterway crossings, 12 toll collector offices, and 14 aqueducts (United States Department of the Interior 2018). *The Ohio and Erie Canal Southern Descent Historic District* NRHP nomination, prepared by Jeffrey Darbee, Nancy Recchie, and Matt Leasure goes into depth about these canal components (United States Department of the Interior 2018:7-9). The canal terminology from the NRHP form which is important for understanding what components helped with the functioning of the canal are as follows:

- **Aqueduct**: Would typically be a structure built with stone abutments and piers with a wood plank-lined trunk and brace framed exterior to carry the canal over obstructions such as a river or creek.
- **Balance Beam**: Was a wooden angled beam atop lock gates to manually open gates.
- **Breast Wall**: A masonry wall at the upstream end of the lock which needed to be as tall as the bottom of the upstream canal prism. Filling the lock would then allow boats to flow over the breast wall into the locking chamber, which then could be lowered to the downstream portion of the lock.
- **Chamber**: The area in a lock in which water level would change.

- **Change Bridge**: A bridge which allowed travel to the other side of the canal prism so the boat could still be pulled by horses or mules.
- **Cramp**: A U-shaped piece of iron that would be inserted into stones to hold them in place.
- **Culvert**: Would typically be made of wood or stone designed to carry a creek or stream underneath the canal prism.
- **Feeder**: Would draw from a reservoir or water source to supply the main canal and could sometimes be navigable.
- **Gates**: Wooden doors that formed a seal against water either on the upstream side of the lock or for containing water that would rise in the lock chamber.
- **Guard Lock**: Typically stopped the flow of water into the canal from another water source as to not allow flooding.
- **Heel Post**: Was located at the top of the lock gate and held in place by a goose neck and at the bottom by a projecting lug. It was the pivot point that formed a hinge allowing lock gates to open and close.
- **Level**: A portion along the canal that did not have an elevation change allowing boats to travel at a faster speed and having no need for navigation locks.
- **Lift Lock/Navigation Lock**: Typically made of sandstone, navigation locks would allow the raising or lowering of boats along the canal when there was significant elevation change.
- **Mitre Sill/Lock Sill:** Would be located on a lock's floor on the downstream portion and would be a V-shaped piece of wood or stone. The lock gates rested against these when it was filled with water helping create a tighter seal.

- **Pocket/Gate Recess**: Where the lock gate would fit into the lock walls when it was fully opened, which protected it from being hit by passing boats.
- **Prism**: Was a typically clay lined channel which allowed travel along the canal. These could range in depth and size but most typically were 26 feet wide at the bottom and 40 feet wide at the top.
- **Quoin**: Was the short face in a gate recess within a lock wall. A curved quoin would allow a heel post to fit into it.
- **Regulating Channel**: A portion of the canal that bypassed a lock on the opposite side of the towpath.
- **Slackwater Pool**: A large body of water that allows boats to cross a river or creek.
- **Sluice/Wicket Valve**: A panel near the bottom of the lock gate. Turning of valves allowed water into an empty lock chamber or allowed the chamber to be drained.
- **Station Number**: A linear distance along the canal used in surveying. It expresses feet from a certain starting point. The beginning point would be Station 0+00 and 2,222 feet away from that point would be expressed as Station 22+22.
- **Towpath**: Was the path that allowed mules or horses to pull boats in a single file line. It would typically be two feet above the water in the canal. In slackwater pools, there would often have to be bridges, or even a floating towpath.
- **Tumble/Spillway**: Was located perpendicular or parallel downstream of the lock chamber, otherwise known as the "waterfall."
- **Watered**: A term that designates a portion of the canal as still retaining water.
- **Weir**: Would be located at the side of the canal to drain excess water. This is so that water would not spill over the earthen berms of the canal prism or inundate the towpath.

With all the canal's parts implemented in following years, trade and economic prosperity increased along the canal and surrounding areas.

The Rise and Fall of the Ohio & Erie Canal

In operation the Ohio & Erie Canal had a surplus in revenue every year from 1825-1840 (McClelland and Huntingdon 1905:70). Eventually 5 more branch canals would connect to the Ohio & Erie Canal due to its success. What made it so important to Ohio and the surrounding area is that it created a navigable waterway that connected to the east coast, the Great Lakes, and beyond. The Ohio & Erie Canal allowed shipping and controlled imports and exports into central and northern Ohio. Several toll booths were set up along the canal, and those traveling along it had to pay a per-mile rate, which initially made plenty of revenue for justification of the canal. Passenger boats could hold as many as 60 passengers allowing passage north and south along the canal. Although only one boat could enter a lock at a time. There were several types of canal boats such as freight, maintenance, and passenger. The boats were typically 14 feet wide and could be up to 80 feet long. Many of the areas along the canal grew immensely because of the construction of the Ohio & Erie Canal and life centered around the waterway instead of around ground transportation. The canal also allowed goods to be received from far off places on the eastern seaboard. This allowed distinct types of furniture, tools, as well as finished and expensive goods to be imported from long distances that settlers could not make themselves. Life along the canal proved to be more luxurious (Gieck 1988; Unrau and Scrattish 1984).

Along with new luxuries settlers had never known there were also infrastructure-related improvements as well as the increase of settlements across Ohio. As economic prosperity in Ohio grew, so did the number of people that wanted to experience it. Settlers had better access to Ohio and with-it new groups of people could enter and bring their culture and heritage. Towns and villages started to be established all along the length of the Ohio & Erie Canal. Ohio was also at this time still vastly unsettled, and this meant cheap and fertile lands for new settlers, as well as a new untapped market with the potential for all kinds of commercial enterprises. This also led to a shift in what many farmers at the time grew. At first early settlers relied on staple subsistence crops such as corn and swine; however, this transitioned to agricultural products that produced more money, such as wheat and cattle. This also paved the way to more heavily forested land being cleared in the surrounding area. Likewise, the construction of brick buildings and roads increased exponentially between the years of 1820-1840. Road infrastructure was specifically built to go to the canal and was easier to build because of the access to materials (Gieck 1988; Unrau and Scrattish 1984; Noble 1988).

Technology and shifting capital led to the demise of the Ohio & Erie Canal. With the influx of cash that had been brought by the canals, people in Ohio were able to invest in infrastructure related improvements such as railroads. Between 1850-1860 railroads were developed rapidly, especially in Ohio, which brought upon the downfall of the canal's golden age. Trains were simply faster, whereas a water route may take a few weeks, a railroad would only take several days. The Ohio & Erie Canal closed for prolonged periods of time due to the weather, flooding, or other repairs that needed to be made. It was also estimated that the Ohio Canal system cost approximately $15,967.653.96 to build and around $12,063,849.47 to maintain over its 80-year lifespan (McClelland and Huntingdon 1905: 110-111). These costs, as well as operating and maintaining the canals in Ohio, put immense pressure on the state. The burden of public infrastructure started to fall on to private infrastructure. Trains outcompeted them and were cheaper. Tolls along the canal route were simply no longer seeing the amount of traffic they once had. The Ohio & Erie Canal fell into further disrepair when it was leased out to a private owner in 1861. It would eventually be reclaimed by the state in 1878. After the Flood of 1913, the State of Ohio put the final nail in the coffin, with all funding being pulled from the canal. Since then, it has experienced seasons of flooding, and freezing, which has done continuous damage to the canal and its ancillary components (Gieck 1988; Unrau and Scrattish 1984). The land along the Ohio & Erie Canal was gradually sold off to private landowners and other state agencies for development or other purposes.

The Ohio & Erie Canal Through Scioto County

In the earliest surveys done for the Ohio & Erie Canal in Scioto County there was special attention noted to the many brooks and streams (Shriver 1824:48). The survey documented that the streams from the hills were numerous. They also could not be relied upon to provide the canal prism with water because in autumn they would dry up. Shriver recommended taking a feeder from the Scioto River between Piketon and Portsmouth in Scioto County (1824:48). Three specific brooks were mentioned being Beaver Brook, McConnel's Run, and Kroniger's Run. Another survey in 1825 from the mouth of Salt Creek to the Ohio River documented that the area to place the canal as very narrow (Kilbourn 1828:108). There was only barely enough space for the Ohio & Erie Canal between the Scioto River and the many hills in the region. It was considered comparatively expensive to build this portion of the canal, although there was little excavation of rock expected (Kilbourn 1828: 108). The Ohio River at Portsmouth was deemed a favorable location for the Ohio & Erie Canal terminus due to the water being deep, the beaches having a well-defined shape, and the anchorage ground for vessels protected by the shape of riverbanks (Kilbourn 1828:108). David Bates, the principal engineer working for the Board of Ohio Canal Commissioners estimated that to build the Ohio & Erie Canal from the terminus of the canal in Scioto County to Big Belly it would cost the state government of Ohio approximately $308,053.47 (Kilbourn 1828:157). The government in Ohio relied on loans to finance the canal. The initial loan the Ohio & Erie Canal received was around $400,000 dollars from investors from the east coast. Originally it was estimated that the Ohio & Erie Canal would cost altogether around 2.3 million dollars. This estimate was far from right. The Ohio & Erie Canal, as well as the Miami & Erie Canal, which was built in a similar period, cost the state 41 million dollars. Of the 41 million approximately 25 million was interest from loans and nearly bankrupted the state (Ohio History Connection 2022). The final cost analysis in 1828 done by David Bates decided the alignment of the Ohio & Erie Canal through Scioto County (Kilbourn 1828:297). Many originally wanted the Ohio & Erie Canal to go on the east side of the Scioto River, but David Bates calculated to construct the canal from the Licking Summit to the terminus of the canal on this side of the river to be approximately $93,207.91. The western side of the Scioto was anticipated to be $9,081.21 cheaper than if it was placed on the eastern side of the Scioto. So, the canal was placed on the western side. The last lock on the canal, Lock 54, was placed on the Scioto River right before draining into the Ohio River by Portsmouth (***Illustration 2***; Chabot 2022).

The *Map of New Channel for the Outlet of the Ohio Canal into the Ohio River, Near Portsmouth, Scioto County, Ohio* surveyed in the year 1900 shows an attempt to repair some of the components of the canal that had deteriorated or became nonfunctional (Ohio History Connection 2022). A sand bar eventually rendered Lock 54 exiting into the Scioto River beside Portsmouth unusable. The Board of Public Works built the new channel which was an old pathway of the Scioto River with two locks. One of which was a double lock at the outlet of the Ohio River. The Ohio & Erie Canal in Scioto County was surveyed near the same period of the

New Channel of the Ohio & Erie Canal to assess the existing canal components. Today only three canal components are recorded in Scioto County, only two of which exist on the NRHP.

Illustration 2. Terminus of the Ohio & Erie Canal

Image provided by Gina Gadot, Portsmouth, Ohio. Image in the public domain.

The Ohio & Erie Canal as a Historic Resource

As previously mentioned, the Ohio & Erie Canal has been well documented throughout history. It is on the National Register of Historic Places (NRHP) currently in several separate listings. The largest two are the *Ohio and Erie Canal Southern Descent Historic District (Discontiguous)* and the *Ohio and Erie Canal* NRHP district in Cuyahoga County and Summit County (Department of the Interior 1969; 2018). The *Ohio and Erie Canal NRHP* district is approximately four miles long and contains three locks, two structures, and an aqueduct (Department of the Interior 1969:2). Nothing is mentioned in the NRHP listing about inlets, weirs, culverts, and many of the other components of the Ohio & Erie Canal.

The Ohio and Erie Canal Southern Descent Historic District (Discontiguous) spans the segment of the Ohio & Erie Canal within Scioto County, which is a focus of this thesis. This district is nominated under Criterion A and Criterion C. For a resource such as the canal to be listed on the NRHP they must meet the eligible criterion from the National Register Bulletin (1997) which include:

A. be associated with events that have made significant contributions to the broad patterns of our history; or,
B. be associated with the lives of persons significant in our past; or,
C. embody the distinctive characteristics of type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or,
D. have yielded, or be likely to yield, information important to prehistory or history.

Aspects of integrity must also be considered. Consideration of the integrity of canal components is integral for cultural resources being recommended to the NRHP, which if listed on the NRHP should maintain several aspects of integrity (Little et al. 2000). The aspects of integrity from Little et al. (2000) are as follows:

1. Location – the place where the historic property was constructed or the place where the historic event took place.
2. Setting – the physical environment of a historic property.
3. Design – the combination of elements that create the form, plan, space, structure, and style of the property.
4. Materials – the physical elements of a property. The property must retain the key exterior materials dating from the period of significance.

5. Workmanship – the physical evidence of the crafts of a culture during any given period in history.
6. Feeling – a property's expression of the aesthetic or historic sense of a period.

   Association – direct link between an important historic event of a person and a historic property.

The Ohio and Erie Canal Southern Descent Historic District (Discontiguous) retains all seven aspects of integrity, communicating its significance as Ohio's first cross-state bulk transport system, as well as illustrating the engineering and construction that allowed it to operate for over eighty years. The Ohio & Erie Canal Southern Descent Historic District that is listed on the NRHP covers a wide area consisting of multiple discontinuous canal components. This section of the canal is the "downhill" section and comprises the route from Newark in Licking County, Ohio to Portsmouth in Scioto County. Generally, canal boats through this section would be lowered about 400 feet to the Ohio River from the center of Ohio. The district comprises of Lock 8 near the village of Baltimore, extending south through multiple counties to Lock 50 in the village of West Portsmouth (United States Department of the Interior 2018).

The nomination forms for these two districts focus largely on canal locks; ten of the fourteen canal features in the nomination form for the southern descent of the Ohio & Erie Canal consist of locks. For the southern descent of the Ohio & Erie Canal there exists only one other NRHP listing for the Ohio & Erie Canal, the *Lockville Canal Locks*, which encompasses seven locks (Department of the Interior 1979). This seems to suggest a disparate amount of canal features such as culverts, watered prisms, aqueducts, weirs, and other ancillary components of the Ohio & Erie Canal have possibly been overlooked as significant contributing resources. While there have been plenty of historical studies done on the Ohio & Erie Canal, little has been done to my knowledge to incorporate hGIS and landscape archaeology to ask broader questions about the landscape surrounding the Ohio & Erie Canal. New developments in archaeological theory, such as Flemmings' approach to landscape archaeology, can now be used together with hGIS to better address questions such as how the Ohio & Erie Canal has changed over time, to analyze canal infrastructure, to create further datasets regarding the canal, and to assess archaeological potential around the canal.

The Ohio & Erie Canal is also widely appreciated by the public as a feat of engineering and by the archaeological community as a point of study. An important archaeological study along the canal that involved one "ancillary" component of the Ohio & Erie Canal on the southern descent occurred in 2012, carried out by the Ohio Department of Transportation (ODOT), however the report is not indicated on the SHPO online GIS mapping system (Aument 2012). The archaeological site on SHPO (RO1165) revealed a disturbed culvert along the Ohio & Erie Canal. This culvert carried an intermittent stream underneath the Ohio & Erie Canal, and the investigation conducted by ODOT revealed that the culvert existed several feet underneath the ground. It was a stone arch culvert approximately six feet high by ten feet wide and approximately 90 feet long (Aument 2012). The alignment of State Route 104 removed the central portion of the culvert, but portions remained intact under State Route 104 and the eastern end remained intact under the VMAC-C golf course (Aument 2012). Another notable archaeological study on the canal was the *Mitigation Report for the Black Diamond Shipwreck at Buckeye Lake, Fairfield County, Ohio* (Sewell and Zink 2017), the only inland shipwreck to be investigated in Ohio. Some investigations have also been done on towpaths along the Ohio & Erie Canal (Klinge and Mustain 2018), and another has been done on a locktender's house (Richner 1992).

