Spring 5-18-2018

Using Digital Mapping Techniques to Rapidly Document Vulnerable Historical Landscapes in Coastal Louisiana: Holt Cemetery Case Study

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A Thesis

Submitted to the Graduate Faculty of the
University of New Orleans
In partial fulfillment of the
Requirements for the degree of

Master of Science
in
Urban Studies

by

Alahna Moore

B.A., University of New Orleans, 2013

May 2018

Acknowledgments

The methodology presented in this manuscript is the result of multiple years of research and experimentation that could not have been possible without the unyielding support and compassion of my mentors and peers. Primary thanks go to Dr. Ryan Gray, who planted the seed of this idea and sparked my interest in the unusual space that is Holt Cemetery nearly a decade ago. In the best of times, Ryan has been an essential collaborator, and in the worst of times, he has remained encouraging despite being verbally dragged at every opportunity given to me. Additional mention should be given to Drs. Connie Atkinson and David Gladstone, who have graciously volunteered to participate on my thesis committee even though the manuscript writing process was even more expedited than the methodology presented. The material covered in each of your classes, as well as the spirit of collaboration promoted by the both of you, greatly influenced the direction of my research and writing. Many thanks are given to Bryan Haley of Coastal Environments, Incorporated, for facilitating the lending of survey equipment and expertise required in order to operate it. Additionally, I'd like to acknowledge Eylene Parrish of Earth Search, Incorporated, for volunteering her time and knowledge in order to educate me about cemetery surveys and best practices for total station use, and Charlotte Willcox, for scanning the few existing burial records from Holt Cemetery that were used in this research. Finally, I have an endless amount of gratitude for the friends and family who have participated in the research and writing processes that produced this body of work. First and foremost, I'd like to recognize Elena Ricci for assisting in this work at every step of the way: from field survey, to photography, to conference presentations, to emotional well being, Elena has remained active and attentive in seeing this work to its completion. Secondly, thanks to my mother, Suzanne Richard, who is my initial and most important source of inspiration, and who just so happens to be more skilled at data entry than any millennial I've ever met. Additional thanks are owed to Elissah Gossiaux, Liazon Wakest, and Victoria Natell for volunteering their time and energy to help build this dataset. Danke schoen to Helen Bouzon, for being a never ending well of solidarity and praise. Many thanks to Weldon Ryckman, for being an excellent editor and a master of rhetoric. I'd also like to offer my resounding appreciation to the friends who visited the cemetery bringing lunch and laughs during the grueling summer field work days: Brittany Tozzolo, Martin Begue, and Michael "Magic" Moises. Gracias to Clayton Hunt, Emmanuel Segura, and Coco Lopez for teaching me the ultimate lesson in work and in life: take a break.

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EOS – Earth Observing Systems

GIS – Global Information Systems

GPS – Global Positioning System

GNSS – Global Navigation Satellite System

GSD – Ground Sampling Distance, how much area on Earth is represented by one pixel in raster

NGS – National Geodetic Survey

NASA – National Aeronautics and Space Administration

RTK – Real Time Kinematic

UAS – Unmanned Aerial System

UAV – Unmanned Aerial Vehicle

UNO – the University of New Orleans

X (Coordinate) – Easting, or eastward measured distance in a geographic coordinate system

Y (Coordinate) - Northing, or northward measured distance in a geographic coordinate system

Z (Coordinate) – Elevation, or the height of the terrain at a location dictated by X and Y co’ords.

Abstract

This thesis outlines a technique for rapid documentation of historic sites in volatile cultural landscapes. Using Holt Cemetery as an exemplary case study, a workflow was developed incorporating RTK terrain survey, UAS aerial imagery, photogrammetry, GIS, and smartphone data collection in order to create a multifaceted database of the material and spatial conditions, as well as the patterns of use, that exist at the cemetery.

The purpose of this research is to create a framework for improving the speed of data creation and increasing the accessibility of information regarding threatened cultural resources. It is intended that these processes can be scaled and adapted for use at any site, and that the products generated can be utilized by researchers, resource management professionals, and preservationists alike. In using expedited methods, this thesis specifically advocates for documentation of sites that exist in coastal environments and are facing imminent destruction due to environmental degradation.

Keywords: archaeology, cemetery survey, climate change, coastal studies, spatial database, digital history, documentation, GIS, Holt Cemetery, landscape studies, Louisiana, material culture, New Orleans, photogrammetry, remote sensing, spatial studies, UAS survey

Background

New Orleans, Louisiana, enters its 300th year of existence in 2018, the same year that the city was listed as the *New York Times'* number one travel destination throughout the entire world. The historic port city is renowned for its blending of French, Spanish, African, and Caribbean architecture, as well as its funeral parades, above-ground cemeteries, spicy seafood, and jazz music. Documentation of New Orleans's many defining cultural elements can help enable future generations to continue to engage with both the natural and built elements of the landscape that provide context to the city's distinctive traditions. Within the coastal region of Louisiana, an area that is imminently threatened by sea level rise, eroding land, and increasing frequency of catastrophic hurricanes, there is heightened pressure to record cultural features before they are lost forever.

This research will employ rapid digital documentation as an adaptive management strategy[1] to preserve spaces facing destruction due to environmental forces, urban development, or general disrepair. An experimental, digital approach is required in dynamic landscapes because entrenched processes of preservation and monitoring have proven insufficient to document cultural resources experiencing rapid change. Workflows currently employed by cultural resource managers and preservationists are tedious, labor intensive, limited in scope of data, and difficult to modify. Sites experiencing the highest rates of change have not been prioritized based on vulnerability, resulting in cultural resources disappearing or being destroyed without detailed record of their existence.

[1] Adaptive management is a paradigm of natural resource management where hazard mitigation projects are designed with the intention of testing experimental processes and collecting data that will be used to monitor how successful specific aspects of the project are at meeting a desired goal. These data points are then utilized in order to actively improve the project design so that future iterations are more successful. Adaptive management strategies are utilized in areas where the outcomes of an undertaking are uncertain, so that they can be adapted and modified on the fly if the results are not as expected.

In response to this situation, technological tools have been designed specifically for documentation and new approaches are being explored by practitioners across resource management and maintenance disciplines (Lecari 2016). In order to illustrate the paradigm shift ongoing within the cultural resource management field, this thesis will demonstrate a newly developed documentation workflow using Holt Cemetery in New Orleans, Louisiana, as an exemplary case study. Holt Cemetery is a paupers' burial space with spatial and material conditions rendering it highly dynamic and vulnerable to environmental damage. Unlike the typical New Orleans cemeteries with everlasting, above-ground tombs carved from marble and stone, Holt Cemetery consists of hundreds of in-ground burials with many hand crafted grave markers made of accessible materials such as wood, cement, and PVC piping. The material conditions at Holt Cemetery are prone to deterioration, exacerbated by subsidence and frequent flooding, posing a serious threat to the longevity of the cemetery space. Additionally, the active use and unique burial traditions at Holt Cemetery have rendered the space difficult to document. Individual plots are reused if no maintenance is performed within a few years, and as a result it is nearly impossible to associate a written burial record with a physical place (Sideman, 2005). The continual reuse of burial plots and the unregulated spatial organization of the cemetery have established a non-linear overlapping pattern of burials. The confluence of these conditions has produced a burial tradition / decorative phenomenon that is starkly an outlier from the typical New Orleans cemetery, manifesting as a geographically unique, volatile cemetery landscape exceptionally susceptible to rapid deterioration. For these reasons, Holt Cemetery was selected as an ideal site with which to utilize an expedited and comprehensive methodology to create the first systematic survey of the cemetery.

Introduction to Proposed Methodology

The project detailed in this thesis will demonstrate an experimental method of collecting large, varied datasets about the landscape of an historical site on multiple scales: from the material culture of an individual burial, to the overarching culture of the entire landscape. This thesis will then discuss options for visualizing multiple overlapping datasets, analyzing data using Geographic Information Systems, and curating this content in an interactive and shareable web-based map. A diverse array of visual, tabular, spatial, and temporal data representing different attributes of the cultural landscape were collected with the intention of providing information for a diverse body of users. The datasets and applications generated by this project are designed for use by researchers interested in land use, historic burial traditions, and material culture in addition to genealogists, preservationists, cemetery sextons, and climate change scientists. While this methodology was specifically designed for use at Holt Cemetery, the techniques and methods employed in this research can be adapted for use in any landscape.

Holt Cemetery is a challenging yet ideal subject for the proposed methodology for multiple reasons. For one, Holt Cemetery is a regionally unique manifestation of burial architecture in New Orleans, and the individuals who utilize the space have historically been underrepresented. Secondly, since Holt is an actively used cemetery space with a high rate of burial turnover, existing survey methods do not operate at the speed required in order to capture data before the landscape endures sizable alterations. Finally, the material culture present at Holt renders it inherently much more vulnerable compared to the above-ground stone cemeteries of a comparable age, reinforcing the need to document the space quickly and thoroughly.

In order to analyze the material landscape of Holt Cemetery, a survey methodology was designed using technological tools such as RTK GPS equipment, close range aerial photogrammetry using Unmanned Aerial Systems, and mobile phone data entry platform to create a robust spatial and tabular dataset. The purpose of this dataset is to provide information that can be used to make inferences about the landscape and meaning of Holt Cemetery utilizing the materials adorning burial spaces as the primary cultural content within the space. The purpose of this case study is to generate documentation of the location, physical characteristics, and material culture of individual grave plots at Holt Cemetery so that patterns can be easily identified and examined.

Introduction to Holt Cemetery Case Study

Holt Cemetery is a burial space located near the intersection of City Park Avenue and Orleans Avenue in New Orleans, Louisiana. The cemetery officially opened as an indigent cemetery in the late 19th century, presumably immediately after the closing of the two Locust Grove indigent cemeteries in 1879. Presently, Holt Cemetery occupies approximately five acres of space with primarily in-ground burials. Unlike the prototypical above-ground tombs made of marble that have come to define New Orleans burial architecture, the graves at Holt Cemetery are much more modest in material and ornamentation. A large percentage of grave markers found at Holt are handcrafted using affordable materials, although there are a number of military and commercial headstones throughout the space. Many of the graves at Holt are adorned with wooden or cement curbs, then covered with shells or gravel. This style is reminiscent of individual family cemeteries and folk burial spaces found throughout the American South, but this style of cemetery is unusual within the urban context of New Orleans.

The entrance to Holt Cemetery lies approximately three miles northwest of the walls of the original colonial city, the downtown center of New Orleans commonly called the French Quarter. Throughout the 1800s, the city grew semi-concentrically around the French Quarter, developing rapidly along waterways and the high ground formed by natural levees built up sediment deposited by flowing water.

Figure 1. This satellite image depicts the city of New Orleans, with the French Quarter highlighted in yellow and Holt Cemetery highlighted in red. Imagery courtesy of Google Earth.

The area surrounding Holt was historically well suited as a burial ground because it was located outside of the residential areas, close in proximity to Bayou St. John and the Orleans Railroad line along present day Orleans Avenue. Proximity to a waterway and rail line ensured an efficient method of transporting dead bodies from the urbanized center to burial grounds on the outskirts of town, where they were far enough away to not inflict illness on the living population. For this reason, multiple burial grounds were established in the area in the mid 19th century. One third mile away from Holt Cemetery is the intersection of Canal Street and City Park Avenue, the hub of some of the city's most notable cemeteries. Greenwood, Cypress Grove, St. Patrick #1, and Oddfellows Rest cemeteries have become culturally iconic because they each contain rows of the ornate, above-ground marble tombs that are synonymous with

New-Orleans-style burial decor. This aesthetic, a burial technique often justified by limited space and sinking land, has become emblematic of a New Orleans cemetery. The pervasiveness of this style is apparent in the media and advertisements produced for tourists, or by observing satellite imagery of cemetery spaces in New Orleans. In attempting to make New Orleans burial architecture a monolithic facet of the city's culture, variations of cemetery spaces that do not adhere to the above ground burial format are typically underrepresented and overlooked.

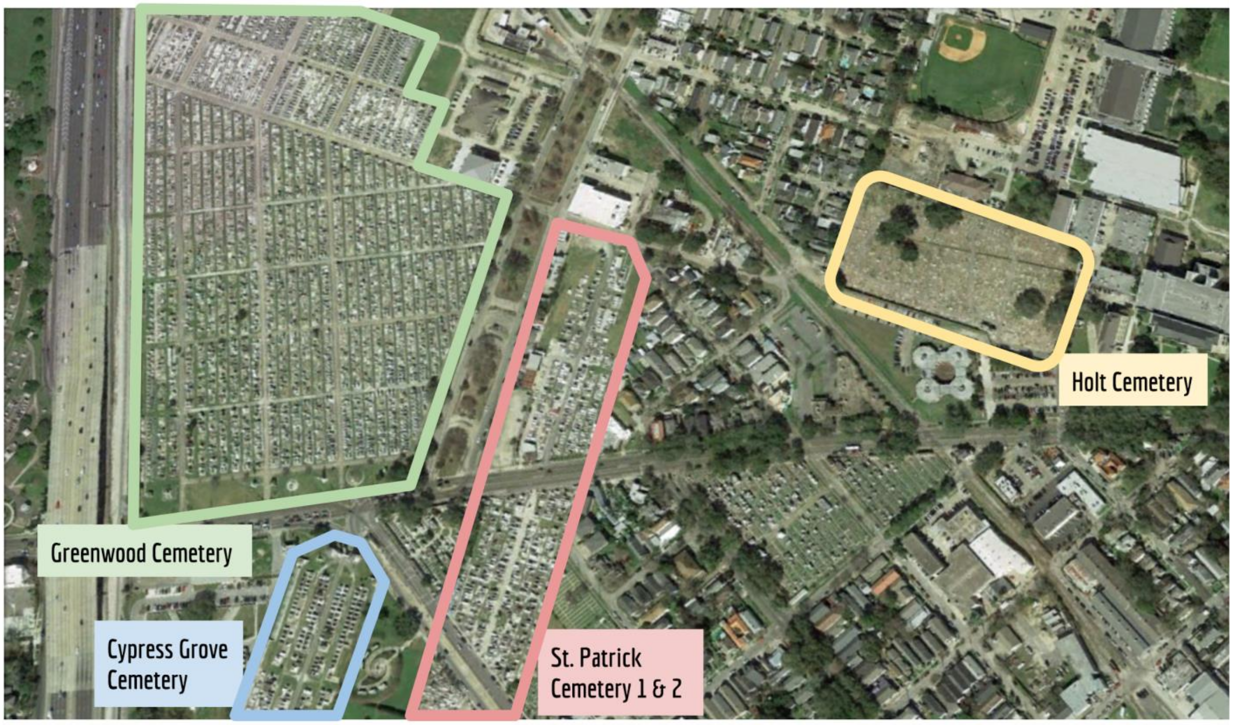

Figure 2. The satellite image above shows the location of Holt Cemetery in relation to three of the city's major above-ground cemeteries: Greenwood, Cypress Grove, and St. Patrick I & II. Imagery courtesy of Google Earth.

Why is Holt Cemetery Significant?

Holt Cemetery, as a stylistic outlier from what is typically recognized as a New Orleans style cemetery, speaks volumes about the origin of burial traditions in the city and why the above-ground tomb is so pervasive within New Orleans. Inquiry into the genesis of stylistic discrepancies between Holt Cemetery and traditional above ground cemeteries influenced the research design that built the data collection procedures exhibited in this thesis. While there are many theoretically backed assumptions about the development of burial traditions within the city of New Orleans, this methodology sought to provide statistical evidence with which to generate conclusions specifically about the unusual aesthetic, spatial layout, and historical use of space at Holt Cemetery.

