Visualizing Boone History:
A Case Study in Developing a
Physical and a Digital Map Display

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Abstract

Daniel Boone, an American frontiersman known for his hunting prowess, for blazing the Wilderness Trail through the Cumberland Gap, and for exploring Kentucky, moved in 1799 with approximately 20 other settlers to what is now known as the Femme Osage Valley in Missouri. He was invited by Spain, who owned the region at the time, to encourage colonization and was given approximately 850 acres of land along the Missouri River. During his time there, he was appointed commandant by the Spanish, and later hosted Lewis & Clark during their expedition west. The complexities of early American frontier culture are exemplified at the Historical Daniel Boone Home at Lindenwood Park, a 300-acre tourist site operated by the St. Charles County government. It is comprised of three original buildings of the Boone family, one an elegant limestone house not often associated with the more elementary log-cabin shelters found on the frontier, and a village of relocated nineteenth-century buildings. The mission of the Park is to preserve and interpret early American frontier culture through education and preservation of existing artifacts of the Boone family and their contemporaries. There is a spatial awareness gap among the interpretation tools that the park historian would like to address, by creating a table-top map display of a hand-drawn map of region that was developed by one of their lead historical contributors. They are also interested in the potential of a web-based interactive map as another level of visual communication. This design analysis explores the development of a physical map display for the hand-drawn map and uses that as a starting point to explore the development of digital web map using the potential of GIS to create multi-scale historical representations of the area.

Introduction

Our cultural landscape is shaped through the many generations of social and economic activities that helped develop regions on a foundation of physical terrain and local climate that enabled or constrained resource development. Yet over time, the populace is often more in tune to present events and it becomes easy to forget the myriad historical activities that shaped regions. A bridge becomes more the concern of a traffic event and less a reminder of the namesake that established a fur trading post that grew to a now bustling town, such as St. Charles, Missouri. Roads are just numbered route ways to get from point A to point B, as opposed to named paths representing a location it is actually reaching. Such is the case with Mexico Road, which leads to the town of Mexico near 100 miles west of St. Charles (Missouri T. S., St. Charles County Place Names, 1928-1945, 2017). Another two-lane road named "Boone's Lick Road" runs from Main Street west towards Interstate Highway 70. Most people take the name at face value and don't realize it was actually named for the Boone's Lick Trail, created by two of Daniel Boone's sons that led to a salt lick west of Columbia, Missouri where they extracted salt for about six years (Association, 2017). This trail became one of the major routes west for settler colonization. It has been said that if St. Louis was the Gateway to the West, Boone's Lick Trail is how you got there. Today, much of the Boone's Lick Trail was used to create Interstate Highway 70.

But a nomenclature that focusses on Boone and his era cannot avoid other labels, such as Femme Osage, the name of the creek on which his homestead was built. Femme, the French word for woman, hints at a prior knowledge of this area by French settlers or fur-traders within part of the once vast territory known as Nouvelle France, and Osage reminds of the American

Indian use of this area. Historical interpretation of frontier regions, for far too long associated with a narrative that begins with the “first white baby”, has to grapple with these prior presences. How to do that, while still foregrounding the important roles that the Boone settlers played, is one of the core research goals of this report. Although the built environment of the Boone Home can provide visual cues to that past, an array of historical maps stretching across two centuries can become the templates for additional visualization and interpretation, especially when georeferenced for use with GIS technology.

Background

The mission of the Historical Daniel Boone Home at Lindenwood Park is to provide a center that fully integrates learning on all education levels; preserves and protects the historical structures, collections and natural resources that comprise the facility; and interprets the early American frontier experience in Missouri as exemplified by the Boone family and their contemporaries (County, 2017). Currently, there is a spatial awareness component that is missing from the site. There are no maps or geospatial displays that currently exist connecting past historical elements to the modern landscape. The park would like to close this gap by developing a physical relief model and is very interested in how digital mapping can support public outreach. The park welcomes any new endeavors to support historical research and public interaction.

The Boone Home and village is a 300-acre historical site comprised of three buildings original to the property and a ‘simulated town’ comprised of mid-19th century structures obtained from within a 50 mile radius of the site. Many of these other structures are from the German settler time period, and were rescued from demolition threats over a number of years. Their

location around an oval ‘commons’ is not typical of Midwestern settlement layouts, and thus presents some degree of inauthenticity and are a challenge for accurate interpretations in 2018. Well-intentioned efforts by serial owners of the site over several decades have led to a complex landscape ensemble that now face challenges of maintenance and educational programming.

Additionally, while there are related data that do exist, there are no central repositories for Boone-related GIS data. Through the use of GIS, the County can leverage visual communication methods and supplement the interpretation process by including multiple mapping products. The lead interpreter of the site reflects on the importance of maps to the mission:

> For those of us charged to be the keepers of the Boone’s story here in Missouri, this topographic map is an essential tool. Due to the hilly nature and twisty turns found in our valley, most of our visitors have very little perspective beyond the scope of the windshields of their automobile. The topographic map not only provides clarity by providing a contemporary view, but also brings a fresh sense of perspective by literally superimposing the past over the present. By seeing where the various families lived in relation to each other and this valley, our visitors can understand the natural features that were no doubt factors in the family’s choice in where to settle. Our visitors can also understand the difficulties, or lack thereof, in traveling to each other’s properties and this reveals the greater truth: that this area, while not a municipality, was a true community. The map will be of great use in helping us make the story more relatable. (William Ray, 2017)

Static maps are, however, one-directional in communication. This is reflected through the Map Communication Model. In this traditional way of thinking about maps, the cartographer interprets reality and provides that interpretation to the user. The graphic in Figure 1.2.1 is an example of traditional cartographic thought, often still applicable in many circumstances.

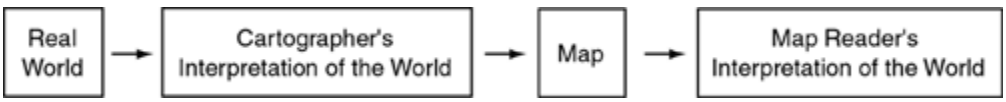


Figure 1. Generalized cartographic communication model.

Conventions of what is illustrated on a map have been socially constructed and norms for interpreting them are trained from high-school on. The federal United States Geological Survey (hereafter USGS) maps have contour lines that people don't see in real life, and the only buildings that are singled out for recognition with other than a flat black square symbol are churches (with a cross icon) and schools (with a pendant). A binary of forested and cleared land is included as well. Tourist maps, whether by the National Park Service or local Chambers of Commerce, often highlight additional features such as washrooms and places for food, as well as parking lots. Road width is exaggerated, for wayfinding purposes.

By contrast, through geovisualization tools such as the interactive map, the user is allowed to actively engage with geospatial data available (MacEachren, 2004). Features such as towns, roads, and parcels are saved as individual files respective to their primary shape. These points, lines, and polygons can be laid on top of one another, creating a stack of information about the same geographic area. Each layer can be turned off and on, as if you were peeling a layer off the stack or placing it back on. You control the amount of information about an area that you want to see, at any time, on any specific map. (ESRI, What is GIS?, 012) The user is then able to create private maps with information specifically chosen to reveal new elements of information.

The value added from these new methods of communication can result in a wider audience. Instead of a single cartographic 'author' such as the federal USGS, a consortium of interested parties can contribute information to meet a variety of constituency needs. Other stakeholders in the project are the St. Charles County government, academia (both K-12 and

higher education), historical societies, and the local community. The benefit is the ability to remotely access the historical site rather than coordinating visits during regular hours of operation. The historical cartographic layers, once only visible through libraries or archives, are now accessible regardless of time or location.

In this project, the goal is to identify and create tools that connect the past to the present through spatial awareness. The focus is on using cartographic methods to provide information and appropriate context to local manifestations of broader North American settlement history as well as specific Boone-era history. The intent is to provide avenues to communicate historical information and promote healthy discussion of historical events by providing attention to physical and cultural features. As such, that wider discussion gravitates from time to time to issues of heritage interpretation, material culture, and social history, ones outside the initial cartographic focus and more likely topics for later consideration (Graham & G. Ashworth, 2000).

The Map

The hand-drawn map, which is the impetus for this project, was created by Ken Kamper, a Boone enthusiast and historian who has supported the Historical Boone Home site through extensive consultation and volunteer work. The park historian felt that using this map would not only address the spatial awareness gap present, but would be a fitting tribute to Mr. Kamper's support over the years. There were evidently many versions of this same map, but the image in Figure 2 is a copy of the original. The extent of the map is a region approximately 30 miles south west of St. Charles, Missouri (fig 3). It covers a 35 kilometer by 18 kilometer area that includes the Femme Osage Valley and part of the Missouri River Valley.

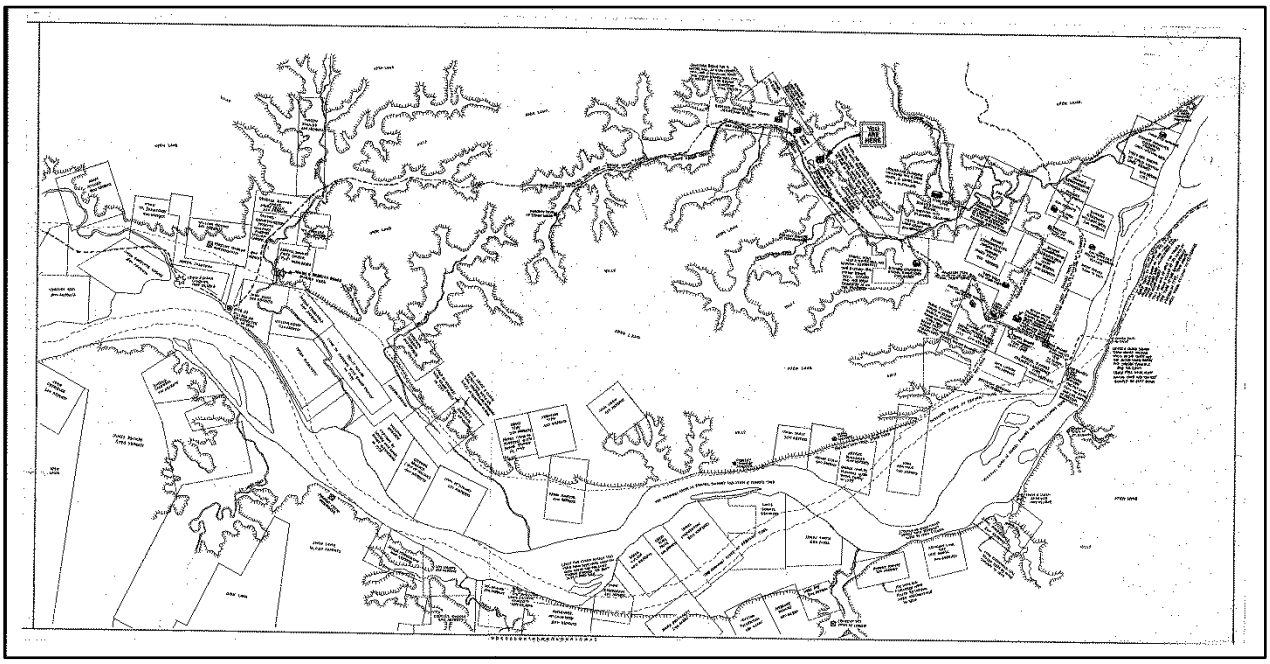


Figure 2. Kamper hand-drawn map.

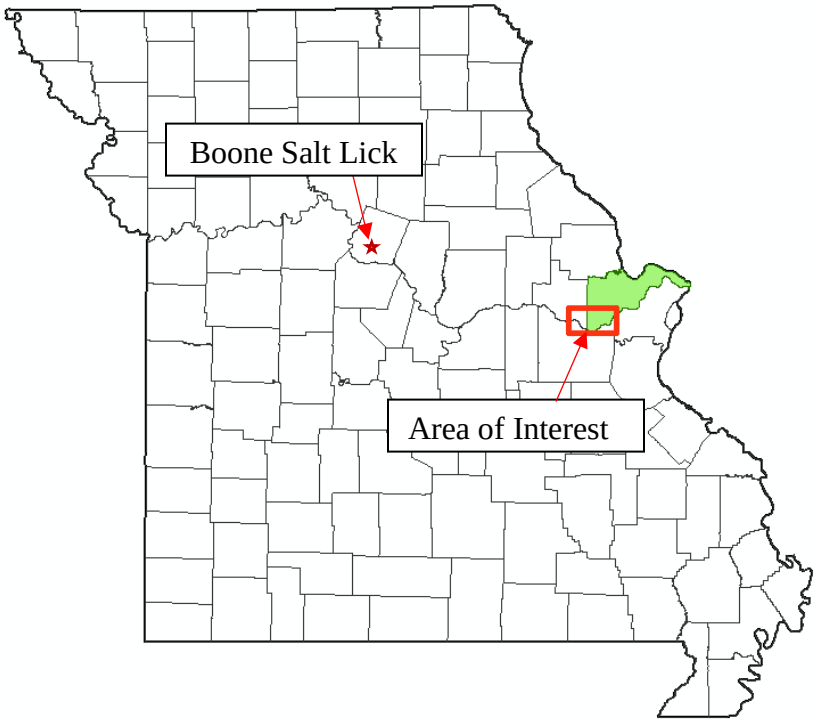


Figure 3. State of Missouri with Area of Interest noted over St. Charles County.