Since the deterioration and abandonment of the Ohio & Erie Canal, it has become a monument of the first economic driving force within the state. There exists a plethora of information on the Ohio & Erie Canal, yet there are still many questions yet to be addressed. Existing information on the canal does not go into depth about the ancillary components of the Ohio & Erie Canal and the information regarding these components are cloistered. Thus, there is significant use in expanding on these cultural resources for the public and historical researchers. A great resource with historical information on the ancillary components on Ohio & Erie Canal is the plat maps recorded in the late nineteenth to early twentieth century by the Canal Commission of the State of Ohio that represent ancillary components, roads, railroads, and buildings near the canal. These plat maps however are functionally limited because they do not show exactly where the canal was placed on the landscape and its surrounding topography. No greater contextual information can be gleaned from them. To my knowledge these have never been fully georeferenced at a large scale to obtain the most accurate placement of the canal. So, this creates an instance where hGIS and landscape archaeology can expand on what is currently known on the Ohio & Erie Canal.

Chapter 3: Theoretical Framework Using Landscape Archaeology and Geographic Information Systems

The Ohio & Erie Canal is well documented and its alignment throughout Ohio is generally known. The canal and its individual components, however, have not been subjected to rigorous landscape analysis using GIS, despite the increased recognition of the technological and theoretical utility of the approach in archaeology in recent years. Although it has not been widely applied to the Ohio & Erie Canal, GIS in archaeology has become one of the fastest growing specializations (González-Tennant 2016:1). No large-scale effort to my knowledge has been made to georeference the plat maps of the Ohio & Erie Canal and analyze archaeological potential using Historical GIS (hGIS), which uses historical documents such as plat maps to answer questions about the past or to inventory canal features based on their location.

Landscape Archaeology

Landscape archaeology, theoretically, has become a point of contention for archaeologists. Landscape archaeology allows archaeologists to investigate cultural activities that can span large areas in contrast to viewing sites as independent entities with limited investigation of wider connections and relationships. Landscape archaeology can be used to analyze plantations, farms, specific buildings, or entire regional landscapes and offers analysis outside the traditional archaeological technique of excavation of stratigraphic layers and the subsequent analysis of material culture from the artifacts (Skolnik 2019:48). Flemming (2012:462) introduces his original thought of what landscape archaeology was when the idea was new in the 1970s, as being a specialist skill, which helped put an archaeological site into its local context or helped develop supplementary historical records. Now, he believes that it is a complex and interdisciplinary method and is an effective way of studying and analyzing long-term human history (Flemming 2012, 462).

William Hampton Adams thought perhaps a better term for landscape archaeology is landscape history (1990:92). He made this distinction when focusing on landscape archaeology on American farmsteads. While his approaches were designed for viewing the American farmstead, they can easily be transposed to viewing large infrastructure such as the Ohio & Erie Canal. In archaeology we often separate the built environment from the natural. Adams proposes that this dichotomy is useful in some purposes, but in truth the built environment is never separate from the natural environment (Adams 1990:92). The built environment is eventually reclaimed by the nature it once sought to control. Thus, a better term to think of is the affected environment and the unaffected environment (Adams 1990:93). Once an untouched stream goes through a tilled field it is no longer unaffected by humans, a wooded lot that has been selectively cut for certain types of wood has been affected by people, a fence across a prairie becomes a new home for fauna. Thus, the built environment has become a natural one (Adams 1990:93). So, a farm is not just comprised of the house and outbuildings but also the fields, streams, and where energy was expended for the improvement of life. To understand a site the whole scope must be examined and by just studying the subsystem (farm buildings) of an entire system (whole 600 acres of a farm), then only a piece of the entire puzzle is viewed. This entire system approach could be applied when viewing expansive infrastructure like the Ohio & Erie Canal.

Adams proposed new questions using the landscape archaeology or landscape history approach such as: when were forests cleared, how does diversification of land use vary through time, when were orchards planted, and when and why were roads and fences built? Adams proposes that some important sources for conducting landscape archaeology or history are aerial photographs, public records, and USGS topographic maps (1990:100). The most important aspect of landscape archaeology is the physical examination of the landscape. He argues observational individuals can trace potential cultural resources by examining the landscape differences and prepare maps of how these resources would have looked (Adams 1990:100). This theoretical framework can be objective or subjective depending on how it is approached. This theoretical framework also allows for broad questions to be asked about the landscape, how it was affected, how it has changed over time, and how the landscape influenced the affected environment.

Postmodernists often argue that conventional landscape archaeology is contradictory, focusing on inductive and deductive forms of reasoning as well as being too pragmatic, essentially using an unimaginative way of addressing landscape archaeology. The phenomenological approach to landscape archaeology became a popular form of archaeological theory as a result. The phenomenological approach to landscape archaeology can be defined as "the study of structures of human experience and consciousness" (Johnson 2012:272). More broadly, it focuses on social practices that create a certain individual or group's experience of the past landscape. For example, Johnson explains the traditional approach to landscape archaeology would have you stress the aerial and plan view of an area, whereas phenomenologists would see this as fundamentally limited, and the people would not have viewed the landscape that way (Johnson 2012: 274). An example of interpreting the landscape as how it would have been experienced is Skolnik's use of Frederick Douglas's writing as an enslaved individual on a plantation as a way of interpreting the plantations layout (2019). People would have experienced the landscape through what they lived and what was experienced through their body. The opposing phenomenological approach to landscape archaeology relies on subjective experience and the description of that experience (Johnson 2012: 274). Johnson admits that there are fallacies to the phenomenological approach, however, he supposes that even with its fallacies very few archaeologists would deny that it is necessary to consider issues of meaning and subjectivity to fully consider the archaeological landscape, and that we are all in a sense phenomenologists (Johnson 2012:279).

Fleming believes that the phenomenological approach has freed itself too much from empirical evaluation (Flemming 2012, 462). Flemming's objection to the postmodernist view, which is used interchangeably with the phenomenological approach, is "if landscape archaeology may be described as a set of investigative skills, which feed into an essentially reconstructive landscape history, the archaeology of landscape is a much more open subject" (2012:463).

Geographic Information Systems (GIS)

González-Tennant proposes that the use of GIS in archaeology focuses on the management of archaeological resources, spatial analysis, map making, and data visualization (González-Tennant 2016:1). González-Tennant (2016:28) suggests that the versatility of GIS allows archaeologists to analyze data in a countless number of ways, one of which is mapmaking and data visualization. The creation of maps can locate archaeological features in relation to one another and the surrounding environment, and even without statistical verification can be useful to discover meaningful patterns (González-Tennant 2016:33). Mapmaking is increasingly becoming a part of data visualization, and GIS helps communicate complex patterns in simple ways (González-Tennant 2016:33). In Cultural Resource Management (CRM) the use of GIS systems has become an integral part of conducting work on cultural resources. Ebert (2004:320) believes that GIS systems will become ever more important in the CRM industry. As such, so too must it be used in studying and analyzing human history.

Georeferencing is the process of assigning digital maps or photos to geographic coordinates and is explained in detail in Chapter 4. The application of georeferencing historical maps has been used in some instances to answer broader questions about people and their landscape. Specifically, Willems et al. georeferenced historical maps produced in 1798-1799 with early twentieth century maps in Egypt to interpret pre-industrial irrigation practices (Willems et al. 2017). Georeferencing these maps allowed for a detailed reconstruction of the eighteenth-century hydrology between regions in Egypt and allowed analysis of the irrigation basins (Willem et al. 2017). Furthermore, Armstrong (2009) used mapmaking to investigate issues of pre-Emancipation freedom as well as land ownership of Afro-Caribbean communities in the Danish West Indies. Historical maps, field surveys, and tax records helped to document cultural and economic developments in the late eighteenth century. Following these examples, GIS, or hGIS with historical maps can be used to broader conceptualize the surrounding environment of the Ohio & Erie Canal and an empirical approach can be used to interpret the archaeology of the canal landscape.

Historic GIS (hGIS)

The subset of GIS that uses historical documents such as plat maps to answer questions about the past is known as historic GIS (hGIS). Skolnik proposed that historical GIS coupled with landscape archaeology can be used as a methodological and theoretical framework for archaeologists to combine the historical question of "when" with the geographical question of "where" (2019:51). Effectively, hGIS allows archaeologists to apply modern statistical analyses to historical maps such as the Ohio & Erie Canal plat maps, as well as digitize and further overlay maps atop each other to facilitate direct comparison. Archaeology is interested in the intersections of space and time, and landscape archaeology prioritizes this, so hGIS furthers theoretical, as well as methodological development (Skolnik 2019:52). This allows further data sets to be made such as mapping the development of infrastructure, reconstructing landscapes, land use over time, and spatial economy (Knowles 2008:8-16). Thus, hGIS could be effective in understanding how the canal was developed, changed overtime, and deteriorated, as well as creating further data sets to be used in the future.

Anne Kelly Knowles provides a framework in which hGIS can be conducted in four characteristics (Knowles 2008:7). Skolnik (2019:51) paraphrased those four characteristics to answer how mid-nineteenth-century plantation landscapes were structured in relation to their geographic setting, their layout, and their ancillary components. He also attempted, successfully, to use hGIS to document surviving plantation landscapes, as well as what they look like in the present (Skolnik 2019:7). He also used hGIS to map the landscape from the perspective of those enslaved, as well as used the enslaved spatial worldview described by Dell Upton, and looked at parallels from the writings of Frederick Douglas (Upton 1984). Knowles's and Skolnik's frameworks for how hGIS can be conducted as I understand them are:

1. The question must be geographical and drive the historical inquiry
2. The historical evidence must derive from geographical information
3. The historical evidence must be analyzed within databases that record both location and time
4. The question in turn must be presented in various forms such as figures, tables, etc., to show change over an extended period of time

This in turn creates the framework in which hGIS can be used to address the Ohio & Erie Canal. Similarly, this thesis like Skolnik's work will use hGIS to document surviving components along the Ohio & Erie Canal and how they exist in the present within a geographical area by using historical canal plat maps recorded at a certain time (when) and similarly represents a certain place (where) within the landscape. The historical evidence (the canal plat maps) is both a representation of location and time and will be compared with further data (historical aerials and Ohio State Imagery Program [OSIP] aerials) to gather more information regarding location and time. The question and associated information will be presented in figures and tables, as well as an interactable map through ArcGIS showing change overtime. This will answer several questions that are geographical in nature, such as assessing archaeological potential along the canal, as well as the potential expansion to the discontinuous NRHP listing.

GIS and Landscape Archaeology

GIS and its usefulness in conducting spatial analysis has made it a useful tool for archaeologists. It was adopted as a tool particularly in the 1980s and 1990s for archaeologists. Early applications of GIS followed the traditional landscape archaeology approach, but quickly became criticized for its reliance on environmental variables instead of social variables (Richards-Rissetto 2017:10). The phenomenological approach, as mentioned earlier, developed in result. However, GIS practitioners has also revealed that the phenomenological approach is not perfect because it has limitations regarding human perceptions as it tends to create summarized human realities that reduce the complexity of people (Richards-Rissetto 2017:11). To overcome both criticisms there needs to be a middle ground to approaching landscape archaeology. Richards-Rissetto summarized criticisms of GIS and how it relates to archaeology as being “environmentally-deterministic” (2017:10). Richards-Rissetto defended against these claims by suggesting that GIS is quantitative software and that archaeologists typically deal with qualitative data. Environmental data is also typically more readily available than other data, so it is most often used (2017:10). Marcos Llobera (2012:504–505) in his article "Life on a Pixel: Challenges in the Development of Digital Methods Within an 'Interpretive Landscape'" believes we can bridge the gap and overcome criticisms in GIS and landscape archaeology by creating a middle ground (2012:504–505). These middle ground points as summarized by Richards-Rissetto (2017:11) are:

1. Situating models and methods into context-rich narratives
2. Explore how processes are played out within context-rich narratives
3. Shorten the gap between empirical information and narratives
4. Generate multiple scenarios as feedback to results

So, to overcome criticisms in landscape archaeology for this thesis the methods need to be grounded in context-rich narratives. Early narrative surveys and documents of the Ohio & Erie Canal can be used to anchor the methods in a narrative outside of just empirical data. Exploring how the Ohio & Erie Canal was built through these context-rich narratives will help explore how certain processes played out and shorten the gap between the data acquired by this thesis and the narrative. Richards-Rissetto explains that GIS cannot be thought of simply as a deductive tool, instead it must be used as an inductive process to formulate new hypotheses (2017:11). Another bridging concept for GIS to landscape archaeology is structuration which is focused on *how* landscapes can structure and characterize certain cultural practices. Structuration can use GIS to analyze social spaces on the landscape, which can give meaning to past human practices (Richards-Rissetto 2017:12). These methods can serve as a middle ground between a traditional approach and the phenomenological approach to landscape archaeology and allows for GIS methodologies and analysis to take place on the Ohio & Erie Canal.

Chapter 4: Georeferencing and Analysis Methodology

Early plat maps of the Ohio & Erie Canal do not contain readily available spatial reference information and do not relate the canal to the surrounding landscape. While viewing the Ohio & Erie Canal plat maps two-dimensionally are useful, more information can be gleaned from its physical, real-world location on the landscape. This information can be obtained when the Ohio & Erie Canal plat maps have been georeferenced and they have a relatively accurate location. Georeferencing is essentially assigning coordinates to a map or aerial photography so that it can be related to some type of geographic coordinate system.

The first step in georeferencing a two-dimensional image or map is to select the appropriate coordinate system. The coordinate system I chose was the Geographic Coordinate System World Geodetic System 1984 (GCS WGS 1984), which is a global coordinate system used frequently in GIS. The plat maps can be viewed as a raster to place them in a relatively accurate location. A raster is data that is displayed by columns and rows of pixels or cells that contain information. Typical raster data could be in satellite imagery or be obtained by using devices such as aerial cameras or remote-sensing devices. Continuous rasters such as satellite images can be used as a data layer to help provide spatial analysis (ArcGIS 2021; 2022).

Georectification

While satellite images tend to have relatively accurate spatial reference information, they do not always provide the most accurate locational data or the most optimal map coordinate system. Satellite imagery can be questionable to assign further raster data to because it can distort the images taken from space. Distortion typically occurs when images are taken from satellite positions because the earth is not a flat surface, thus it is not a completely accurate representation of the landscape. However, orthorectification, which is the process of removing distortions on various images created by topography and the curvature of the earth can be used to make a highly accurate representation of the landscape, typically within a few centimeters. The Ohio State Imagery Program (OSIP) provides orthoimagery consisting of high-resolution imagery and elevation data for GIS users (OGRIP 2022). Georeferenced orthoimagery available on the Ohio Geographically Referenced Information Program (OGRIP) provides a reliable raster dataset good for attaching locational data (ArcGIS 2021; 2022). I chose to georeference the maps to the OSIP aerials because they had been orthorectified and would provide the most accurate locational data.

