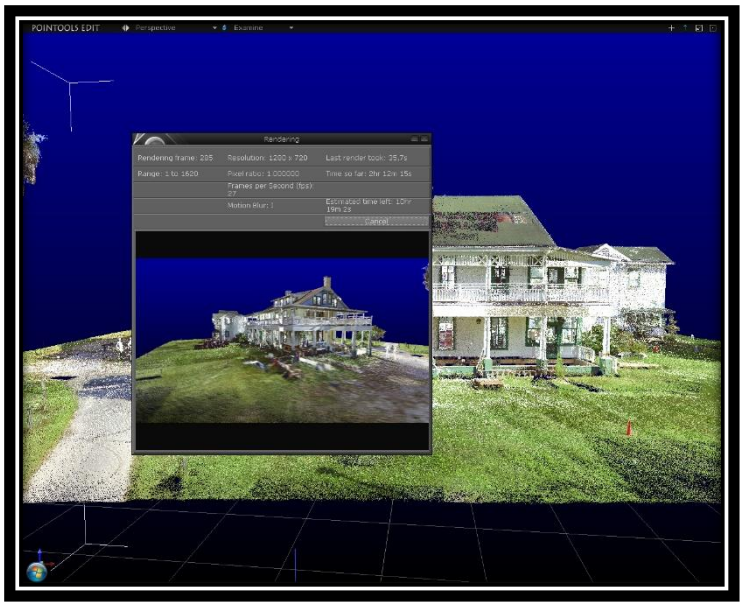
6-1-2014

The Chinsegut Hill 3D Documentation Project

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

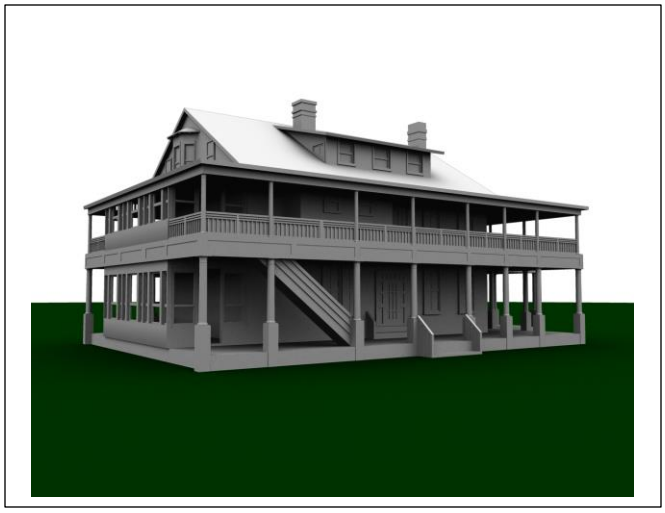
Travis Doering
University of South Florida, tdoering@usf.edu

Jorge Gonzalez
University of South Florida, jorgegonzale@usf.edu



THE CHINSEGUT HILL 3D DOCUMENTATION PROJECT

Applied Interdisciplinary Research in Spatial Technologies



JUNE 1, 2014

Lori Collins, Ph.D., RPA; Travis Doering, Ph.D., and Jorge Gonzalez

UNIVERSITY OF SOUTH FLORIDA

Contributions by Steven Fernandez, Bart McLeod, Jeff Du Vernay, Garrett Speed, and Joseph Evans

Prepared for: The Friends of Chinsegut Hill, Inc. and Hernando County

Project funded by Florida Division of Historical Resources Grant No. MP1405

Table of Contents

List of Figures

Project Overview

The Chinsegut Hill Manor House is listed on the National Register of Historic Places and is located near the City of Brooksville in Hernando County, Florida (Figure 1). The house dates to 1847, when Colonel Byrd Pearson laid claim to the land and surrounding acres to build a home and cultivate sugarcane. Additions and alterations were made in the 1850s and 1860s by subsequent owners, but the most substantial and historically significant period of the house is associated with its early to middle 20th century owners Raymond and Margaret Robins, who entertained famous dignitaries and guests from around the world. The Chinsegut property has changed ownership and management responsibilities several times, and has been in need of major restoration and repairs to preserve the structure (Preservation Resource, Inc. 2013).