Based on written sources documenting trade and migration patterns, it can be inferred that the typical New-Orleans burial style was influenced, like many other facets of the city's culture, from European and Caribbean architectural techniques. This explanation is confirmed by the presence of similar burial architecture in cities such as Paris, France and Havana, Cuba: two cities that had trade relationships and ongoing exchanges of ideas with the city of New Orleans in its formative years. It is a popular conception that the above-ground tomb is functionally well suited for the city's swampy geography, where land is often spongy and unfixed, allowing for bones to wash out of in-ground burials during rainstorms and flooding events. Others believe that the trend of impressive stone monumentation originated out of a 19th century desire to separate the body from the earth, and provide a permanent fixture for the deceased within the geographically and demographically volatile city of New Orleans (Upton 2008). Above-ground burials were a luxury that provided a reminder of home for many wealthy emigrants from Europe and its Caribbean colonies, while simultaneously establishing a legacy and a place of memorialization in a foreign land that was literally set in stone.

Conversely, many residents of New Orleans in the early 18th and 19th centuries arrived to the city with little to no resources, making the cost of burial in this ornamental style prohibitive. Additionally, restrictions based on race and religion limited the spaces where people could be buried. Therefore, the picturesque above ground cemeteries can be viewed as explicitly representative of an elitist class of individuals who had access to burial space and the finances needed to purchase expensive building materials. Holt, as an indigent cemetery, is thought to have developed stylistically and structurally independent of the typical New-Orleans-style cemetery in part because Holt existed in opposition to these cemeteries. Holt Cemetery was established to accommodate the very individuals who were excluded from prototypical New Orleans cemeteries based on barriers such as race, religion, and class, and therefore the development of an anomalous style is likely a manifestation of the differentiation in demographics of those who utilized Holt Cemetery compared to the other cemeteries in the area.

The data collected through this research might be used to examine the demographic factors that influenced patterns of development of Holt, and investigate the ways in which these factors may have lead to a divergence from the typical New-Orleans-style cemetery. By providing statistical evidence about the earliest dates of interment, the types of material used for adornment, and the religious affiliations of those interred, for example, the demographics of those who utilized Holt and the chronological patterns of use can be compared alongside the written records and built landscapes of New-Orleans-style Catholic and Protestant cemeteries.

Holt Cemetery and Marginalized History

Although Holt is just as old as the nearby cemeteries at Canal Street and City Park Avenue, the space has not been paid equal attention by historians, architects, and the city's Convention and Visitor's Bureau. Holt Cemetery aesthetically does not fit in with the prototypical image of a New Orleans cemetery, primarily because of the in-ground, versus above-ground, graves at Holt. In her master's thesis, Jordan Krummel affirms the theory that the stylistic differences and physical neglect of Holt Cemetery are a legacy of the complicated race and class divisions that have defined New Orleans since its earliest days as a city (Krummel 2013, 79). In her work, she recognizes that unlike the nearby picturesque New Orleans cemeteries that have dominated the advertisements presented to visitors of the city, Holt Cemetery has been largely left out of public discourse, the representative dichotomy that also influenced the design of end products for this project.

While the primary focus of this methodology is to rapidly document attributes of a historic site, a secondary motivation is the desire to use innovative technology and digital curation as a way of drawing attention to sites that represent the history of marginalized communities. The proposed methods intentionally utilize low cost and open source tools in an effort to make the processes of data collection and historical knowledge creation more transparent. The digital formatting of visualization and web based exhibition makes historical information that was once confined within archives, reports, and museums, or else not recorded at all, available for public consumption and analysis. Holt Cemetery is an ideal case study for the methodology presented in this thesis, seeing that the processes outlined provide a useful framework for reclaiming authority over historical sites that have had their stories subjugated as a result of racist or classist biases in representation, historically and in tourism media.

Figure 3. This screenshot from a website run by the New Orleans Tourism Marketing Corporation demonstrates the monolithic representation of cemeteries in the area. (New Orleans Cemeteries: Cities of the Dead.")

Prior to 2013, when Mayor Mitch Landrieu's administration allocated approximately $450,000 for renovations there, maintenance and upkeep occurred infrequently at Holt, and there was a lack of signage declaring the space as a historical site open to visitors (Rainey 2013). Presently, the only marker designating the space as a noteworthy historic cemetery is an approximate 1.5' x 1' metal sign affixed next to the front gate of the cemetery. This sign reads:

> "Originally a cemetery for the city's indigent population, Holt Cemetery was first mentioned in city records in 1879, most likely named for Joseph Holt, a physician from Charity Hospital. The original 400' by 600' plot was increased in 1909 with an additional plot on St. Louis Street. Holt is divergent from other cemeteries in the New Orleans area in that burials are entirely underground. The cemetery contains a large number of war veterans. Also, Buddy Bolden, the 'King of Jazz' is buried in an unmarked grave."

The cemetery space is obscured by parking lots and administration buildings, and the in-ground burials are hidden behind walls that are at least nine feet tall. Standing on City Park Avenue, looking down Buddy Bolden Place towards the entrance to the cemetery, all that can be seen of Holt are the branches of the massive live oak trees peeking above the cement fence. While Holt has been largely overlooked as a historical cemetery worthy of attention by academics and visitors alike, this neglect has left the space as an almost entirely unadulterated resource for studying a subset of New Orleans burial traditions. This thesis employs nondestructive, digital methods of data collection, leaving the cemetery an untouched and sacred space while simultaneously creating a detailed record with which to study the space. In using digital documentation techniques, the data collected regarding demographics, space, and material culture at Holt Cemetery can be remotely analyzed by users who lack the physical abilities to be present at the cemetery, further publicizing the conditions of the cemetery in an inexpensive, nondestructive, and inclusive fashion. The use of web based exhibition tools is intended to democratize the authority over cultural data and narrative creation, while simultaneously generating public interest in Holt Cemetery. These processes operate independently of the established structural systems utilized by the New Orleans Convention and Visitors Bureau and other organizations that benefit from creating and controlling a specific, hegemonic historical narrative to represent New Orleans.

Figure 4. Holt Cemetery as seen from City Park Avenue. Screenshot courtesy of Google Street View.

This thesis advocates for utilizing technological tools and digital documentation techniques in understudied historical sites as a way of quickly creating a robust documentary dataset where there previously was none, and also as a means of expanding access to data and authority over narrative creation. The methodology utilized in this project has been designed around the essential belief that the physical condition and material culture of Holt Cemetery is consciously created, and that a careful analysis of the objects and structure observable at Holt can aid researchers in inferring about the lives of the individuals who have utilized this space for the past 140 years. While the landscape of Holt appears chaotic to the untrained eye, and primary sources are limited, a systematic approach to cataloging and analyzing the material culture currently present at Holt Cemetery can yield information about the underlying culture of the community that interacts with the cemetery and reproduces meaning in a sacred place, in the present day and also in the past. Additionally, studying Holt as a geographically unique rendition of a New Orleans cemetery could prove informative about overarching history of burial traditions in New Orleans.

Figure 5. Unlike many cemeteries that regulate the location of burials and the types of material that can be used as decoration, Holt affords full decorative control of burials to the family and friends of those interred. Signs like this remind visitors that items that many would consider to be trash may actually be intentionally placed offerings.

Research Questions

- How can digital mapping techniques be integrated into existing cultural resource documentation workflows?
- In what areas can existing documentation techniques be improved upon?
- What information is important to collect in order to thoroughly represent an historical cemetery landscape?
- What inferences can be drawn from the material culture, physical landscape, and patterns of use in a cultural landscape?
- Why is it important to document vulnerable and understudied cultural landscapes?

Primary Sources

Published scholarly sources pertaining to Holt Cemetery are sparse. Holt Cemetery was briefly mentioned in the book *New Orleans Architecture Volume III: The Cemeteries,* published by Friends of the Cabildo, but this source describes the physical appearance of the cemetery without citation from archival sources (Huber, 1974). The most in-depth history of the cemetery has been collected in two separate graduate thesis publications that provide ethnographic analysis and secondary references to Holt Cemetery. While Jordan Krummel provides an overarching analysis of the social and political climate surrounding Holt Cemetery in the present day with her thesis *Holt Cemetery: An Anthropological Analysis of an Urban Potter's Field,* the most comprehensive collection of sources regarding the institution of the burial space and subsequent ownership have been cataloged and summarized by Ian Branyon in his 1998 work, *An Investigation into the Ethnographic and Historical Significance of Holt Cemetery* (Krummel, 2013; Branyon, 1998).

According to Branyon's research, it appears that the land currently occupied by Holt was part of a parcel including the southern portion of the area City Park as its boundaries exist today. This land has remained primarily open swamp, agricultural, or parkland for the past two centuries, with some exceptions. Signage at the cemetery claims that Holt was founded in 1879 and named after Dr. Joseph Holt, a member of the city's Board of Health, although this claim has been difficult to verify using archival sources. The land that Holt Cemetery occupies has changed ownership multiple times since the early 1800s, yet a chain of title is presently unverifiable because key records have not been discovered or do not exist. The lack of existing research and elusive documentation has further complicated the task of establishing a definitive history of the cemetery. Most of what is officially recorded about Holt Cemetery originates in notarized acts regarding construction and infrastructural improvements happening in and around the parkland surrounding Holt, rarely regarding the cemetery directly. Branyon's understanding of the space's history is largely derived from early civic records, minutes from council meetings or surveys required for public space administration, and other secondary sources that merely confirm the existence of an unnamed cemetery near the intersection of present day Orleans and City Park avenues (Branyon 1998, 47).

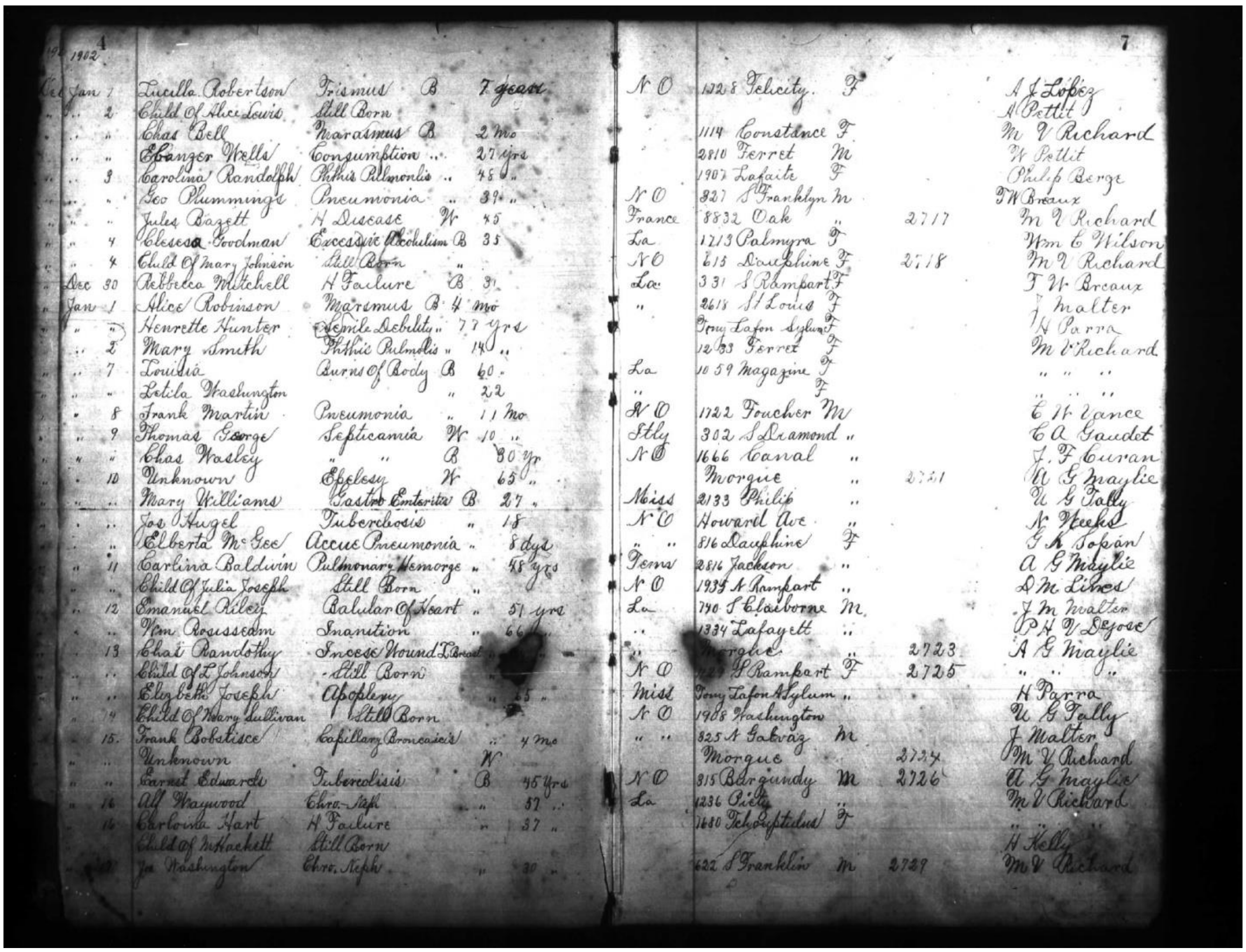

Figure 6. Sextons records for Holt Cemetery dating from January 1, 1902. (Guide to Genealogical Materials…)

The first official burial records for Holt Cemetery date back to January 1881; however, records are incomplete and inconsistent year by year. Sexton's records from the period between 1901 – 1953 are thorough and available through the New Orleans Public Library (Interments, 1881; Interments in Holt Cemetery, 1901-1953). These burial records lack any spatial component, adding to the difficulty in generating usable research about the cemetery and those who historically used the space. Holt is listed as an unnamed cemetery near City Park on a map generated by the Mississippi River Commission's 1874 terrain survey (Branyon 1998, 43). In this drawing, the unnamed cemetery appears as large as nearby Cypress Grove Cemetery, and nearly as expansive as Greenwood Cemetery. It is recorded that in 1878, the Police Administrator for the First Ward of the city was designated as the caretaker for the City Park, and in the subsequent year, there is record stating that a civilian named Patrick Mealie was paid $500 to construct a fence surrounding Holt Cemetery and to record interments in the cemetery (Branyon 1998, 44). Throughout the 1880s, the park area surrounding Holt Cemetery fell out of favor, as the location for New Orleans's primary City Park was relocated to Audubon Park, the site of the 1884 World Exposition. As a result, there were few changes in the landscape of Holt during this time. It wasn't until the early 20th century, when the farmland north of the former City Park was turned into the City Park Race Track that Holt Cemetery appears in official city documentation once again (Branyon 1998, 51).

In 1918, the City Council requested the City Engineer to conduct a survey of the area in speculation of building a trade school, and the cemetery parcel is indicated on this map. Then, in 1920, the Business Men's Racing Association started leasing the Fairgrounds horse racing track. This organization immediately sought to purchase the City Park Race Track land and eliminate its competition. In order to negate the possibility of further competitive developments, the Business Men's Racing Association gave the parcel of land north of City Park, including present day Holt Cemetery, to the City of New Orleans, where it would eventually be turned into the space of the present day New Orleans City Park (Branyon 1998, 52). Spare for the maps documenting these transactions and speculative developments, Holt Cemetery remains largely absent from the city's official record of parks and cemeteries, although a New Orleans Public Library guide states without citation that Holt Cemetery was officially enlarged in 1909 (Guide to Genealogical Materials…). An unnamed cemetery west of Delgado Community College appears in United States Geological Survey maps beginning in 1939, and its acreage and location appears unchanged in subsequent maps released in 1949, 1951, and 1986 (Branyon 1998, 53-65).