With accurate locational data and a map coordinate system, a raster can then be aligned with control points otherwise known as vector data. Vector data creates the boundary of a certain area and then the raster data fills the area in with the pixels or cells to project the image. The process of aligning raster data with control points requires that coordinates be assigned to locations that can be accurately identified within spatially referenced data. These can be real-world coordinates associated with identifiable natural features in the landscape such as the mouth of stream, rock outcrops, or mountains. Manmade features can also be used as control points such as road intersections, buildings, and agricultural fields. The use of several control points that are spread out will result in a more spatially correct project that transforms the image to accurately fit the landscape. This outlines the general process of georeferencing the canal (ArcGIS 2021; 2022).

Historical GIS Information Sources

Using ArcGIS Pro, OSIP aerial imagery can be imported as TIF files that can serve as the raster dataset to further connect locational data to the canal plat maps. The OSIP aerial imagery that were the most useful ranged between the years 2006-2010. OSIP aerial imagery was taken between 2011-2014, however proved to be less useful in this instance as the surrounding areas were inundated and made it more difficult to assign control points to the landscape. Once the OSIP aerial images were loaded into ArcGIS Pro, they provided an accurate projection of the landscape. However, the landscape has changed dramatically since the Ohio & Erie Canal was built. To georeference the plat maps as accurately as possible, older aerial photographs were obtained to glimpse the canal within the landscape. Thus, my first data set to be used in hGIS comes from aerial photographs produced by ODOT in the 1940s and 1950s that show portions of the canal. Not only do these aerial photographs give the best chance at seeing remnants of the canal, but they also depict how the landscape has changed over time around the canal and how modern infrastructure has changed around it. These aerial photographs are superbly detailed, cover a large landscape, and create a dataset vital in the analysis of the canal plat maps. Being from the 1940s and 1950s, most of these aerial photographs were not georeferenced. I had to georeferenced these aerial photographs before raster data and control points could be assigned to the plat maps (ODOT 2022).

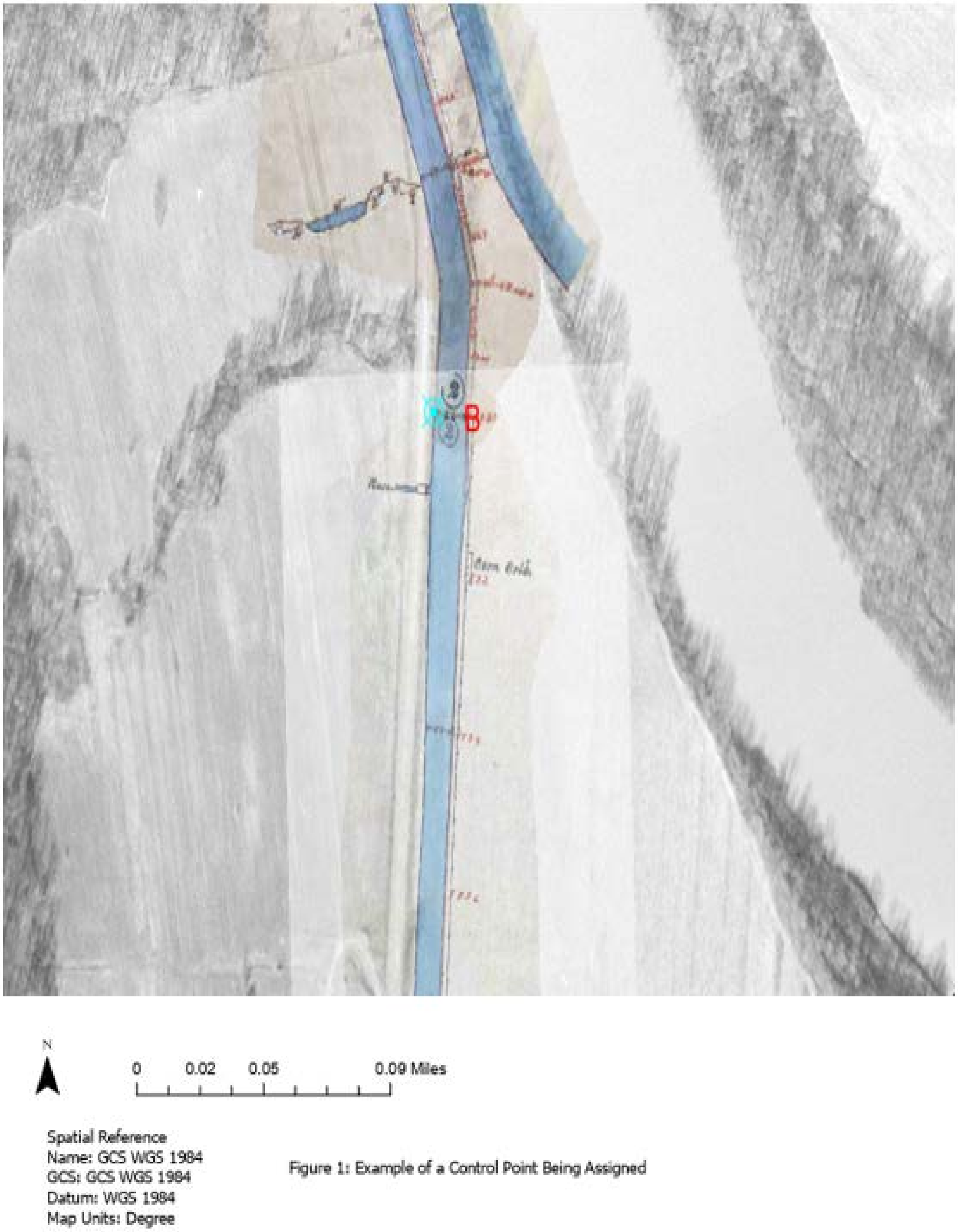
Assigning control points worked similarly for the aerial photographs and the Ohio & Erie Canal plat maps. First, an ODOT historical aerial photograph was downloaded and imported into ArcGIS Pro where it could be georeferenced over the OSIP aerial. Control points were selected that were unlikely to change between historical and modern imagery, such as roads and buildings ***(Figure 1)***.

Less frequently, streams, bridges, and banks of rivers were chosen as these features are more subject to natural change or alteration through artificial means. Lastly, USGS topographic maps were used to better see features such as roads, rivers, stream designations and relate the topography to the other imagery used. Specifically, three topographic maps were taken from

USGS Topoview: the Otway, Ohio 1915 topographic map, the West Portsmouth, Ohio 1961 topographic map, and the Wakefield, Ohio 1961 topographic map to get good coverage of the canal (Garrity 2022).

Once raster data and control points were created for the historic aerial photographs the Ohio & Erie Canal plat maps were obtained from the Ohio History Connection Canal Plat Map Collection (Ohio History Connection 2022). These canal plat maps are digitized plat maps of Ohio canals dating from 1890-1912. They were created by the Canal Commission of the State of Ohio under the direction of the Department of Public Works. It is also important to note that these were made available from the support of the Canal Society of Ohio which is a volunteer organization dedicated to recreation, education, research, and preservation related to Ohio's historic canals. These canal plat maps are separated out by county and are listed by their stations along it. When the canal was surveyed, the plat maps were numbered from north to south, so the highest station number within a county would always be the southernmost plat map. Multiple portions of the canal would often be on one image and so they had to be digitally cut into different portions so that they could be accurately placed.

Figure 1. Example of a Control Point Being Assigned



Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

The Ohio & Erie Canal plat maps contain information regarding the location of canal components in the early 1900s. Once cut, they would be imported into ArcGIS Pro and georeferenced creating raster data. Subsequent plat maps of the Ohio & Erie Canal could be georeferenced to the previously georeferenced portion, making the process easier after the first canal plat map was placed within a county. Plat maps could also be attached to portions of the canal documented in the Ohio State Historic Preservation Office (SHPO) online mapping system, representing field-verified, real-world locations. A shapefile was obtained of the previously recorded portions of the canal and imported into ArcGIS to act as supplementary mapping data to align the plat maps (Ohio Canal Plat Map Collection 2022).

It is also important to note that there is another set of canal plat maps, many of which document the canal after 1913 when the greatest Ohio statewide flood occurred (ODNR 2022). They were not used in this thesis due to being representative of a later period along the canal. I thought instead it was most important to document the canal components as early as possible. The canal plat maps after 1913 likely had several canal components destroyed after the Great Flood in 1913 and it could be that they were not recorded, so the earlier maps were used instead. However, these maps could be used to supplement and to further analyze the canal. Particularly, a study could be undertaken to determine the effects that the flood had on canal components. It is also equally important to address that the canal plat maps were made in the early 1900s which was during the end of the Ohio & Erie Canal's lifespan. These maps are incredibly detailed but are likely incomplete. These maps could contain structures not original to the canal, which is evident by a tile culvert on Station 2056 matching with an ephemeral stream. It is also likely that some canal related buildings and structures were demolished by the time of these surveys so there could exist additional subsurface architectural archaeological features or archaeological sites outside of this data.

Using this process, the plat maps could then be georeferenced relatively accurately with a small margin for error. With everything given raster data and having spatial reference information the plat maps, as well as the aerials, could be analyzed for existing components on the landscape and why ancillary components were place where they were on the landscape. In Skolnik's dissertation, he believed that the "coupling of spatial datasets that are drawn at different scales, with different thematic focuses, or from different time periods can be combined to create new geographic knowledge" (2019:224). Differences between the plat maps, the historical aerials, and the more modern orthoimagery can be compared allowing for simultaneous comparison of spatial datasets. Furthermore, the use of GIS to conduct reconnaissance on archaeological sites with non-planimetric (non-flat shape) aerials employs a tool to locate previously unidentified archaeological sites with a high degree of accuracy (Skolnik 2019:224). Thus, this methodological approach shows the utility of using hGIS to do historical archaeological projects, especially regarding analysis of the canal.

To begin the analysis of the canal and its ancillary components, Global Positioning System (GPS) points were assigned to all the canal components within Scioto County. These points were then recorded, as well as the component, its stations numbers, and any other applicable comments or information that could be assigned given the information provided on the canal plat maps, historic aerial photographs, modern aerial imagery, and topographic maps. This allowed analysis of the landscape regarding how it has changed since the plat maps were made, as well as what canal components could be identified on the landscape based on the proximity of GPS points. Modern imagery could be used to see if portions of the canal that had not been previously recorded still existed on the landscape. The hill shade layer in ArcGIS was used to see remnants of the prism of the canal. Even further, topographic maps and hill shade base maps within ArcGIS could be used to detect subtle traces of the canal in places it was not visible otherwise.

Analysis of the Cloistered Portions of the Canal

While multiple components along the canal will be examined, there exists one component, culverts, in Scioto County that I have identified as extremely important in identifying and analyzing further in Chapter 6. Culverts are architectural infrastructure archaeological features associated with the canal that can be easily overlooked, have truly little evidence of being recorded on the Ohio & Erie Canal, and are more easily threatened due to this reasoning. Scioto County, and its unique topography and hydrology challenged the construction process of the Ohio & Erie Canal. An effect of the landscape on the Ohio & Erie Canal was that its terrain caused the need for so many culverts. The engineering of the canal thus was dependent on its setting. Early historical accounts of the area describe that the many streams in the area were unpredictable. Therefore, there was a need for culverts, but this also meant that there was a lack of other components on this section of this canal such as inlets and weirs. This would seem to indicate at first glance that culverts could be contributing resources to the NRHP listing under Criterion C, or even Criterion D enhancing the significance of the canal at the local level. Specifically, this could perhaps enhance the understanding of the canal being associated with Appalachia, a historical culture area. With so few examined, little is known about the design of culverts along the canal, and how they varied. Culverts, by their design, seem less technical than some other canal components, but they played a large part in the planning and engineering of the canal which is explored more in Chapter 6. Likewise, these resource by their design are more hidden than other canal components being located underneath the canal prism. By locating these resources this will effectively help manage these types of resources in the future.

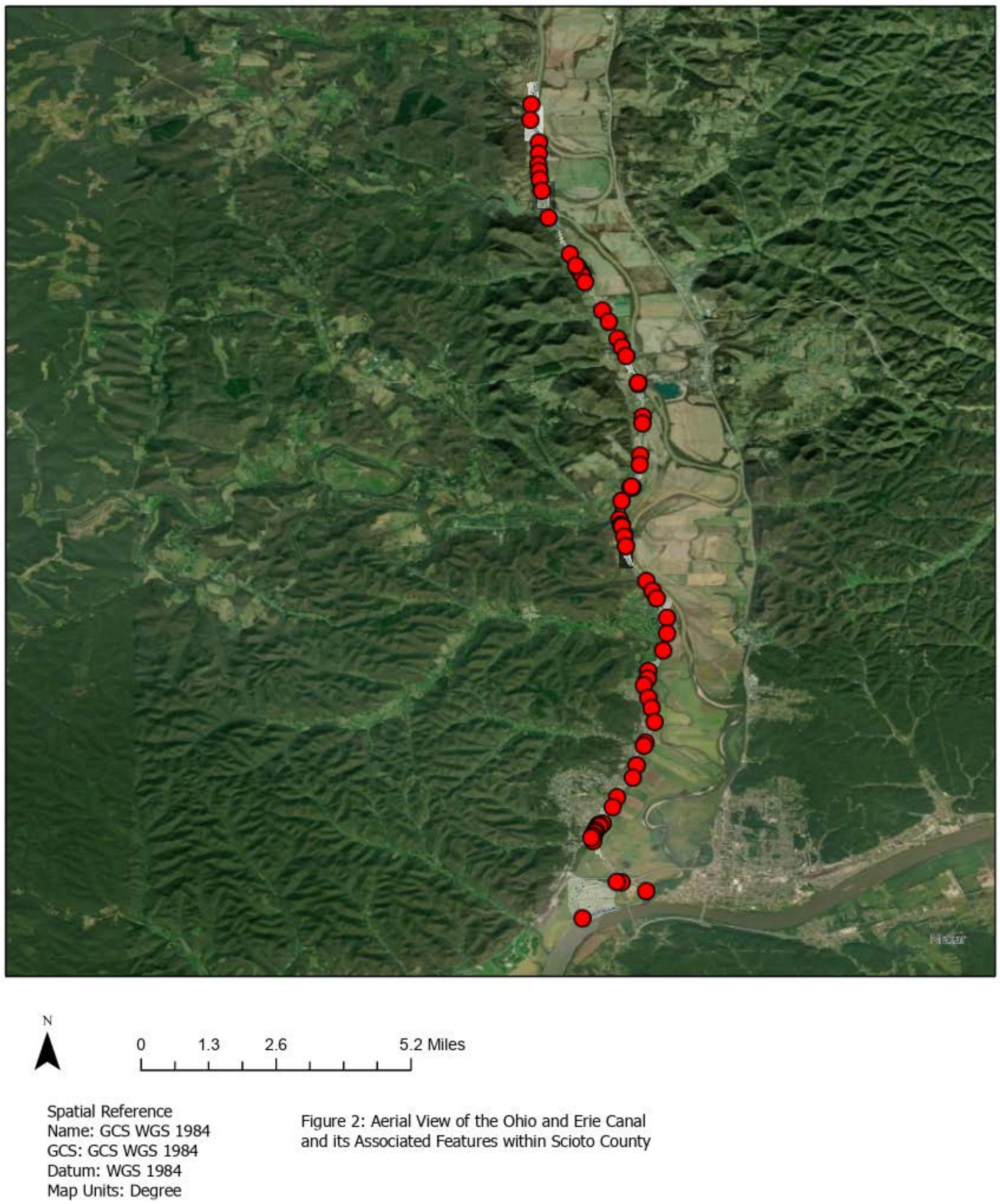
Data Sharing

Lastly this data will be saved as geoTIFFs as to easily access the georeferenced canal plat maps within Scioto County, as well as the historical aerials and OSIP aerials. All the data used will be combined in a map package within ArcGIS so as retain all the data used for this thesis. The map package that was used for this thesis can be obtained from the author of this thesis upon request. A table of the recorded canal components will be listed in this thesis. It is the intent of this thesis to possibly be included in the Digital Guide to the Ohio River by the Ohio River Recreation Trail. The Ohio River Recreation Trail is creating a multi-layer database that can be used for trip planning and project development (like bike trails), in which knowing the extant features of the Ohio & Erie Canal and its alignment is extremely valuable. In the future, projects such as this one with publicly available data could help in designing public trails to historic resources. This data will also likely be useful in future planning of CRM projects along the Ohio & Erie Canal, giving users the ability to better understand where components of the Ohio & Erie Canal could be. This will help in their identification but also possibly help reveal contributing elements to existing NRHP districts of the canal. So, it is important that this data be shared with any whom may be doing projects along the Ohio & Erie Canal.

