2017

De Soto National Memorial GPS and Terrestrial Laser Scanning Survey

Lori Collins
*University of South Florida*, lcollins@usf.edu

Travis Doering
*University of South Florida*, tdoering@usf.edu

Jorge Gonzalez
*University of South Florida*, jorgegonzalez@usf.edu

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Scholar Commons Citation
Collins, Lori; Doering, Travis; and Gonzalez, Jorge, "De Soto National Memorial GPS and Terrestrial Laser Scanning Survey" (2017). *Digital Heritage and Humanities Collections Faculty and Staff Publications*. 14. [https://digitalcommons.usf.edu/dhhc_facpub/14](https://digitalcommons.usf.edu/dhhc_facpub/14)

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Lori Collins, Ph.D., Travis Doering, Ph.D., Principal Investigators, with Lead 3D Specialist Jorge Gonzalez

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De Soto National Memorial GPS and Terrestrial Laser Scanning Survey
Project Overview and Methods
Spatial survey fieldwork was initiated on 5/27/2016, with a GPS survey including mapping support for the National Park Service Southeast Archeological Center (NPS SEAC) excavation at the William Shaw Tabby House Site (8MA70), and to assist with a public archeology day at the Desoto National Memorial during the SEAC project. GPS work centered on the MA70 locale, but interpretive signage, park trails, shoreline, sandbag areas, previous survey marker and monument locations, and other prehistoric and historic features were documented. The NPS SEAC excavation unit locations were also recorded in conjunction with spatial survey work (Figure 1).

On 2/16/2017, the authors returned to the site and performed a GPS Real Time Kinematic professional survey in conjunction with licensed surveyors from Southeastern Survey and Mapping Corporation (SSMC). Two (2) benchmarks designated "SSMCTBM CMA-1" and "SSMCTBM CMA-2" were set in the Desoto National Memorial Park, near the Tabby House Ruins, in Section 18, Township 34 South, Range 17 East, Manatee County Florida by SSMC. The horizontal positions for all features are relative to North American Datum, NAD 1983, 1999 adjustment; State Plane Coordinate System, Florida West Zone and are based on the National Geodetic Survey (NGS) control designated "M 082" with PID "AG9187". The horizontal information included in this report for this project is accurate to+/- 1 foot. This horizontal information is to assist future recovery of the benchmarks and should not be used as control for horizontal positioning. The vertical information shown hereon refers to a National Geodetic Survey (NGS) point designated "26156 A" with PID "DP6639" and a published elevation of 3.66 feet and a National Geodetic Survey (NGS) point designated "26156 B" with PID "DP6640" and a published elevation of 4.66 feet according to the North American Vertical Datum of 1988 (NAVD88).

A US Corp of Engineers (U.S.C.E.) standard disc marker surrounded in concrete was noted to be near the tabby ruins in an area inundated during high tide (Figure 2). The marker was stamped with "U.S.C.E. Line 3" and was likely a reference for a survey marker that was initially established closer to the east/center

Figure 1. GPS survey during the NPS SEAC archeological excavations, led by Dr. Margo Schwadron, at the William Shaw Tabby Ruins.
Figure 2. US Corp of Engineers survey marker at DESO, as seen during high tide (above) and low tide (below). Although still in situ, this marker is subject to movement and is not reliable or verified for use.
end of the point in 1925 but was lost in 1958 according to the National Geodetic Survey datasheet, after work along the shoreline trail had begun. Additionally, a US Department of Interior NPS survey marker was found discarded along the shoreline area north and east of the tabby ruins, having likely also been impacted by erosion and shoreline loss (Figure 3). This monument, due to being removed from its surveyed location, was collected by the NPS DESO rangers during our work.

The spatial survey field work performed by the SSMC personnel conforms to the Minimum Vertical Accuracy and is in accordance with the STANDARDS OF PRACTICE set forth by the Board of Professional Surveyors and Mappers in Chapter SJ-17 requirements of Florida Administration Code. The measurement methods used for data collection referenced within this survey report meet or exceed this requirement. The dimensions shown hereon are in United States standard survey feet and decimals thereof, unless otherwise noted (Figures 4-7).

Also occurring during this field visit, USF performed further GPS data collection across the site and conducted a terrestrial laser scanning survey of the tabby ruin locale (Figure 8). The laser scanning, consisting of 11 tripod-based scanning positions across the tabby ruins area, provided georeferenced information for the geodatabase and is being used to offer a digital reconstruction of the site based on historic images, known methods and materials of construction, and measurements and pattern understanding made possible from spatial detail gathered inclusive of surrounding terrain. This survey utilized phase shift laser scanning technology with millimetric accuracy (Figures 9 -12).