Literature Review

This project outlines a methodology for collection of spatial, tabular, and archaeological data using cutting edge technology in order to make the process of cultural resource management more efficient, accessible, and nimble. While the workflows that are presented in this thesis were designed specifically for documentation of a vulnerable cemetery landscape, the processes are meant to be useful in cultural landscapes of all varieties and at any stage of deterioration or change. While this thesis is the first of its kind to focus specifically on the development and utilization of a comprehensive documentation methodology, the concept of employing technology in order to expedite site documentation is common across disciplines and the results of these projects are the subject of many scholarly articles. Archaeologists, historic preservationists, environmental scientists, cultural and natural resource managers alike are turning towards experimental technological approaches in order to increase efficiency and improve the functionality of their work, and their multidisciplinary experiences have influenced the methodology presented here. There are many schools of thought and practice that have motivated the development of these methods, ranging from hazard mitigation, climate change adaptability, landscape preservation, and utilization of digital history to democratize historical knowledge creation. Research in these subfields has built a foundation that is used to justify the necessity of the proposed methodology, especially in a landscape as culturally rich yet ecologically fragile as coastal Louisiana. This literature review is intended to give insight into the frameworks that supported the development of methods employed in this case study so that others facing similar issues with common intentions can adapt the processes to suit their needs.

Digital Applications

This project intends to employ a cutting edge technology in order to digitally document a vulnerable cultural landscape. The use of technologies such as RTK GPS, UAS aerial imaging, and smart phone data collection are revolutionary in that they minimize the amount of time required to collect a huge sum of data, while the computational abilities afforded by GIS and web based data visualization have greatly expanded upon the research capabilities and ability to preserve and exhibit cultural landscapes digitally. The methods developed in this project relied heavily on two documentation projects that took place in New Orleans. The benefit of remotely sensed photogrammetric data and the necessity of documentation for paupers burial spaces was clearly articulated in University of New Orleans student Raymond Heitger's work in which he utilized thermal photogrammetry to perform the first survey of subsurface graves at Charity Hospital Cemetery. In line with Heitger's project, this project will use remote sensing technology and mapping tools in order to create a dataset that can be used to infer about the history of use in a cemetery space without breaking ground or disturbing the place (Heitger 2006). Workflows from Frank G. Matero and Judy Peters' digital surveying methodology presented in their article detailing work that occurred in St. Louis Cemetery Number 1 were adapted and expanded upon for the methodology employed at Holt Cemetery. The justification for this research is summarized in the article "Survey Methodology for the Preservation of Historic Burial Grounds and Cemeteries,"

> "The combination of digital tools with archival research and field recording can improve the efficiency of historical research, the speed and accuracy of surveys, and the quantity and quality of archival information directly hyper-linked to site features. This combined approach can also become the tool for future documentation of treatments, maintenance, and changing conditions (Matero 2003, 42)."

The incorporation of GIS, GPS, photogrammetry[2], and remote sensing technology to expedite documentation and expand accessibility of results is a practice that has become increasingly popular in disciplines such as archaeology, cultural geography, ecoforecasting, and disaster management (Chodoronek 2015; de Noronha Vaz 2012; Güney 2003; Reeder 2012; Reeder-Myers 2015; Wernke 2014; Wüst 2004). One such project that received public notoriety was highlighted in the summer 2016 edition of ESRI's *ArcNews* bulletin. Ross Brewer, of Marietta, Georgia, performed a similar survey using handheld GPS receivers in order to map the 4,500 total graves in the Marietta Cemetery. In this project, Brewer worked at a pace plotting approximately 35 graves per hour, recording demographic information such as the birth and death dates of the individuals interred. This work was published using ESRI Storymaps and is available on ArcGIS online as a Story Map under the title "Marietta: Places of Grave Importance" (Brewer, 2016).

Figure 7. The online web map created by the City of Marietta identifies the location of each grave, the demographic information associated with it, and also provides stories about relevant individuals buried within the cemetery.

[2] Photogrammetry refers to the science of using overlapping stereo photographs in order to generate scaled and measurable data products. This can refer to UAS aerial photogrammetry, where aerial photographs captured by an Unmanned Aerial System with camera trigged at measured intervals are triangulated in order to generate spatial data, but it can also refer to using overlapping photographs in order to generate 3D models of objects, structures, and landscapes.

Spatial Documentation

This project is heavily rooted in the tradition of public history, an offshoot of the discipline of history that intentionally creates knowledge based on the shared stories, experiences, and material culture of people who are typically omitted from dominant narratives found in history text books, archival records, and museums. While the discipline of public history has cultivated a completely new perspective and approach towards creating history, this project is equally indebted to the shift in historical methodology commonly referred to as the spatial turn. As described by Michael Crutcher in his book *Treme: Race and Place in a New Orleans Neighborhood*, the spatial turn represents a post-structural shift in thinking about space, less as a scattering of sites where events happened, and more as a physical network that is constitutive of the various discourses that influence its shape and function: social, political, and environmental (Crutcher 2010). The ecological knowledge held by locals, engineers, and environmentalists, as well as the space-based relationships examined by geographers and cartographers have contributed to the canon of historical production by providing multiple new avenues in which to analyze and reimagine events of the past. In addition to examining the physical landscape, the spatial turn brought the trend of using neighborhoods and communities as the unit of analysis for ethnographic, sociological, and historical works. With the invention of Geographic Information Systems, henceforth referred to as GIS, researchers in all disciplines were able to computationally analyze and present spatial data in easy-to-communicate map format. This software positively impacted historical research by providing a new toolkit for analysis, expanding the capabilities for analysis of large datasets, and revolutionizing the way that historical stories could be exhibited (McCoy 2009).

This paradigm shift allowed for a much more diverse subject matter to be viewed as historically relevant and worthy of research and exhibition, largely as a result of oral, material, and spatial data being seen for the first time as a primary source of information. This information allows for an alternative reading of history using references that are frequently employed as supplementary sources in historical research. The majority of historical knowledge is based upon written record, and the activities and lives of individuals with lower class and racial status were typically omitted from official documentation by hegemonic actors that actively suppressed the narratives of marginalized people by denying them the ability read or write, and thereby controlling the creation of history by dictating the narratives that would withstand time. By elevating the respectability of alternative sources, subjugated histories, forgotten spaces, and working class stories have had a resurgence in literature, museum exhibitions, and publicly employed historical narratives. This opening of dialogue has lead to incorporating historic sites that do not fit a specific narrative into existing research, as a way of studying the variances that occur in public spaces through the lens of race, class, and gender (Ashmore 2002; Miller 2006; Wright 2005).

Representation through Cemetery Spaces

With Holt Cemetery as an exemplary case study, data collection practices employed in this project were designed in order to create a systematic record of material conditions and spatial distribution of burial sites, allowing for future analysis of patterns of land use and the demographics of those who utilize the cemetery space. These areas of focus were identified as important in order to record and analyze changes in the landscape of Holt Cemetery, and to learn more about the societal conditions that produced this unusual historic site. These intentions were set based on the belief that the material and spatial landscape of Holt Cemetery can provide a wealth of information about working class burial traditions, New Orleans cemetery architecture, and the overarching development of the city in the late 19th century. Simultaneously, the cemetery can be interpreted as a space that has evolved in step with the changes that have occurred within society writ large. As explained by Branyon in his discussion of Holt Cemetery, the physical site and orientation of the cemetery, as well as the distribution of plots, their ornamentation, epitaphs, burial goods and grave offerings can yield vital information about the lives of those interred at Holt, as well as the social and power structures that existed throughout its active use (1998, 1). In the past, funerals and burials were used as a tool to celebrate one's wealth, or create the illusion of prosperity, so that those who have passed retain a high social status and their children can use their ancestors' burial as a physical testament to their own inherited class (Pearson 1982). This phenomenon is exceptionally relevant in a place such as New Orleans: a port city of immigrants, with a longstanding hierarchy dividing people based on race, wealth, and class. In a place such as Holt Cemetery, where the majority of those interred were of lower class and did not own much in terms of property, the burial space acts as a claim to a territory as well as a physical testament to the family's legacy (Upton 2008). Dell Upton describes a rise in sentimental personalism during the Antebellum Period in New Orleans, a phenomenon that encouraged the belief of the burial space as an extension of the person and the cemetery as a complex where former and present community members could intermingle. This sentiment is essential for marginalized communities, specifically for descendants of the poor and enslaved peoples who commonly lacked literacy, material possessions, financial capital, and documentary records with which to build a legacy in a specific place. For these individuals and their families, a special reliance was placed on burial space to establish a connection to place. In her recent *New York Times* article entitled “Why Slaves’ Graves Matter,” Sandra A. Arnold writes:

> “Memorialization keeps us connected to what is most significant about those who are no longer with us. So what does it mean that the grave sites of countless enslaved Americans have not been afforded this recognition? Since the emancipation of enslaved Americans, their public memory has become abstract. Cemeteries, graveyards and memorials are visual reminders for us. They exist because we desire to memorialize those buried there. By gracing the sacred spaces of enslaved Americans with that same intention, we can give humanity and dignity to their memory (2016).”

This basis of this project is influenced by those who have worked with marginalized groups to bring to light unknown aspects of their history, as well as those who have fought to understand the processes and purposes for subjecting one’s knowledge and experiences. This research design was heavily influenced by the work of other scholars who have utilized unwritten sources as a means of reanalyzing dominant historical narratives (Wright 2005).

Material Culture of Cemetery Landscapes

In searching for alternative means of generating knowledge, this project was developed with specific regard to those who have utilized the materials found in cemeteries as a primary sources to develop ethnographic and cultural understanding (Francaviglia 1971; Wright 2005). Cemetery studies, as specialization of both archaeology and material culture studies, has long been practiced but rarely seen as a discipline unto itself. Harold Mytum has compiled the premier reader on this subject, *Mortuary Monuments and Burial Grounds of the Historic Period*, a text which highlights the wealth of data that can be collected by way of tomb stone transcription, landscape interpretation, and burial material culture studies while also providing sample methods in which to perform such analysis. In the preface, Mytum laments “the linking between above and below ground data has rarely been achieved, and the integration of graveyard data within settlement and landscape archaeology has also been likewise rarely attempted" (Mytum 2004, viii).

With this missing link in mind, the methodology generated for this project was designed in a way that sought to document specific elements of the materials found within the cemetery that would be most informative to researchers across a variety of disciplines. For example, elements such as the repetitive symbols found on burial markers can be used to quickly grasp the spiritual affiliations of the cemetery, and whether the religious affiliation of an individual impacted the spatial location of his or her burial within the landscape. The oldest and most recent death date listed on each tombstone were collected as a way to infer when graves were established, when they were last used, and whether maintenance had been performed on the grave following its last interment. Specific focus was placed on the materials used to build, mark, and decorate burial plots so that patterns in material their condition could be used to speculate about the class status associated with individuals interred and the family and friends who maintain their resting places. These questions were designed in order to build a framework that could be used to bridge the gap between investigations into the past uses the cemetery and examinations into its present patronage and material evolution (DeSilvey 2006; Miller 2006).

Methodology

This research aims to develop an innovative and efficient method of documenting and exhibiting a variety of data representative of a cultural landscape. The goal of this process is to create a dataset that can be used as a means of preservation, a research tool, an aid for maintenance professionals, and a variety of other applications. Documentation techniques were influenced by Frank Matero and Judy Peter's 2003 survey of St. Louis Cemetery Number #1 in downtown New Orleans. This work outlines the essential steps required to perform a cemetery survey and provides insight into how digital data collection, mapping, and curation can aid in the conservation and management of historic burial grounds. The material typology utilized in this project was adapted from previous surveys of Holt Cemetery performed by Drs. Shannon Dawdy and Ryan Gray.

Motivations

This methodology was inspired by the belief that thorough documentation is an essential aspect of studying a historical site, in that documentary records allow researchers to access a site, prioritize the necessary work, and manage resources in an effective, repeatable, and justifiable manner (Matero 2003). In order to fully understand the landscape of Holt, a systematic survey would need to be completed in order to identify patterns in interments, material phenomena, and spatial layout within the cemetery. The primary objective of this methodology is to have the ability to create a multifaceted and adaptive method of performing a cemetery survey that will collect both spatial and demographic information about burials in an accelerated fashion.

There are believed to be five thousand extant grave plots at Holt, some of which contain multiple burial markers on a single grave. The range of variation in burial style and décor is seemingly limitless, therefore a data entry platform was designed that could easily be amended and updated as new patterns emerged. Since Holt is an actively used space with a high rate of burial turnover, an expedited survey methodology was necessary in order to capture a complete dataset before elements of the landscape move and change. Additionally, the mobilization speed of the survey was considered essentially important to protect cultural landscapes that lack the necessary protections to survive in the event of a natural disaster. Satellite imagery following Hurricane Katrina shows the Holt Cemetery almost completely submerged, and though Katrina was a particularly devastating natural disaster, the cemetery still experiences flooding on rainy days. Due to poor drainage, the cemetery frequently remains inundated for long periods of time, leading to material destruction and exposure of bones. Seeing as the majority of materials used at Holt are impermanent, unfixed, and prone to deterioration, a methodology was designed that aimed to capture large amounts of detailed data specifically focusing on the material conditions of the cemetery in the shortest amount of time possible. In the event of a looming destruction event, such as a hurricane or flood, methods were designed with the intention that data collection could be initiated and completed within a one week span. This length is reflective of the ability of meteorologists to accurately forecast anomalies in weather patterns that could pose a threat to vulnerable cultural resources. In order to meet these metrics, innovative approaches were employed using existing technological tools that would expedite the data collection process and establish a framework for analysis and curation using digital datasets in raster, vector, and tabular formats.

Figure 8. The satellite image above depicts Holt Cemetery and surrounding area five days after Hurricane Katrina. The north side of the cemetery is completely inundated. (Image courtesy of Google Earth)

Figure 9. The image above shows a completely submerged burial. This photograph was taken during the field survey portion of this project, one day after an unremarkable rain storm.

The primary tools used in this process were a smart phone with mobile web browsing capabilities, a smart phone camera with a mobile photo annotating application, a digital SLR camera, an unmanned aerial vehicle with attached camera, and Real Time Kinematic [3]surveying equipment. Each of these tools creates a different portion of the dataset, and each portion can be function independently or as a multifaceted database.

While aspiring to maximize the speed and detail of data collection, another driving component that influenced the design of this research was the goal that all tools required to recreate the processes outlined would be accessible to practitioners regardless of their financial backing and technical skill levels. This project was designed so that each component could act as a standalone data set, in order to suit the needs of end users who lacked access to a specific tool that was used in this project. The functional basis for each step in this methodology is discussed in the following sections, so that processes can be adapted in order to work with tools that are accessible to the general public. In this research, tools were selected in order to collect the highest resolution data at the fastest possible speed, but these specifications are not necessary in order to build a comparable database. For example, free, NASA EOS produced satellite imagery can be used in place of UAS generated imagery and handheld GPS receivers can be used in place of a RTK GPS receiver. In this tradeoff, one sacrifices the high accuracy and resolution of data collected using the suggested methods in exchange for a low to no cost alternative. By designing a method that was inherently flexible, the intention was that any individual or organization who wishes to perform a similar survey of a historic site can design their own methods using this manuscript as a suggestive guide.