The main manor house is an irregular design Frame Vernacular with a side gable main roof. Historic alterations of the home included the removal of a widow's walk that previously comprised a central roof portion of the home (Huse 2003). This walk was removed in 1963, and like other physical changes and additions, have had impact on the structure's integrity and presence today. Other important and contributing aspects to the property include two Civilian Conservation Corps (CCC) Era house structures (Figure 2), a historic family cemetery (He673) (Figure 3), the grave memorial of Raymond Robbins and his wife, Margaret (Figure 4), and several landscape features such as historic plantings consisting of memorial oak tree locations (Figure 5). Additionally, modern cabins and facilities were constructed on the home property, and nearby are agricultural research station facilities.

The current 3D survey effort was funded through a State of Florida grant obtained by the Friends of Chinsegut Hill, Hernando County, who are the site stewards and managing authority. Working with the Friends group, AIST used the latest in 3D Terrestrial Laser Scanning (TLS), Geographic Information System (GIS), and Global Positioning Systems (GPS) survey techniques to create a Historic Building Information Management (HBIM) documentation of the interior and exterior of the house. This procedure also allowed the accurate mapping and recording of the associated landscape and terrain features. Data collected in the 3D survey were used to produce accurate as built and measured drawings of the manor house, and along with the visualized 3D data, are helping engineers and construction specialists restore and conserve the home. Additionally, detailed terrain and feature mapping using GPS are allowing the development of a more complete understanding of the site and its related structures, such as an historic cemetery, CCC or New Deal Era structures, and to assess the possible locations of historic slave quarters. Several features relating to the 1930s CCC era activities on the property were also recorded in the present survey, including bridges, water sites, structures, and agricultural activity locales. The survey results will be available online and include 3D visualizations of the existing manor house structure and other features.

All field work and research was done in conformance with the Florida Division of Historical Resources (FDHR) recommendations as stipulated in the FDHR's Cultural Resource Management Standards & Operations Manual, Module Three: Guidelines for Use by Historic Preservation Professionals and Rule Chapter 1A-46, Florida Administrative Code. The Principal Investigators for this project meets the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716-42).

Aerial LiDAR data was acquired and processed to provide a detailed terrain mapping project for the Chinsegut Hill landscape area, providing a topographical understanding of the historic and modern setting. Additionally, GPS survey and GPS photography were used to field truth and verify areas of interest, such as structures and historically depicted features as noted in our historic cartographic review. Historic maps depicting the property and assets were georeferenced and made part of a developed GIS geodatabase. This geodatabase