Figure 3. This US Department of Interior N.P.S. survey marker was found discarded on a pile of rock rip rap along the NE shoreline at DESO and was collected by park staff during our visit to prevent possible removal by collectors.
Figure 4. Survey sheet for the CMA-1 Benchmark location established near the tabby ruins.
Figure 5. Documentation sheet for the CMA-1 control location established.
Figure 6. Survey sheet for the CMA-2 Benchmark location established near the tabby ruins.
Figure 7. Documentation sheet for the CMA-2 control location established.
Figure 8. Location of benchmark data collected during the RTK GPS survey to allow for georeferencing control of the 3D TLS survey.
Figure 9. The linear wall feature of the tabby ruins was recorded from the NW corner to the NE corner to allow for georeferencing of the TLS Survey information.
Figure 10. Terrestrial Laser Scanning (TLS) survey at the 8MA70 William Shaw Tabby Ruins was conducted along with GPS control survey work at the site.

Figure 11. 3D terrain details captured across the William Shaw Tabby Ruins area using terrestrial laser scanning survey. This survey will allow for future digital reconstruction of the site, applications for terrain modeling and reference with archeological excavation work conducted at the site.
Figure 12. Terrestrial Laser Scanning survey at the tabby ruins is allowing for accurate mapping of structural elements, and for the eventual virtual modeling and interpretation of the site.
Work following these field collections consisted of the construction of a GIS geodatabase containing relevant data layers and raster images, including georeferenced maps and sketch map drawings that show cultural features as well as historic shoreline indications. Historic aerial imagery is also included from multiple years in the geodatabase and has been georeferenced to the project area to provide contextual information on environmental conditions and shoreline erosion processes and change. These historic imagery files are also provided in an online interpretative presentation, that allows interactive examination and comparison of imagery from various years with noted shoreline change occurring that has impacted the site area (see: http://arcg.is/2qwKgHy and http://arcg.is/2qx7XzP ; Figure 13). GPS data was provided from the NPS Southeast Archeological Center, with information concerning the excavation unit positions and sizes provided to be included in the finalized geodatabase along with surveyed control positions and information (Figures 14- 16).

Figure 13. Interactive on-line slider maps allow the comparative viewing of historic imagery in relation to present day conditions. Erosion and other change processes can be readily seen using these visualization tools.
Figure 14. GPS survey information and georeferenced TLS 3D survey data, shown above in relation to the NPS SEAC excavation unit locations at the William Shaw Tabby Ruins (BMA70/DESO 2.01) site. The TLS survey allows for a higher resolution measured terrain understanding in the area of the ruins (below).
Figure 15. LiDAR processed for the DESO project shown in relation to the TLS survey location data collected at the tabby ruins as well as probable prehistoric site locations and extents derived from both remotely sensed (RS) data (LiDAR and imagery) as well as examination of historic aerials and the Schwadron (2000) map, shown below, which provided ground verification of noted features from the RS data.
Figure 16. Aerial LiDAR data shown in relation to noted USCE survey marker (see Figure 2) and archeological survey features of note that appear to relate to historic fence structures in proximity to the tabby ruins area. A linear pattern is noted near the present-day shoreline to these features with other posts noted to the west and east of the tabby structure primary area.
Geodatabase Layer Descriptions
A geodatabase for the project was created that combined a number of data layers and raster graphics that were georeferenced. The data come from NPS SEAC field excavation work at the site (seasons 1 and 2), which were provided and are combined into the database unedited, along with original survey data collected by the DHHC at USF and affiliated licensed surveyors from SSMC. Historical aerials, aerial LiDAR data, a modern aerial, and a number of digitized features are also included, along with georeferenced historic maps that provide environmental and cultural context and meaning. To view these layers and their associated metadata, use of ArcCatalog is suggested. Version 10.5 was used in the current survey (Figure 17).

Layer Descriptions
1) Florida Master Site File Layers (Sites and National Register locations) – These data are from an April 2017 download from the FMSF and consist of data extracted from the Florida Master Site File that have a spatial components within the De Soto National Memorial. Sites and NR locations are provided that fall within the project area.
2) 1920 Charles T. Earle sketch map of the area that has been georeferenced by Digital Heritage and Humanities Collections at the University of South Florida Libraries.
3) 1973 Black and White aerial image retrieved from the Florida Department of Transportation (FDOT) and georeferenced by the Digital Heritage and Humanities Collections at the University of South Florida Libraries.
4) 1977 Black and White aerial image retrieved from the Florida Department of Transportation (FDOT) and georeferenced by the Digital Heritage and Humanities Collections at the University of South Florida Libraries.

Figure 17. ESRI ArcCatalog view of the data layers and information with metadata description and thumbnail preview of files within the geodatabase accompanying report.
5) 1980 Black and White aerial image retrieved from the Florida Department of Transportation (FDOT) and georeferenced by the Digital Heritage and Humanities Collections at the University of South Florida Libraries.

6) 2014 Florida Department of Revenue RGB one foot orthophoto

7) Interpretive Materials data layer at De Soto National Memorial, was collected by the Digital Heritage and Humanities Collections at the University of South Florida Libraries, using a Trimble Geo7x with a Tornado Antenna on a 2-meter pole. GPS data was collected on May 27, 2016. Post-processed using Trimble Pathfinder software with corrections applied.