[3] Real Time Kinematic surveying, commonly referred to as RTK, is a very accurate method of terrain surveying that triangulates the position of two antennas on the ground in relation to a network of satellite-based positioning systems. Measurements are corrected in real time in order to achieve extremely high accuracy of measurements.

In addition to accessible tools, this project was designed so that the workflow would be simple and supportive of collaboration, and resulting data would also be available for public use. Starting with the processes used to create data, the methods utilized in this project were designed with the intention of being participatory, meaning that the authority to create data would be shared among the interested public regardless of boundaries such as physical ability, financial constraints, or lack of training. In order to accomplish this, essential data such as photographs and spatial locations were collected in the field by the primary researcher and then published online with public access. The ability to transform this visual data into tabular data was made accessible by using the preexisting, no cost platform of Google Forms for data entry. The resulting spreadsheet, GIS shape files, and instructions for use will be published in a cloud based repository, such as Google Drive and ArcGIS Online, so that the final products can be utilized by anyone with internet access and data can be collected, shared, downloaded, and analyzed by an endless number of users, subverting the common notion that trained professionals are the only users with the expertise and authority needed to generate conclusions from raw data. By building processes that democratize methods of data collection and utilizing digital platforms to curate that data, this project advocates for a nonhierarchical approach to knowledge creation.

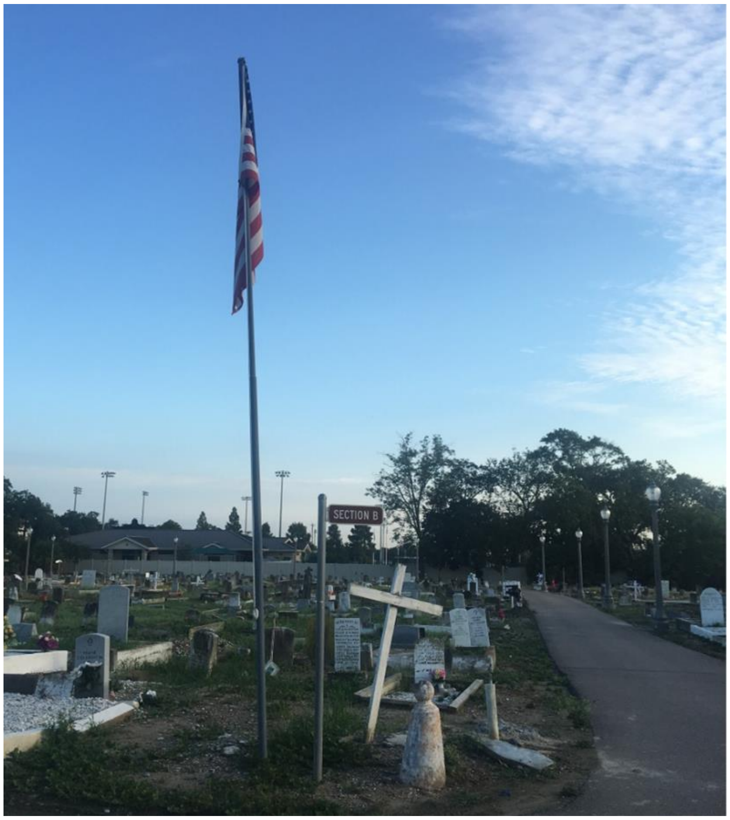

Figure 10. The image depicts Holt Cemetery with a sign denoting “Section B”, the study area for this project.

Field Survey

Based on time constraints, this project sought to examine only a portion of Holt Cemetery. To support the proposed methodology, the area of interest defined as “Section B,” an area chosen because it is entirely unobscured by trees and therefore would generate quality data using GPS equipment. Secondly, each grave site within this section was assigned a unique plot ID: an alphanumeric code that begins with the section of the cemetery (in this instance, always the letter B) followed by a number that uniquely identifies it. To complete this task, each grave was photographed using the smart phone camera and each image was annotated in blue and white text with the plot ID written onto the image of the grave plot. For burial plots with multiple associated markers, a period was placed after the plot’s unique ID and the markers were numbered counting up from 1 starting with the easternmost grave. For example, B420.1 is the easternmost marker for plot B420, and B420.3 would be the third marker from the east in the same plot. If markers are arranged on the plot in a north to south orientation, B420.1 would be the marker near the head of the grave, and B420.3 would be the marker nearer to the foot of the grave. In order to maintain consistency, IDs were assigned in a grid pattern, starting at the south-eastern most edge of the study area and continuing west down the row of graves, then moving north one row and continuing at the eastern edge of the study area. The extended Plot ID was annotated onto the photo and oriented so that it was clear which marker was being referenced, as demonstrated in Figure 12. Each photograph file was renamed as its unique plot ID, and then uploaded in a shared folder on cloud based file repository. For this project, Google Drive was utilized to organize files, reference photographs, and collaboratively create data. Using an online file management system such as Google Drive allows the plot ID information and visual references to be accessible to multiple collaborators at the same time using their own mobile devices. Individually named files were chosen as the best practice so as to utilize the pre-existing search feature of Google Drive.

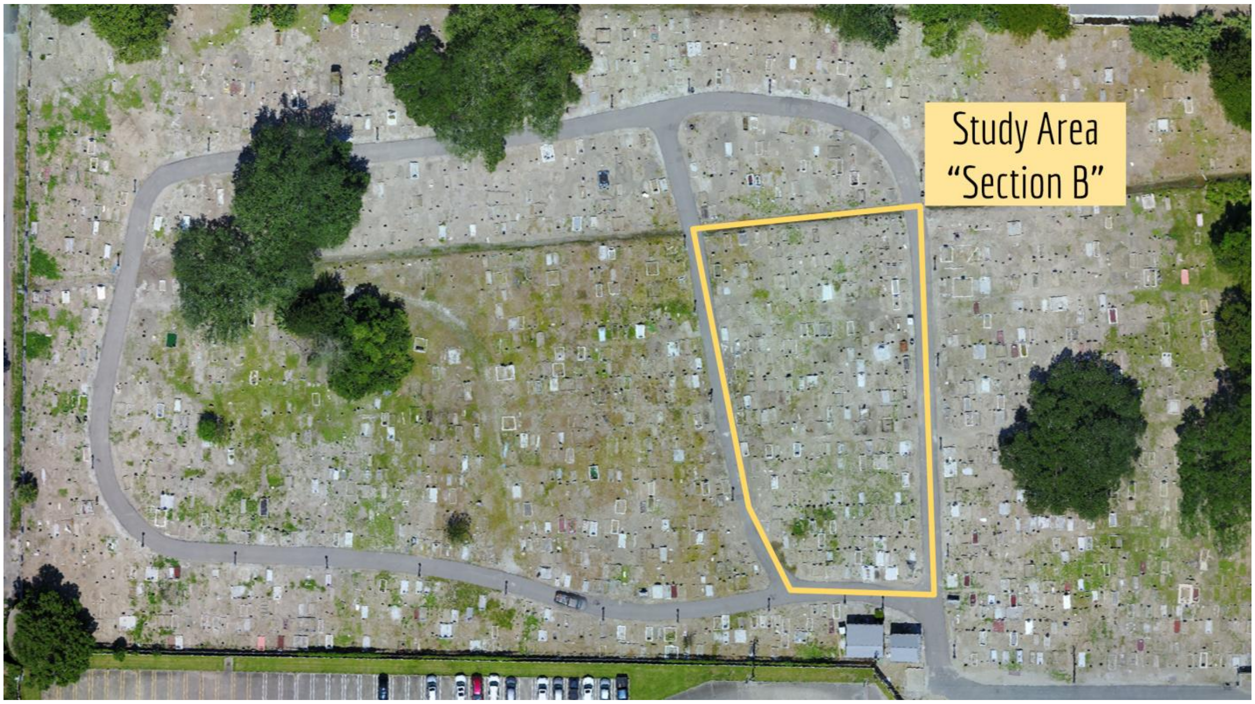

Figure 11. The orthomosaic above was generated by processing photographs captured using a UAS. The study area for this project is highlighted in yellow.

As a result of the unclear distinction between individual burial plots at Holt Cemetery, there was occasionally confusion over whether a burial space should be considered active or abandoned. Additionally, the lack of regulation in plot location resulted in rows of graves that merged and diverged without clear order. Therefore, a classification system was established in order to determine which burial plots were assigned an ID, and which were considered abandoned. For example, a depression in the ground might be indicative of a previous burial, but without any material evidence to confirm this, it cannot definitively be said that this space was or still is actively used as a burial. Grave sites lacking any man made materials directly associated with the burial or visible signs of anthropogenic activity were not considered as burial plots during this survey. To be considered a burial plot and assigned an ID, each supposed grave was required to contain at least one of the following features:

A) A clearly discernible tombstone or other permanent marker

- Markers should be facing the associated plot, or directly on top of the plot

B) A curb setting outlining the boundary of the plot

C) A sign of intentional anthropogenic activity, either at the time of burial or afterward

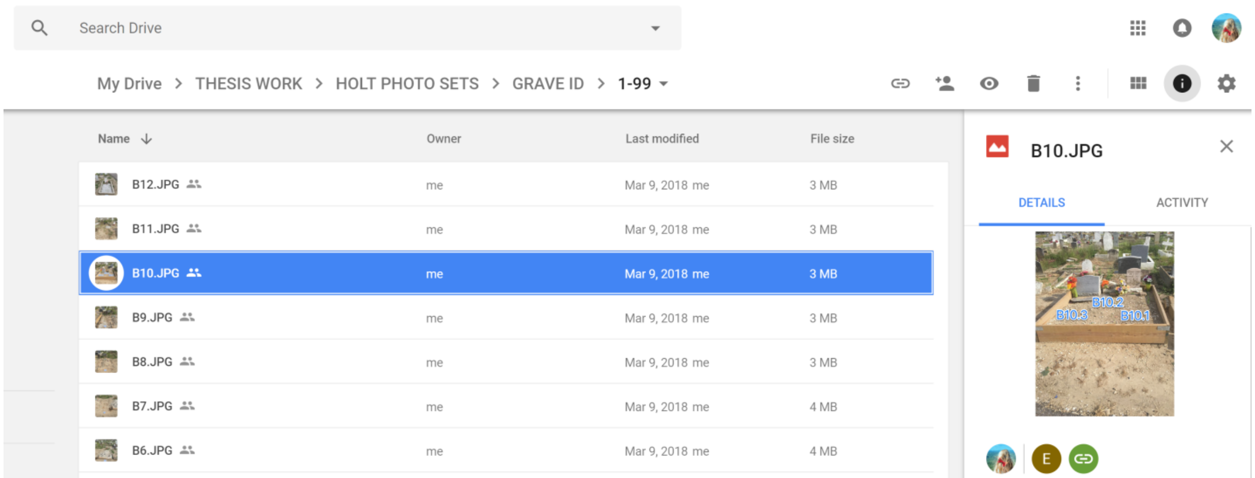

Figure 12. This screenshot illustrates Google Drive's functionality as a file management system, the search feature, and a sample annotated photo with Plot ID.

Next, spatial information for each burial plot was collected using Topcon HiPer-V RTK survey equipment. Real Time Kinematic surveying, commonly referred to as RTK, is a very accurate method of terrain surveying that triangulates the position of two antennas in relation to each other by triangulating the locations of the Base and Rover antennas with the Global Navigation Satellite System, abbreviated as GNSS. The GNSS incorporates multiple satellite global positioning systems, including the United States' Global Positioning System encompassing about 32 Earth-orbiting satellites as well as GLONASS, a system of 24 Russian satellites, and other regional satellites that communicate with the RTK antennas via radio communications in order to determine the position of a point on the earth based on its relationship to each of the satellites in the GNSS system (GPS Guidelines for RTN/RTK…

2013). While each antenna is in communication with the orbiting satellites, the RTK antennas are simultaneously establishing Bluetooth connections between Base and Rover antennas, in addition to establishing a Bluetooth link with a tablet that runs an application sending instructions to the RTK system. For this project, the tablet used was a Topcon Tesla, running the Topcon sponsored survey application, Magnet Field.

In order to maintain visibility between the RTK antennas and the satellites providing their position, the antennas were required to be raised from the ground, although the coordinates collected would be based on the elevation of the Earth's surface. In order to achieve this, the base station was placed on a level tripod, and the Rover antenna on a stadia rod. The height of each antenna was measured from the earth's surface to a designated point on the antenna, and then this height measurement was input into Magnet Field in order to adjust the positioning equation to account for the antenna's height off of the ground.

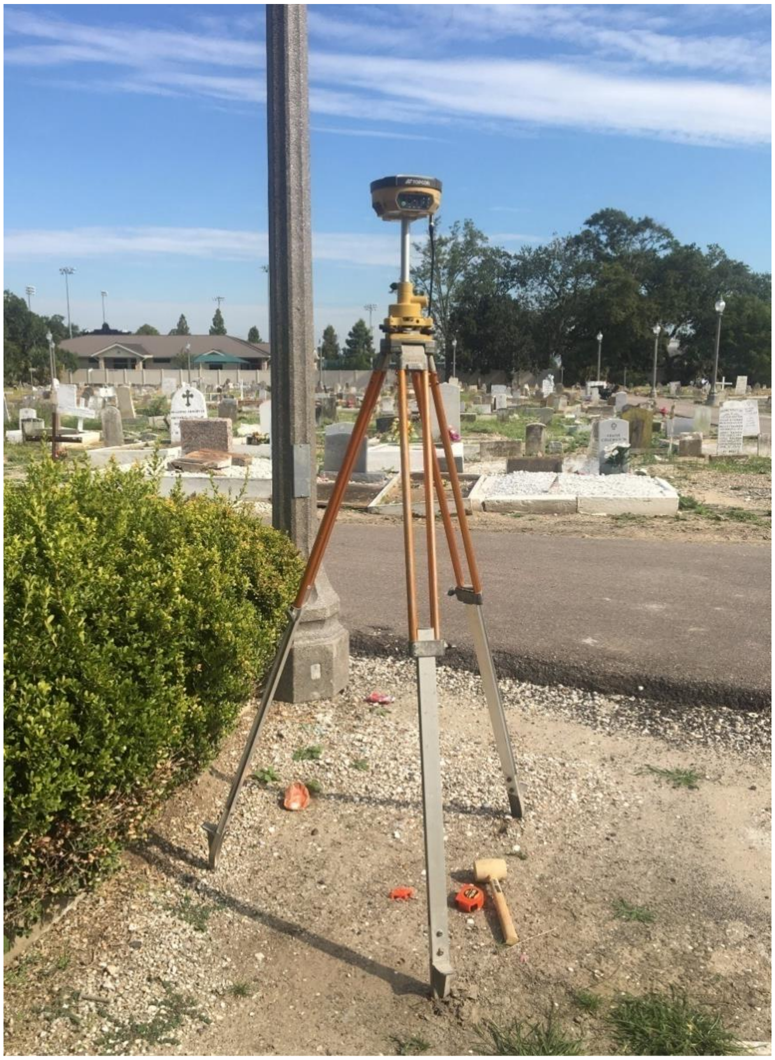

Figure 13. For this project, a Topcon HiPer-V RTK system was utilized. The photo above shows the base antenna stationed on a tripod directly above the reference point, demarcated using an orange stake placed in the ground.