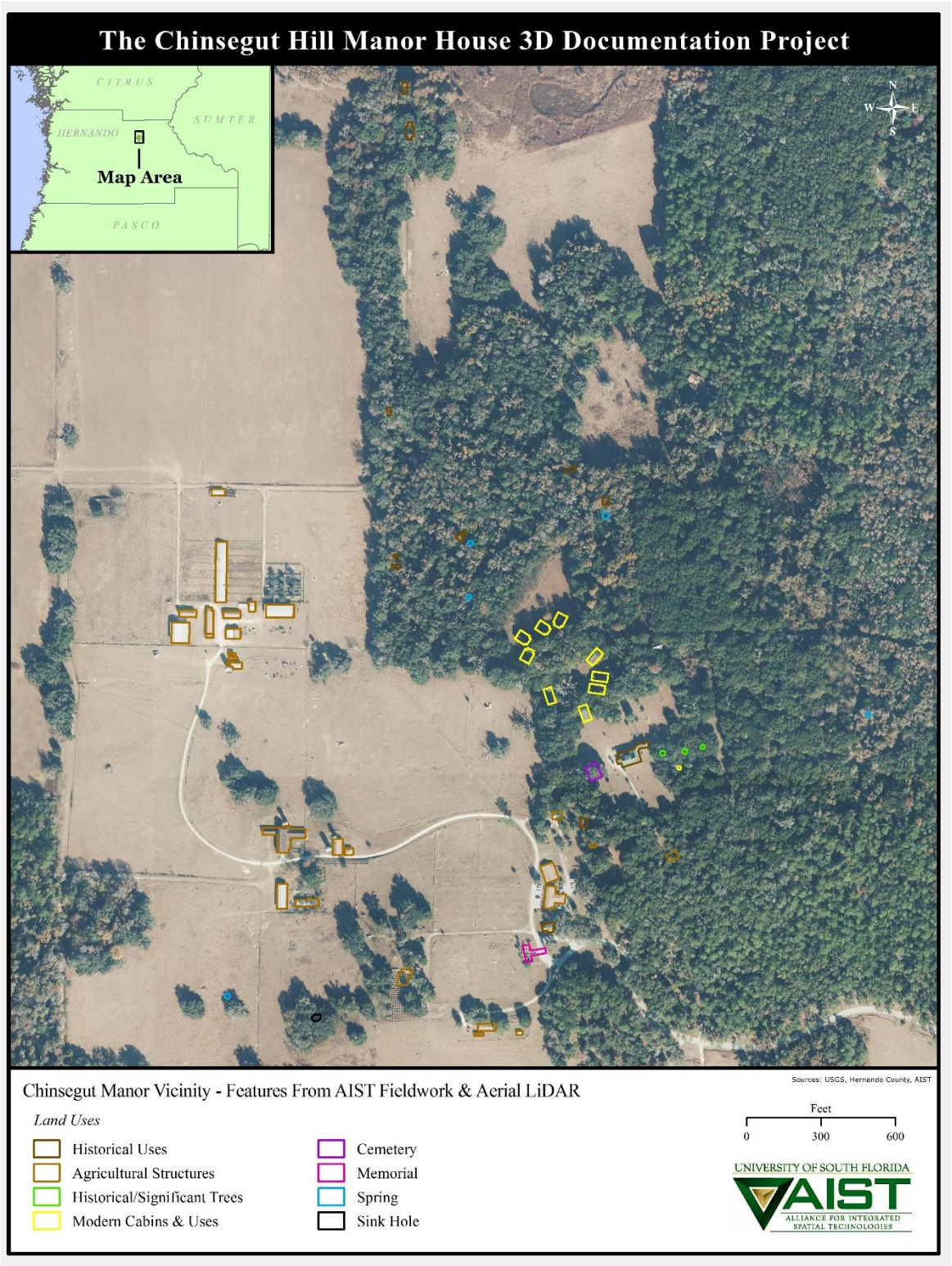


Figure 1. Project area vicinity map for the Chinsegut Hill Manor House 3D Survey.

Figure 2. Extant CCC era house structures from the 1930s are located to the southwest of the Chinsegut Manor House.

Figure 3. Six headstones commemorate the pioneer burials for the Ederington family, dating from 1851-1866. The stones and in particular the engraving is less evident than in the photographs taken of the Chinsegut Hills Cemetery (He673) in 2011 by the Hernando Past Cemetery Study, and are on file with the Florida Master Site File. Motifs include lambs, a weeping willow, and flower designs. Additionally, the survey plot location for the cemetery that is on file was incorrect and is updated with this survey (see: Appendix A).

Figure 4. Memorial marker near the Altar Oak location for the Robins burials.

Figure 5. Large live oaks are of historical significance to the property, such as the Ascension, Altar, and Lenin (not pictured) Oaks that function as memorials on the site (Huse 2003).

and derived products provide a spatial understanding for resources that historically were and presently are located within the Chinsegut Hill landscape area. This report overviews the project and provides representative product examples and links to digital materials developed.

Results

HBIM is a new approach to bringing multiple types of data together, including 3D, 2D, and historic legacy formats, providing an important tool for management and decision-making. The HBIM survey begins with a bringing together of remotely sensed (aerial LiDAR and imagery) data and historic information with ground-based survey data such as TLS and GPS survey data and collected photographic attribute information. One of the major HBIM products is the creation of full 3D models including information about an object's surface, methods of construction, material make-up, deformation, and transformational detail. The resultant survey can be used to create tomographic or sectional analyses of the structure, detailed CAD and 3D renderings, orthographic projections, and 3D models (wire frame or meshed surface textures) for both the analysis and conservation of historic objects, structures, and environments (Murphy 2013). Using meshed 3D models, new techniques such as 3D Printing, can also be used to create interpretive and tangible items, including full landscape and structure scaled models or even the potential for full-sized architectural detail and object replicas.

Three dimensional data collected in the survey of the Manor House and two CCC era structures were used to create a digital archive of current "as-is" conditions, as well as to provide information for the "as-built" understanding of these structures. Complete CAD renderings for the manor house were derived from the 3D laser scanning survey data. These renderings provide the most accurate examination of the structure to date and offer valuable information about the house performed prior to the current restoration project. These data are useful for engineering records and establish an architectural archive for the home. A developed GIS geodatabase, using GPS survey data and collected GPS photography, along with environmental and cultural information, also provide a valuable tool for the overall landscape consideration and management of the property into the future. The archival sources of information, including historic paper maps, photographs, diary descriptions, and other historical legacy data, have been brought into the current spatial database when possible, to provide contextual and relevant understanding of place. Products developed from the current survey are designed so that they are expandable, allowing for on-going research and updates to be included and to provide a platform for future learning and sharing about the past. Interested researchers and students can continue to add to the record, for example, associating historical documents and other information to the developed spatial platform.