8) DEM- Digital Elevation Model- A digital elevation model created in ArcGIS using aerial LiDAR data obtained through NOAA. LiDAR data from the 2007 Florida Department of Emergency Management Southwest Florida LiDAR survey. The digital elevation model was interpolated to 6-inch horizontal resolution.

9) DSM- Digital Surface Model - A digital surface model created in ArcGIS using aerial LiDAR data obtained through NOAA. LiDAR data from the 2007 Florida Department of Emergency Management Southwest Florida LiDAR survey. The digital surface model was interpolated to 6-inch horizontal resolution.

10) NPS Archeological sites within De Soto National Memorial extracted from the South East Region (SEAC) GIS data layer (data provided).

11) Excavation Units provided by the NPS SEAC, unedited and used for unit shape location (note this shapefile was removed from the geodatabase, as there is a projection error with the file. The files can be added to a project from the original source).

12) Remotely sensed (LiDAR or imagery) derived mound or other feature locations based on elevation of the LiDAR dataset.

13) Sandbags at the De Soto National Memorial digitized from GNSS data. GNSS data was collected using a Trimble Geo7x by the Digital Heritage and Humanities Collections at the University of South Florida Libraries.


15) Shoreline of De Soto National Memorial digitized by the Digital Heritage and Humanities Collections at the University of South Florida Libraries from the Florida Department of Transportation (FDOT) color aerial photograph from 2014.

16) Surveyor GPS Data – Two monuments were established with vertical and horizontal information collected to provide control for current and future surveys conducted at the site and to provide reference and monitoring locations. In addition to these two set positions (markers set), two additional higher precision horizontal positions were taken on the tabby ruin structural remains. These positions included the NW corner stone (in situ stone) and a position taken along a wall feature. These positions were acquired to assist with the georeferencing of future survey data, including the 3D laser scanning survey of the tabby ruins area.

17) Tabby House Ruins location was digitized as a squared off area using the Digitized Site Features layer as a reference. This is an NPS SEAC layer and is slightly different from the TLS survey position.

18) Color representation of the terrestrial laser scan data to show the Tabby House ruins as a photo – not georeferenced in this versioning.
19) Trails at the De Soto National Memorial were digitized from GNSS data and aerial imagery. GNSS data was collected using a Trimble Geo7x by the Digital Heritage and Humanities Collections at the University of South Florida Libraries, and aerial imagery used was from a 2014 Florida Department of Revenue (FDOR) image. Excavation Unit shapefile from the park service with locations adjusted to USF Libraries GPS locations. GPS data was collected using a Trimble Geo7x with a Tornado Antenna on a 2-meter pole. Because NPS SEAC returned to the site for further work, this layer should be used in conjunction with GPS data collected from the NPS SEAC. NPS Shapefiles that were provided and when appropriate, placed unedited back into the geodatabase include: DESO datum locations, DESO excavation units, pine post features, DESO season 2 stand-alone units, DESO post features. The file representing excavation unit corner point locations was not added due to error with file when attempted to include.

Directions for Future Applications
Recommendations for future work at the site include the further use of the collected 3D TLS survey information to create a virtual model of the William Shaw Tabby Ruins. This model will be a combination of spatial measurement details of note from the survey conducted, along with known information concerning construction materials, size, and orientation as noted in an existing historic image (Figure 18). The tabby house at Shaw’s Point is said to predate William Shaw’s 1843 arrival, and to have served as a Civil War outpost position, post office and in 1878 as a quarantine station before being abandoned and having its floor dug up by treasure hunters (Favorite 2013). The historic photograph depicts the tabby wall construction with wooden beams and door frame, lintel and other roof supports, with a thatched palm roof construction. Of note in the photo is a man (Capt. Tole Fogarty) shown for scale in the doorway, along with his cast shadow, which can be used to examine possible orientation of the structure (Figure 19). For example, the image shows the man’s shadow cast to his left side behind him, meaning he was facing into the sun. An examination of the sun’s path, using the sunearthtools.com program, suggests that the door to the structure would likely face west or slightly north in order for the shadow to cast behind and to the left of the person (Figure 20). These types of tools in combination with the archeological data and spatial survey information can assist with forming a better understanding of the landscape place and use through time. The laser scanning and GPS survey support a more holistic consideration of patterning and can also prove useful for long term site monitoring and provide accurate control for further data recovery, visitor experience development, and archeological documentation needs.
Figure 18. 3D modeling using the TLS data (above) processed to examine ground-based terrain features at the MA70 site (below), allows for scalar considerations of the structure based on documented structural remains (tabby blocks) and ground surface aspects. Using the data collected, virtual representations can be constructed that will reflect not only the size and shape of the structure on the landscape but using the materials and textures to support interpretive development.
Figure 19. Historic image showing the tabby ruins structure at Shaw’s Point (Favorite 2013:18).

Figure 20. An examination of shadow based on the position of the sun relative to the site location using https://www.sunearthtools.com/.
References
Favorite, Merab-Michal

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