Chapter 5: The Data Along the Canal

To address the lack of recorded ancillary structures on the southern descent of the Ohio & Erie Canal, a total of 35 separate portions of the canal plat maps were georeferenced to the modern landscape to identify archaeological potential, ancillary structure locations, and to support recommendations for new contributing resources to the NRHP-listed historic districts. This set of maps encompasses stations 1770 through 2660 along the canal in Scioto County, as well as the new channel later built for the outlet of the canal into the Ohio River. One portion of a canal plat map encompassing stations 2572 through 2610 was further broken down into separate portions as to more accurately georeference portions along that plat map. To georeference these portions of the canal plat maps, a total of 27 OSIP aerial images were obtained from OGRIP (2021), likewise a total of ten historical aerial photographs dating from 1946, 1949, and 1953 depending on what was available in the area around the canal from ODOT (2022) were utilized. ODOT aerial photographs then had to be georeferenced to allow for the canal plat maps to be georeferenced over them. In ***Figure 2,*** below, the entirety of the path the canal took through Scioto County is georeferenced with the historical layers and OSIP layers not displayed. Seven separate categories of ancillary canal components or features which could be extrapolated from the canal plat maps were assigned GPS coordinates. The seven categories consisted of aqueducts, buildings, bridges, culverts, inlets, locks, and waste weirs. These components represent 70 individual features correlating to what was indicated on the canal plat maps through stations 1770-2660 in Scioto County. These
components are represented as red dots.

Figure 2. Aerial View of the Ohio and Erie Canal and its Associated Features within Scioto County

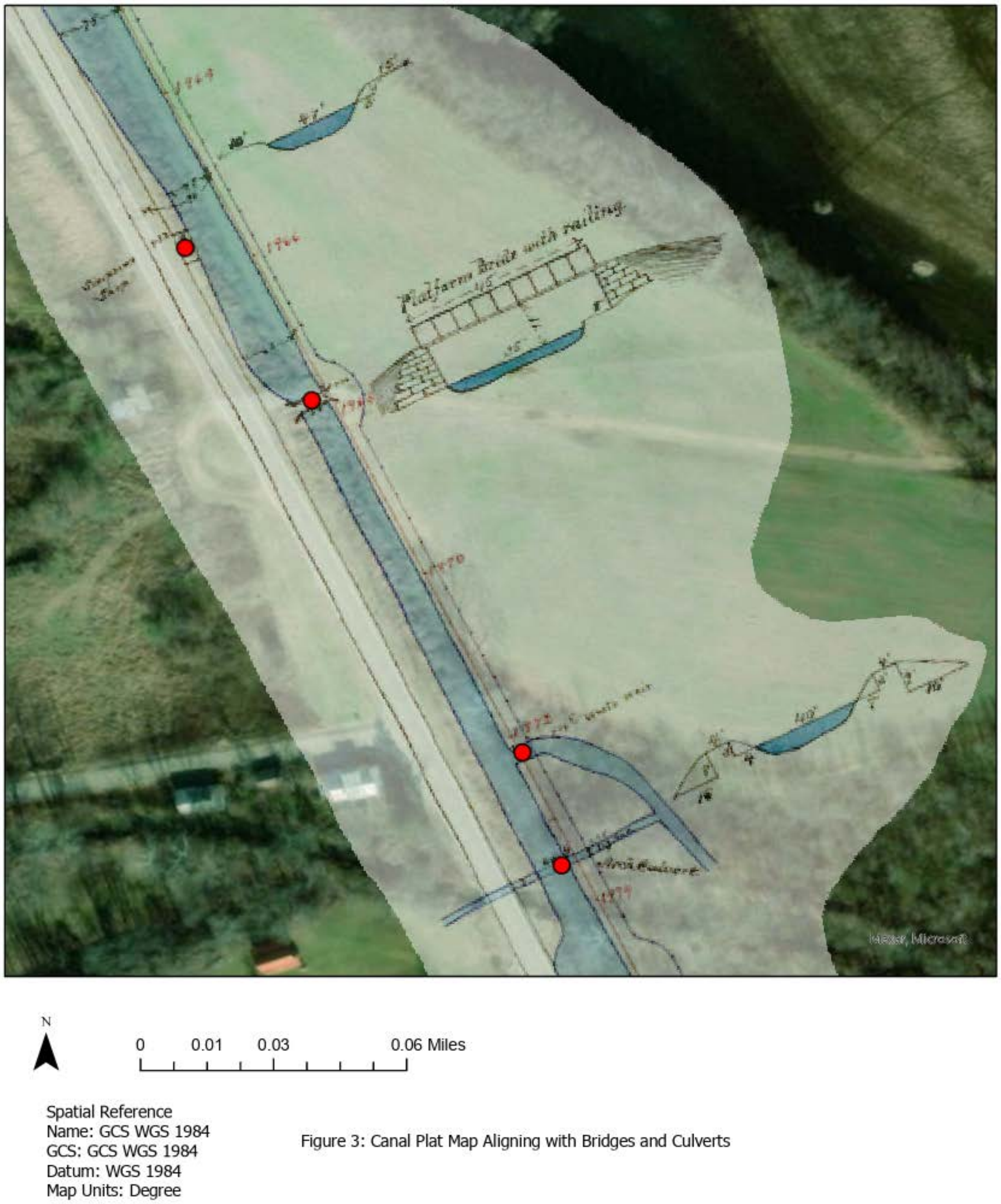


Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

Corn cribs were also indicated on the canal plat maps but were considered loosely related to the canal and were not given coordinates like the other 70 individual canal components. Three of the 70 individual canal components given GPS coordinates were previously recorded resources. All three of these were locks. Two of the of these locks were listed on the NRHP and are explained further below. The other recorded lock, which is one of the "newer" locks built, was listed on the Ohio Historic Inventory. The purpose of ***Figure 2*** is to show the general alignment of the canal and the density of recorded canal components. With everything georeferenced, the three different data sets (canal plat maps, historical aerials, OSIP aerials) can be viewed simultaneously. This new interactable, map allows users to zoom in to view smaller details or zoom out to see the greater landscape or patterns along it. These separate layers allow me to set their transparency, as well as rotate them to match up similarities and details.

The process of assigning GPS coordinates can be seen against canal components indicated on the Ohio & Erie Canal plat map (***Figure 3***). These consist of a building (Simpson's Shop), a bridge (Platform Bridge), and a culvert (Arch Culvert) roughly matching against an intermittent stream. Finally, for the determination of intermittent vs. perennial or ephemeral streams, USGS topographic maps were overlayed atop culverts and aqueduct locations to determine what type of streams correlated to which canal component. The GPS coordinates represent three aqueducts, 16 various buildings, 23 bridges, 13 culverts, two inlets, nine locks, and four waste weirs (***Table 1***). These were all given a survey number to quickly reference the certain component in this table. If a name for a component was indicated on the canal plat map, then it was recorded into the

Figure 3. Canal Plat Map Aligning with Bridges and Culverts



Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

table. The station number in which the component resided between or on was also recorded in the table. General comments were recorded on each resource and whether stream alignments could be extrapolated from certain components like inlets, culverts, and aqueducts.

Table 1. Canal Ancillary Components within Scioto County

Survey Number	Component Type	Name	GPS Coordinates	Comments/Stream	Station
1	Aqueduct	Camp Creek Aqueduct	38.952781 - 83.045537	Total length of 86 feet. An 8-foot stone pillar holding the aqueduct up. Twelve feet to the bottom of the aqueduct from the water transferring under the aqueduct.	1790-1792
2	Aqueduct	Bear Creek Aqueduct	38.921193 - 83.04076	Total of 107.5 feet.	1910-1912
3	Aqueduct	Brush Creek Aqueduct	38.837189 - 83.020997	Total of 100 feet.	2238
4	Building	Simpsons Shop	38.90787 - 83.03307	N/A	1964-1966
5	Building	Blacksmith Shop	38.9032 - 83.030584	4 feet from water	1984-1986
6	Building	Blacksmith Shop	38.89225 - 83.023946	N/A	2028-2030
7	Building	Mill	38.845934 - 83.017989	30 by 30 feet	2024
8	Building	N/A	38.8463 - 83.017623	26 by 22 feet	2201-2204
9	Building	Stable	38.835677 - 83.020584	20 by 22 feet	2242-2244
10	Building	Lumber Shed	38.835271 - 83.020366	62 feet by?	2244-2246
11	Building	Blacksmith Shop	38.835166 - 83.020312	14 by 17 feet	2244-2246
12	Building	Wagon Shop	38.832327 - 83.019661	16 by 60 feet	2256-2259
13	Building	Barn	38.790944 - 83.014174	30 by 47 feet	2419-2421

Survey Number	Component Type	Name	GPS Coordinates	Comments/Stream	Station
14	Building	Stock Sheds	38.752417 - 83.025675	Shed is 100 feet wide. No length given. Addition on northern side 20 by 60 feet.	2568-2572
15	Building	Frame	38.75195 - 83.026675	Davis Distillery. 169 feet by 81 feet.	2572-2576
16	Building	Stone Building	38.751782 - 83.026911	Davis Distillery. 169 feet by 40 feet	2572-2576
17	Building	Frame	38.751577 - 83.026874	Davis Distillery. 60 by 62 feet.	2572-2576
18	Building	Frame Store House for Distillery	38.750534 - 83.027674	Davis Distillery. 62 by 200 feet.	2576-2580
19	Building	Flour Mill	38.748451 - 83.028863	Total width 85 feet. 52 feet long on eastern side. Western side 43 feet. Two extensions, one northerly and another southerly. Northern 18 feet wide. Southern 15 by 20 feet.	2584-2588
20	Bridge	Farm Bridge	38.939109 - 83.043467	No road alignment on aerial.	1840-1842
21	Bridge	Old Bridge Abutments	38.936017 - 83.043584	Just the abutments, and no possible road alignment.	1852
22	Bridge	Farm Bridge	38.934185 - 83.043393	No road alignment on aerial.	1858-1860
23	Bridge	Farm Bridge	38.931925 - 83.043194	Access road aligns with bridge on aerial.	1865-1868
24	Bridge	Platform Bridge with railing	38.907381 - 83.032664	Aligns with farm access road	1966-1968
25	Bridge	Farm Bridge	38.887578 - 83.021506	No road alignment on aerial.	2046-2048
26	Bridge	County Pivot Bridge Iron	38.875198 - 83.015815	Matches with Lucasville Road historically.	2094-2096
27	Bridge	Floating Bridge	38.8639 - 83.014582	N/A	2136

Survey Number	Component Type	Name	GPS Coordinates	Comments/Stream	Station
28	Bridge	Wooden Farm Bridge	38.852395 - 83.01533	Matches with farm access road.	2177-2179
29	Bridge	Wooden Farm Bridge	38.842308 - 83.020415	No road alignment on aerial.	2218-2220
30	Bridge	Wooden Farm Bridge	38.815153 - 83.010605	Access road on historic aerial.	2324-2326
31	Bridge	Wooden Farm Bridge	38.809716 - 83.007736	Access road on historic aerial.	2347-2348
32	Bridge	Wooden Farm Bridge	38.805374 - 83.007715	Matches with bridge on aerial but no road.	2362-2363
33	Bridge	Wooden Farm Bridge	38.800632 - 83.008822	Matches with bridge and road on historic aerial.	2382-2384
34	Bridge	Wooden Farm Bridge	38.787433 - 83.01292	No road alignment on aerial.	2431-2433
35	Bridge	Wooden Farm Bridge	38.784608 - 83.012048	Same as Station 2431 + 33. Matches with bridge and road on historic aerial.	2443
36	Bridge	Wooden Farm Bridge	38.780721 - 83.011208	Same as Station 2431 + 33. Matches with bridge and road on historic aerial.	2457-2459
37	Bridge	Wooden Farm Bridge	38.775007 - 83.013706	Matches with bridge and road on historic aerial.	2479-2482
38	Bridge	Farm Bridge	38.768648 - 83.01619	Same kind as the one at Station 2479 + 82. Matches with bridge and road on historic aerial.	2504-2506
39	Bridge	Farm Bridge	38.765172 - 83.017275	Same kind as the one at Station 2479 + 82. Matches with bridge and road on historic aerial.	2516-2517
40	Bridge	Farm Bridge	38.756999 - 83.022861	Same kind as the one at Station 2479 + 82. Matches with bridge and road on historic aerial.	2550-2552
41	Bridge	Foot Bridge	38.751704 - 83.026569	By the buildings associated with Davis Distillery.	2572-2576

Survey Number	**Component Type**	**Name**	**GPS Coordinates**	**Comments/Stream**	**Station**
42	Bridge	Iron County Bridge	38.748996 -83.028436	Aligns with modern bridge.	2584
43	Culvert	Stone Arch Culvert	38.948451 -83.045824	Unnamed (Intermittent)	1807-1809
44	Culvert	Stone Arch Culvert	38.928691 -83.042622	None indicated	1878-1879
45	Culvert	Arch Culvert	38.905891 -83.031863	Big Run (Intermittent)	1972-1974
46	Culvert	Wooden Culvert	38.895391 -83.025781	Slate Run (Intermittent)	2016-2018
47	Culvert	Tile Culvert	38.885126 -83.02031	Unnamed (Ephemeral)	2056
48	Culvert	N/A	38.88267 -83.01911	Devers Run (Intermittent)	2066
49	Culvert	Stone Culvert	38.874877 -83.01574	Unnamed (Ephemeral)	2096
50	Culvert	Stone Arch Culvert	38.865763 -83.014481	Crow Hollow (Intermittent)	2128-2130
51	Culvert	Stone Arch Culvert	38.854999 -83.015177	Little Buck Knob (Intermittent)	2167-2169
52	Culvert	Stone Arch Culvert	38.82 -83.013501	Sheep Pen Run (Perennial)	2306
53	Culvert	Stone Arch Culvert	38.79279 -83.0131	Pond Creek (Perennial)	2411-2413
54	Culvert	Stone Arch Culvert	38.77409 -83.014163	Dry Run (Perennial)	2483-2485
55	Culvert	Stone Arch Culvert	38.759748 -83.021656	Unnamed (Intermittent)	2540-2541
56	Inlet	Run	38.942185 -83.04342	N/A	1830-1832
57	Inlet	N/A	38.911065 -83.034789	N/A	1952-1954
58	Lock	Lock 48	38.846076 -83.017356	On Aerials.	N/A
59	Lock	Lock 49	38.829678 -83.019164	On Aerials.	N/A
60	Lock	Lock 50	38.749911 -83.027873	On Aerials.	N/A
61	Lock	Lock 51	38.748911 -83.028341	Possibly southern portion on aerial.	N/A

Survey Number	Component Type	Name	GPS Coordinates	Comments/Stream	Station
62	Lock	Lock 52	38.747524 -83.028338	Not on aerials	N/A
63	Lock	Lock 53	38.736039 -83.020385	Not on aerials	N/A
64	Lock	Lock 54	38.733598 -83.013536	Not on aerials	N/A
65	Lock	New Lock to Ohio River	38.736148 -83.021762	Not on aerials	N/A
66	Lock	New Lock to Ohio River (2)	38.726004 -83.03129	On Aerials.	N/A
67	Weir	Waste Weir	38.906252 -83.031989	N/A	1972-1974
68	Weir	High Water Waste Weir	38.904958 -83.031293	N/A	1976-1978
69	Weir	Waste Way	38.817218 -83.011717	N/A	2316-2318
70	Weir	Waste Weir	38.794915 -83.012955	N/A	2405-2407

Areas of high archaeological potential were determined by the proximity of canal components and an area of high archaeological potential is shown in ***Figure 4.*** The manner in which archaeological potential is derived is discussed further in Chapter 6.