Web-based 3D Visualizations and Animations

One powerful tool that emerges from the HBIM survey is the ability to visualize a structure in 3D and to readily share these data through on-line and classroom viewing. Utilizing data obtained from the 3D TLS survey of the manor house and CCC structures, 3D fly-through models were created to show the dimensional details of Chinsegut. Another method of 3D data visualization is the production of websharing tools that are used to collaborate, distribute, and work with scan data sets. As part of the project survey, webshare tools have been developed for use in the current restoration project and for use as an archive of the TLS survey of the Chinsegut Manor House. These data are provided in a "*webshare2go*" format, on an external drive as part of the project, and other visualizations are provided as standard URL viewing formats, using the CHROME web browser. For example, using aerial photos from 1973 and 2011, as well as an aerial LiDAR derived Digital Elevation Model (DEM), it is possible to compare the historic and current landscape variables and to visualize the results in an easily viewed on-line platform (Figures 6 and 7).

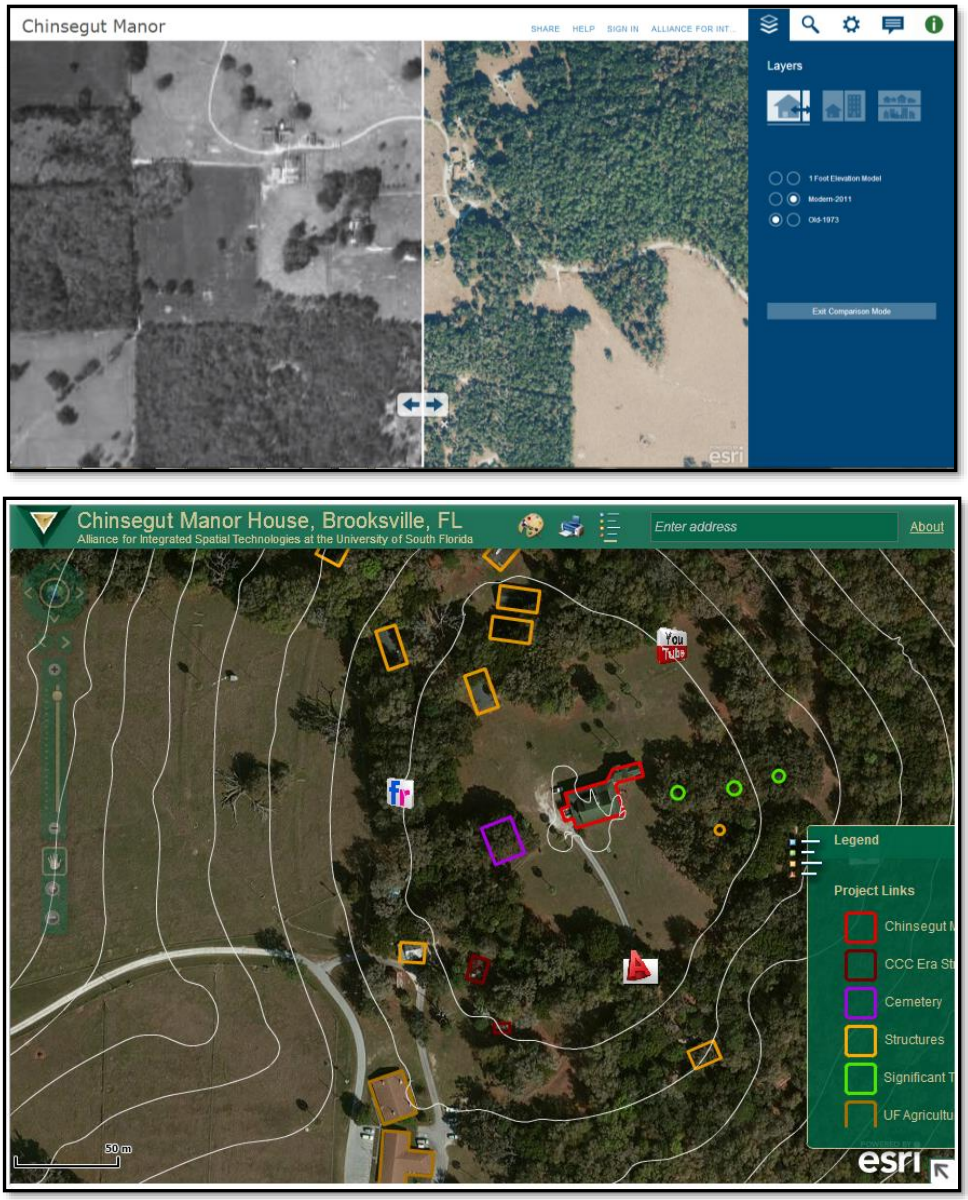


Figure 6. Web viewing platforms for landscape features and terrain information. A slider tool allowing for visualization of modern, historic and elevation data.