Real Time Kinematic surveying works by first setting up a base station antenna on a reference point where the geographic coordinates and elevation (commonly called X, Y, and Z coordinates) are known. Surveyors utilize a variety of coordinate systems in order to communicate locational information, and therefore the known coordinates must exist in a coordinate system that is compatible with the surveying application being used. If the coordinates of the base station are not known, the position of the base can be determined by continuously triangulating the location of the base antenna with the location of the GNSS satellites that are in the sky at the time of measurement, and then generating an averaged coordinate based on these measurements. Once the position of the base antenna is established, this point will be used as a reference point in order to collect measurements in the field. A separate rover antenna is attached to a stadia rod and the height of the rod is input into Magnet Field. The option to input rod height is provided with each individual measurement recorded in the field, therefore, if an obstacle obscures the visibility between the Rover antenna and the orbiting satellites, the rod height can be adjusted repeatedly mid-survey without impacting the elevations of the data collected. The exact location of the RTK rover is calculated relative to the location of the base station, and Magnet Field adjusts these measurements in real time based on the location of the GNSS satellites in communication with the RTK system at the time of the measurement. This means that measurements are considered to be more accurate if there are more satellites in communication with the RTK system at the time of measurement. Figure 14 illustrates the RTK surveying process and how measurements are determined.

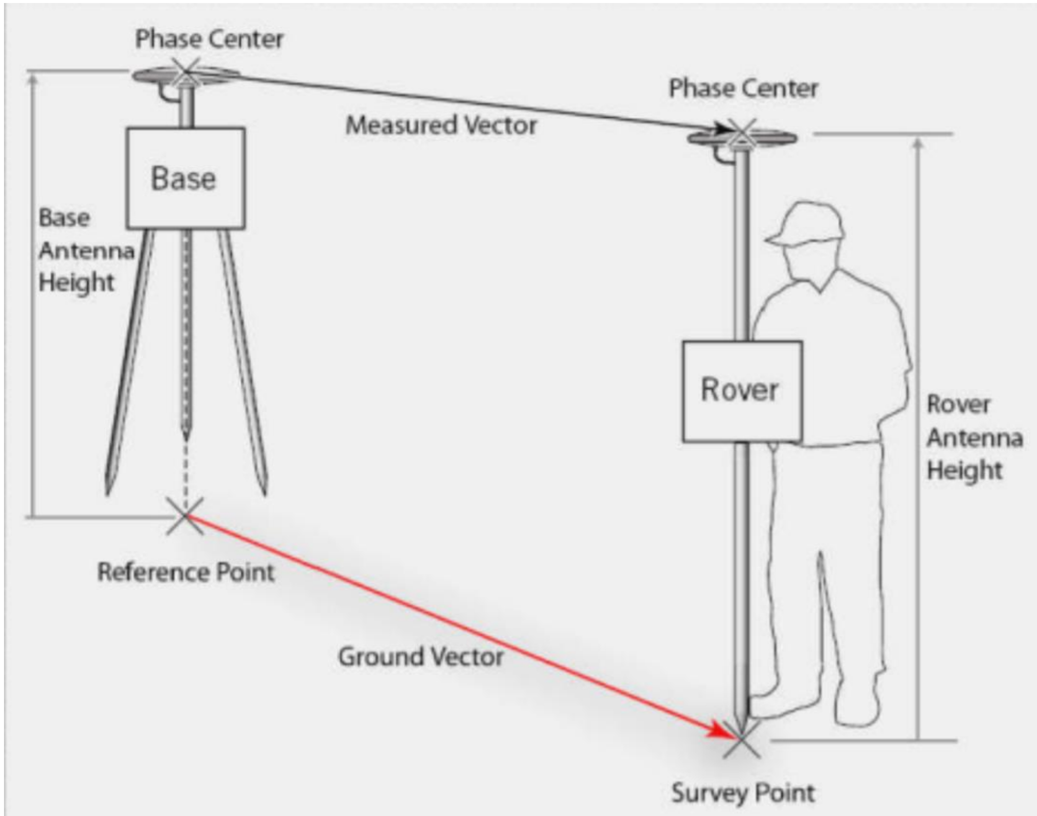

Figure 14. This diagram illustrates the data collection process using an RTK system. (GPS Guidelines for RTN/RTK… 2013)

Prior to mobilizing an RTK survey, a physical point on the earth with known spatial coordinates must be established as a reference point. Extremely accurate locational information is available through government-mandated terrain surveys, such as the National Geodetic Survey database. NGS survey points are commonly used as reference points for urban surveys because they are abundant throughout the nation, their locational accuracy is trusted, and their information is easy to access. In order to incorporate these points into an ongoing survey, the operator performs a task commonly referred to as "tying into the known points." To do this, the operator would first position the RTK rover over the NGS survey point, then manually input the X, Y, and Z coordinates of the point as found on the NGS database website into the surveying application used to control the RTK equipment. Using the application, this point would be coded as a reference point and all subsequent measurements would be calculated in relation to this known reference point. Seeing as the base antenna and the rover antenna need to be near to each other with an unobstructed visual link between them in order to maintain a Bluetooth connection, it is rare that a NGS survey point is within range of the area to be surveyed. To solve this issue, a temporary reference point can to be established close to the survey area using the NGS survey point with known coordinates as a primary reference point. To do this, the RTK Base antenna should be fixed upon the NGS survey point, and the Rover antenna should be placed at the desired location of the temporary base point. The NGS survey point has a known location, and the X, Y, and Z coordinates of the NGS survey point are entered into the surveying application. Next, the RTK system determines the location of the Rover antenna by calculating the distance and change in elevation between the Base antenna located on top of the NGS survey point and the location of the Rover antenna, located on top of the temporary reference point. The precise location of the temporary reference point should be marked with a semi-permanent fixture, such as a plastic stake with an X drawn on the surface, so that the exact location of the temporary reference point remains the same throughout the survey. After the temporary reference point is established, the RTK Base antenna should be moved to the temporary reference point, where it will remain for the duration of the survey, unless another temporary reference point is determined necessary. Once the first temporary reference point has been established by tying into the NGS survey point, all subsequent reference points can be established using the initial temporary reference point. Once the reference points have been established, the Base antenna will remain static, while the Rover antenna will be moved around the areas being surveyed in order to collect measurements. Each individual point measured during the survey will be recorded using a similar relational algorithm as the one used to establish the temporary reference point from the NGS known survey point: each measurement is determined as a based on the change in northing, easting, and elevation between the location of the RTK Rover antenna and its distance to the Base antenna.

According to the National Geodetic Survey database, there are two previously surveyed reference points located within one mile of Holt Cemetery. These points are located on the campus of Delgado Community College, as depicted by white triangles in Figure 15. These points are typically marked with a permanent metal marker that identifies them as National Geodetic Survey points and indicates the year of their initial survey. An example of this marker can be seen in Figure 16. In order to ensure the highest possible accuracy, operators should only tie into a NGS survey point if their area of interest is within a few miles of an NGS survey point. Exceeding this distance makes erroneous measurements much more likely, as a result of the curvature of the earth skewing distance measurements between base and rover.

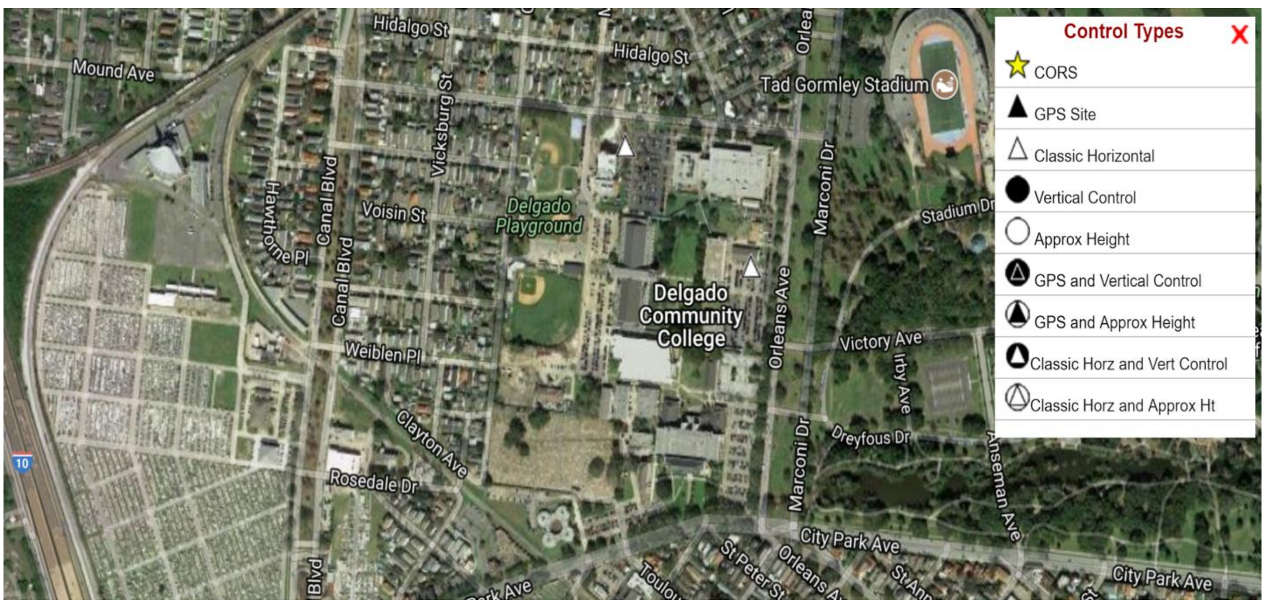

Figure 15. This screenshot was taken from the National Geodetic Survey web map. The two white triangles indicate the location of two NGS survey points near to the study area. Holt Cemetery is located south of the baseball diamond. (https://www.ngs.noaa.gov/NGSDataExplorer/)

Figure 16. This image represents the typical marker used for NGS survey points. These markers are fixed into the ground and are intended to be immovable.
(https://commons.wikimedia.org/wiki/File:United_States_National_Geodetic_Survey_marker_QO1858.jpg)

If there are any errors in connectivity between the NGS survey point and the RTK system, there are alternative methods of establishing a reference point that are less accurate yet still effective. If no NGS survey point is available, a temporary reference point can be generated by collecting thousands of X, Y, and Z coordinate readings on a single point using only the GNSS satellites for triangulation, and then averaging all of these readings together to determine one usable coordinate. This method places a large amount of trust in the accuracy of the locational information being received from the GNSS satellites, and therefore this method should not be attempted with fewer than ten satellites in communication with the RTK system. Additionally, the more points that are recorded and averaged, the higher the accuracy of the temporary reference point. Based on protocol used by local surveyors, it is recommended that anywhere between 3,000 and 5,000 points averaged for a base point will yield measurements with fewer than 6 inches of error (Carey, 2017). In order to minimize erroneous measurements, the minimum number of readings collected was set to 10,000 coordinates of the RTK Base antenna. Once the temporary reference point was established, this point remained the static reference point that the RTK rover referenced in order to capture spatial information during the field survey of Holt Cemetery.

Following the establishment of spatial reference points, two separate point based datasets were collected: one for the burial markers, and a second for the boundaries of the burial plots. First, the RTK rover was used to collect one point, or coordinate, for each fixture that appeared to be a complete or remnant permanent marker for a burial space. These points were coded using the phrase MARK and then named according to the Plot ID associated with the marker. Secondly, the four corners of each burial plot were recorded, starting at the southeast corner of each plot and rotating clockwise. These points were coded as PLOT and identified with a code: **B###-***, where B is the section, # is representative of the plot ID, and * is representative of the corner of the plot where the coordinate was captured.

- PLOT B420- is the southeasternmost corner
- PLOT B420-1 is the southwesternmost corner
- PLOT B420-2 is the northwestern
- PLOT B420-3 is the northeasternmost corner

The previously documented photoset containing images of each burial with annotated Plot IDs was referenced during the RTK survey process in order to ensure that all data collected using the RTK system was coded with the correct plot ID. Seeing as the initial annotated photoset had been uploaded and shared on Google Drive, the plot ID and a visual reference were available while in the field, using the Google Drive mobile application. This step was intended to minimize error in the coding of the spatial data, and to enable multiple users to work simultaneously using the same photoset as a visual reference.

Figure 17. Raw data captured using RTK equipment, overlaid onto UAS generated orthomosaic. Blue dots represent the corners of each burial plot, and red triangles represent the location of burial markers.

Using the point layer[4] coded PLOT as a reference, a polygon shapefile[5] was created by drawing polylines between the four corner points of a burial plot and creating a single polygon feature for each burial plot. Each polygon feature was assigned an attribute PLOT_ID which corresponded with the unique ID of each grave plot. This attribute was used to join the spatial data with the tabular data that was collected later in the process. The spatial component of this survey is crucially important because, prior to this instance, there are no known records that can be used to corroborate the archival information regarding a specific burial spot and a physical location on the earth.

Once the field survey phase was completed, a secondary photo set was generated to capture more detailed features of each burial marker. Photographs were captured using a Nikon

[4] A vector dataset consisting of many individual disconnected data points.
[5] A shapefile is a type of vector dataset that can be brought into a Geographic Information System. Vector data is made up of interconnected points, lines, or polygons with informational attributes. (Raster data, conversely, is composed of pixels that are assigned a numerical or color value.)

D200 digital SLR, or single lens reflex, camera in an east-to-west grid pattern, imitating the pattern used for the initial Plot ID assignment survey. Once the secondary photoset was captured and uploaded to a computer, the photos were corroborated alongside the original photoset containing photos annotated with the burials' Plot ID and the new, high resolution files were renamed according to the Plot ID. If multiple markers were present on one single grave plot, the photos were named according to the extended plot ID of the specific marker that was centrally focused in the photograph. The elongated plot ID was built from the Plot ID followed by a period and a number designating the location of the marker on the grave. Once the photos were renamed, they were uploaded to Google Drive in a separate folder so that they could be referenced by collaborators in the field. These high resolution photos were intended to add an additional reference point for identifying graves at Holt, and to provide curation quality data for each individual grave. Photos were captured throughout the month of October, while many families were preparing for the holidays of All Saints Day. In New Orleans, All Saints Day is typically celebrated by decorating and maintaining the burial spaces of family and friends. Photos were captured specifically at this time so that the graves were documented at a point in time that would, theoretically, reflect each grave at its highest likelihood of being maintained with new decor.

Next, the appearance and dimensions of the entire space were documented using low altitude aerial imaging techniques employed by an Unmanned Aerial System, or UAS. For this project, a DJI Mavic UAS, or drone, was used at a height of approximately 200 feet above ground level to capture overlapping aerial photographs of the cemetery. These photographs were photogrammetrically processed in order to create a georeferenced orthomosaic image[6] of the cemetery landscape, and this orthomosaic was then used to corroborate the spatial accuracy of the RTK survey data. This step created a dataset that is functionally equivalent to data collected by earth-observing satellites, but the resolution of the imagery is much greater when collected with a UAS. While satellite imagery is commonly used in order to monitor changes in vegetation and land cover, the low resolution imagery produced by satellites does not capture the incredibly miniscule features found at Holt Cemetery, and satellite imagery is not collected frequently enough to document the rapid changes occurring in this particular cemetery. To put this into perspective, most satellite imagery has a Ground Sampling Distance, or spatial resolution of approximately 5 meters, meaning that each pixel in the imagery represents a space on the earth of approximately 5 meters. Google's satellite imagery is updated on an annual basis for areas in the United States, and although other imagery sources are more frequently updated, the nature of satellites collecting imagery incorporates the limitation that a satellite typically only passes over a specific area once every few months. Comparatively, imagery generated using UAS is exponentially higher in resolution because the sensor capturing the image is so much closer to the Earth. For example, the GSD of the orthomosaic of Holt Cemetery created for this project is approximately 1 inch per pixel, and the flight path used to generate the imagery can be saved and repeated as frequently as is needed.