Lastly, the canal components need to be compared to what currently exists on the NRHP. Only two portions of the Ohio & Erie Canal are recorded in Scioto County as separate discontinuous districts: Lock 48 encompassing 17,600 square feet and Lock 50 encompassing 13,200 square feet. As previously mentioned however, there are seven other locks represented in the NRHP in separate counties as well as one inlet, a lockhouse, aqueduct abutment, and a 2.36-mile watered prism (United States Department of the Interior 2018).

Figure 4. Area of High Archaeological Potential

Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

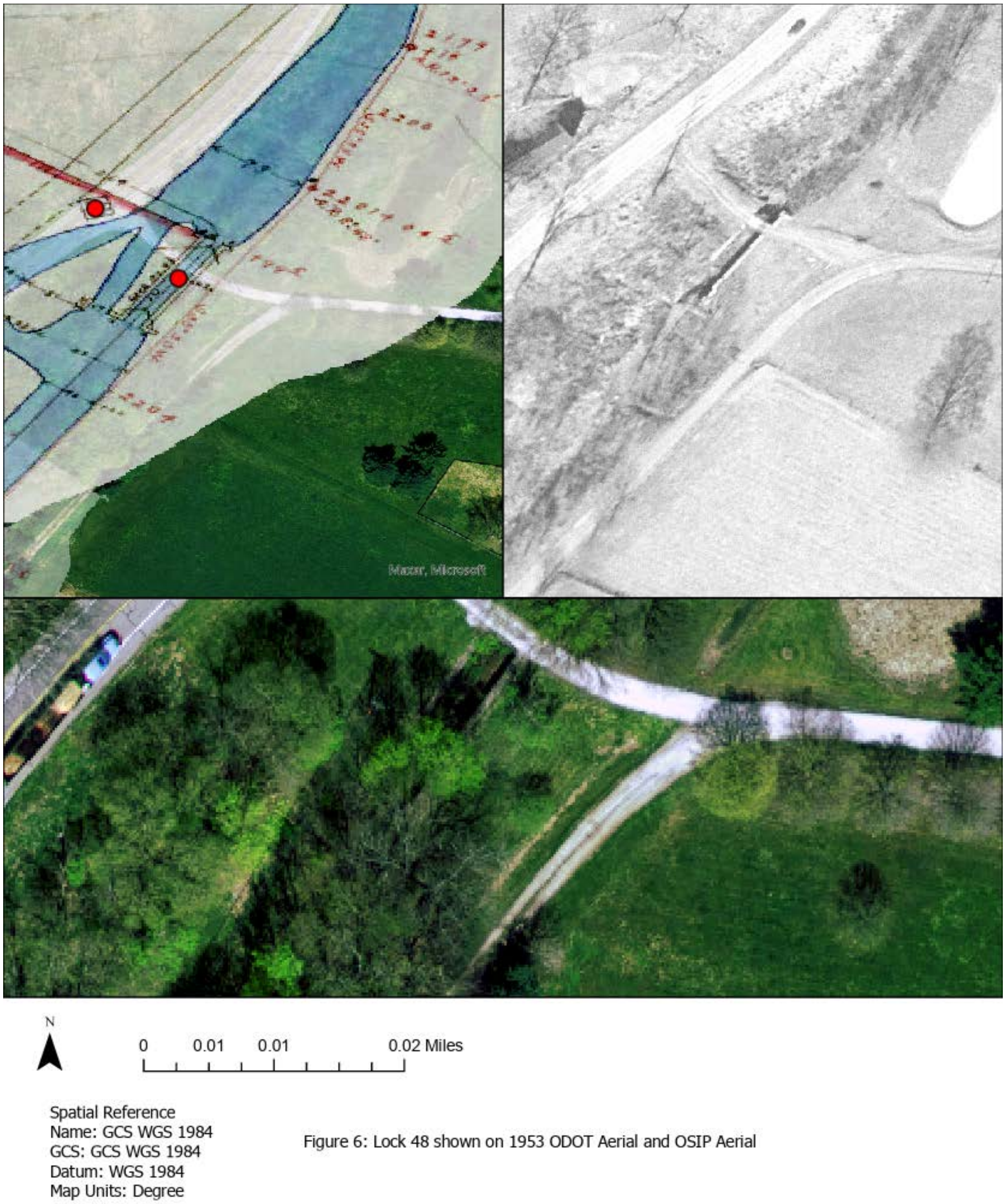
The two locks represented on the NRHP in Scioto County are the two barely visible red districts indicated by black arrows shown in ***Figure 5.*** This representation is meant to convey how little is on the NRHP in Scioto County rather than showing the resources. Out of the 70 resources identified, this means only two are on the NRHP. None of these resources are recorded as archaeological sites, although an archaeological site exists beside Lock 48. Two more components are listed on the Ohio Historic Inventory (OHI). This means only four resources out of the 70 are "recorded". Lastly within this section Lock 48 is shown on historical aerial photographs as well as shown on an OSIP aerial image and recorded as a component of the canal (***Figure 6***).

Figure 5. Two Portions of the Discontinuous NRHP District within Scioto County

Figure 5: Two Portions of the Discontinuous NRHP District within Scioto County

Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

Figure 6. Lock 48 shown on 1953 ODOT Aerial and OSIP Aerial



Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

Chapter 6: Using Historical Geographic Information Systems (hGIS) to Remap and Analyze the Ohio & Erie Canal

With the historic canal plat maps, historic aerials, and modern aerials georeferenced, this dataset allows for users to analyze past configurations of space to and examine what components still exist along the canal. The main data which this thesis relies on are the historic canal plat maps that show how the Ohio & Erie Canal existed in the early 1900s. The Ohio & Erie Canal plat maps are difficult to view when zoomed out and little can be gleamed from this perspective as previously shown in ***Figure 2***. Using georeferencing, a total of 70 components of the canal could be attached to GPS points as they would have existed when the canal plat maps portrayed them. This data collected and the interactive map will be used to answer several questions proposed by this thesis. One of these is whether hGIS can be used to perform a landscape analysis of select portions of the southern descent to identify and record locations of ancillary components of the Ohio & Erie Canal and areas of archaeological potential. Can hGIS be used to demonstrate components that are on the contemporary spatial landscape? What can the data and historical documents answer about ancillary components of the Ohio & Erie Canal along the landscape? Should these ancillary components be further recommended to the NRHP as contributing resources?

While hGIS cannot guarantee finding a component as it exists on the modern landscape without field examination of the site, it can certainly help. Many of the canal components are too small to be viewed from an aerial view, however this does not mean they do not exist, nor does it mean that the georeferenced canal maps do not match up with the components. I hypothesize that the data obtained by this survey indicates that there is a high probability that the georeferenced canal plat maps match with previously existing canal components and that there is a high potential that intact canal components intersect at the locations provided by the georeferenced canal plat maps.

Culverts, Remapped and Reimagined

There are several lines of evidence (culverts, locks, and the canal prism) that indicate the high probability and high possibility of intact components intersecting with the georeferenced canal plat maps. The primary evidence is extrapolated from culverts, which cannot be viewed directly on the spatial contemporary landscape. These components of the canal are likely subsurface features that survive as archaeological architectural features due to being located underneath the canal prism and located several feet below the ground surface. This allows them to easily be overlooked and more threatened due to development than other components along the canal. As this type of resource is “cloistered” or communicating little to the public, what is currently known about the culverts along the canal must be expanded. The *Ohio and Erie Canal Southern Descent Historic District* NRHP form currently indicates that a culvert “would typically be made of wood or stone designed to carry a creek or stream underneath the canal prism” (United States Department of the Interior 2018:7-9). The explanation on the NRHP form for culverts clarifies their purpose along the canal and suggests that culverts should be located near creeks or streams. There were fourteen culverts identified on the canal plat maps during the early twentieth century, which is 18.5% of the overall components identified recorded (***Table 1***). Twelve of the thirteen culverts (92.3%) matched with existing hydrological features such as streams and creeks. This data by itself suggests a high probability that the georeferenced canal plat maps match with culvert locations. Although, matching culverts with streams does not expand on what is currently known about culverts, nor does the simple fact of correlating streams to culverts suggest that they currently exist in that location. Therefore, it is important to expand what is currently known about culverts to suggest they could still be located on the contemporary spatial landscape. The combination of historical documents and GIS can help understand culverts more and suggest if they can still be located on the landscape regardless of if they cannot be directly viewed on the landscape. As previously mentioned, culverts are often overlooked; however, this does not justify the effort to locate them through hGIS alone. Therefore, the significance of culverts along the canal must be established. Otherwise, what separates these culverts from those of today? Are there different varieties? What is their function or how were they built?

The data indicates that out of the entirety of culverts identified 53.8% matched with intermittent streams, 23% matched with perennial streams, 15.4% were ephemeral streams, and 7.7% could not be assigned a designation. The designation of a type of stream is explained by Rowland's in *the Features Shown on Topographic Maps* (1955). Hydrological features such as streams are indicated as perennial if they are single or double lined. Intermittent streams are dashed-dot lines. Ephemeral streams are not indicated but can be assigned along a stream if it is not indicated as intermittent or perennial.

Out of the thirteen culverts, there are ten culverts (76.9% of the total amount of culverts) which were made of stone. Further, nine of those culverts were listed as being stone arch culverts (69.2% of all culverts were stone arch culverts by design). Five out of the nine stone arch culverts (55.5%) matched overtop of intermittent streams and three out of nine (33.3%) matched with perennial streams on the landscape as indicated by USGS topographic maps. The one stone arch culvert between stations 1878-1879 did not match up with a stream on USGS topographic maps. One culvert did not indicate a certain type of construction material or design. The remaining culverts identified were a tile culvert and a wooden culvert which means 15.3% of the culverts built within Scioto County were built of a different material other than stone. It is likely that the tile culvert is a later addition or perhaps a re-culverted stream, as this would not make sense during the construction period of the canal. This data suggests that most culverted streams along the canal in Scioto County were of stone arch design and matched with either intermittent streams or perennial streams. The data does not seem to indicate anything new regarding wooden and tile culverts, as there was simply not enough of these components to define them further. How does this data then indicate the high possibility of intact components intersecting with the georeferenced canal plat maps? To explain this correlation, we must draw from historical documents regarding the canal.

Understanding how some culverts were constructed can be extrapolated directly from the agreement between the canal commissioners of Ohio and the contractor proposed in doing the work along the canal. This was the general agreement contractors had to sign before they were permitted to conduct the work (Kilbourn 1828). The building process of culverts in the contract are explained as,

> And the said part – of the first part further covenant and agree to erect and build in a good, substantial and workmanlike manner, a culvert or culverts in such place or places and of such form, dimensions and plan, as the commissioners or either of them, the resident engineer or any other engineer in the employ of said commissioner, may direct, which shall in all cases be built of good substantial stone, laid in water cement and made true and smooth, on the outer as well as in the inner side. And the said part – of the first part further agree to construct a mole or pier of such breadth and height as said commissioners or the engineer having superintendence of the work under them may direct, along the wash or slate banks

> on said section. Said mole shall be formed of good solid, durable timber, of which that forming the sides of the mole shall be well hewed, and shall be at least twelve inches square and at least 25 feet in length; the sides shall be laid perpendicularly and securely connected together with ties not less than 10 inches in diameter, clear of bark, which shall be let into the side timbers with a dovetail and square shoulder at each end well fitted to said timber so as to prevent their moving and sliding upon each other. Each tie shall be let into the timbers, in which it rests, half the thickness of the dove tail at the end, and the other half shall be let into the side timber next above, so that the side timbers will meet and form a tight joint, and the ends of the ties shall be cut off smooth and even with the outside of the mole. The cribs so formed shall be filled with slate, soap stone, or other stone or gravel, and a bank shall be formed on the inner side, next the canal, of the usual slope, of good solid earth as in other cases. The moles so formed shall at each end be securely united with the bank of the canal. All of which shall be done agreeably to the directions of the engineer having charge of the work (Kilbourn 1828:115).

In summary, culverts were supposed to be created with dry laid stone and attached with concrete, then further smoothed. Further, to separate the canal prism and the culvert, a mole had to be constructed which would prevent water from freely flowing beneath it. This would effectively separate the water in the canal prism, and the water culverted underneath it. The mole would be an exceptionally large structure, with large hewn timbers approximately 12 inches square and 25 feet long. These timbers would be connected with 10-inch dovetails joints, used commonly in timber framing, and stacked creating a crib. The crib would then be filled with a variety type of stone and an earthen bank formed to connect to the canal. This suggests that culverts along the Ohio & Erie Canal were a complex engineering process and extra detail had to be undertaken to ensure that the water between the canal and the stream did not connect. Architectural moles are not mentioned in any of the NRHP listings consulted for this thesis. This large infrastructure piece between the canal and culvert seems to detail a more methodical engineering process that is currently mentioned regarding culverts. One extra construction process should be mentioned in general about the canal to understand the general location of culverts. The agreement also details the general dimensions of the canal prism which would be "in all places be least forty feet wide in the canal at the surface, twenty-six feet wide at the bottom, and four feet deep" (Kilbourn 1828:213).