The features contained on this map are both modern and historical. Locations of modern towns are identified as well as historical towns, such as Boone's town of "Missouri" (fig.4). Land grants for Boone, his family, and accompanying settlers are outlined with refined precision. Points of interest features such as Salt Boat Landing and Boone's Judgement Trees are identified.

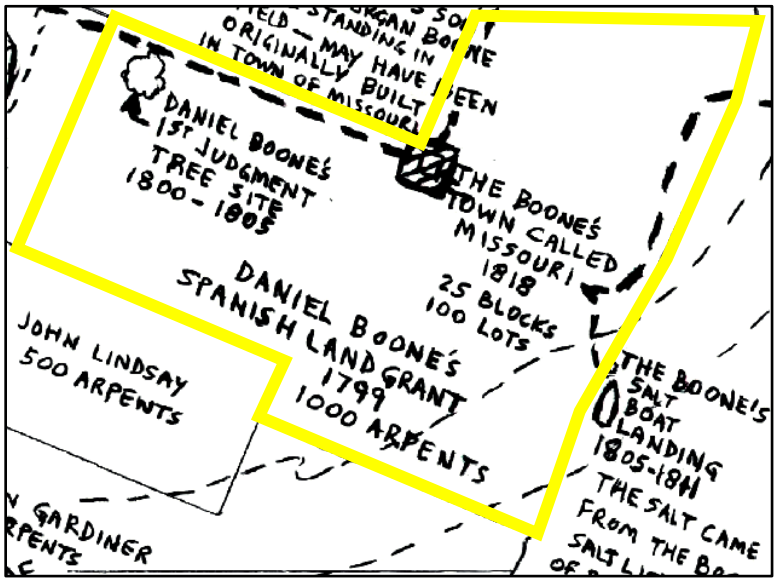


Figure 4. Close-up of hand-drawn map.

Lewis and Clark, who travelled through the area in 1804 and 1806, had interactions with Boone and the map notes campsites and various activities of the expedition. The features are all inked in black and the background is all white. There is no color, in other words. Point features are noted by icons such as log cabins, stone homes, cloud forms, star forms, and crossed squares. Area features are represented by unfilled polygons. Linear features are represented in dashed, solid, and blanket stitch lines. The unique feature about this map is inclusion of narratives and stories. They are hand written, with arrows to indicate the feature they are associated with. In

Figure 5, the narrative is in regard to features present on the property of Daniel Boone Hays, grandson of the frontiersman. The addition of these narratives brings historical life and context into view through events and relationships.

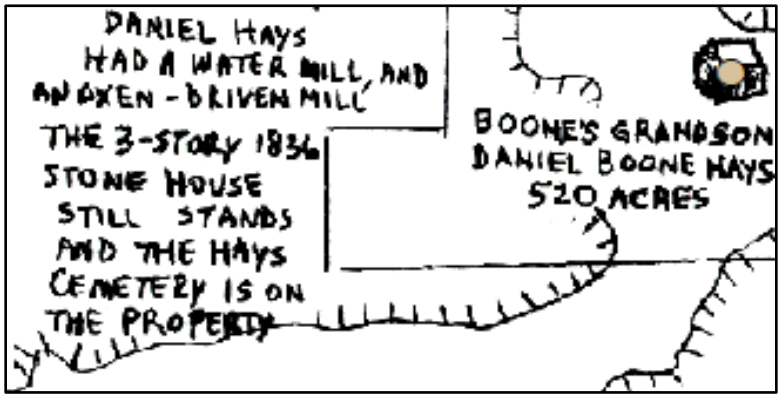


Figure 3. Close-up of narrative from hand-drawn map.

There are a series of cartographic elements missing from the map. Standard marginalia, such as a scale, north arrow, or a legend, are absent. This prevents the user from taking any measurements from the map or knowing the orientation of the map. The lack of legend requires the user to spend extra time interpreting the symbology which, given that everything is grayscale, could lead to misinterpretation. The lack of color is not inviting and muddles the clarity of the information presented. Also, there is not an indication of timeframe for the features that exist on the map or date for when the map was created which can somewhat distort the relationship of time. It is the lack of sourcing, however, that is most detrimental to further use of this map. With nothing to indicate how features were created, what projection was used, or even registration points for reference coordinates, it appears there is nothing to allow use in other applications.

To address some of these concerns, the author of the map was contacted. Mr. Kamper spent significant time researching public records to ensure he placed features as accurately as

possible. When asked about why he created the map, he responded with “I made it for two purposes; one for the Judgment Tree park at Matson... where a colored version now exists, and one for the Boone Home site...” (Kamper, 2017).

Although Mr. Kamper is not a cartographer, he used the most reliable tools available to him to document his research. When asked directly, he responded that he repeatedly enlarged a modern USGS topographical map using a copier until he had a number of sheets to paste together into one large map. He then traced one or some of the contours onto a large sheet of Mylar. It may not be a perfect tracing, but probably close (Kamper, 2017).

One of the other major questions with this map is how the content was sourced. Mr. Kamper indicated that “The content comes from years of research, with a number of the items being learned or uncovered at different intervals during that time. Many books, maps, discussions with older residents, original government surveys, later private surveys, and trips to the locations to see the sites in person. The key is that hearsay things like in County Histories were ignored, and all that is shown is accurate with documented sources (that I no doubt still have somewhere)” (Kamper, 2017).

Such ambiguities lead to an additional concern regarding converting the map to digital form. The version used for this project is a photocopy of the original which was then provided to the park historian. This photocopy was then scanned for use in this project. Given that both transformations of the map inherently introduce a fair amount of error, it is immediately known that this would not likely be reliable enough to be digitized and used as a traditional GIS analytic resource. This does not, however, discount its usefulness, particularly in terms of developing a physical raised relief map. In light of the sourcing information that was provided, it can still be a significant resource for current historical discussion and as a basis towards more refined GIS

projects. Property parcels are a significant element of the Kamper map, and many of these find expression in various nineteenth and early twentieth century maps, such as those from 1875 and 1903, that can be georeferenced to accurately align features. The hydrology of the area covered, especially that of the Missouri River, has changed in important ways over the last two centuries, and this too will have to be taken into consideration in a revised map. Using the hand drawn map as the focus, I hope to carefully navigate these concerns, define manageable project boundaries, and create resulting products and recommendations that are feasible and valuable.

Cartographic Principles, Physical Maps, Digital Maps

The Historic Daniel Boone Home currently provides interpretation and learning though educational tours and site displays. Among these displays, there are the buildings themselves and the items within them are all carefully preserved and captioned as appropriate. During the tours, interpreters provide information about early American frontier life and readily answer questions using items from within the buildings. While there are some maps for reference, there are not additional spatial components that provide perspective to the area with modern context. In this section we will discuss the importance of multiple mapping methods and how they improve visual communication.

The Historic Daniel Boone Home would like to have a raised relief map model developed from the paper Kamper map. For the physical display the paper map would be georeferenced and overlaid onto elevation data. The final map will then be collectively sent to a vendor for production of the final display. For the web based interactive map, we will take information from the hand drawn map to identify the necessary thematic layers. We will then take a macro to micro design approach to identify what it would take to create an interactive web map of Boone

history that has the flexibility to be expanded as new features are collected. We will assess needs, identify features that provide appropriate time period context, review layout and symbology concerns, and then have a small pilot project as a first step towards a larger project.

Content

Features on a map can serve a few different purposes. They can represent an item in a one to one term, such as point icon for a log cabin or a stone house. The form of icon or symbology used can evoke a perception. This can be the case with a color use, where a red line used to represent a trail may be interpreted as more treacherous than a green line used to another trail. They can also communicate context when displayed with other features. Ultimately, it is the role of the author to determine what features most appropriately and correctly serve the purpose of the map to prevent bias and miscommunication of the idea. In reviewing the feature layers for this project, the following were identified to most appropriately provide context and clarity to both regional and Boone history. They were also not meant to be exhaustive depictions of features, but act as invitations for deeper exploration.

The Physical Region

The region in which Boone and others settled is still relatively rural today despite the extensive urban growth in the broader region. The rolling hills are primarily forested with some cropland, wetland, and glades; there other features such as limestone cliffs and bluff escarpments. The vegetation is primarily composed of deciduous forest and includes unique species such as persimmon, osage orange, hickory, white oak, and black walnut. By summer it develops a dense shrub layer of pawpaw, spicebush, and tree saplings which provide habitat for the Kentucky warbler, wood thrush and American redstart (Conservation, 2017). There is an

existing historic data resource known as the Missouri Spatial Data Information Service (MSDIS) that includes tree species, land cover, vegetation, and several other datasets. The files are ESRI proprietary interchange format, also known as ArcInfo export format. Using the Import Interchange file to Coverage tool from ESRI should manage the data conversion into a coverage file, although the Import from E00 script tool has been more effective. Should any issues arise with obtaining the data, contacting MSDIS should result in positive communication and timely resolution. Modern representations of this information is often in the form of polygons to roughly blanket identify occupying range of an animal or points to represent the location of a particular tree type. However, GIS data is only as good as its source. In the case of the historic tree species file, the data is represented as points reflecting individual tree species such as white oak or persimmon. The land description information, which note land as rolling surface or sandy loam, is recorded as line files. Both files display not by the expected location of the feature, but by the land survey from which the information was obtained, as noted in Figure 6. This is also noted in the feature description, readily found in ArcCatalog. This highlights two important points that should be carried out through future feature collection efforts. First, updating the feature description in the metadata ensures the user is clear about a feature and how it is represented. Secondly, historical data can only provide so much information.

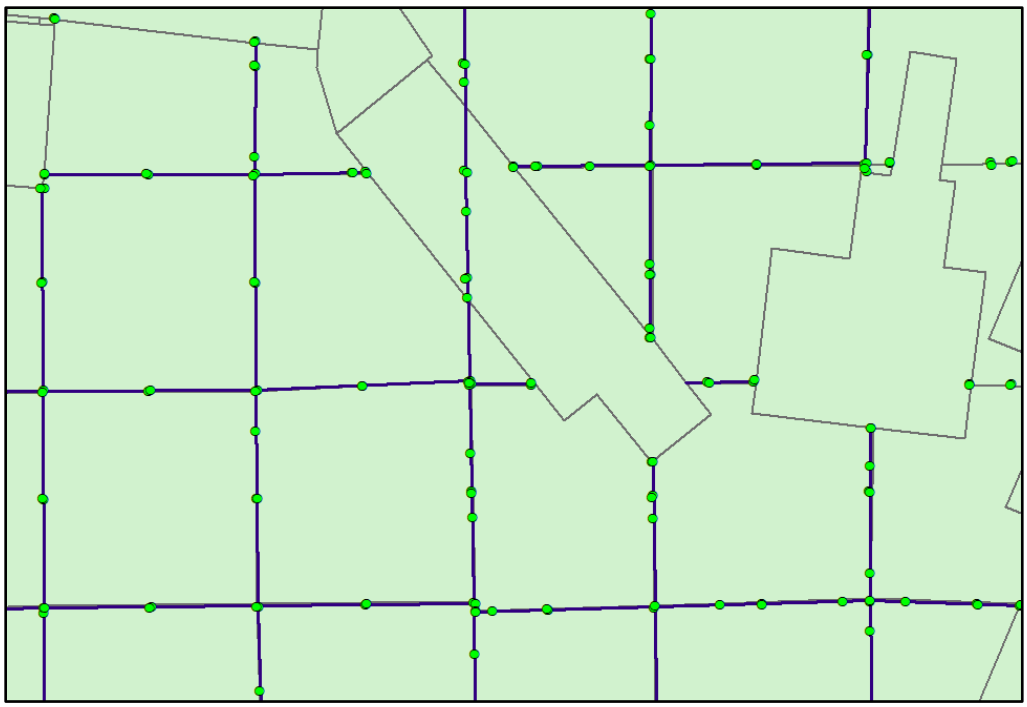


Figure 4 Public Land Survey System parcels (polygon), Historic Land Description (line), and Tree Species (point) coverages displayed in ArcMap.