The orthomosaic generated in this project was created by designing an autonomous gridded flight path over the area of Holt Cemetery using the Pix4D Capture mobile phone application. Using this methodology, the UAS was automatically triggered to capture photos at equal intervals, producing a series of aerial nadir photographs with upwards of 60% overlap on

[6] A georeferenced orthomosaic image refers to a raster dataset with a known absolute geographic location. An orthomosaic is a piece of spatial data generated by stitching together many overlapping aerial images. The majority of satellite imagery is composed of georeferenced orthomosaic images.

each side. These images were then processed using Pix4D Desktop, a photogrammetric processing software, in order to create a georeferenced orthomosaic image that can be brought into a Geographic Information System, or GIS. This high resolution imagery can be used to observe details in the landscape, and because of the speed of data capture, this process can be completed on a regular interval basis in order to closely monitor changes. The georeferenced orthomosaic imagery was used as a base layer in order to enhance the aesthetic presentation of these datasets, as well as to corroborate the point data collected during the RTK survey by providing a secondary spatial and visual reference.

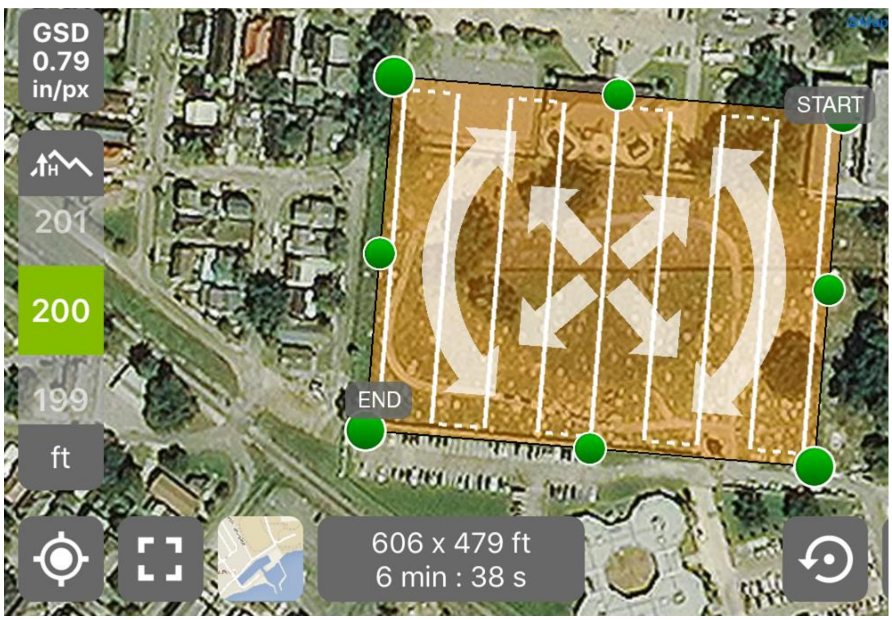

Figure 18. This screenshot was captured from the smart phone used to pilot the Unmanned Aerial System. The application used, Pix4d Capture, allows users to select a survey area and an altitude and then automatically generates a flight plan and triggers the UAS camera at the appropriate time in order to generate accurate spatial data.

Database Creation

A tabular dataset[7] was generated in order to record the physical and material conditions of burial plots as well as textual information from burial markers. In a typical cemetery survey, this step would be completed using a pen and paper to document features and transcriptions from each grave individually, then this information would be manually entered into spreadsheet

[7] A tabular dataset refers to textual data that is stored in rows and columns, typically in spreadsheet format.

format. In order to increase efficiency and eliminate unnecessary tasks, this step has been reimagined using a smart phone and an automatic form generator. For this project, a Google Form was generated and shared with data collectors, along with the two aforementioned photosets containing a visual representation and a unique Plot ID for each burial. These two documents are accessible on most smart phones using the Google Drive mobile application, meaning that many users can collaboratively participate in building the tabular dataset simultaneously. Rather than recording and then transferring written data into a digital format, this method directly inputs your data into a preformatted spreadsheet. This step makes the documentation process much easier for the user, as well as the researcher who has to prepare the survey data into usable content. Additionally, the form can be updated and modified as needed, even in the middle of an ongoing survey without compromising the data. While this step was intended to be completed in the field, it is possible that this process can be completed using just the photographs of the burials and burial markers, if inclement weather impedes the field survey.

Using the Google Form, descriptions of the material objects and textual features of each burial plot were recorded. The material culture typically found in Holt Cemetery was divided into classes based on function: marker, curb, decoration, and plot cover. The variations typically found at Holt were observed and documented by first reviewing the annotated photo logs, then generating the chart found in Figure 19. The variations listed in this chart were then transcribed in the Google Form as a checkbox, where multiple materials could be listed as present within one burial plot. Markers, curbs, and plot covers are typically permanent features, while decorations encompassed impermanent materials without anything physically grounding them to the burial site, objects including stuffed animals, floral arrangements, notebooks, beer cans, and blunt wraps. For each of these categories, detailed information regarding the materials, appearance of wear and maintenance, as well as textual transcriptions of marker text and pertinent notes about the condition of each individual graves were recorded in the field. This tabular information was automatically transcribed from the Google Form responses to a Google Sheets spreadsheet, and then exported as a comma separated value[8], or .csv file. This .csv file was then opened in ArcGIS[9]. Using the unique ID of each burial plot and marker, the point features for burial markers and the polygon features of plot boundaries were joined with tabular data.

[8] A comma separated value is a common file type for tabular data. Data is organized in rows and columns, and each value is separated by a comma. Separate records are divided by a line break. This file format is accepted by a wide variety of softwares.

[9] ESRI ArcGIS is the premier Geographic Information Systems software. Although ArcGIS was used for this specific case study, other GIS programs would produce identical results.

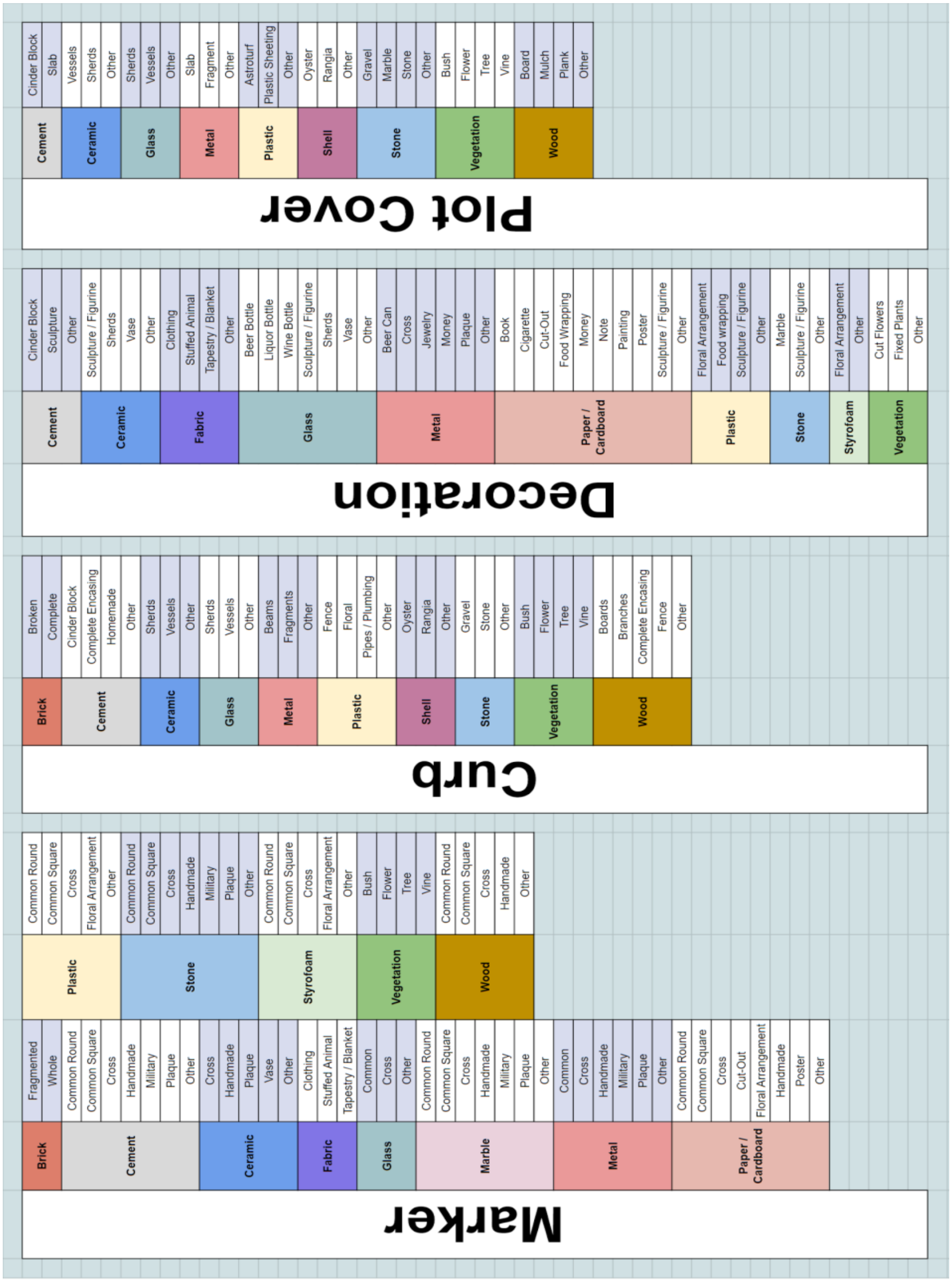

Figure 19. The chart above categories the different parts of a burial, including the marker, curb, decoration, and plot cover. This material typology chart was created based on observations during the initial field survey.

Conclusions and Discussion

Using this methodology, spatial, visual, material, and textual information describing each individual burial in the study area was collected and combined into one functional dataset representing Holt Cemetery as a contiguous cultural landscape. The dataset created using this methodology established the groundwork for an eventual survey of the entire cultural landscape of Holt Cemetery. As mentioned previously, this dataset can be updated and expanded upon in a piecemeal fashion, focusing on current needs and phenomenon observed by users of the dataset.

Time Tables

In order to accurately monitor the time spent on each task, a time sheet was created for field work, and notes regarding start and end times were recorded for office tasks. A breakdown of the active time that was required for each step of the process is detailed below. Although this case study was a collaborative effort, the time required for a single operator working eight hour work days to repeat this process from mobilization to completion is approximately 11.5 days.

<u>Field work</u>
ID Assignment: 4 hours
RTK Survey:50 hours
Photo Collection:11 hours
Tabular Data Collection:12 hours
UAS Flight:10 minutes
TOTAL: ~77 hours

<u>Office Work</u>
File Organizing:4 hours
UAS Data Creation:2 hours
Polygon Creation:3 hours
Tabular Data Collection:4 hours
GIS Database Creation:2 hours
TOTAL: 15 hours

SETTING REFERENCE POINT			
DATE	**START**	**END**	**TOTAL**
Thu, September 14, 2017	9:00 AM	2:15 PM	5.75
Fri, September 15, 2017	8:15 AM	3:00 PM	6.75
Mon, September 18, 2017	9:15 AM	3:15 PM	6.00
Total			**18.00**
FIELD SURVEY			
Tue, September 19, 2017	7:30 AM	2:30 PM	7.00
Wed, September 20, 2017	8:15 AM	1:15 PM	5.00
Thu, September 21, 2017	11:00 AM	3:00 PM	4.00
Fri, September 22, 2017	11:00 AM	3:00 PM	4.00
Wed, October 25, 2017	11:15 AM	3:15 PM	4.00
Thu, October 26, 2017	8:00 AM	12:00 PM	4.00
Fri, October 27, 2017	8:00 AM	12:00 PM	4.00
Total			**32.00**

Figure 20. Time sheet used in order to track time spent in field performing RTK survey.

Issues Encountered

Recordkeeping endured some difficulty whenever more than one person worked on a task simultaneously, and therefore a more robust system for time management with these complications considered is suggested if this project were to continue at a later date. It should be noted that multiple difficulties were encountered throughout this project, and with each setback unnecessary additional time was added to the workflow. In order to improve the process for future researchers, the issues experienced during the initial implementation of this methodology will be discussed at length.

One of the largest issues encountered during this process occurred in the set up stage of the field survey. Although the National Geodetic Survey listed two known survey points within a mile of Holt Cemetery, neither of these points could be located. After the points were not located visually, a second attempt was made using the RTK GPS as a guide. In order to do this, the coordinates from the NGS database were input into the survey app and set as a destination. Even with a high accuracy guide pointing directly to the location of the NGS survey points, they were not located. The closest point was demarcated to be in the administration building of Delgado's campus, and the second point was defined as being beneath a radio tower on the north end of campus. It is assumed that these points were removed during construction on campus, and that this issue would not have arisen had a survey of the study area had been performed prior to field work.

Since the NGS points were obstructed, a secondary method was implemented of establishing a reference point by continuously collecting the coordinates of the temporary reference point and averaging these coordinates. The location of the temporary reference point was chosen so that there would be unobstructed visibility between the RTK base antenna and rover throughout the survey area, while ensuring that there was ample room for the base station setup without interfering with traffic in the cemetery. Once the temporary reference point location was selected and the equipment set up, the base antenna was instructed to continuously collect coordinates. In general, the RTK system collected about 40 coordinates per minute, meaning that it would require approximately four hours to collect the required 10,000 points. Due to technical difficulties, the survey application reset in the middle of point collection, and therefore this process had to be repeated four separate times. This difficulty consumed multiple days of setup time that had been intended for field work.

The field survey was made quite difficult as a result of the landscape of Holt Cemetery. The nonlinear pattern of burials in the cemetery and the lack of uniformity from one grave to the next required that naming convention for the burial plots and associated markers be adapted on the fly. The presence of multiple markers on one plot as well as markers that did not face in the direction of the associated plot made it very difficult to create a systematic and repeatable formula for assigning Plot IDs. Additionally, the absence of a precise grid formation made it very difficult for a consistent order to be maintained throughout the initial ID assignment, the marker and plot RTK surveys, and the high resolution photo collection. This lack of grid formation did not entirely derail the process, but it did introduce room for error during the next step of corroborating points and photos, resulting in eight photos of burial markers without a known Plot ID to associate them with.

It was immediately evident while creating the polygon layer that the shape of the grave plots were inconsistent and frequently overlapping. This is believed to be a result of both the ad hoc structure of the burials, as well as the inconsistent terrain within the cemetery. In multiple instances while performing the RTK survey the stadia rod could not be kept at an even elevation as a result of overlapping burial materials, deteriorating curbs, and swampy terrain. This inconsistency resulted in burial plot polygons that are commonly in the shape of exaggerated trapezoids rather than neat rectangles. Although this situation has made the data less visually impressive, there was not enough time allotted in the research design with which to address aesthetic concerns, and therefore these rogue polygons were maintained. It is suggested that for future work, polygons should be generated initially by visual analysis of a UAS generated orthomomsaic, then this polygon layer should be ground-truthed[10] using RTK GPS equipment. This alternative approach would theoretically save time, money, and manual energy, while creating a more visually appealing end result.