Therefore, it is reasonable to say that if culverts existed underneath the canal prism which was approximately four feet deep, then culverts if they exist on the contemporary landscape must be located several feet deep underneath the canal prism. There is no doubt that a substantial degree of disturbance has occurred within Scioto County along the Ohio & Erie Canal overtime. There especially has been a substantial degree of disturbance with State Route 104 running adjacent to most of the historical location of the Ohio & Erie Canal. However, road construction typically does not go four feet deep, and as shown by the interactable map created by this project, most of the original alignment of the Ohio & Erie Canal is depicted on the modern landscape as a large ditch beside the road. This is largely due to the buildup of sediment over the hundred years the canal has not been in use. Since so much silt has been deposited overtime there that could mean that multiple culverts remain intact, or at the very least the remnants of culverts still exist. So, the depth, silt deposition, and construction methods leave an exceedingly high likelihood of possibly encountering intact culverts. However, due to these resources being located beneath the ground surface these architectural archaeological resources are more so in danger. That is evident with little evidence of culverts being inventoried. The canal through Scioto County is also located so closely to State Route 104, and culverts in this portion of the canal are more likely to experience disturbance as such. Culverts as revealed are more than meets the eye in terms of their function and design along the canal. However, more is revealed regarding culverts and their significance through the lack of other ancillary components identified in Scioto County further in this analysis.

<u>*Locks are Already Locked Down*</u>

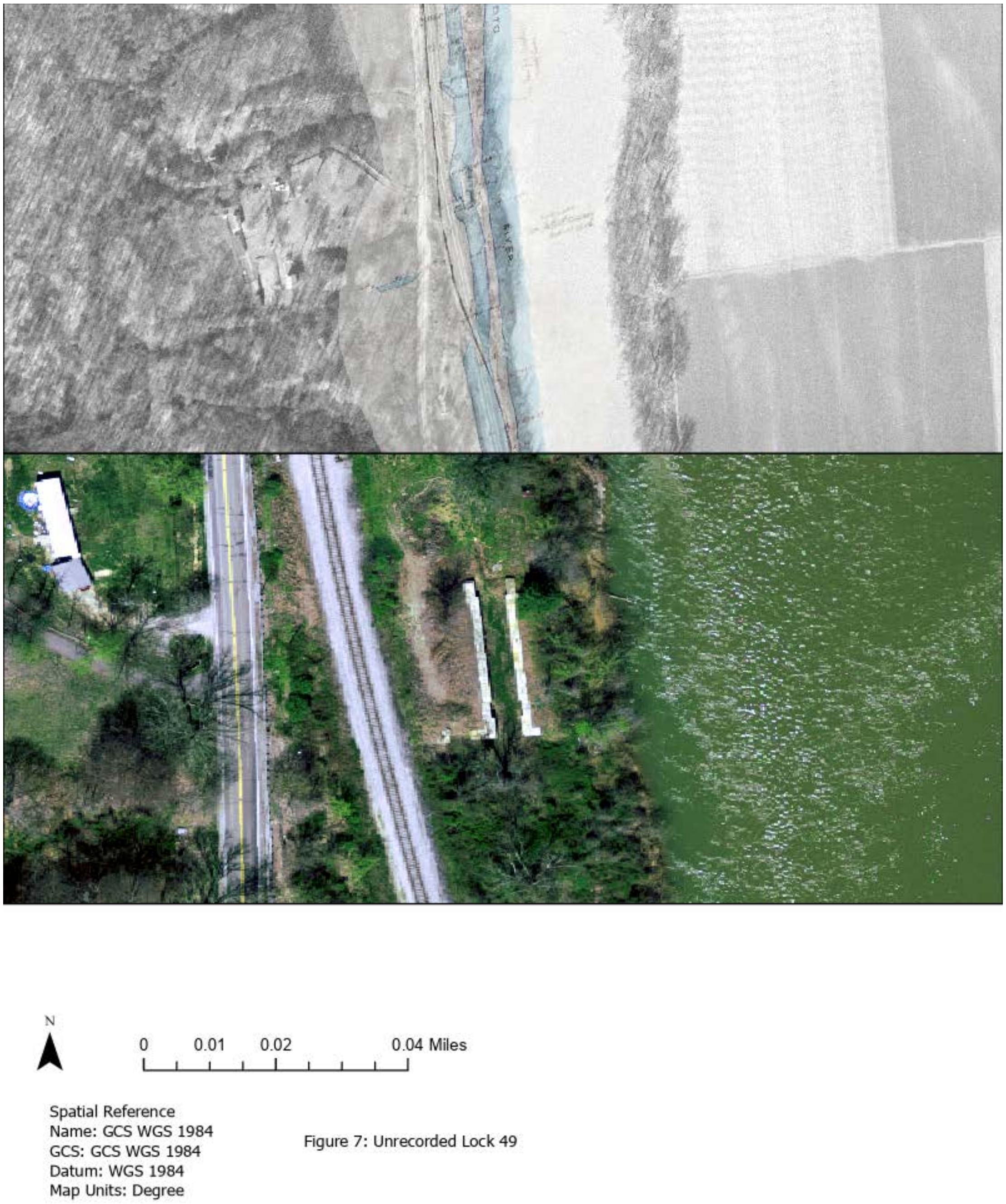
There are two locks that currently exist on the NRHP (***Figure 5***). These are Lock 48 and Lock 50, shown as two little red districts within Scioto County. The canal plat maps georeferenced well with these two documented resources. An example of Lock 48 georeferenced can be seen on ***Figure 6*** in the data chapter. Remapping the Ohio & Erie Canal plat maps at these two historic resources is another line of evidence suggesting that there is a high probability that the georeferenced canal plat maps match with previously existing canal components and that there is a high possibility that intact canal components intersect at the locations provided by the georeferenced canal plat maps. The georeferenced canal plat maps also mapped with the New Lock built to connect to the Ohio River, not listed on the NRHP but on the Ohio State Historic Preservation Office online mapping system as being on the Ohio Historic Inventory (OHI). However, it needs to be proven that hGIS can identify unrecorded canal components on the contemporary spatial landscape. This can be proven by the identification of one new lock, which is not listed on the NRHP nor on the Ohio State Historic Preservation Office online mapping system. This lock is Lock 49 and it is hard to understand why it is not currently recorded (***Figure 7***). It can be easily viewed on the contemporary landscape and likely from State Route 104.

While it is not on the NRHP or the SHPO online mapping system likely locals and gongoozlers (canal enthusiasts) know the location well. Lock 49 also comparably is in much better condition than Lock 48. Lock 48 has a road going through its northern end and its walls look in disrepair (***Figure 6***). Oddly enough within the 1953 photograph of the area is a structure on top of Lock 49.

Still locks are widely represented on current NRHP nominations along the Ohio & Erie Canal and their functioning is well documented. Lock 49 is shown simply to represent how hGIS can identify unrecorded canal components on the contemporary spatial landscape.

This suggests that while hGIS may have trouble directly identifying smaller components of the Ohio & Erie Canal on the contemporary landscape, it can clearly identify larger structures that have left an impact on the landscape. It can also remap previously recorded components of the canal to gain knowledge about the greater contextual area around them.

Figure 7. Unrecorded Lock 49



Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

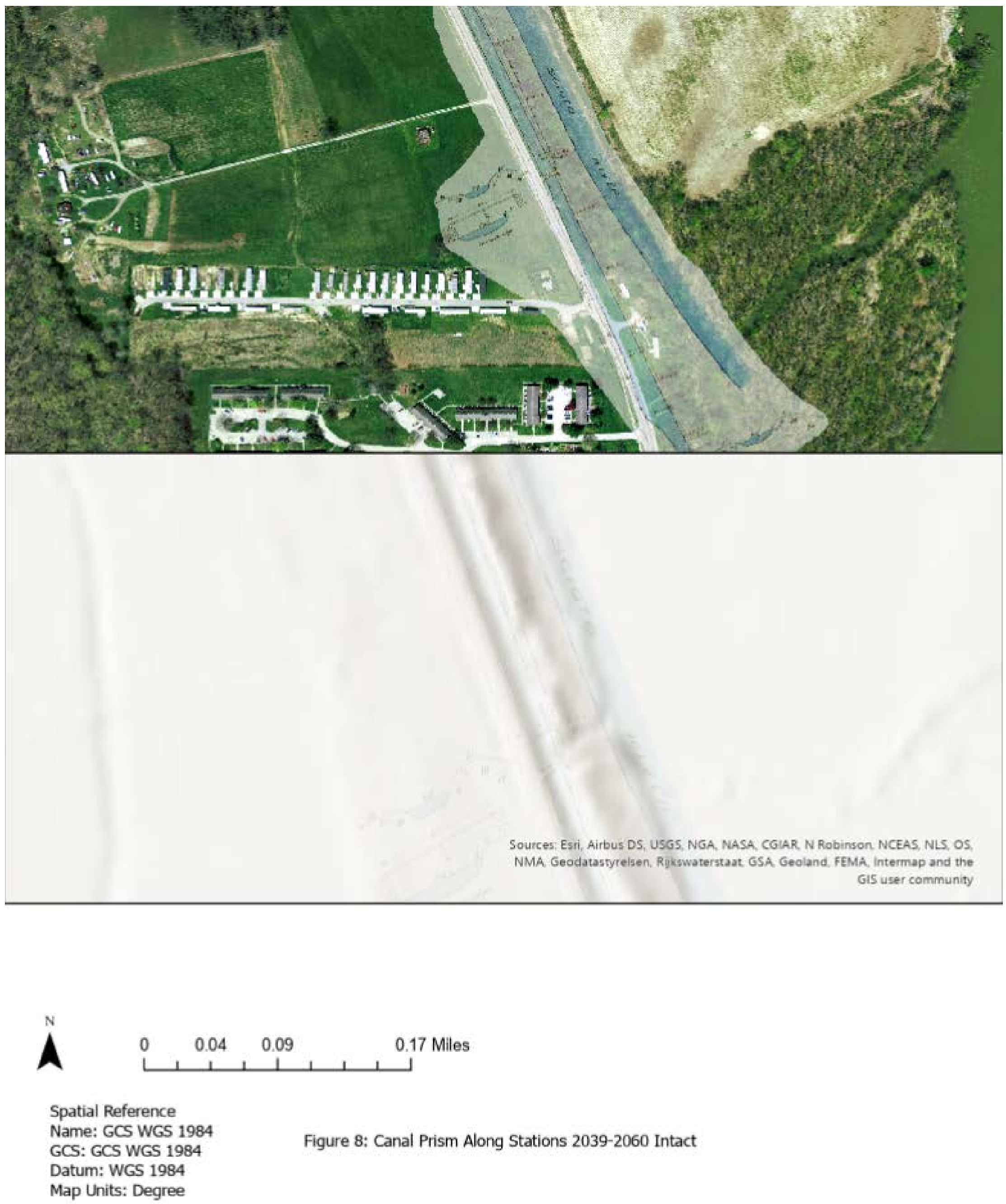
The Distorted Prism

Modern aerials also represent many portions of the canal prism in Scioto County. At first glance this linear feature seems to just be a large ditch, but the canal plat maps alignment, as well the World Hillshade layer in ArcGIS shows the impact the canal prism left on the landscape. Stations 2039-2060 of the canal prism are comparatively intact (***Figure 8***). The modern OSIP aerial shows how the canal prism largely looks like a ditch adjacent State Route 104. The hillshade layer shows the berms of the canal prism with the plat map georeferenced opaquely overtop. Likewise, stations 1978-2000+93 match up with the canal prism on the hillshade layer. The agreement between contractors and the canal commission stated that the canal prism had to be at the very least 40 feet wide at the top, 26 feet at the bottom, and four feet deep (Kilbourn 1828). Further the earthen berm had to also be “at least two feet, perpendicular measurement, above the topwater line; and such a slope shall be preserved on the inner side of the banks, both above and below the top water line, that every foot perpendicular rise in said bank shall give a horizontal base of one foot nine inches” (Kilbourn 1828:213).

Measuring the distance from the road to the canal berm gives roughly the distance in which the canal should have been. Between station 1992 and 1994 it gave the width of the canal as 50 feet, and the measuring tool in ArcGIS roughly indicates the same on the Hillshade layer.

The berms seem to be intact on the eastern side, however, the western side is questionable with State Route 104 likely extending into the canal. The towpath on the western side of the canal is largely gone being located mostly in the road. This helps argue the hGIS can not only identify previously existing canal components along the canal, but also what still exists on the contemporary landscape today.

Figure 8. Canal Prism Along Stations 2039-2060 Intact



Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

Figure 9. Canal Prism Along Stations 1978-2000+93

Figure 9: Canal Prism Along Stations 1978-2000+93 Intact

Plat maps provided courtesy of the Ohio History Connection, Columbus, Ohio. Plat maps modified by Mason Waugh.

Additional Ancillary Canal Components and Archaeological Potential

There were very few inlets and waste weirs I recorded along the canal in Scioto County with the hGIS analysis, which seems to reveal more on the importance on culverts. Only two inlets could be identified and four waste weirs. This was not expected, as it was originally thought that several inlets would be needed to keep the water level constant. However, the eariest prelimnary survey of the feasibility of the canal helps explain at least the lack of inlets. James Shriver created the reconnaissance of the landscape before the creation of the Ohio & Erie Canal. He surveyed and created a topographical description of the general area in which the Ohio & Erie Canal was proposed (Shriver 1824). When he reached Piketon and the area all the way down to Portsmouth in Scioto County, he mentioned that "the streams from the hills are numerous, and if each would afford but a little water, a sufficiency might be calculated upon; but it is said that many of them dry up altogether every autumn. To take a feeder from the Scioto River may be found feasible" (Shriver 1824:95). This seems to suggest that the hydrological features in Scioto County could not be relied upon. As was indicated by the stream designation for culverts, a majority of the streams were either intermittent or ephmeral, suggesting that there would be seasons where no water would be flowing through these streams at all. Thus, they could not be relied upon to keep a constant flow of water. There were also several perenial streams which could have a constant water source. Three culverts were given a perenial stream designation, but also three aqueducts were considered perenial water sources. These streams were not used because of the unreliabilty of them during the rainy seasons. While they may have proved a constant water source they would have also caused flooding, which was already a sincere concern along the canal. Thus, the water in Scioto County had to be diverted instead of added to keep the canal functioning. This would explain the lack of inlets, however not the lack of waste weirs. It was originally thought that to reduce flooding multiple high water waste weirs would located likely every several mile or certain length along the canal. This was not the case. Two waste weirs, 67 and 68, were located approximately 520 feet away from each other, while waste weir 69 was approximately 0.75 miles away along the canal. Nor were the waste weirs placed in any location repeatedly after a inlet or lock. Thus, there was no clear pattern. However, what this seems to speak to is how the topgoraphy and hydrology of Scioto County necessitated the need for culverts, whereas inlets and weirs were not as important to the region of Ohio often associated with Applachia, a historic culture area. This also seems to enhance the importance of the canal localy within Scioto County. I believe this also shows a clear importance of the engineering needs of the canal being dependent upon the setting of the area and landscape,

This leaves buildings and bridges along the canal. As another line of evidence of the effectiviness of georeferencing and the use of hGIS, the bridges identified largely matched with historic roads. Of the 23 bridges identified, 16 (69.5%) of them matched up with roads on historical aerials from ODOT. Furthermore these bridges were largely wooden farm bridges, speaking to the agricultural character of Scioto County in the early 1900s. From an aerial view it is difficult to positively ascertain if any of these bridges still exist today. It is also considered unlikely as many of these bridges were likely replaced or deteroriated over time being largely made of wood. What the hGIS and the canal plat maps can do though is pinpoint the location of historical photos along the Ohio & Erie Canal. A photo from the early the early 1900s obtained from the University of Akron, University Libraries, Archival Services (2022) gives a bit of information to pinpoint the likely location of a historical photo (***Illustration 3***). The information provided with the image gives the vague description that a bridge is located roughly nine miles north of Portsmouth. With this vague information and the location of bridges indicated on the plat maps and their design sometimes included it is possibile to make an assumption on what bridge was in the photo.