Hydrology is another important facet of the region that impacts the land and settlement. The Missouri River has changed its banks significantly over time and this can be seen when reviewing the historical topographic maps. This has resulted in early land grants and towns being presently “under water”. Such is the case with the town of La Charette and even Boone’s original Spanish land grant. Approximately 30 miles southwest of St. Charles, and some 50 miles west of St. Louis, is a tributary to the Missouri River called the Femme Osage Creek. This is one of the oldest and most puzzling French names in the state, including Lewis & Clark both referring to the “Osage Woman’s River”. (Missouri T. S., St. Charles County Place Names, 1928-1945, 2017) Many variant names have been recorded, including "Faim of the Hoozaw River", "Femme Osage River", "Osage Womans River", and "Wife of Osage River". There have, of course, been imaginative attempts to supply an explanation, such as that the stream was named from the

finding in it of the body of a drowned Osage squaw, or else that the French so named it because they saw an Indian woman there when they first reached its banks. Similar stories have been posited to explain the similar and equally early French names Bon Homme Creek and Bonne Femme Creek, for a nearby stream which also empties into the Missouri River. Very probably all three names were French translations of the original Indian appellations (L&C, ed. Thwaites; Ordway JOURNAL, ed. Quaife; EWT. ed. Thwaites; Conard II, 422; Barns, 173; Williams N.E. MISSOURI I, 681; COUNTY ATLAS 1875, 12; Miss Leech's thesis; Benj. Emmons). This part of the country is generally called Boone's Settlement, having derived its name from its first inhabitant Col Daniel Boone, a gentleman well known in the early settlement of the state of Kentucky. Cf. the note by the editor Thwaites: (I. 27).

Daniel Boone

Colonel Daniel Boone was 65 years old when he came to Missouri, which was under Spanish control at the time (Harper, 2017). He had blazed the Wilderness Trail through the Cumberland Gap, and established the town of Boonesborough in 1775, initially a Fort on the west bank of the Kentucky River, as part of activities of the Transylvania Company. The Transylvania Company was a land speculation project led by North Carolina investors' intent on creating a new British colony, though the land they sought was also coveted by Virginia (Williams, 2006). So this "frontier" region beyond the Cumberland Gap was not a free-for-all accessed by individual settlers, but rather a site for real-estate speculation by investors at a variety of distances away from the region, as well as land owned by various Indian nations who contested and resisted this assault on their lands. One of the most recent efforts to understand the cartography of this frontier region in the decades between the end of the French and Indian War and the War of Independence is provided by Edelson in his *The New Map of Empire*, where one

entire chapter is devoted to the western frontier (Edelson, 2017). A webpage of 250 historical maps from his research, all georeferenced to a contemporary base map, provides an exciting example of the potential of digital cartography for conveying historical data in a widely accessible manner (http://mapscholar.org/empire/).

Boone lived in many places, beginning near Birdsboro, Pennsylvania. After moving with his family to North Carolina as a teenager and established his reputation as a fine hunter and trapper, here is where he later married Rebecca Bryan. During the French and Indian War, he met John Finely who was the motivator to hunt in Kentucky (Missouri T. S., Daniel Boone, 2017). In 1767 they went through the Cumberland Gap establishing what is today known as the Wilderness Road (Missouri S. C., 2017). He lived in Boonesborough for five years during the War of Independence and was a recognized figure in Kentucky. He was captured by the Shawnee and lived among them for several years, raising suspicions over his possible loyalty to the British. Court martial charges brought by Callaway were eventually rejected, and after a period back in the Carolinas, Boone moved to a new Kentucky site, Boone's Station, from 1779-82. He spent a few more years back and forth between Kentucky and Virginia, before moving to Missouri (Kamper, What Brought Daniel Boone to Missouri, 1999). While in Missouri, Boone was an appointed syndic and settled disputes that arose among the area settlers. He became famous for holding court under a large tree on his son Nathan's land. This tree was known as the "Judgment Tree" (Missouri T. S., Daniel Boone, 2017). There are many reasons for which Boone moved to Missouri and those motivations can be identified in the kind of person he was. The impact of this can be displayed by visualizing the locations of where he lived and key points of interest that reflect what he did.

Historic Trails and Hunting Routes

Boone was known for being a trailblazer and for extensive hunting trips. It would remiss to leave a layer of trails out of the discussion. There are three major trails noted on the Kamper Map: Boone's Trace, Boone's Trail, and King's Road all of which are more associated with general travel and commerce. While not all were specifically blazed by Boone himself, when observed on the map, they all intersect near what was the town of Missouri. This brings attention to the influence that the Boone family had on the region. Line features of this type cross vast distances and often carry a fair amount of uncertainty simply due to lack of recorded information. Collecting against a USGS topographic map or an orthorectified image yields sufficient results fitting to the source information given. This information can be readily noted in the metadata and/or field attribute data.

Dwellings

Boone and his family provide a view of early frontier life that should invite one to further investigate the many significant historical facets that make up the rich and varied history of American settlement. To this end, it is important to note that Boone's westward journey began in Birdsboro, Berks County, Pennsylvania. His father, Squire Boone, built a log cabin in the Oley Valley in 1730 and worked as a weaver and blacksmith. Daniel was born in 1734 (Silverman, 1998). In 1750, after being expelled from the Quakers because a son married a non-Quaker, Squire Boone and his family moved south down the Shenandoah Valley, like many other Pennsylvanians in colonial times, to North Carolina, where Daniel Boone lived from when he was 16 years old. Of relevance to the Lindenwood site is the residential built environment of colonial settlers in the Delaware Valley. Log cabins grew to two stories in height, and then another set of bays were added, and most aspired to replace log by stone. The region has many five-bay, two-story houses with end chimneys and a central hallway that signal educated

connections to then-dominant British tastes (Glassie, 1972). Such aspirations to upgrade travelled as part of the mental baggage of settlers, so it is not surprising that a mark of ‘status achievement’ in Defiance, Missouri was the five-bay stone house that visitors see today. The Nathan Boone house is a Georgian style stone home, reflecting the Eastern influence (fig.7).

Figure 5 Nathan Boone Home - 1880. Courtesy of Historic Daniel Boone Home.

The Kamper map indicates three primary styles homes; the log cabin, the log house, and stone houses. Using these features as a sample, collecting these into feature files allows collection of deeper architectural history through attribute fields. An article entitled Vernacular Architecture in Rural and Small Town Missouri discusses the importance of “cultural conservation” and notes the nuances particularly associated with the Missouri region, touching on Georgian and Federal “I houses” (Marshall, 1994). This provides a very good supplement to a more refined dwellings attribute table, the descriptive fields associated with the feature class.

The Indigenous Cultures

To help frame the regional historical context of the site, the antecedents of the native cultures that lived in this area before European and American settlers should be considered. The mound city of Cahokia in East St. Louis is the most vivid reminder of a Mississippian-era presence, and perhaps there were mounds in St Charles County that could be identified even though they have been removed. St. Louis, once known as Mound City, does take the bulk of the historical mound building reputation, especially when compared with St. Charles County. Sugarloaf Mound off Highway 55 in south St. Louis is the last remaining evidence of the mound culture and is now under the protection of the Osage Nation (Weil, 2012) (Holleman, 2017). However, the Heartlands Conservancy project "*The Mounds – America's First Cities*" identified over 500 mounds that were at one time present in the St. Louis metro area region with 30 visible in the St. Charles area. (Leonard, 2016) (Conservancy, 2017). Coordinating data sharing with the Heartland Conservancy for the mound locations point file in the St. Charles area would certainly add value to this regional historical layer.

Following the Mississippian abandonment of the area, there were at one time seven different American Indian tribes in the region. It should be noted that there is currently differing preferences to the term used when collectively referring to these groups. For consistency, this report utilizes the term "American Indian". As noted in Figure 2, they are Otoe, Missouri, Osage, Chickasaw, Ioway, Illini, and the Quapaw. The Missouria, the namesake for the state and the river, were among the earliest to interact with French and Spanish fur traders and are specifically noted by Louis Joliet and Jacques Marquette during their exploration (Tribe, 2017). The Osage Indians have a broad association with the region, trading furs with the French and later Canadian traders. Their historical boundaries and nomadic patterns might be identified, as well as locations

of any known campsites or favored trading sites. Other tribes that spent time in Missouri primarily as a result of cultural changes in the East and various Indian removal acts, include the Sac and Fox, Shawnee, Delaware, Cherokee, and Kickapoo.

There are many resources for exploring the American Indian tribes of Missouri to clarify and supplement locational research. The University of Missouri Native American Studies: Special Collections and Archives provides a list of resources that date back to 1812. It also indicates that to access these and other historical documents, it is best to contact the State Historical Society (Library, 2017).

There appear to be two schools of thought when it comes to cartographically representing American Indian cultures. There are those maps that use a name only placed over a region and those maps that use distinct boundaries. The figures below reflect both options.

Figure 8. Map courtesy of University of Missouri Peace Studies

Figure 9. Tribal Nations by Aaron Capella

Each method has its merits, yet they can confine the thought process in how these cultures really operated. One option, which is out of the scope of this particular project but well worth noting, is the use of animated maps to represent the nomadic movement of these groups using shaded polygons. Additionally, these could provide impact when representing the movement of these groups as a result of disease, settlement, and treaties. The US and Osage

signed their first treaty on November 10, 1808, by which the Osage made a major cession of land in present-day Missouri. Under the Osage Treaty, they ceded 52,480,000 acres (212,400 km^2) to the federal government. (Congress, 2003)**.** Using the descriptor information in the treaties, boundaries can be identified, and developed into a series of maps that provide a new level of perspective to this moment in history.

Early Settlement and Territorial Missouri

Despite transferring control to the Spanish in 1763, the French presence remains deep rooted in the area. One possibility in the digital map displays might be to point out the French presence in the area through early maps to remind visitors of the French colonial settlements along the Mississippi, including Kaskaskia (1703), Fort de Chatres, Prairie De Rocher, etc in Illinois. The area was populated by Canadiens from Quebec who sought trade with Plains Indians up the Missouri River, but also by slaves from Santo Domingo brought in to labor in lead mines. Ste. Genevieve, founded in 1735, is the site of distinctly Franco-Caribbean architecture with often hipped roofs, *poteaux en terre* (post in ground) walls, and verandahs, silhouettes that were distinct from the log cabins of the frontier (Stepenoff, 2014). It could also be useful to remind the visitor of the layouts of St. Charles, founded 1769 by a French Canadian fur-trader as Les Petites Côtes, "*The Little Hills*", (Society S. C., 2017), under the authority of the Spanish who controlled the area after the end of the French and Indian War. Likewise, St. Louis was founded by French fur traders, in 1764, with a layout familiar in other towns established by the colonial French.

Illustrations, such as that of the map of the United States 1789-1790 in Figure 10, provide very nice visual context to the political arena of the time. The area circled on the boundary of the Colony of Louisiana and the Northwest Territory identifies the location of the Boone family settlements, on the fringes of territorial Missouri.