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[10] Ground-truthing refers to the process of checking results that were generated outside of the field by returning to the study area and confirming that the results are accurate using alternative methods of collection and analysis.

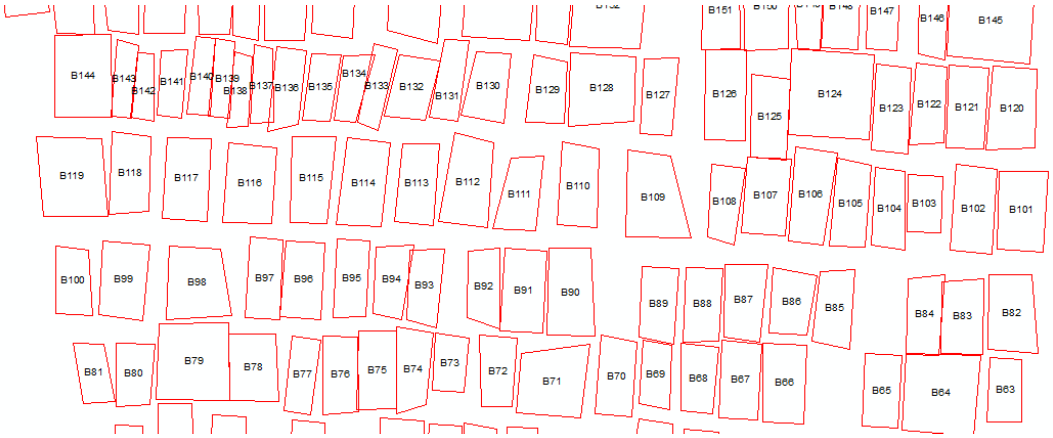

Figure 21. This sample shows the non-rectangular shape of burial plot polygons.

Additionally, the quality of the transcription data had to be compromised in order to meet deadlines. Originally, it was intended that the data collected via Google Form would include complete transcriptions of the text on all grave markers, as well as the birth and death years of all interred in the cemetery. It became apparent after completing the documentation of a few dozen graves that thorough documentation could not be completed within the limitations of the research project and the restrictive opening hours of Holt. On a positive note, the advantage of using Google Forms as a documentation tool is that the form itself can be modified mid-survey without compromising the data already collected. The changes made to the Google Form were performed in order to save time, but also to isolate the information that would be most useful to researchers and family members who would be using this database as a tool to examine demographics and day to day use of the cemetery space. For instance, the option was eliminated to input the birth years and death years associated with each individual listed on a single grave marker. This data were often inconsistent even on the same stone, where it was observed that as room on the stone became scarce the birth year of those interred was frequently left off of the marker. Instead, the "names associated" category was left alone, so that those who wish to search for the burial spaces of their friends and families could query based on the name, and that query would return the location and photos of the grave plots. To replace the birth and death years, two questions were asked: earliest death year associated and most recent death year associated. Theoretically, the burial would have originated at the time of the earliest death year, and the last time it would have been used would correspond with the most recent death year on record. Although this conclusion is not definite, it provides enough data about the use of burial space and whether maintenance had been performed on the plot following the most recent burial. Additionally, the option to input recurring symbols was added to the Google Form once it was acknowledged that many graves had the same symbols: crosses, stars of David, knots, and birds. These symbols may be stylistic; however they also have symbolic and religious associations that cannot be determined definitively without further data collection. Other issues encountered were inconsequential and inherent in the formulation of this research method for this particular area of study. For example, some burial records were missing data because the text on the burial markers was obscured by dirt or decorations.

Although Google Drive has a robust search feature, its filtering abilities left much to be desired. When sorting photos by name, it was noticed that photos often appeared in the order of: B1, B10, B11, B12, onward through the 100s, until finally B199, B2, B20, B21, so on and so forth. For an unexplained reason, this phenomenon was only experienced when sorting files on the Google Drive smart phone application, and not when sorting files from a computer's browser. For this reason, the folders containing reference files had to be sorted before entering the field, otherwise each photo that was to be referenced had to be located by a manual search, rather than a simple swipe to the next photo in sequence. One immediate solution for this issue was to subdivide photographs into sets of 99: 1-99, 100-199, 200-299, and so forth.

Additional setbacks occurred when trying to create tabular data in the field. The data entry platform was designed to be used in the field, but time limitations and inclement weather mandated that this process be adapted to suit the limitations. Rather than recording data in the field, the majority of tabular data was created by reviewing the two photo datasets and transcribing information based on the photographs. This variation in processes had both negative and positive results. With data created based solely on photographs, there were multiple instances in which text was illegible and therefore records were left incomplete. If burial decoration was in the way of marker text, there was no way to move the obscuring object without returning to the field. In the future, it is intended that incomplete records will be identified and a ground-truthing endeavor0 scheduled in order to confirm the existing tabular data sheet. On a positive note, making this task an in office procedure rather than a field based procedure made it much easier to crowd source data entry. From remote locations, upwards of five individuals simultaneously participated in visual analysis and record creation for burial text, materials, and condition. As a result of multiple participants, there was some variation in quality and phrasing for data entered. This issue was controlled by requiring the operator entering data to enter his or her initials for each record created, and then the principal operator edited the final spreadsheet in order to generate a uniform format for all data entered.

It should be noted that some of the burial records in this dataset have multiple responses for specific questions, such as the question regarding burial marker materials. The explanation for this discrepancy is that some graves have markers made up of multiple materials – such as grave B14, which consists of metal, paper / cardboard, and a photograph- yet the marker type can be labeled singularly as repurposed. Additionally, the inconsistent nature of burial markers resulted in many records containing very detailed descriptions, while others contained piecemeal bits of information. This discrepancy is occasionally necessary, but after acknowledging the slant put on the data produced, it is suggested that the survey be restructured so that each question is required to have one primary answer, with all additional notes reserved for the "remarks" section. Allowing for freedom of expression between multiple users created an inconsistent ledger which required ample clean up in order to be functional within a GIS.

Figure 22. Burial B14 is a prime example of why Holt Cemetery is challenging to systematically survey

The battery life of electronic equipment was less prevalent an issue than initially expected; however, when this issue did arise it would often cause major setbacks. In one such instance, a dead phone cut the workday short by multiple hours, and then subsequent days of consistent rainfall and incompatible schedules between the operator and the equipment lender halted the entire data collection process for a matter of weeks. Despite the presence of setbacks, and a start to finish time that exceeded initial expectations, this experimental endeavor met all of the goals that were set during the initial stages of the project.

Results

While the area surveyed for this project only accounts for approximately 10% of the burials within the cemetery, the results provided from this endeavor have proven three major points about the methods as a whole: the introduction of digital tools greatly expedites the quality, speed, and adaptability of performing documentation surveys for cultural landscapes. Secondly, a systematic survey of the physical space, the temporal use, and the material culture in a landscape can provide valuable data with which to analyze the use of the space historically. Finally, the adaptability of a documentation methodology is essentially important in order to generate a functional and purpose driven dataset. Although the primary intention of this research was not to draw conclusions, a brief overview of some of the results generated from this dataset have been included below. These examples are presented in order to demonstrate the specific ways that this dataset can be employed by users in fields ranging from cultural resource management, natural resource management, genealogy, preservation, and more. This dataset allows for the first ever statistical examination of burial practices at Holt Cemetery, and allows for researchers to gain insight into the day-to-day functions of Holt Cemetery as a working class burial space representing the diverse public of the city of New Orleans.

Although this dataset is only a representative sample, data suggests that patterns are visible in the content and material culture found at Holt Cemetery, and many of the initial assumptions made about the cemetery are being refuted. For example, this space was approached under the visual assumption that the majority of markers at Holt were handmade. Based on the 424 markers recorded as having a definitively identifiable material, it appears that the presence of handmade and repurposed markers is relatively uncommon. The tables below indicate that commercial and military markers are the dominant types, and that the majority of veterans buried within the Section B study area served in World War II. This statistic is telling about the past use of Holt Cemetery, and the lives of those who patronize the space.

This multifaceted dataset supports a variety of research functions, and can be utilized to identify patterns within the heterogeneous landscape of Holt Cemetery that can be used for a variety of applications. For example, using a GIS program, the tabular data found in the PLOT layer's attribute table can be queried to identify all graves that have handmade wooden markers, and this data can be quantified to indicate patterns in material usage as well as the spatial distribution of materials can be examined. The exceptional detail captured in this survey allows for even more fine-grained analysis of the function of a specific material used; for example, filtering the tabular data allows for one to examine how many handmade wooden markers are painted versus inscribed, how many of the painted markers are in a "slightly damaged" or "badly damaged" state, and whether any spatial or temporal correlations caused an increase in deterioration. This tool can be utilized by archaeologists who wish to study the evolution of burial materials in Holt cemetery, or as a comparative dataset examining cemeteries in New Orleans as a whole. Additionally, by filtering the attribute table based on burial materials and the condition of the burial, this tool can be used by sextons and maintenance professionals at the cemetery in order to monitor the rate of deterioration for specific materials, or to investigate which areas of the cemetery are experiencing increased deterioration. In doing this, the groundskeepers can more efficiently maintain the cemetery landscape by understanding what conditions within the landscape are causing increased deterioration and mitigating these issues.

As a result of the high level of detail captured through individual marker documentation with multiple intersecting textual, visual, and spatial components, the informative potential of this dataset is remarkable. The data collected can be useful for those who are interested in studying a specific subset demographic of those interred at Holt Cemetery. A military historian can use this database to identify examine how many veterans are buried in Holt, which wars the majority of interred veterans fought, or to complete a comparative analysis of the average length of life for working class veterans of World War II compared to the Vietnam War, for example. Researchers interested in the unique and handmade burial markers for which Holt is known can use the interactive map to isolate all handmade markers and identify their locations within Section B of the cemetery, leading to questions about the spatial distribution of burials based on the class of the individual interred. Genealogists and family of the interred can search the "Name" attribute in order to locate the burials of their family members. Researchers who are seeking to create a chronological history of Holt Cemetery can use the attributes of "Earliest date of burial" in order to determine an approximate date for the burial, which can provide insight into the evolution of burial practices over time. Maintenance workers can query the attribute "Most recent date of burial" as well as the "Grave condition" attribute in order to determine whether a grave has been abandoned. The findings presented below are preliminary examples of the types of analysis that can be performed and the inferences that can be drawn with the data that has been collected.

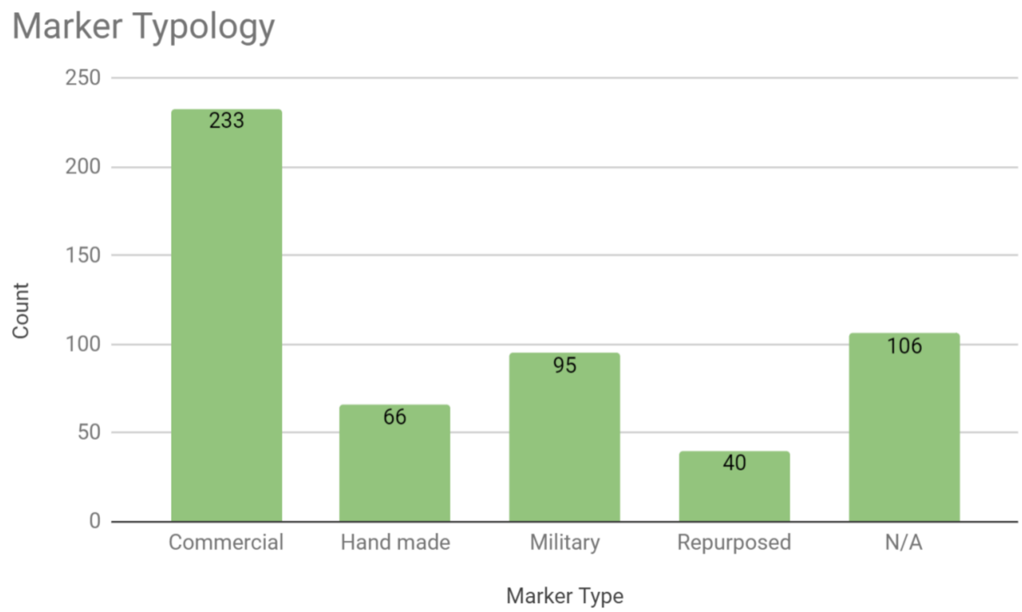

Figure 23. This chart depicts the total number of markers of each type found within the sample area. Markers listed as N/A were typically not present, although occasionally the material type was unidentifiable by photographs alone.

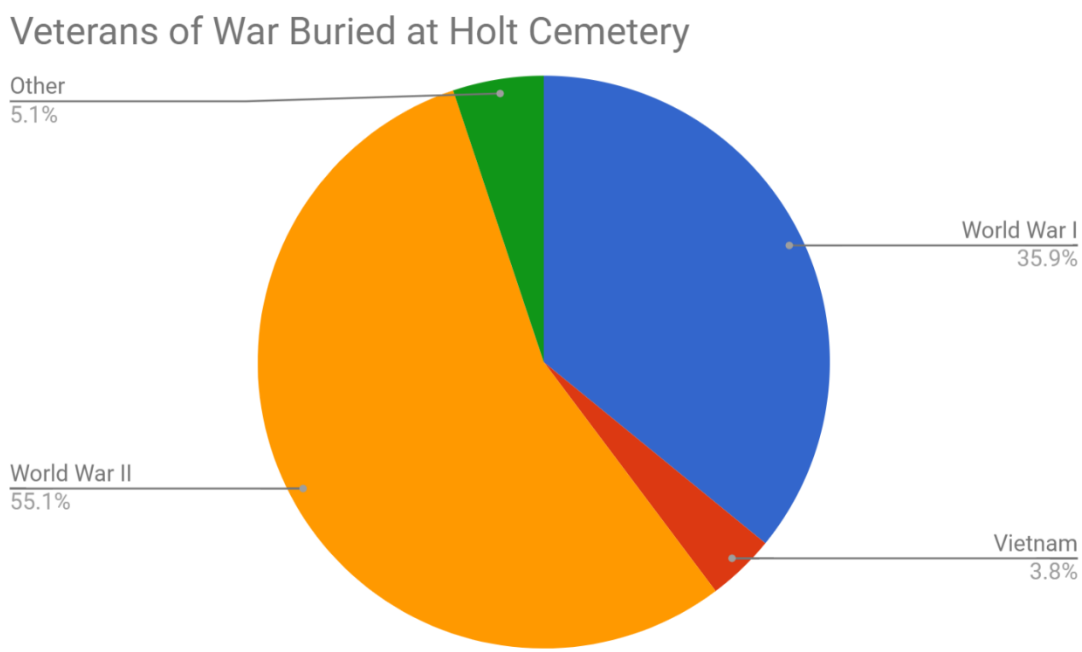

Figure 24. This chart depicts the wars that were listed upon military headstones in the study area of Holt Cemetery.