Illustration 3. Bridge, Nine Miles North of Portsmouth

Image provided courtesy of the University of Akron, University Libraries, Archival Services. Louis Baus Canal Photograph Collection. Image in the public domain.

Given the design of the bridge it is likely that the photo correlates to survey number 29 in ***Table 1***, a wooden farm bridge between stations 2218-2220. The canal plat maps indicate a bridge of the exact design as the one indicated in the photo in this location and this would be a little shorter than nine miles north of Portsmouth. Knowing the placement of these bridges could help understand farmstead makeup around the canal in the future.

No buildings that existed along the canal could be identified on the contemporary spatial landscape but they can point to archaeological potential. The *Ohio and Erie Canal Southern Descent Historic District (Discontiguous)* is listed on the NRHP under Criterion A and C, excluding the criterion primarily concerned with archaeological sites. Archaeological potential along the canal is mentioned though. Archaeological potential along the canal as listed in the NRHP form are areas that would have been loci for human activity (United States Department of the Interior 2018:7-8). These are areas such as towpaths, the prisms, the site of locks, millsites, and dockage or basin areas where goods would be unloaded. Areas between locks, in which boats would have a long dwell time would also have an increased chance of archaeological potential. These are excellent interpretations of where archaeological potential could be. Furthering, this hGIS, coupled with georeferencing the canal components can point to more specific locations. Building locations, especially those that are closely clustered together would then have a higher chance of archaeological potential. One of these areas in Scioto County would then be in the previously shown ***Figure 4***. Several buildings related to the distillery complex, which would have shipped on the Ohio & Erie Canal, are mapped in close proximity to Lock 50. A closer look at the Davis Distillery dated to be sometime in the early 1900s is shown in ***Illustration 4.*** and ***Illustration 5***.

Illustration 4. Scioto Distillery, 2 ½ Miles from Portsmouth

Image provided courtesy of the University of Akron, University Libraries, Archival Services. Louis Baus Canal Photograph Collection. Image in the public domain.

Boats near Lock 50 would have a significant dwell time, but also the buildings, while no longer extant have possibily remained sufficiently intact to contain archaeological resources that could yield information about the distillery, or about people along the canal and its relationship to adjacent industries. Some degree of disturbance has likely occurred in these locations, but while that might lessen the probability of encountering cultural resources it does not lessen the archaeological potential.

Illustration 5. Davis Distillery, North of Portsmouth

Image provided courtesy of the University of Akron, University Libraries, Archival Services. Louis Baus Canal Photograph Collection. Image in the public domain.

NRHP Eligibility

Finally, with the latest information about some of the ancillary components along the canal and locations identified should they be further recommended to the NRHP as contributing resources? Before components of the canal can be considered on the NRHP they must meet the eligible criterion from the National Register Bulletin (1997) which are mentioned at the end of Chapter 2.

Consideration of the integrity of canal components is also integral for cultural resources being recommended to the NRHP, which if listed on the NRHP should maintain several aspects of integrity. The seven aspects of integrity also listed in Chapter 2 were used to recommend more resources to the southern descent of the Ohio & Erie Canal discontinuous NRHP listing (Little et al. 2000).

As it currently stands the *Ohio and Erie Canal Southern Descent Historic District (Discontiguous)* as aforementioned is currently eligible for Criterion A and Criterion C. The canal itself can be connected to Criterion A as being associated with events that have made significant contributions to the broad patterns of our history such as Ohio's "canal era", however, for this district it is especially important to focus on Criterion C. Specifically, the NRHP form calls out the district as significant because of the "area of engineering because it encompasses well-preserved examples of structures critical to canal operation – locks, an aqueduct abutment, a guard lock, a feeder, and a watered prism" (United States Department of the Interior 2018:26). While one could certainly make the argument for the newly identified Lock 49, or perhaps the newer lock built on the Scioto River, this would be perpetuating the fact that lift locks are disproportionately overrepresented compared to other canal components. This is also not to say that these resources should not be considered on the NRHP listing, because they likely should be, but the argument for locks significance has already been made a multitude of times. There is also suggestive evidence for several portions of the canal prism still intact in Scioto County. Much of the canal prism in Scioto County is in a rural context as to suggest that it has integrity of setting and feeling. Wooded vegetation has grown around much of the watered prism in Scioto County, conflating much of the canal prism as a ditch, whereas the canal prism would have been grubbed so obstructions would not fall in the water. There also exists one section of the canal watered prism already on the NRHP listing. Watered prisms along the Ohio & Erie Canal are also relatively well represented so not as much emphasis should be taken in making the argument for these being added to the NRHP listing.

One ancillary component, culverts, displays a considerable amount of evidence for recommendation to the NRHP listing as contributing resources, especially because it covers the southern descent of the Ohio & Erie Canal. The Ohio & Erie Canal had several key aspects to its function. One of those can be identified as maintaining the control of water flow. Too little and boats could not properly travel, too much and water would spill over earthen berms and cause further damage to other canal components. As mentioned by the earliest survey for the canal, the hills surrounding the Scioto River from Piketon to the canal terminus near Portsmouth contained numerous streams. They could not be relied on to afford water, because they would either dry up, or would flood during the rainiy seasons. Converting these streams as inlets would have detrimentally affected the canal, causing too little or too much water to be present within the canal. So, to deal with this unique challenge orginating from the topography of the Appalachian hills many of the streams were culverted. Nor were these culverts a simple undertaking as special detail had to be taken in their construction. A unique feature to many of these culverts were the moles which had to be constructed between the canal prism and the culvert. These in themselves were massive structures with a certain process in which they had to be built. Without the contruction of the mole between the canal and culvert water would have been able to free flow between the stream and the structure. Culverts were also especially important, particularly in this section of the canal because they diverted water away from the canal. Likely there is a lack of other ancillary components in Scioto County because the large need for culverts in the Appalachian region. This portion of the canal, I believe can be associated with the Appalachian culture group. Within Appalachia, the landscape often has a profound impact on how life is shaped, built with and around the landscape and topography of the region. The canal through this portion of Ohio is an early account, of what I would call Appalachian influence through the landscape. The NRHP form calls out the current district as significant because of its engineering and structures critical to canal operation, thus, if there should be any addition to the NRHP listing it should be culverts as they were critical infrastructure in canal operation and the mole building process was an engineering feat for the period, especially within Scioto County. Thus, culverts played a vital role on the canal and are essential to understanding how the Ohio & Erie Canal operated. Culverts are a structure that was used to adapt to certain topographical challenges. Removing culverts along the canal would not have allowed the canal to function due to the necessity of proper water levels. The significance of culverts within Scioto County also possibly points a new criterion not currently listed on the current NRHP listing; that being Criterion D. Culverts could not be directly viewed on the contemporary spatial landscape, but this is not because they likely do not exist intact and are instead subsurface architectural archaeological features. Culverts could be located approximately four feet underneath the canal prism and due to this fact and silt deposition over time, they likely exist subsurface. This would explain the lack of any canal culverts being currently recorded and why none were documented on the NRHP listing. The Ohio & Erie Canal ancillary components are not gone from the landscape, just cloistered. As an outcome of this thesis, current NRHP listings on the Ohio & Erie Canal should be amended or perhaps a new nomination should be created to include culverts so that their importance can be conveyed to the public.

Chapter 7: Conclusion

This thesis has taken historical maps from the early nineteenth century along the Ohio & Erie Canal and used historical Geographic Information Systems (hGIS) to simultaneously answer several questions regarding the landscape, components of the canal, and the feasibility of recommending more to the NRHP listing within Scioto County. For certain, these methods and data have a high probability and high potential of revealing intact canal components on the contemporary spatial landscape. Historical Geographic Information Systems as a mechanism of recording what formally existed on the canal is unparalleled and gives those who utilize the created map by this project the knowledge of what could be in the general vicinity of the canal. Larger structures along the canal that still exist can be identified with ease and can be used as a prospection method, which can be used to plan further field verification. Historical Geographic Information Systems usefulness as a prospection method is evident by the identification of previously unrecorded Lock 49 and the canal prism still existing in several areas within Scioto County. While hGIS has limitations when identifying smaller ancillary components along the canal it is effective at allowing analysis regarding large areas and resources such as canals. It can certainly be used to answer why ancillary components along the Ohio & Erie Canal are located where they are. The *Ohio and Erie Canal Southern Descent Historic District (Discontiguous)* listed on the National Register of Historic Places is a great resource identifying several important canal components. However, being eligible for Criterion C, it is significant because of the engineering and structures critical to canal operation. As revealed by this thesis, culverts in Scioto County were essential to the operation of the canal and were an engineering feat separating the water of the canal and the water of streams. Culverts along the canal are necessary for understanding how the Ohio & Erie Canal operated. As shown culverts in Scioto County helped the Ohio & Erie Canal adapt to the many hills and the streams originating from them in the region. Culverts in this region of Ohio and likely many others were essential to the functioning of the canal. Removing culverts along the canal would not have allowed the canal to function due to the necessity of proper water levels. Therefore, culverts when identified should be considered and recommended as contributing elements to this discontiguous historic district. There also is the possibility that these resources should be considered under Criterion D for being subsurface architectural archaeological features.

The nature of these questions proposed by this thesis draws on empirical evidence regarding where components could be, and if they still exist but are also backed by narratives when the canal was built nearly 200 years ago. In a word, this thesis was an experiment to discover what has been forgotten and cloistered about the ancillary components of the Ohio & Erie Canal. Landscape archaeology theoretically helped this thesis in being able to ask questions regarding the broader connections to the natural and built environment. Some of the questions landscape archaeology allows for are those that focus on the natural environment and how the built environment was affected by the natural. Hydrological features such as streams, as well as topography had a large effect on the canal. These features of the environment worked into the decision-making process regarding the placement of the canal and its several components. The decision-making process for culverting the many streams in Scioto County were because of how unpredictable they could be.

It is my sincere desire that this thesis has revealed new ways of understanding the canal along the landscape in Scioto County and the role that the "ancillary" components played on the canal. Upon originally envisioning the completion of my thesis, I wanted to create something that either I or others could build upon and utilize in the future. With only one county of the Ohio & Erie Canal georeferenced and analyzed there is immense value in continuing this type of analysis along this canal and all the others in Ohio. Perhaps, this thesis was beginning of something much larger, and I will continue to add to the interactable map I have created over time. This thesis has also helped me postulate several other interesting points of analysis that could occur surrounding the canal and I believe are important to mention to encourage further analysis of the canal. This thesis used the canal plat maps prior to the Great Flood in 1913, however, at least in Scioto County and likely others there exists plat maps right after the flood. Analysis could be done assessing the damage done to the canal between these two time periods. Could it be determined how much damage the Great Flood of 1913 had on the Ohio & Erie Canal? During this time-period the canal was already out competed by the railroad. What large damages doomed the canal to no longer be in operation? It was also revealed that multiple different contractors worked on the Ohio & Erie Canal. It might be interesting to examine various construction techniques and variances. How much labor was done along the canal by prisoners? Did camps of workers that were common in the area also work along the canal? How do the ancillary canal components in poorer counties at the time relate to those of more well-off counties? Do urban counties do a better job at preserving canal components due to the funding potential, or do rural counties preserve canal components due to less development or less attention or traction from tourists or historians?

The final question to ponder is what future uses can this hGIS undertaking contribute to and what can the public dissemination of this project result in? For the public, such as gongoozlers like myself, the Canal Society of Ohio, or even state agencies I see this project and the new data created as a new tool and methodology to look at the canal and reconstruct its infrastructure to mirror its actual existence nearly 200 years ago. Perhaps the public could use some of this information and GIS applications on their own to identify components of canals that are less well documented. The public with the use of the information in this undertaking could better explain the function of some of the ancillary components on the Ohio & Erie Canal. One component of the Ohio & Erie Canal, culverts, I believe help convey the importance of water management along the canal and helped in the function of the canal. I also believe the information in this thesis could help the public better understand the environmental factors which played a key role in the building of the canal. The identification of cultural canal components along the landscape will allow the public in Scioto County to preserve certain resources or perhaps help state agencies in planning future projects within the general vicinity of the canal as to not impact cultural resources. Specifically, the Ohio Department of Transportation and the Ohio Department of Natural Resources could find value in the entirety of the canals being georeferenced that was done in this thesis. There is also a growing interest in cultural heritage management and creating large trails for the public to understand historical resources like canals. I can see this data being immensely useful to the public in trail planning. In Cultural Resource Management, this data could provide a template for conducting surveys along canals and allowing for more refined survey areas to be focused on where canal components are mapped. Culverts also now provide an interesting challenge to those conducting surveys along the canal. How can culverts be identified if they are possibly covered by several decades of deposition? There also exists a predictive element to this thesis. Culverts specifically are shown aligning particularly with perennial and intermittent streams, and with this knowledge it is possible that this could be applied to other canals within Ohio. On the plat maps some canal components are not indicated, so if a culvert did not exist on a perennial/intermittent stream on a plat map, given the information we know now, could we say that at one point it had? I believe the answer is likely given that nearly all the streams were culverted in Scioto County. The predictive element of this thesis could then be applied to the Miami & Erie Canal and likely other feeder canals such as the Wabash & Erie, the Sidney Feeder, the Hocking Canal, the Sandy & Beaver Canal, and the many other canals in Ohio. Historical GIS also has the potential to identify many different components of these canals. The Ohio & Erie Canal is well documented and without the plat maps and historical information gathered for this thesis it would have been difficult to reveal so many new details on the canal. Yet, I believe the ideas applied to this thesis can be generalized to canals not as well documented as the Ohio & Erie Canal. Historical aerials still have the potential to identify canal components and with the Hillshade layer in ArcGIS the canal prism would likely be identifiable even without canal plat maps. Hopefully gongoozlers like myself find interest in this thesis and find ways to use the data and map created by this thesis. Topographic maps also have the ability to identify streams that could allow for culverts to be predicted on those streams.

For my parting quote I draw on Kilbourn as he described his work and the importance on compiling the original documents created by the Canal Commission of Ohio which fits perfectly as I view my remapping, inventory, and analysis of the Ohio & Erie Canal and the hope that it too be shared with the public. Paraphrasing Kilbourn, the histories of ancient improvements, for the extension of commerce, are lost in oblivion of a thousand ages, while the consecration of idols are embellished by the historian. Thus, “the collection of facts now embodied, will afford light and data to other states and other countries: they are facts too, which would ere long be scattered and lost, or only be preserved in the departments of state and be procured with difficulty by the statesman, the political economist, the philosopher, and the historian” (Kilbourn 1828:8).