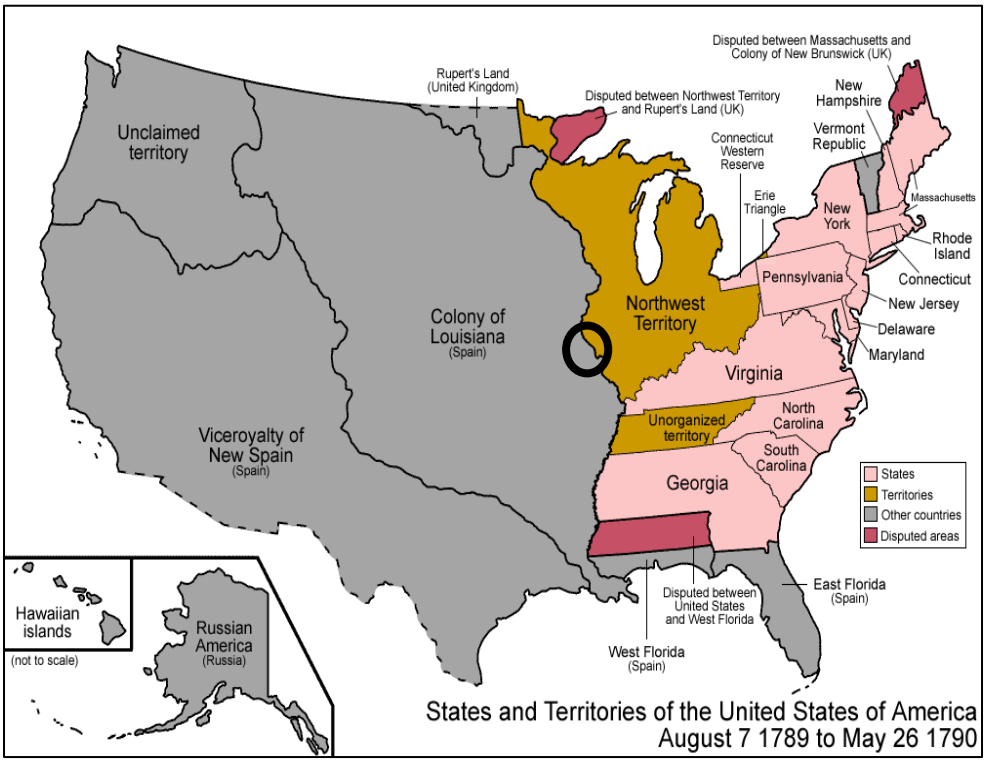


Figure 6. Credit La Chuleta Congela (2010) States and Territories of the United States of America (August 7, 1789 to April 2, 1790

This map in Figure 7 of territorial progression from 1804 to 1819 is an excellent example of how the boundaries were evolving in a relatively short period of time. Digitally, this could provide very useful context to other features of the area.

Figure 7. Map Display from St. Charles Missouri Visitors Center.

Land Grants

Earlier the arpent and the acre were noted on the Kamper map. Arpents are an older unit of measure like that of acreage, although the measure of an arpent is about 0.84 acres. The French would divide the land into these long lots where the measurement was in arpents. This method of land division provided each land-owner with river frontage as well as land suitable for cultivation and habitation. When the U.S. conducted their surveys in Township and Range, there were many instances where the previous land claims were surveyed as well (Fuchs, 2018). This was to convert from the metes and bounds method to the more reliable Public Land Survey System. French and Spanish private claims lie embedded in the rectangular survey pattern in St. Charles County, Missouri and are displayed on the historical USGS Topographic maps.

For this project, there are two land grant feature files available. The first is from Dr. James Harlan at the University of Missouri Columbia, called "*preown*". Through a project called ***Lewis and Clark Across Missouri***, Dr. Harlan studied survey documents and digitized land grants throughout the state of Missouri. The second file are the digitized features from the Kamper map with attributes (fields) determined to be easy to update, easy to read, and facilitate attribute queries. There are slight differences in the information and how they align when compared with the land grant outlines on the USGS Topo maps. The arrows in figure 11 highlight shape differences in the data. What is not known, is just how the boundaries were determined for the digitized and the paper map boundaries.

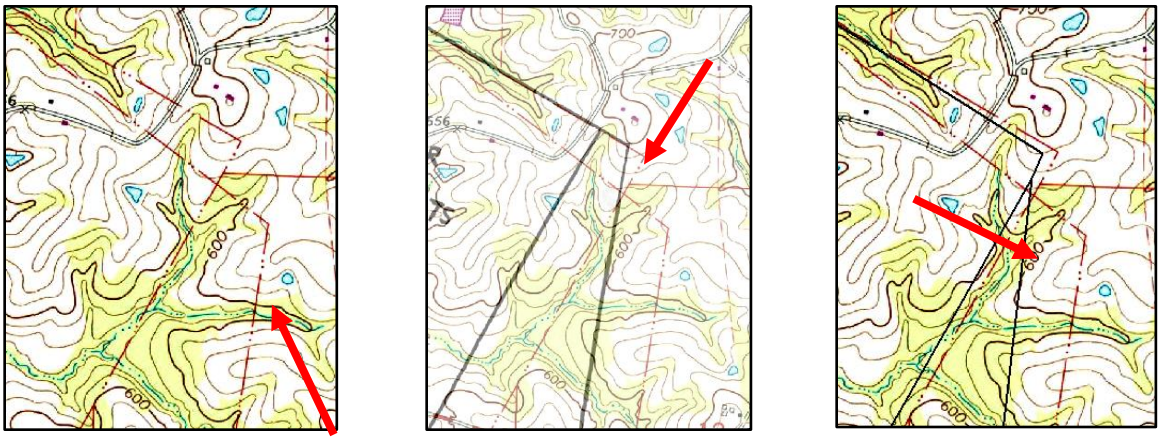


Figure 8. Comparison of land grant information.

This would make for excellent further study and identifying a process for how to accurately determine those boundaries would support further quality control efforts. A visit to the County Assessor office to obtain the original survey documents was on the docket for this project but unable to be accomplished. A suggested study topic would be to include the assistance of a civil land surveyor and investigate the land grants from within the area of interest in this project,

completing and expanding Kamper map land grant feature class. Including an experienced land surveyor incorporates some of the measuring techniques not many GIS or historical experts are familiar with. This information can then be applied to a revised map that reflects land grants over time or by originating grantor.

German Settlement

Just after the passing of Boone in 1820, there was an influx of German settlement that left a lasting impression on the region. A man by the name of Gottfried Duden is often credited with introducing the region to Germans via his book entitled *A Report on a Journey to the Western States of North America* published in 1819. However, the organization of emigration aid societies, rulers forcing churches to unite, quicker travel by rail as well as steam instead of sail, and rapidly increasing German taxation all contributed to a desire for Germans to emigrate (Society T. S., 2017). Those who emigrated often had some education or trade, and brought with them traditional German methods of farming. They established wineries, published newspapers, and entered into politics (Luebbering, 1996). This presence is most notably found today in the naming of well-established towns, such as Schluersburg, Augusta, and New Melle, and the many Lutheran, and Evangelical churches that still stand today. This is also an important connection to the Early Heritage Village as many of the structures originate from this time-period. A study that could prove useful to the discussion of German emigration would be to visualize settlement across time and then overlaying it the original village structure points.

The Role of Women

Frontier life was rough and violent. This required women to be resourceful, independent, yet balanced with the meekness and piety that was expected of women, particularly Quaker, of the time. Rebecca Bryan Boone was celebrated in her role as a frontier woman. She and Daniel

had 10 children. While pregnant with her 9th child, she opened her home to her six young nieces and nephews when her sister-in-law passed away. Daniel supported his family by hunting and would be away for long periods of time due to hunting, trading, along with other responsibilities such as legislative duties and survey expeditions. Rebecca was then the head of household and was reputed to be an experienced community midwife, the family doctor, leather tanner, sharpshooter and linen-maker. She managed the typical farm, could butcher and preserve meat, grew and harvested crops (Trout, Rebecca Bryan Boone, 2017).

Mary Easton Sibley is another influential woman in the St. Charles region. At the age of 29, she and her husband George settled on property just outside of St. Charles. They named the property Linden Wood on account of the many linden trees on the property. Mary Easton Sibley believed strongly in the importance of education for everyone, especially women, African Americans, and new immigrants. (Trout, Mary Easton Sibley, 2018) In 1830 she started a small school for girls and in 1834 started a separate school for free black and slave children. She viewed slavery as a national crime and saw education as a way to end it (Trout, Mary Easton Sibley, 2018). Thus, she continued education for girls despite losing students due to pro-slavery critics. Lindenwood School for girls, founded in 1827 by the Sibleys, later became Lindenwood University which is now a thriving 500 acre coeducational liberal arts university.

These descriptions of frontierswoman are more focused on culture. Representing women in a spatial context is not only about the physical location of key topics, but of the influence that a person had on the culture around them. Identifying locations such as birthplace, death place, cemeteries, and places of key events can show the activities of the person during their life. However, schools, companies, roads, parks, and landmarks are often are named for an influential person, such as Rebecca Boone Elementary school in Warrenton, Missouri. Although its true

origin does remain a mystery, the name “Femme Osage” itself is a clue to early French and Indian interaction and nods to the importance of women in culture.

Identifying these locations in the Boone Home digital interpretation project can display some of the influence of women in the community. A fine example of a grass roots mapping project is currently being conducted by the East End Women’s Museum. This is currently a virtual museum with the goal of obtaining a permanent brick and mortar site dedicated to research, record, and represent womens’ history across east London (Museum, 2018).They are using a Google Maps function with interactive links to add point locations of women. When selected, an information bar appears to the left of the map providing information about the woman at that particular point. What makes this especially interesting is that there is no time restriction. The museum invite all women to nominate an individual, modern and historical.

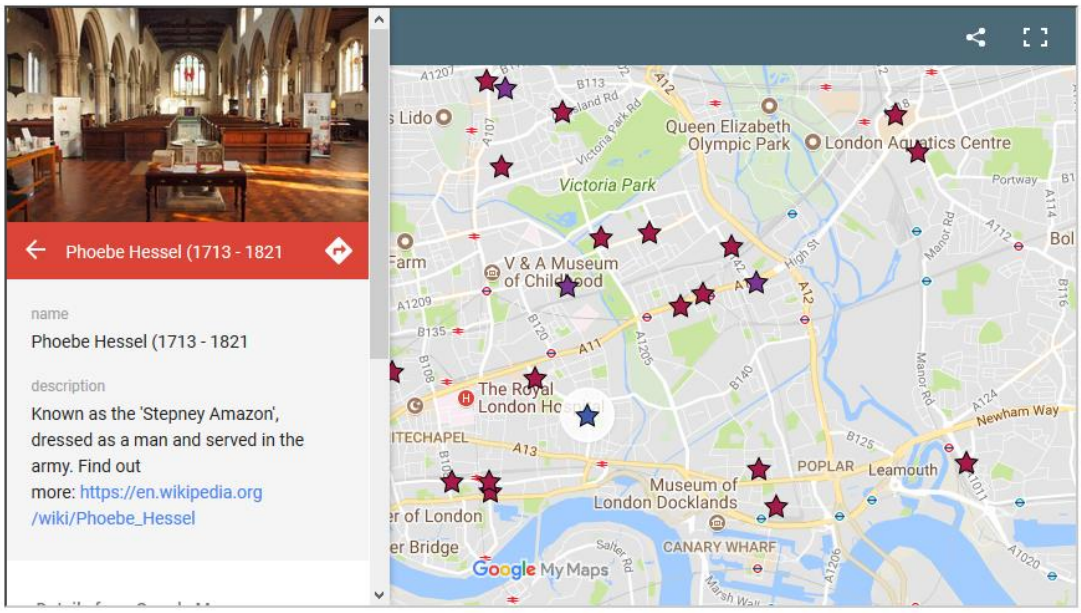


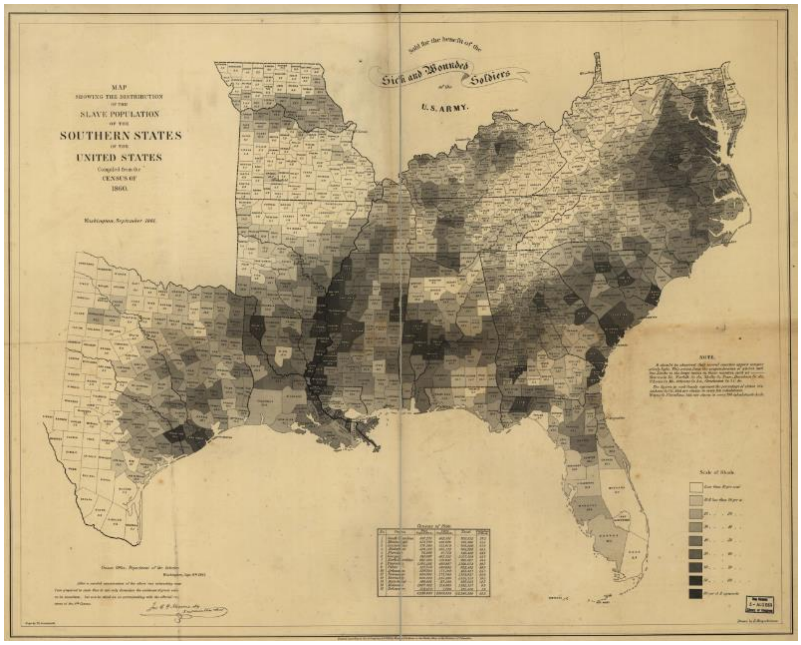
Figure 9 East End Women's History Map

There are many resources available that discuss influential women of Missouri, such as the MissouriWomen.org and the Women of Historic Missouri website from the State Historical Society of Missouri. Using a similar method as to that of the East End Women's Museum, a useful map could be developed with this information. However, it is recommended to have a bit more information, such as a legend, to invite users to further investigate the resulting map. While this is at a state level recommendation, as it was more difficult to identify something at a county level, it reflects how women can be celebrated on a scale that might have an impact larger than just their local community.