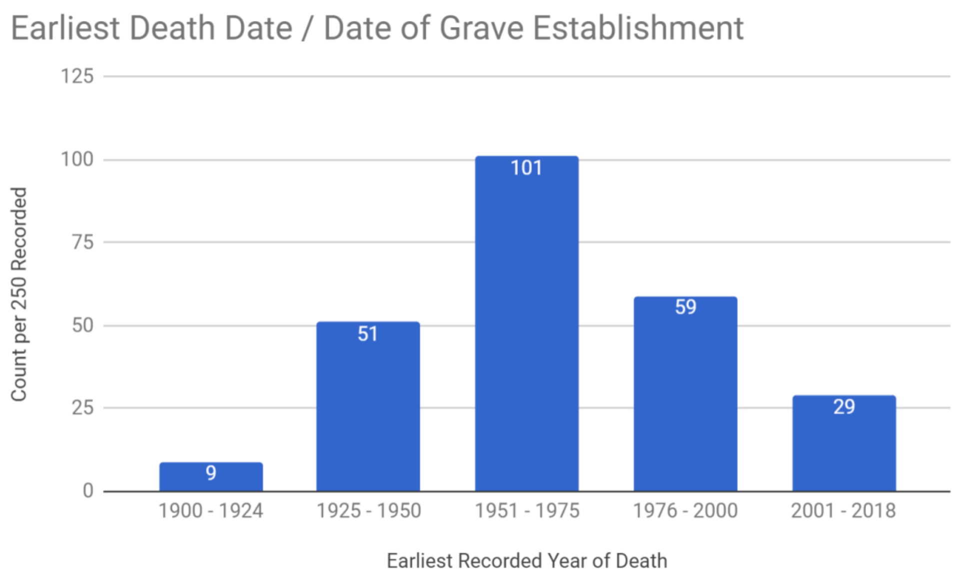

Figure 25. This graph illustrates the time periods with the earliest recorded death dates. Theoretically, this information can be used to infer when the burial was established by its current owners.

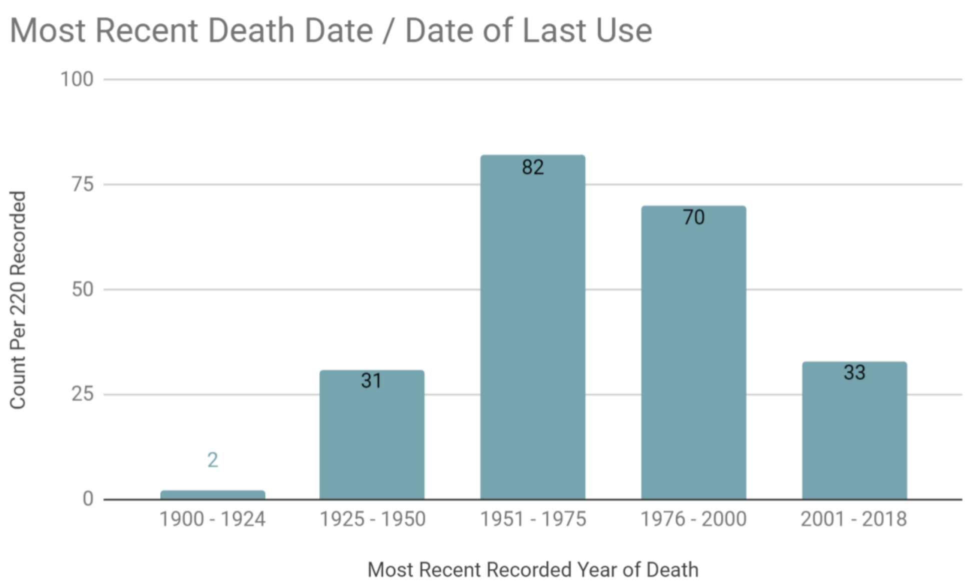

Figure 26. This graph illustrates the time periods with the most recent recorded death dates. Theoretically, this information can be used to infer the time period of the most recent interment, and therefore draw conclusions about the most recent maintenance on the burial plot.

Additionally, this data can be used to examine spatial patterns in material typology and use at Holt Cemetery. The tabular datasets provide a great deal of information at a very high level of detail, but in order for this data to function well within a GIS platform, the data have to be simplified greatly. In order to create a striking visual appearance, the material typology for each marker was averaged and assigned a primary marker type for each burial plot, regardless of the number of markers associated with that plot. Additionally, the earliest year of death category provided too wide of a range with which to create useful maps, and therefore this category had to be aggregated. With that being said, there are still patterns to be identified within the spatial distribution of burial plots at Holt Cemetery, and inferences that can be drawn based on these patterns. As an example, two maps have been created: one illustrating the distribution of marker materials throughout the study area, and the second showing the presumed age of individual burial plots and how these plots are concentrated within the landscape. These inquiries are quick representations of the type of questions that can be answered with this dataset, presented here with the intention of prompting new research questions drawn from the intersection of spatial, material, and conditional data.

The data collected in this endeavor are the first of its kind at Holt Cemetery, providing the ability for in-depth analysis that was previously stuck within the realm of speculation. The charts, maps, and example applications provided here are merely suggestions for how this dataset can be used with reference to the specific individuals and disciplines that this data collection methodology was designed to support. In addition to its functionality as a research tool, it should be noted that the initial intent of this process was to illustrate a low cost and open source methodology with which to document vulnerable historic sites. The methodology illustrated in this thesis has proven that pertinent data and physical attributes of a cultural landscape can be collected and utilized as a viable method of preservation, especially in the scenario that the landscape is inevitably going to cease to exist. Although continually evolving, the longevity of Holt Cemetery is relatively secure. That being said, if ever the cemetery does cease to exist, the data collected through this research can be curated and exhibited as an eternal representation of the cemetery, demonstrating the importance of this research for cultural landscapes threatened by climate change, land loss, and urban development. Although the physical space may no longer exist, the information and physical attributes can be preserved through detailed, multilayer documentation.

Figure 27. This map shows the spatial distribution of marker materials within the study area of Holt Cemetery.

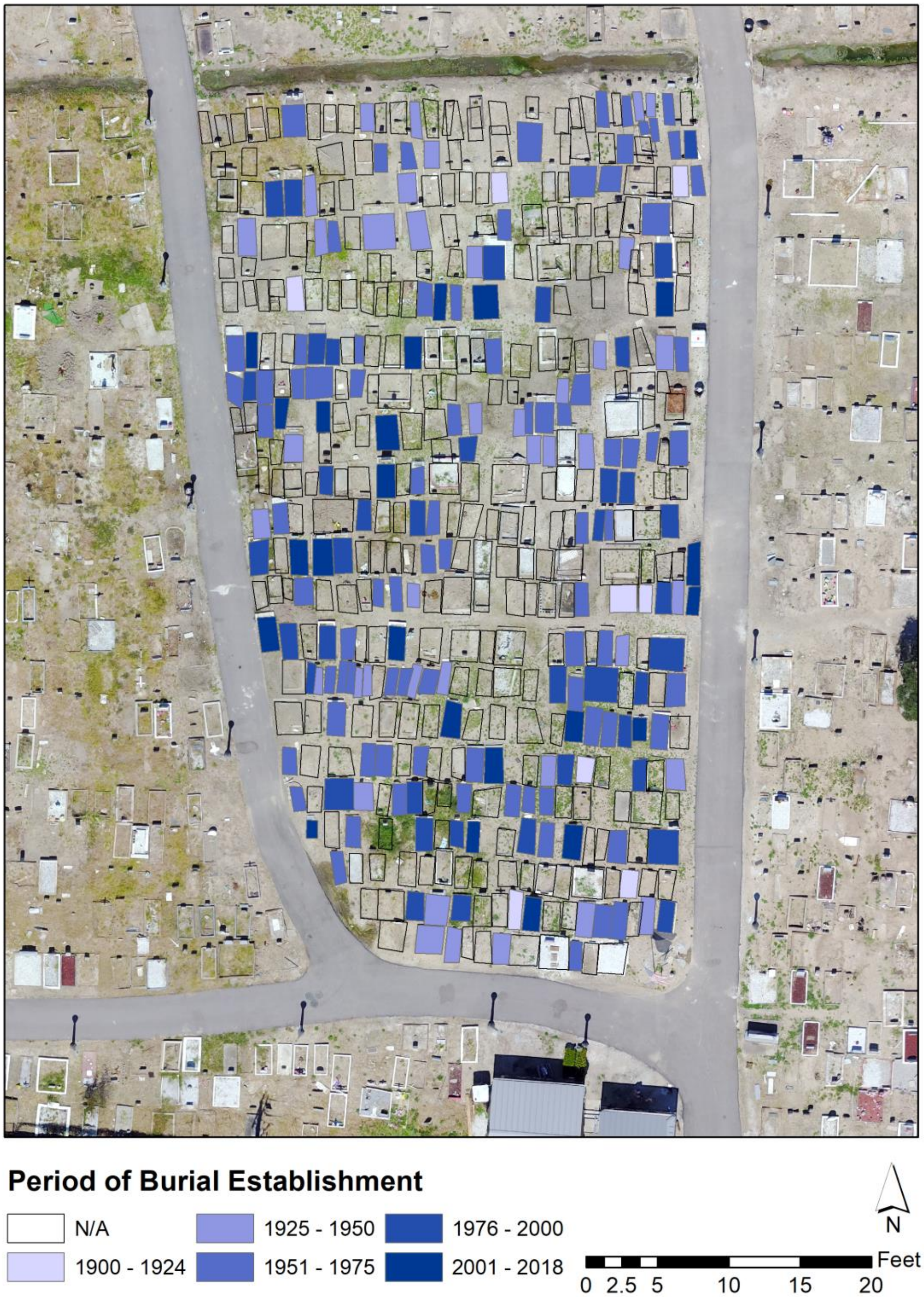

Figure 28. This map shows the spatial distribution and assumed age of burials in the study area of Holt Cemetery.

Future Work

This project has established a sample methodology with which to document multiple attributes of a historic landscape. Although the surveying process was designed for use in a specific type of historic cemetery, it is intended that this process can be repeated in a variety of other cultural landscapes. In order to test this hypothesis, I am actively seeking the opportunity to test this methodology in a variety of cemetery landscapes in order to better refine the practices and address complications that might arise from variations in terrain and burial architecture. In recent years, a sizable amount of attention has been paid to cemeteries located in the coastal zone of Louisiana, specifically in the far south bayou regions. These landscapes are facing destruction at a rate much faster than that experienced at Holt Cemetery, and therefore this methodology could prove essential in the documentation and conservation of these burial spaces.

Additionally, this project was originally designed with the intention of publishing the final products in a web based map format so that the general public, or those lacking the software and technical skills required to perform a GIS analysis, could utilize the data to answer research questions. Time constraints within this project have not allowed for this step to reach completion. Although the data utilized in this project has been uploaded and made open source, the next step in order to meet the goals set forth at the beginning of the project would be to build an ESRI Story Map or comparable web application that inexperienced users could successfully utilize. This step is small in the grand scheme of things, and hopefully will be finalized in the weeks following the publication of this thesis.

Conclusions

This thesis has demonstrated one experimental approach for rapid digital documentation of spaces. It is intended that the different tools and techniques utilized within this project will be adapted as a suggested framework for site documentation that can be modified and scaled for use with any artifact, structure, site, or landscape facing destruction due to environmental forces, urban development, or general disrepair. The increasing rate of sea level rise as well as the lightning speed of new development within New Orleans have rendered inefficient the restoration and rehabilitation aspects of historic preservation in the area, making the application of experimental documentation and curation a viable avenue for those who are interested in conserving the cultural components that are the framework the distinctive culture in New Orleans, and coastal Louisiana as a whole. The tools and techniques outlined in this thesis serve to improve on processes employed by a variety of professionals operating within the realm of cultural and also natural resource management; from archaeologists to groundskeepers, geographers to geologists. The results produced using this methodology can be used as examples of how to build informational databases that can be used as research tools, interactive and immersive exhibits, and as conservation material for cultural landscapes that are overlooked and at risk.

This thesis has provided the first comprehensive guide of how to design and implement a low-cost digital documentation project with suggestions of how to analyze and exhibit the resulting data based on applications of the Holt Cemetery case study. While this methodology was designed using the expertise and resources of a practitioner of cultural resource management, it is intended that the tools and techniques described will be accessible and repeatable for the general public. At this time, the money, time, and skill required to perform this research may be prohibitive for many, but this situation will inevitably change as the technology utilized becomes more accessible. The technology used in this project- RTK GPS, GIS, UAS, and smart phones- will inevitably become exponentially less expensive while simultaneously becoming more user friendly and prolific within society as time progresses. It is presumed that the processes detailed in this thesis will become more common within adaptive management strategies in the coastal regions of the United States and beyond as the crises of climate change and limited habitable space impact all societies within the coastal regions of the world. Although this process is not a solution to these crises, it demonstrates a quick, affordable, and accurate means of historical documentation and representation that can be utilized for a variety of purposes, including preservation, research, management, and exhibition. Historical sites such as Holt Cemetery may not be highly regarded at the current moment, yet as cultural features begin to disappear from our landscape, the inherent value in documentation will become apparent to those within the cultural resource management profession, and hopefully, to the public who enjoy and craft their own identities based on these cultural landscapes. It is my hope that this research has proven informative and inspiring for those with a culturally conscious mindset who feel powerless in the face of climate change.

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Vita

Alahna Moore is a candidate for a Masters degree in Urban Studies and a coastal science certificate through the University of New Orleans. Alahna was raised in the coastal town of Houma Louisiana, and she has personally experienced the exponentially increasing rate of landscape degradation occurring in the deltaic regions of the Gulf Coast. Throughout her young life, the changes caused by changing climate, rise of sea levels, erosion of landmass, and industrial proliferation have exacerbated the processes of landscape change, resulting in an unforeseeable future for those who live, work, and craft their identities within the cultural framework of coastal Louisiana. These experiences have informed and motivated the ethos of Alahna's work, culminating as a call to action for developing expedited methods of preservation and documentation to be used in threatened geographic areas like the Gulf Coast. Although the land in question may not be able to be protected, it is the belief of the author that the material culture found built upon the landscape and deep within the mud, as well as the stories and lived experiences of those native to threatened lands should be prioritized, documented, and exhibited as a means of resisting the cultural erasure caused by climate change.

Alahna has dedicated her research towards advocating for the longevity of cultural landscapes in South Louisiana by employing archaeology and ethnography alongside a variety of digital techniques such as GIS, remote sensing, UAV photogrammetry, and web applications to collect and visualize historical data. Through interdisciplinary work, Alahna has worked to democratize the creation of knowledge and promote environmental literacy by developing low cost and open source tools for data collection, visualization, and curation. In collaborations with local artists, scientists, and activists, as well as through her professional work with NASA DEVELOP, the University of New Orleans Center for Hazards Assessment, Response, and Technology, UNO's archaeology department, the Michael-Mizell Nelson Digital History Lab, and the Midlo Center for New Orleans Studies, Alahna has published workflows and exhibited content using interactive maps and 3D models in order to communicate historical and ecological information to a diverse audience. These methods have been presented for international audiences at conferences focusing on a range of subjects, including coastal environments, historical archaeology, digital documentation, and Geographic Information Systems.

In addition to these accomplishments, Alahna is certified by multiple federal organizations including the Federal Aviation Administration (FAA), National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration Applied Remote Sensing Training (NASA ARSET), and the leading purveyor of spatial and environmental analysis software, ESRI. As of January 2018, Alahna is a certified Louisiana Master Naturalist and the Communications Chairperson on the Louisiana Master Naturalists of Greater New Orleans board of directors. When she is not working, Alahna enjoys spending her time biking, boating, and wandering with her beloved dog, Coco Lopez.