Appendices

Appendix 1. Ohio History Connection Image Order Form & Use Agreement 83

Image Order Form & Use Agreement

CONTACT INFORMATION

First Name: Mason   Last Name: Waugh

Company: n/a   Unit/Department: n/a

Shipping Address: n/a

City/State/Zip: Columbus, Ohio

Phone: 7404643466   Fax:

Email: waugh.113mason@gmail.com

DELIVERY METHOD

Unless otherwise requested, images will be delivered by email to the address provided. Images are digitized at a minimum of 400 dpi and sent as a TIFF file.

CITATION

Please credit images with the following credit line:
"Courtesy of the Ohio History Connection (call number)."

Describe the images you are requesting. Please be as specific as possible.

IMAGE NAME OR DESCRIPTION	IMAGE/CALL NUMBER
Ohio and Erie Canal plat map (Encompassing Stations 1670 - 1793)	BV4919_002.jpg
Ohio and Erie Canal plat map (Encompassing Stations 1793 - 1897)	BV4919_003.jpg
Ohio and Erie Canal plat map (Encompassing Stations 1897 - 2000)	BV4919_004.jpg
Ohio and Erie Canal plat map (Encompassing Stations 2000 - 2117)	BV4919_005.jpg
Ohio and Erie Canal plat map (Encompassing Stations 2117 - 2223)	BV4919_006.jpg
Ohio and Erie Canal plat map (Encompassing Stations 2223 - 2327)	BV4919_007.jpg
Ohio and Erie Canal plat map (Encompassing Stations 2327 - 2431)	BV4919_008.jpg
Ohio and Erie Canal plat map (Encompassing Stations 2431 - 2553)	BV4919_009.jpg
Ohio and Erie Canal plat map (Encompassing Stations 2553 - 2660)	BV4919_010.jpg
Ohio and Erie Canal plat map (New Channel)	BV4919_011.jpg

Digital Services • 800 E. 17th Ave., Columbus, OH 43211 • p. 614.297.2530 • f. 614.297.2546 • images@ohiohistory.org

OHIO HISTORY CONNECTION

Image Order Form & Use Agreement

USE INFORMATION

Intended Use: For my thesis and recreating the maps in ArcGIS.

Title of publication(s), presentation, exhibit, where reproductions will appear:

THE CLOISTERED INFRASTRUCTURE OF THE OHIO & ERIE CANAL: AN ANALYSIS

Author, editor or producer: Mason Richard Waugh

Publisher, production company: ______________________

In accordance with the reproduction conditions set forth, I apply for permission to publish the described materials. (Sign below)

Mason Waugh — 4/13/2022

Signature (REQUIRED) — **Date (REQUIRED)**

Jenni Salamon

OFFICE USE ONLY • Ohio History Connection Authorization *(Signature)*

CONDITIONS OF REPRODUCTION

1. **One-Time Use.** The right to reproduce materials held in the collections of the Ohio History Connection (OHC) is granted on a one-time basis only, for the specific use defined in this agreement. Any further reproduction of this material is prohibited without the express written permission of the Ohio History Connection.
2. **Use Agreement.** Materials are reproduced for research use only and may not be used for publication, exhibition, or any other public purpose without the express written permission of the Ohio History Connection.
3. **Credit.** Any publication, exhibition, or other public use of material reproduced from the collections of the organization must credit the Ohio History Connection. The credit line should read "Courtesy of the Ohio History Connection" and should include the image or call number. OHC would appreciate receiving a copy or tearsheet of any publication/presentation containing material from the organization's collections. These can be sent to the address provided below.
4. **Indemnification.** In requesting permission to reproduce materials from the collections of the Ohio History Connection as described, the requestor agrees to hold harmless the OHC and its Trustees, Officers, and agents either jointly or severally from any action involving infringement of the rights of any person or their heirs and descendants in common law or under statutory copyright.
5. **Reproduction of Copyrighted Material.** Permission to reproduce materials in which reproduction rights are reserved must be granted by signed written permission of the persons holding those rights.
6. **Copyright.** The Ohio History Connection provides permission to use materials based on the organization's ownership of the collection. Consideration of the requirements of copyrights is the responsibility of the author, producer, and publisher. Applicants assume all responsibility for questions of copyright and invasion of privacy that may arise in copying and using the materials.

   Warning concerning copyright restriction: The copyright law of the U. S. (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted material. Under certain conditions specified in the law, libraries and archives are authorized to a photocopy or reproduction. One of the specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship or research." If a user make a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement. This institution reserves the right to refuse to accept a copying order if, in its judgment, fulfillment of the order would involve violation of copyright law.
7. **Photographs of Objects.** The Ohio History Connection retains rights to photographs taken of artifacts owned by the OHC. The images may be used for research, but any publication or public display is subject to the above conditions of reproduction. A new use agreement and appropriate fees must be submitted for each use.

Digital Services • 800 E. 17th Ave., Columbus, OH 43211 • p. 614.297.2530 • f. 614.297.2546 • images@ohiohistory.org

Bibliography

Adams, W. H.
1990 Landscape Archaeology, Landscape History, and the American Farmstead. *Historical Archaeology*, *24*(4), 92–101. http://www.jstor.org/stable/25616053

Armstrong, D. V.
1985 An Afro-Jamaican Slave Settlement: Archaeological Investigations at Drax Hall. In *The Archaeology of Slavery and Plantation Life*. Theresa Singleton, editor, pp. 261-287. Academic Press, New York, NY.

ArcGIS
2022 *Help*. *What is raster data*? -Help | ArcGIS for Desktop. Retrieved January 8, 2022, from https://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/what-is-raster-data.htm

2022. *Overview of georeferencing*. Overview of georeferencing-ArcGIS Pro | Documentation. Retrieved January 8, 2022, from https://pro.arcgis.com/en/pro-app/latest/help/data/imagery/overview-of-georeferencing.htm

Aument, B.
2012 *The Post Section 106 Review Discoveries Related to Camp Sherman and the Ohio & Erie Canal from the ROS-SR 104-14.26 and ROS-SR 207-0.00 (PIDs 21250 & 18492) Highway Improvements in Scioto and Union Townships, Ross County, Ohio*. Copy on file at the Ohio Historic Preservation Office.

Chabot, G.
2022 Portsmouth, Ohio. Circa 1860. At the terminus of the Ohio Erie Canal. The Point at the intersection of Scioto and Front Street.

2022 *A New Map of Ohio with its Canals Roads and Distances,* 1846. Published by S. Augustus Mitchell, Philadelphia, PA.

Ebert, D.
2004 Applications of Archaeological GIS. *Canadian Journal of Archaeology / Journal Canadien d'Archéologie*, *28*(2), 319–341. http://www.jstor.org/stable/41103496

Fleming, A.
2012 *The future of landscape archaeology.* In S. J. Kluiving & E. B. Guttmann-Bond (Eds.), Landscape Archaeology between Art and Science: From a Multi- to an Interdisciplinary Approach (pp. 461–470). Amsterdam University Press. http://www.jstor.org/stable/j.ctt6wp79m.36

Garrity, C.
2022 *Get maps*. USGS Topoview. Retrieved March 12, 2022, from https://ngmdb.usgs.gov/topoview/viewer/#4/40.00/-100.00

Giecj, J.
1988 *A Photo Album of Ohio's Canal Era*, 1825-1913. Kent State University Press, Kent, Ohio.

González-Tennant, E.

2016 Recent Directions and Future Developments in Geographic Information Systems for Historical Archaeology. *Historical Archaeology, 50*(3), 24–49. http://www.jstor.org/stable/44956008

Johnson, M. H.

2012 *Phenomenological Approaches in Landscape Archaeology*. Annual Review of Anthropology, 41, 269–284. http://www.jstor.org/stable/23270711

Kilbourn, J.

1828 *Public documents concerning the Ohio canals which are to connect Lake Erie with the Ohio River: Comprising a complete official history of these great works of internal improvement: Kilbourn, John, 1787-1833 : Free download, Borrow, and streaming*. Internet Archive. Retrieved March 13, 2022, from https://archive.org/details/publicdocumentsc00kilb/mode/2up?q=

Knowles, A. K., and A. Hillier (editors)

2008 *Placing history: how maps, spatial data, and GIS are changing historical scholarship*. ESRI Press. Redlands, California.

Klinge, D. F., and C. Mustain

2018 *Report on the Phase II Data Recovery Excavations at 33SU679 For the Ohio-Erie Canal Closure Assessment Project*. Copy on file at the Ohio Historic Preservation Office.

Little, B., E. M. Seibert, J. Townsend, J. H. Sprinkle, Jr., and J. Knoerl.

2000 *Guidelines for Evaluating and Registering Archaeological Properties.* U.S. Department of the Interior, National Park Service, Washington D.C.

Llobera, M.

2012 *Life on a Pixel: Challenges in the Development of Digital Methods Within an "Interpretive" Landscape Archaeology Framework*. J Archaeol Method Theory 19, 495–509. https://doi.org/10.1007/s10816-012-9139-2

McClelland, C. P., and C. C. Huntingdon.

1905 *History of the Ohio Canals: their Construction, Cost Use and Partial Abandonment.* Ohio State Archaeological and Historical Society and the Press of Fred J. Heer, Columbus. Ohio.

National Park Service

1997 *National Register Bulletin: How to Apply the National Register Criteria for Evaluation.* United States Department of the Interior, Washington D.C.

Noble, V. E.

1988 *Report of an Archaeological Survey along the Ohio and Erie Canal Towpath, Cuyahoga Valley National Recreation Area, Summit County, Ohio*. Prepared for and copies on file at the U.S. Department of Interior, National Park Service, Midwest Archaeological Center, Lincoln, Nebraska.

Ohio Department of Natural Resources
2021 *Ohio Canal Lands original plat map drawings.* Retrieved October 6, 2021, from https://ohiodnr.gov/wps/portal/gov/odnr/discover-and-learn/safety-conservation/about-ODNR/real-estate/ohio-canal-maps

Ohio Department of Transportation
2022 *Public aerial image requests*. Pages - Public Aerial Image Requests. Retrieved November 22, 2022, from https://www.dot.state.oh.us/Divisions/Engineering/CaddMapping/Pages/Public-Aerial-Image-Requests.aspx

Ohio Geographically Referenced Program
2021 OGRIP data downloads. Retrieved October 6, 2021, from https://gis5.oit.ohio.gov/geodatadownload/

Ohio History Connection
2022 *Ohio Canal Plat Map Collection*. Retrieved November 22, 2022, from https://cdm16007.contentdm.oclc.org/digital/collection/p16007coll93

2022 Ohio and Erie Canal. Retrieved March 22, 2022, from https://ohiohistorycentral.org/w/Ohio_and_Erie_Canal?msclkid=2e2cba49aa4011ec9c21e2a82bca599e

Richards-Rissetto, H.
2017 What can GIS + 3D mean for landscape archaeology? Journal of Archaeological Science, Volume 84, 10-21, ISSN 0305-4403, https://doi.org/10.1016/j.jas.2017.05.005.

Richner, J. J.
1992 *Archaeological Excavation at Site 33-Cu-314: A Mid-Nineteenth Century Structure on the Ohio and Erie Canal*. Copy on file at the Ohio Historic Preservation Office.

Sewell, A. R., and J. P. Zink
2017 *Mitigation Report for the Black Diamond Shipwreck at Buckeye Lake, Fairfield County, Ohio.* Copy on file at the Ohio Historic Preservation Office.

Shriver, J.

1824 *An Account of Surveys and Examinations: with Remarks and Documents, Relative to the Projected Chesapeake and Ohio and Ohio and Lake Erie Canals*. Published by Fielding Lucas Jr. Obtained https://archive.org/details/accountofsurveys00shri/page/n5/mode/2up?q=Portsmouth. Digitized by University of Pittsburgh Library System

Skolnik, A. B.
2019 *"The Real Distance was Great Enough": Remapping a Multivalent Plantation Landscape Using Historical Geographic Information Systems (HGIS).* Maryland University, Digital Repository at Maryland University. https://drum.lib.umd.edu/handle/1903/22207

Tilley, C. Y.
1994 *A phenomenology of landscape : places, paths, and monuments* (Ser. Explorations in anthropology). Berg.

United States Department of the Interior.
1969 National Register of Historic Places Inventory – Nomination Form. *Ohio and Erie Canal*. NPS Form No. 10-300. Retrieved from the Ohio Historic Preservation Office Online GIS Mapping System: https://gis.oshpo.org/Geocortex/Essentials/OMS/REST/pdf/NR/Cuyahoga/66000607.pdf?token=SKLCQxZhnK-EC0Rj5n_w0l2QAAlKMk5gySlEqAONYBQbOAmgAAO5nB3RCpOy8k_A-jbxnh8n8N

1979 National Register of Historic Places Inventory – Nomination Form. *Lockville Canal Locks*. NPS Form No. 10-300. Retrieved from the Ohio Historic Preservation Office Online GIS Mapping System: https://gis.oshpo.org/Geocortex/Essentials/OMS/REST/pdf/NR/Fairfield/74001480.pdf?token=SKFP2oF5wdbkOM7d29gbSBEAAAvVZ_2R808ku1oXibOJZmkgAANmjqMjcGXG5CNe2V7Rvis2v

2018 National Register of Historic Places Inventory – Nomination Form. *Ohio and Erie Canal Southern Descent Historic District (Discontiguous)*. NPS Form 10-900. Retrieved from the Ohio Historic Preservation Office Online GIS Mapping System: https://gis.oshpo.org/Geocortex/Essentials/OMS/REST/pdf/NR/Fairfield/SG100003572.pdf?token=SKLCQxZhnK-EC0Rj5n_w0l2QAAlKMk5gySlEqAONYBQbOAmgAAO5nB3RCpOy8k_A-jbxnh8n8N

University of Akron Archival Services
1900s Old distillery, 2 1/2 miles north of Portsmouth. Retrieved from http://www.uakron.edu/libraries/archives/.

1900s Bridge 9 miles, north of Portsmouth. Retrieved from http://www.uakron.edu/libraries/archives/.

Willems, H., Creylman, H., De Laet, V., & Verstraeten, G.
2017 The Analysis of Historical Maps as an Avenue to the Interpretation of Pre-Industrial Irrigation Practices in Egypt. In H. Willems & J.-M. Dahms (Eds.), *The Nile: Natural and Cultural Landscape in Egypt* (pp. 255–344). Transcript Verlag. http://www.jstor.org/stable/j.ctv1xxszt.13

Unrau, H., and N. Scrattish.
1984 *Ohio and Erie Canal Cuyahoga Valley National Recreation Area, Ohio*. Manuscript on file, National Park Service, U.S. Department of the Interior, Lincoln, Nebraska.

Upton, Dell.
1984 White and Black Landscapes in Eighteenth-Century Virginia. Places 2(2):51984 White and Black Landscapes in Eighteenth-Century Virginia. Places 2(2):59-72