Slavery

The shadows of history can be difficult to navigate, yet in doing so, it reveals another critical view of how cultures operate and develop. Slavery was a distinctive part of life in early Missouri with a region just northwest of St. Charles known as the Little Dixie due to the extensive use of slavery (Feunfhausen, 2017). However, there were abolitionists throughout this time opposed to slavery, including many of the Germans who emigrated to the region in the early 1800s. The Boone family were among many families who owned slaves and included them in their life on the frontier. Derry Coburn was a slave owned by Daniel Morgan who was initially tasked with assisting Daniel Boone on one of the hunts along the Missouri River. As it turned out, Derry become a regular companion to Boone on multiple hunting trips and expeditions (Morrow, 2010). Nathan and Olive Boone have a more extensive history of slave ownership during that time at their homestead near Springfield, Missouri. However, it is noted that there was a slave girl who arrived with Nathan and Olive. Her name is unknown, though it is noted she likely lived in the kitchen of the Nathans' stone home when it was complete (William Ray, 2017).

A geospatial discussion of slavery specific to the region of interest, however, can be difficult to address. It is not that there is a lack of knowledge on the existence or extent of slavery use, but a lack of detailed locational information. Many of the old slave quarters have been



destroyed or fell into disrepair (Feunfhausen, 2017). This is the case with the likely location of slave quarters at the Historic Boone's Home Site, where the only evidence of the structure is a photo. Additionally, if locations are noted they are generalized to a town or region. The paper *African-American Slavery and Freedom on the Nathan Boone Farm* by Dakota Russell does an exceptional job of following slaves of the Boone family and their stories, some to see freedom. It also indicates where many of the slaves would reside, primarily at a town or regional level, to include St. Charles and the slave quarters on the homestead near Springfield. The 1860 choropleth map of slavery by county used by President Lincoln in Figure 11 shows where slavery was most prominent. A current study of the decadal census data within Missouri in a GIS system and displayed in the form of choropleth, would be an excellent way to reflect the dichotomy of slaves and free blacks within the state across several decades prior to emancipation.

Other evidence of slavery that could be mapped would likely be best at a larger Metro St. Louis level. Available sources with known locations are census data, free black churches, the Old Slave Road of nearby Chesterfield, and not forgetting the early slaves brought in by the French. In 1720, the French brought slaves from Santo Domingo for labor in the lead mining in Des Peres, located miles south west of St. Louis City. One suite of images, perhaps at the regional scale of the maps that show the French presence in the area, would be to note the map of the Missouri Compromise, with Missouri coming in as a slave state, and one slightly later image

Figure 10. Distribution of the slave population in the South, based on 1860 census results. Originally published in 1861. Courtesy of the Library of Congress

would be the maps of percentages of slaves by county as of 1860. Another method of mapping that could prove useful is to identify sources of the slave owners themselves. Many moved from Kentucky, Tennessee, North Carolina, and Virginia to Missouri. The periphery information from a study of this topic could reflect industry themes or fluctuations of slavery over time.

The Early Heritage Village

On the Boone Home property resides the Early Heritage Village, a construct developed over the course of many years through a combination of intent and opportunity. The owner of the property in the 1980s, initially began bringing structures to the area. He had the intent of collecting a series of historic homes and structures to create a sort of theme park. This vision was not necessarily historically cohesive, and so some of the buildings have architectural "embellishments" not original to the structure. He gave the property to Lindenwood University with a President who envisioned something more academic in nature and more historically

accurate...something more "Colonial Williamsburg" using the existing structures and bringing in new ones as they became available. However, after several later Presidents, interest and priorities changed within the University and the site was donated to St. Charles County. Every structure was collected from within 50 miles of the site and some are very unique, such as the Spanish Fort from 1736, what is most likely the last Horizontal Walking Wheel gristmill in the mid-west, and the Mount Hope School House from 1836. There are also some modern-built structures using historic techniques, such as that of the half face shelter and the wood-fired kiln. To make the most of the existing structures, the collection was framed as a village with different buildings staged to represent life around the early 1800s, such as a tavern and a surveyor's office. While the historic discrepancies, such as building placement on the property in the shape of an oval, will be less inviting to many historians, this is an opportunity to showcase fine examples of regional history. One method of displaying this collection is through an ESRI Story Map (Map Tour). For this project, a Map Tour was created using ordered points with photos and narratives for each point. Guests visiting the online site for Boone's Home can take a virtual walking tour of the collection learning more about the region and what to expect with an on-site visit. Further information about the village origin points can be developed in a similar manner. There is currently a feature class file developed with this information that needs additional refinement.

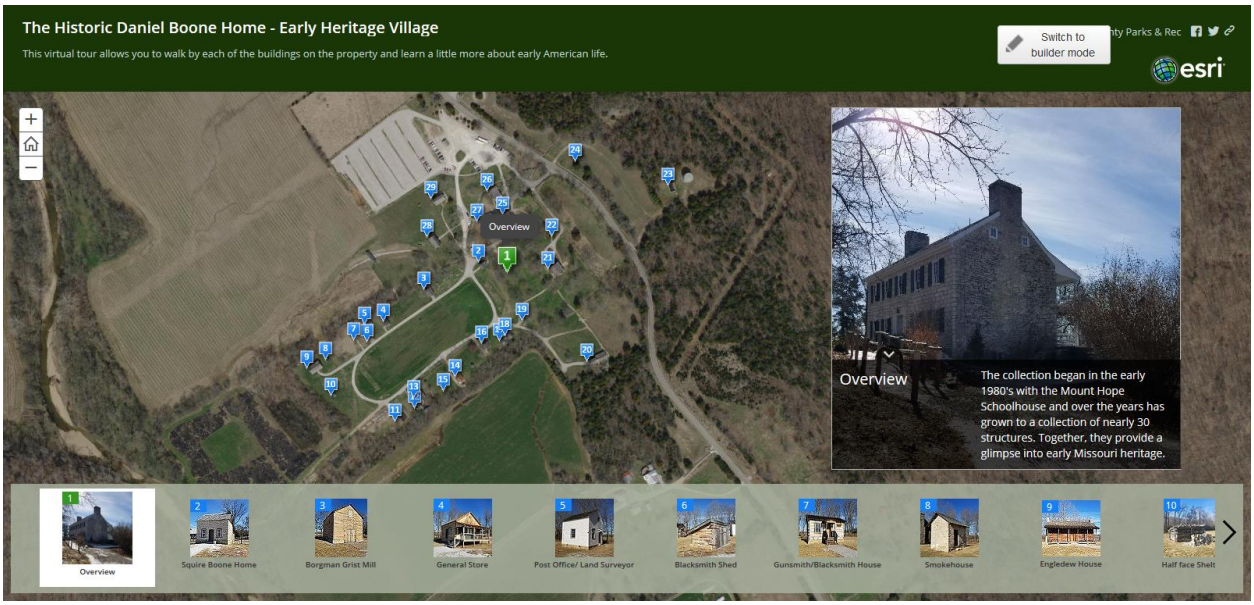


Figure 11 Story Map: Village Map Tour

Data Preparation, Collection, and Storage

As noted in the discussion of feature layers, there are various forms of sources. For this project, they have been roughly identified as features from the Kamper map, existing data, and future data. Data preparation of these sources must be performed to develop a cohesive and consistent result. Each of the topics in Figure 15 must be addressed to bring the data into single platform and can be treated as the same set of steps for developing a physical or a digital map.

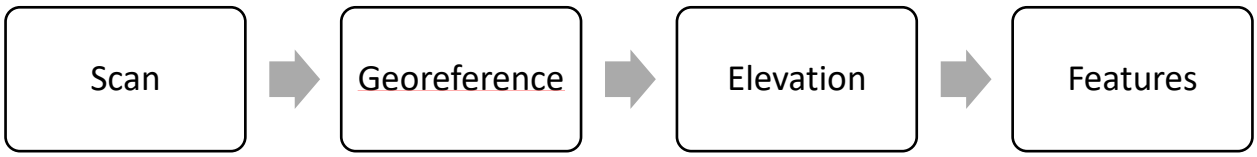


Figure 12. Data Preparation Workflow

Scan

To begin, the original paper map required pre-processing operations to allow it to be used by ArcMap. The original map dimensions were 30 inches in width by 58 inches in height. The map was scanned into PDF format, in a 300 dpi map. The Office Max location used for the first scan had a new large scanner and I requested the top DPI scan. The employee was new and not expressly familiar with the machine. I later verified the parameters of this map scan by having a graphic designer verify them in Photoshop. I contacted Office Max again and found that the scanner was their "blueprint" scanner and they did not have anything larger or able to do more refined scans.

To use the file in ArcGIS, I used the Convert PDF to GeoTiff tool in the ArcMap Conversion toolbox. The default parameters resulted with no display. The parameters were adjusted to use no compression during the conversion. The result was a three band geotiff oriented vertically. The Rotate tool was used to reorient the file horizontally. After consulting with vendors who generate raised relief maps, it was brought to my attention that a high resolution scan of the original map would be required if any physical print was required for something larger than the original print. This is a goal of the intended tabletop map and therefore it was an important point to address. High resolution in these terms refers to 600 dpi or higher.

After discussion with the Parks Director about existing structures on the map that could be reliable sources of control, a number of locations were identified. It was suggested by the Park Historian that most roads in some of the older towns have not changed much over the years and could potentially serve as more centralized locations for the town. Old regional atlases could identify locations, and then locations could be collected via mobile mapping device. These could then be the more accurate control points. Combined with a higher resolution scan, this could result in a more fitting georeferenced solution.

To do this, local companies who do large format scanning were researched and contacted. These companies use more refined scanning methods that include securing the document to a flat surface and overlaying it with a glass plate to minimize creases and surface imperfections. These methods are for art reproduction and therefore the intent is to duplicate the document as precisely as possible (Trotter, 2018). The four resulting files from the chosen vendor was a direct raw full color image, a grayscale image, a grayscale that was color corrected to intensify the white and black color contrast, and a final 50% reduced file size of the color corrected file. A comparison of the various scans are noted in Figure 16.

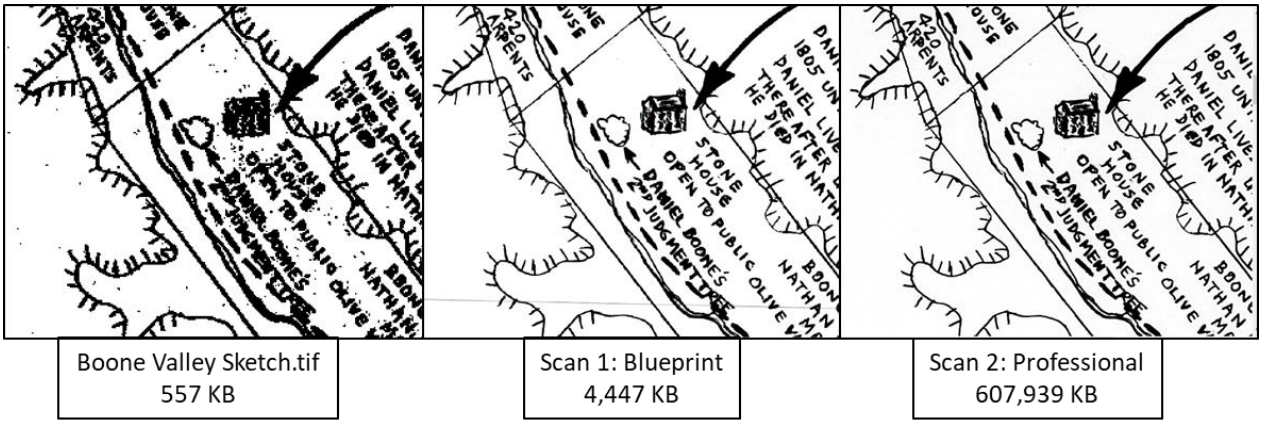


Figure 13. Comparison of scanned maps and respective file sizes.

The first image is the original scan in tif format that was stored with the St. Charles County Parks and Recreation Department. The writing is blurred and there are random pinpoint speckles that are not present on the physical. The second image is that of the first scan in pdf format with a blueprint scanner. Visually it is clearly an improvement with distinct lettering and lack of speckling. However, the 300 dpi does not allow for the map to be enlarged without degrading the image quality. The final image is the professional scan in tif format. Though it

initially does not appear much different from the second, it does have the ability to be enlarged without compromising quality.

Factors that Compromise Historical Map Accuracy

At the forefront of this project, both in terms of existing data and new data to represent historical features or events, is the question of accuracy tolerance for data to be useful. Are quantifiable values achievable to nail down the reliability of a source? The short answer is that it is truly dependent upon the source. Anne Kelly Knowles wrote a chapter in the book *Placing History* by ESRI that specifically addresses uncertainty in historical GIS. She notes one of the issues is a perception of mapping, and GIS in particular, demanding a level of accuracy that historical data cannot support (Knowles, 2008). Some sources will be physically present to collect information from, such as building remnants, and the technology to collect that information may have measurable values associated with it. Other sources are going to be more obscure and vague, such as historical narratives and interviews. In these cases, it might be necessary to piece together more information from multiple documents for a more refined location, but uncertainty often remains. Uncertainty in data should not be a means by which its usefulness is discounted. By conducting thorough research, using the best technology accessible, and being aware of where uncertainty may be present, many times the quality of data can be much better than the 80% solution.

There is a very good potential for a very good georeferencing solution of the Kamper map, yet a perfect solution will not be achieved due to a few factors related to original map development and historical methods of recording information. The original map that was developed is essentially a mosaic of paper maps that have been enlarged with copiers. The copier can introduce slight distortions in the ‘translation’ of the image. If the pages are not aligned

precisely when ‘mosaicking’, an error can be introduced that can become progressively worse due to slight changes in angle as noted in Figure 17.

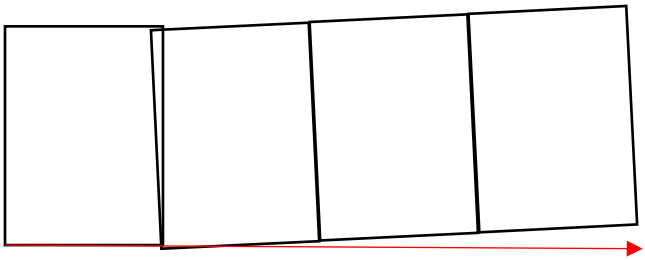
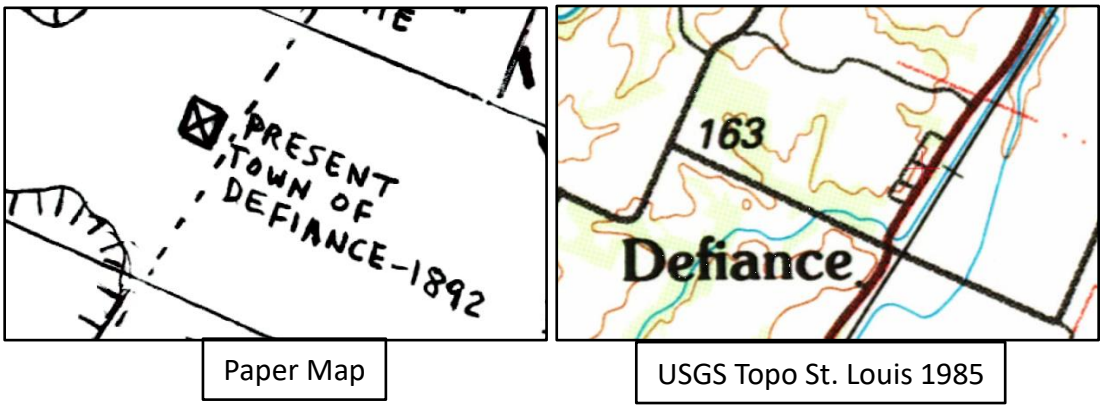


Figure 14. Potential alignment error in Kamper map increasing over distance.

There is very little basemap information that can be used as tie points and towns are one



of the few features that can be connected to a controlled location. Since towns are represented as point symbols, those single points can cover a large area of ground. The location of the town of Defiance in the Kamper map, represented as a point symbol, is compared with that of the USGS 7.5 topographic map in Figure 18.

It is important to note that scale is a key factor. To be able to include detail such as roads, the scale must allow for that. The hand-drawn map does not necessarily allow for such detail.

Figure 15. Visualizing a town with a point as compared to including main roads.

This is where it becomes important to know if that single point for the town represents the city center, a road intersection, or is it arbitrarily placed over the town.

Georeferencing

To make the Kamper map digitally useful, it needs to be scanned. The scan does not initially come with spatial registration information, so it will also need to be georeferenced. Georeferencing is the process of defining geographic locations on the scanned image and assigning a coordinate system to the file. This is accomplished by using a geographically controlled image and using tie points to assign this location to the same location on the scanned image (ESRI, Fundamentals of georeferencing a raster dataset, 2014). In Figure 19, the controlled image is being linked to the uncontrolled vector file. The green cross at the intersection is being tied to the yellow cross on the same intersection of the vector file.

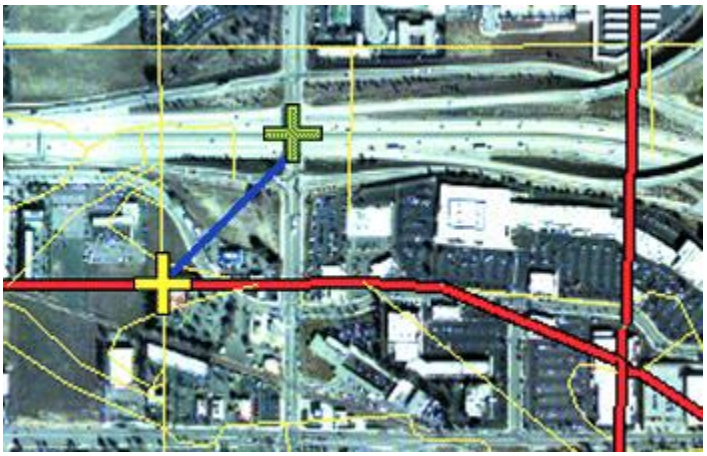


Figure 16. Example of tie points linking vector data to a controlled raster image. Courtesy of ESRI.

Georeferencing historical maps is not a new process and there are many websites available that do just this. California Polytechnic State University has collected a comprehensive

resource list of historical GIS data and georeferencing sites that is certainly worth reviewing at http://guides.lib.calpoly.edu/gis/HGIS. The David Rumsey Map Collection is a particularly

exceptional site that not only has an extensive collection of georeferenced historical maps, it has a site that user can actually conduct georeferencing (https://www.davidrumsey.com/view). The user can either georeference their own map or help with a current list of about 6000 maps that still need to be georeferenced. Something else that makes the David Rumsey site even more interesting is the ability to overlay historical maps with other existing maps or overlay it onto elevation data in a 3D viewer (see fig 20).

Figure 17.Map of Yosemite Valley, 1883, shown in the 3D view in Georeferencer courtesy of the David Rumsey Collection.

Another good site for more information about georeferencing and historic data is through the Spatial Humanities site through Scholar' Lab, a peer reviewed set of tutorials on spatial tools and resources for teaching and research. Here there is a step-by-step guide to georeferencing historical data where an orthorectified image is used as the control data (Humanities, 2010). In the case of this project, an orthorectified image may not be the best choice for controlling the image. The Kamper map was developed by using mylar overlaid onto USGS Topographic maps and lacks the feature precision that would be necessary to identify like features on a controlled image. Using the original source to essentially 'reproduce' the process ensures the most likely alignment and use of like features.

The source maps used to develop the Kamper map are not specifically identified; however, given Mr. Kamper's response that "multiple maps were mosaicked together" and "USGS topo maps were used" (Kamper, 2017), it is very likely they were 7.5 minute quadrangles. Through The National Map, the georeferenced pdf version of the quadrangle maps can be obtained up to 2006. Since there is a source with a known coordinate system, it can act like a control and the potential of the Kamper map being tied to it is very high. It can be tedious to maneuver through the National Map for historical downloads, so it is recommended to instead use the interactive map tool TopoView to obtain geotif files. TopoView shows the many and varied older maps of each area, and thereby is especially useful for historical purposes (USGS, TopoView, 2017). The historical topo files, however did result in multiple spatial reference systems, to include NAD 27 Polyconic, NAD 27 Transverse Mercator, and WGS 84 Transverse Mercator. In 2009 the USGS made a push to generate the maps digitally resulting in the US Topo GeoPDF. These are new maps based on GIS data, but still use the traditional papermap layout.

Using the National Map for download results in useable geopdfs, but the files are named numerically. The user is required to visually inspect each image, identify the title, and then rename the file accordingly. The coordinate system of the GeoPDF topo maps are in North American Datum of 1983 (NAD83) Universal Transvere Mercator (UTM) Zone 15S.

In comparing the topo maps across methods, it was found the alignment was very good, but very small error was still identified. Figure 21 shows a US Topo map displayed with reduced transparency over a historic USGS topo map. The darker line to the left of the red and white road is an example of the slight shift in information. The USGS website addresses accuracy issues with the following statement:

> The accuracy statement printed in the margin of most 20th-century USGS topographic maps referred to absolute horizontal and vertical accuracy. This statement was tied to the National Map Accuracy Standards (NMAS). US Topo maps are as accurate as the data sources used to make them, but because these sources are many and varied, it is not possible to make a single simple statement that the map as a whole meets a particular level of accuracy. The maps therefore do not carry a traditional accuracy statement on the map face. Accuracy information for individual data sources is included in the metadata file attached to each US Topo file (USGS, How accurate are US Topo maps, and why don't they have an accuracy statement?, 4).

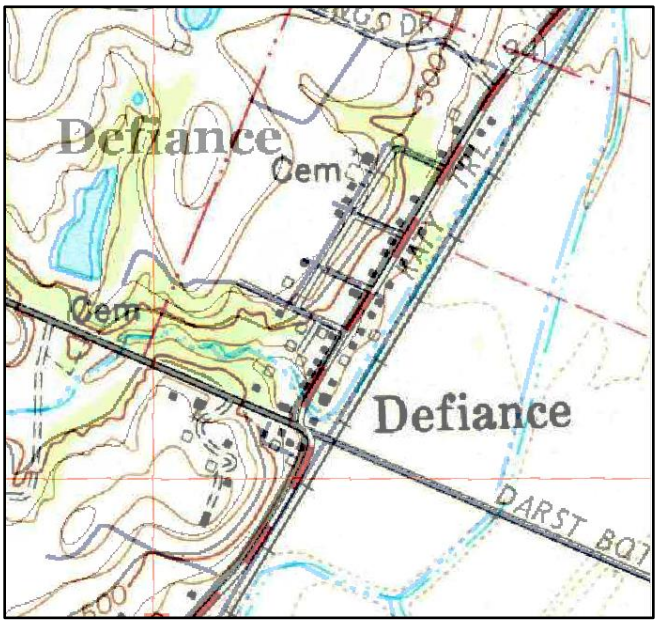


Figure 18. US Topo overlaid with transparent display onto Historic USGS Topo map.

Given the uncertainty in the topo maps and in the development of the Kamper map, the process becomes less “georeferencing” and more “rubbersheeting”, although the term georeferencing will continue to be applied to the process. While the resulting data is therefore not appropriate for large scale geospatial databases, it certainly does not diminish the usefulness of the information. Appropriately used, this is an exceedingly useful map.

The workflow for georeferencing (fig 22) is relatively simple beginning with determining what to use for control, often an orthorectified image. Depending on the software used, the actual process of georeferencing will be conducted in the control projection so the end result is the target dataset being "tied" to the control projection. Locations are identified that can be readily found on both the control and the target datasets, then the maps are tied together. In this particular case, the same process will be applied to ensure a best fit of the data. The figure below highlights the main points and notes some of the details that need to be addressed with respect to the low quality scan in pdf format. The high quality scan in tif removes the conversion step.

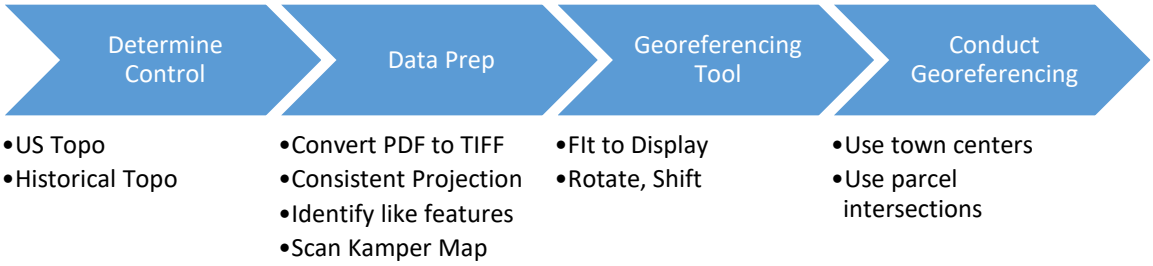


Figure 19. High level georeferencing process with low quality pdf scan.

Initially, the US Topo maps were used as control since they were the most current and all files were a consistent projection. The only features on both maps that could be tied together were that of town centers, most of which were located centrally on the target map. This is a less than desirable spread because it only ties down the center of the map and the edges can significantly warp. The result was relatively good, but significant errors were noted particularly in the southwest area of the Kamper map.

In reviewing the USGS Historical Topo maps as control, it was determined that they would be the more appropriate option. The maps chosen were primarily from the 1970s and

1990s which reduced mismatched projection issues, resulting in only reprojecting two topo maps to NAD 27 Polyconic. These would have been more likely the maps used in the development of the original map and there was a feature on them that could potentially resolve the tie point spread concern. Unlike the newer, US Topo maps, the historical maps included land grant boundaries. This was verified from the symbology key provided by the USGS (USGS, Topographic Map Symbols, 2). Using like parcel intersections, multiple tie point options were identified. For this project, eight points were used and the focus was primarily towards the outer edges of the map. The result showed an improved fit among the parcel placement; however issues were still evident in the southwest region of the map (fig 23).

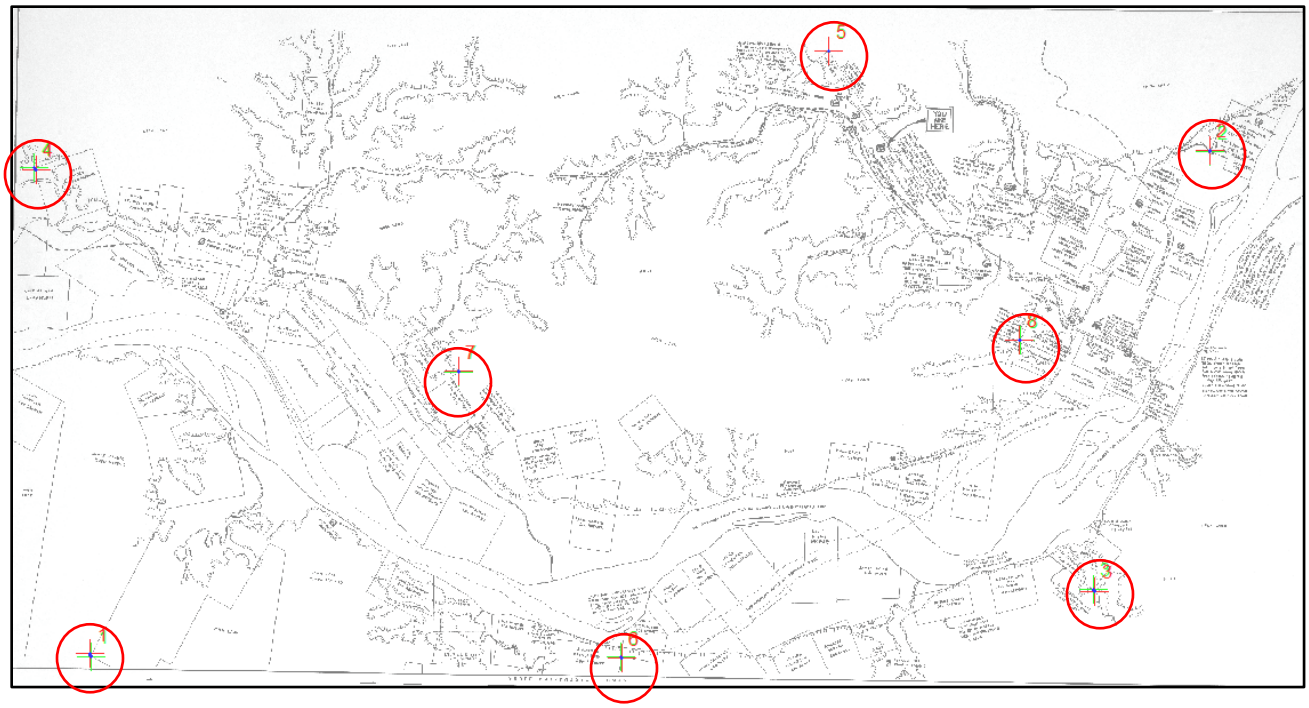


Figure 20. Locations of tie points used on parcel intersections.

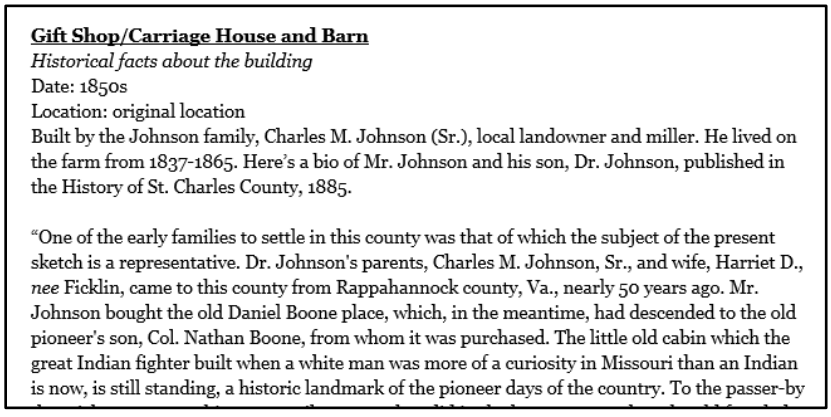
Elevation Data

One purpose of the physical map display is to provide guests a deeper understanding of the terrain and how it impacted settlement in the region. To accomplish this, the available elevation data in the region was reviewed to identify that which would represent the area while maintaining manageable file sizes. There are several options of elevation data to use, to include 30 meter and 10 meter USGS digital elevation model (DEM), as well as 1 meter LiDAR available through MSDIS. It was determined that the 30 meter resolution data was too generalized and would actually "smooth" out the region removing key relief element. USGS 10 meter, however, maintained both the integrity of the relief and managed the filesize. The investigation of the 1 meter LiDAR data resulted in data that requires further validation and was not useable beyond initial visualization.

Through MSDIS, there are DEM mosaic and point cloud .las datasets. Initially, it was anticipated that the elevation mosaics would sufficiently work for the project. However, while in discussion with the St. Charles GIS Department it was noted that there were some discrepancies and potential poor processing of the data. Given the seeming availability of the original point cloud data, it would make sense to attempt to create new elevation grid files and conduct a comparison of the information to determine poor data or poor processing methods. Unfortunately, this could not be accomplished as the las files for St. Charles County are missing spatial reference information from the header files. Additionally, there appear to possible issues with the spatial reference when it was attempted to be applied. Auxiliary data provided indicated that the spatial reference was for State Plane Coordinate System 1983 (2403). This is for the western side of Missouri as opposed to (2401) which is for the eastern side of Missouri.

Features Data – Narratives, Data Management, Collection

With historical data there are two particular concerns with features themselves. There is the feature itself, resulting in an actual location with associated attribute data such as who or what or when something occurred. Then there are narratives. These are the stories and relationships behind a given feature or set of features. No existing, definitive methods were identified in previous projects that effectively combine these information sources. However, experience lends itself to finding the way that keeps methods simple. One of the issues identified with this project were the massive amount of sources and how to document that information appropriately. Ultimately, it appears that having a supplemental written document that correlates to a feature file allows all the necessary citation and attribute information to be recorded in an easy to read manner, as opposed to overloading a feature class. It is recommended that when developing a feature file with associated narratives, a Word document be developed with a feature name, the location, the narrative with appropriate sourcing, and any further attribute data that might be fitting. The image in Figure 22 provides a nice example of a format that was effective for creating data for this project.



Gift Shop/Carriage House and Barn
Historical facts about the building
Date: 1850s
Location: original location
Built by the Johnson family, Charles M. Johnson (Sr.), local landowner and miller. He lived on the farm from 1837-1865. Here's a bio of Mr. Johnson and his son, Dr. Johnson, published in the History of St. Charles County, 1885.

"One of the early families to settle in this county was that of which the subject of the present sketch is a representative. Dr. Johnson's parents, Charles M. Johnson, Sr., and wife, Harriet D., *nee* Ficklin, came to this county from Rappahannock county, Va., nearly 50 years ago. Mr. Johnson bought the old Daniel Boone place, which, in the meantime, had descended to the old pioneer's son, Col. Nathan Boone, from whom it was purchased. The little old cabin which the great Indian fighter built when a white man was more of a curiosity in Missouri than an Indian is now, is still standing, a historic landmark of the pioneer days of the country. To the passer-by

Figure 22. DBHandVillage.pdf from the Historic Daniel Boone Home

Before collecting data, there must be a means to store it. It is recommended to use a File Geodatabase using feature datasets and feature classes to structure the data. This is an effective method of organizing data: there are fewer size limitations to the files, topology rules assist in quality control, and feature collection itself. Additionally, raster data can be stored in a geodatabase which could help with source file storage. Another advantage assists data entry for attribute tables through coded domains. A coded domain assigns valid values or ranges for the attribute table that forms part of the information contained within a feature class. This helps to reduce errors in data entry by eliminating invalid entries. It also reduces data entry time by creating a series of drop-down menus (Tennant, 2002).

This project started with gathering all possible feature theme layers and assessing the commonalities and the differences to identify data and source themes. There is not a lot of existing information available on best practices for structuring a historical GIS. However, a paper written about a sample geodatabase for an archaeology project provided an example that could be molded to this project (Tennant, 2002). The resulting geodatabase for this project needed to be easy to navigate through, have clear feature names, and be flexible enough to update as needed. The structure outlined in Appendix A provides feature datasets for the major themes of information that are currently used in this project and those that might be addressed in future projects. The features classes, Appendix B, within the datasets have more robust attribute tables to support the addition of new information if it available. Multiple projections were found when exploring existing data sources; however, the predominant feature class project is North American Datum 83 Universal Transverse Mercator Zone 15. This was chosen as it was a

common projection friendly with different raster datasets, QT Modeler, ArcMap, and existing vector datasets.

Feature collection may be conducted by land survey, orthorectified image, or through field collection using the Global Positioning System (GPS) constellation. For this project, both digitization and use of the GPS constellation via mobile phone GIS application provided a financially prudent and yet reliable method of feature collection. The paramount question, however, is the accuracy of mobile GPS feature collection sufficient for this project? Additionally, are the merits of conducting field collection via high accuracy GPS receiver necessary?

There are several factors that do affect how well the algorithm that a mobile device runs on the GPS signal it receives. ESRI conducted a study on the accuracy of GPS collection on mobile devices. They conducted tests using smartphones, smart phones connected to "consumer grade" GPS receivers, and smartphones connected to high accuracy receivers, open sky and through canopy. They found that "locational accuracy is pretty much the same regardless of manufacturer. In the open sky, mapping with several devices approximately **90%** of all positions collected fell within **3m** of our baseline" (Shaner, 2013). More specifically, all positions collected with a smartphone alone were within 3 meter accuracy. When a high accuracy receiver was connected, the results showed all positions were within 1 meter accuracy. A test was conducted using SW Maps, an app for Android phones. SW Maps is a GIS style app that allows the user to collect information using their phone, or connecting via Bluetooth to a handheld GPS device. The files are stored in projects and feature files on the phone in point, line, or polygon format. These files can then be easily shared as a zip file via email. There were pros and cons to this method of collection. Initial set up of the system could be a bit confusing in how it structures

projects and features. Once set up, it ran quite effectively and was very easy to update with fields, comments, and photos. It stores the data on the device and then shares the data in shapefile format with both 2D and 3D versions pending device capability. The results were cross referenced against USGS Topo maps and GoogleEarth validating the approximate 3 meter accuracy in some locations, while others were spot on. This indicates that reasonable information may be collected via cell phone app for certain circumstances, such as larger features like caverns, campsites, or recording the origin point of a structure before it is to be moved. For features requiring a bit more refinement, handheld GPS receivers are an effective means of obtaining a reliable coordinate. Although the method was unable to be tested in this project, it was the recommended approach by an active land surveyor (Fuchs, 2018). Working on both civil and federal government projects with both handheld and high accuracy receivers, it was noted that for most civil projects the handheld receivers capable of accuracy better than 3 meters were very effective and without the expense of time or money for a high accuracy receiver. It is highly recommended to conduct a thorough review of available GPS-GIS studies and GPS devices prior to initiating use for future collection efforts.

Digitizing features for the purpose of this project allowed for two points to be addressed. First was that it reflected the accuracy and inaccuracy of hand drawn maps. When overlapping the resulting features with USGS Topo maps along with orthorectified imagery, some areas were exceptionally accurate while others are less so. The other point was that it allowed for data storage methods to be tested. A file geodatabase proved an effective means of ensuring data was stored in the proper projection, organized, and allows for quality control.

Physical Map Development

Currently the Kamper map is a single image and when overlaid onto the terrain, it would only show up as black and white. Additionally, the lettering of the narratives would be difficult for the reader to interpret over the terrain. To improve the visual communication while retaining the historical integrity of the map, the features were digitized and used as the sample in the geodatabase structure. A new layout was developed respective to the original Kamper map, but brings out the nuances of information. A proper basemap can provide a lot of information for the reader to get spatially oriented within a modern context. Replacing the white background with high resolution aerial or satellite imagery readily shows the modern locations of urban and rural regions. Another option, is to use a historic USGS topographic map recolored to a two-tone color ramp that allows it to function more as a basemap. For this project, the 1809 and 1903 maps were used as they provided great historical and modern context, despite neither entirely covering the area of interest. Newer topo maps that did cover the area lost a bit of the context so they were not used. The biggest concern with choosing a basemap for a tabletop map is how it will enlarge. In this case, the historical topo maps are excellent for digital use or smaller versions, but when expanded to the potential tabletop size resulted in a pixelated, less than stellar product. This is truly a question for the printing vendor and what the software can handle.

The features can still be input then be color coded and new annotations can be added to more readily distinguish trails from creeks and so forth. In the resulting layout, the symbology was kept simple to reduce visual clutter and allow the user to be able to see the trails twisting through the topography and winding creeks. Intuitive point features were used, such as stars for towns and house shapes for dwellings, to keep the familiarity of the feature while color tones were used to distinguish types. The overall colors used were intended to maintain a “historic feel” yet allow feature individuality. To highlight the Boone family land grants from the others a

brighter color was used to allow the reader to see how the family settled all along the Femme Osage Creek Valley. By digitizing the features, attribute data can be added and then used for more categorized symbology. In the case of land grants, filling in more of the attribute information, such as year, adds another level of information for the reader. The legend, north arrow, and scale were positioned for clarity and to the right as an 'end to the sentence'. Since most readers start from the left and end on the right the map is taken in first and then legend used as reference. Additionally, it is nearest the most Boone family centric features for quick viewing. The final map is available in the map document provided to the Historic Daniel Boone Home as well as geotif format.

Physical Map Printing Vendors

Completing the final physical map product requires the use of professional printing vendors. There are several companies within the U.S. that produce physical maps but there are nearly as many methods of printing. The final report of vendor options reveals mostly custom processes and in many cases custom equipment. The Vendor Summary Report has the complete listing of companies researched and available product information.

Digital Map Development

The digital format recommended and used for this project is the ESRI Story Map as it allows a combination of maps created by the author, existing historical references, and the addition of narratives. The results are easy to read and, once developed, are relatively easy to update as needed. The caveat to this format is that it requires an ArcGIS Online account due to the data storage associated with it. In this case, the St. Charles GIS Department is already established with ArcGIS Online and this makes Story Maps a worthwhile option for the Historic site. For this project three Story Maps were developed and will be transferred to the Historic Site

for further refinement and use. The first is the ***The Historic Daniel Boone Home - Early Heritage Village*** map previously mentioned in this report. Structured in a Map Tour format, this provides remote guests the introduction into what the simulated village is comprised of. The next map developed is in a Map Journal format entitled ***Daniel Boone: From Pennsylvania to Missouri***. This follows Daniel Boone from his birthplace through all the locations that he lived, ending in Missouri. The point file indicating those locations was researched and created for this project. It can be found in the associated geodatabase provided to the Historic Site. The final map is another Cascade format entitled ***History of the Femme Osage Valley and Vicinity***. It introduces the reader to the early Indigenous cultures of the area, displays territorial changes and early colonial settlement and then discusses other impacts to the culture such as influential women and slavery. The maps, links, narratives, and images work together to combine historical information with geospatial context that is easy to understand and interesting for the reader.

There are several notes to be aware of when developing a Story Map, beginning with the web browser. Mozilla Firefox was used extensively in the development process; however, the Cascade style builder is only accessible through Chrome or Safari. There are several guides from ESRI and online blogs that provide an abundance of information making customization very attainable, especially at the developer level. It is, however, a tedious process that takes a deceptive amount of time to institute. This is because there is a lot of flexibility with what can be used and what can be edited. Approaching the structure with a general flow of topics/outline in mind, allows the flexibility for changes in the event that visual display is less than favorable or a site link has issues. Attempting to develop a more rigid plan can be a bit defeating when those unexpected hiccups arise. Of the utmost importance during development, is having a separate document that retains the links to sites. Keeping an ordered list in a word processing document

or spreadsheet with the associate narratives/links/map names is the best backup in case the ‘save’ button hangs up. When generating maps in ArcGIS Online to be used, load the feature content first then create a map from it. Maps can be used across Stories which does save time; just pay extra attention when making adjustments or changes for a particular view. This prevents any accidental, fundamental map changes that might carry through to another Story point. Finally, save and save often.

Conclusion

This project began with the desire to fill a spatial awareness gap by researching the means necessary to convert a paper map to a tabletop map, which then evolved into examining the options for developing a digital map of the same source data. The process of developing map displays for the Historic Daniel Boone Home has revealed the potential of historical GIS and several important factors to consider when translating a paper map into digital. Throughout this paper, existing historical GIS projects were explored that provide the user a new look at history through searchable data and interactive web map development. This also speaks to just how big of a project historical GIS can become as these are operated by a team of experts. Uncertainty was studied and is a vital consideration when determining historical data. Combining the expertise of historians with GIS analysts ensures the right data sources are considered and that impact of uncertainty is minimized.

Data preparation for both the physical and digital map displays begins the same. Scanning the data at low resolution is fine for some purposes, but for the development of a tabletop map and digitization a professional, high quality scan is required. The professional scan for this project is a deliverable so that it may be applied to future projects as needed. This minimizes the introduction of error which can become evident during the process of assigning

real-world coordinates to the map. There is a method to the georeferencing madness and while it is important to find appropriate control sources, it is also important to conduct tie point collection in a manner that also minimizes error. In this case, using the land grant intersections resulted in an improved final result which is a deliverable of this project. Elevation data is necessary for a tabletop map and it was determined that the 10 meter bare earth dataset from the USGS would provide the appropriate amount of relief for clear visualization. Higher resolution data was investigated and showed that not only would it take up a massive amount of file space, some of the detail would get lost at the needed scale. Elevation data can also be visually depicted with 3D visualization software. A sample video was developed as another deliverable.

At the core of the project is feature content. A geodatabase was developed to provide structure for existing data, flexibility to include and expand on future datasets, and means to leverage the quality control measures. This is a deliverable and will include some of the existing periphery data sources used in this project. This data was combined with historical USGS topographic maps to create a digital version of the paper map in a geotif format. This layout provides a strong example of the desired end result table top map, but it will need to be submitted to a vendor for completion. To assist in the table top map research, vendors were contacted and the information was collated into a supplemental report. There were three digital maps developed that utilized the existing ArcGIS Online Story Map features that are considered the final three deliverables. The first is focused on the Early Heritage Village at the Historic Site and provides guests a new method of viewing the collection of structures. The second is centered on the life of Daniel Boone and identifies where he lived from Pennsylvania to Missouri. A new feature file was researched and generated to provide as accurate a list as possible. The final story map is focused on the Femme Osage Valley and Vicinity bringing the regional history to light.

This acts as an introduction that hopefully inspires further research by the reader into the rich history of the region. All these maps make extensive use of existing historical GIS and geographic resources and include new feature files generated in this project.

This project was presented to a group consisting of the Historic Daniel Boone Home Site, St. Charles County Parks and Recreation, St. Charles County GIS Department, and the Friends of Daniel Boone Burial Site. The post-presentation discussion was rich and insightful with a focus towards multiple future projects. Methods on encouraging more middle and high school age audiences were discussed through workshops directed towards advanced placement classes. One possibility would be to investigate the more subtle, yet important locations of early settlement of St. Charles. St. Charles Borromeo Church was dedicated on November 7, 1791 at Jackson and South Main Street. A log church built in typical French fashion was dedicated by the Spanish Lieutenant Governor who at the same time changed the town name from “Les Petites Cotes” to “San Carlos” later anglicized to St. Charles (Missouri T. S., S0138, 2018). A replica of the log church, constructed in 2004, reflects the vertical log construction as opposed to more commonly expected horizontal log construction.

Figure 21. Replica of St. Charles Borromeo Log Church

Presentations of this project and versions of it, were suggested at other workshops at the site bringing a deeper awareness to sense of place. Additional studies were explored with respect to the regional history, to include a historic economic study related to gristmills and output after a discussion of water versus steam mills. Available documentation could indicate where particular gristmills were, product type, output of that product, and servicing area. With respect to the discrepancies in land grant boundaries identified between the Kamper map and Harlan shapefiles, it was noted that different sources do present different interpretations of the original surveys. This only stresses the importance of thorough attribute fields and sourcing, though a singular study could prove interesting.

Several questions were asked about the project itself. It was noted that the ability to flip back and forth between historic and modern maps would be desired in the digital map. It was

also recommended to use the ESRI Web App Builder for this. This suggestion was explored and while the web app builder didn't on the front end seem to have the function, another Story Map did. This was then linked within one of the Story Maps but the result feels cluttered. It needs more tinkering. It was also suggested to further explore the various metadata templates available for use in ArcCatalog. The intent with the question was as a method of recording source data, but it doesn't necessarily address the multiple source issue that occurs when validating features. This will still be investigated as it could still be beneficial.

Upon final reflection of this project, it appears that historical GIS requires an exhaustive amount of work for an exceedingly useful reward. From a personal standpoint, working with historians was enlightening in both how history is interpreted and how it is expressed. There is a nuance present which requires the GIS analyst to step back and absorb, so as to accurately tailor feature content and respectfully represent in map development. It is recommended to view all deliverables of this project as a baseline to further, more refined studies on a topic by topic basis. This allows for flexibility of human resources and expertise as available. Ultimately, this can result in an effective and informative blend of history and geography.

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Appendix A

Geodatabase Structure

Structure of Geodatabase Content. Feature Datasets are a single projection and these are in NAD83 UTM Z15N. If a different projection is used, it is recommended to include it in the title.

	Name	***Purpose***
File Geodatabase:	BooneHomeData	Features related to Daniel Boone and the Femme Osage region.

Feature Dataset:	Artifacts	For smaller features such as tools, equipment, utensils, etc.
	Boundaries	For features that are based on boundaries, such as parcels, townships, legal, state, county, territories, etc.
	Cultural	Features that are culturally based, to include trading posts, event locations, commons areas, etc.
	DanielBooneBio	Features related directly associated with Daniel Boone.
	Environmental	Related to topography, land use, land cover, hydrology, soils, etc.
	MSDIS_UTM	Files obtained through MSDIS.
	Structures	Features related to buildings and structures such as barns, homes, cabins, shelters, silos, gristmills, etc.
	Transportation	Related to means of travel, to include trails, roads, paths, and routes.

Appendix B

Historical Feature Layers List

Feature classes set up within the geodatabase.

Feature Dataset	*Feature Class*
Artifacts	
Boundaries	AOI_UTM
	HistLandGrants
	Towns
Cultural	
DanielBooneBio	BooneBattleSites
	BooneHunts
	BoonePOI
	BooneResid
	DBooneLandGrant
Environmental	HydroHist_Line
	HydroHist_Poly
	HydroModern
	IslandsHist
MSDIS_UTM	Mo_Counties
	MORiv_UTM
	preownLG_AOI
	preownLG_Harlan
PolyconicFeatures	AOI_Poly
Structures	BooneVillage
	BooneVillageOrigin
	DwellingHist
Transportation	TrailsHist

Appendix C

Story Map Project Links

Links to Story Maps within author profile.

The Historic Daniel Boone Home - Early Heritage Village:
http://nga.maps.arcgis.com/apps/MapTour/index.html?appid=274164d966fd4f54b0b2f15f4e041a1f

Daniel Boone from Pennsylvania to Missouri:
http://nga.maps.arcgis.com/apps/MapJournal/index.html?appid=73ca80e005f9480ab8d47dcba268429a

Femme Osage Valley and Vicinity Regional History:

http://nga.maps.arcgis.com/apps/Cascade/index.html?appid=b79ff2280a694631ab9f857de8015c8c