https://usfaist.maps.arcgis.com/apps/CEWebViewer/viewer.html?3dWebScene=32d66e955e4e4cb1b7e1efb0bfa522d2

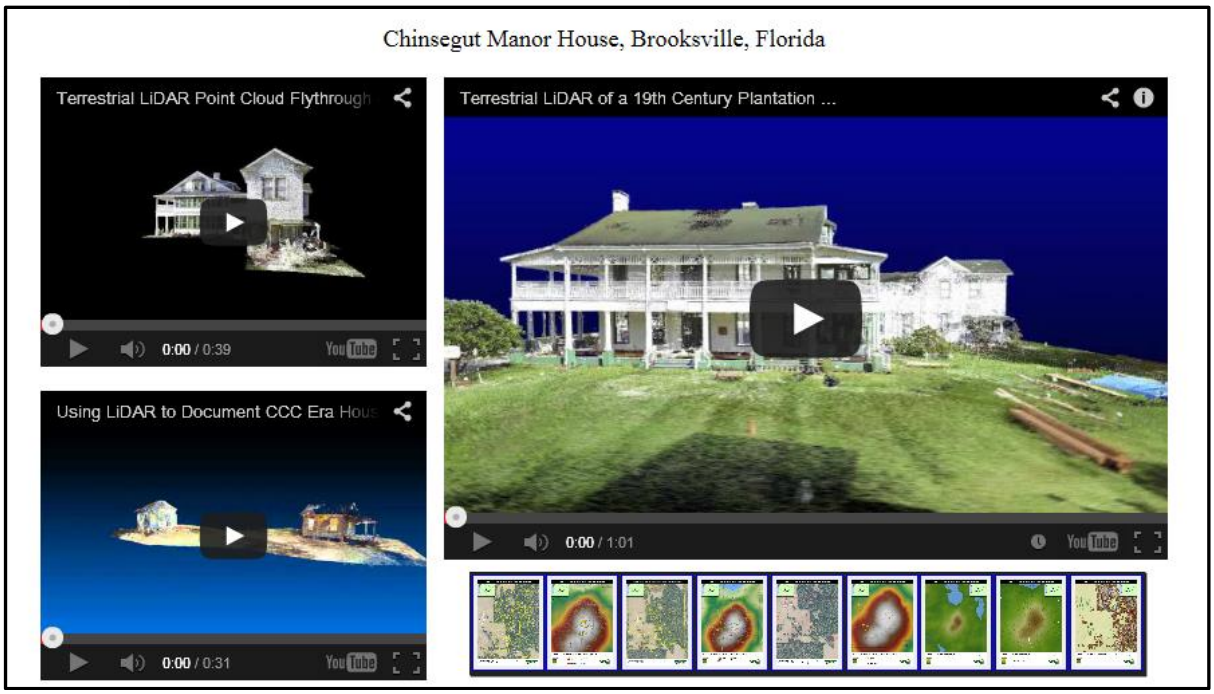


Figure 7. Web-based products for the Chinsegut Manor House 3D Survey Project. Website digital collections serve as living documents and can be added to and expanded, including future research and survey updated postprocessing. 3D CAD from laser scan data has been processed to solid surface models, also allowing for 3D printing and rapid prototyping of architectural details, including for future needs.

Sectional and CAD Analyses

3D imaging can be evaluated by sections. These sectioning of data, or tomography, provide a detailed understanding of issues relating to structural integrity and deformation when applied critically to historic buildings. We have modeled and produced a series of tomographic slices through the Chinsegut Manor House that show house elevations and site plan areas. Using the 3D point cloud of collected X, Y, Z, and RGB measurements and values (Figure 8), tomographic slices can be made at defined and selected planes and intervals. These slices provide architectural and engineering deformation and change analysis information that can, in no other way, be measured as precisely or visualized in this manner (Figures 9-14). From these slices and data, we have produced as built archival floor plans, documenting conditions prior to the current restoration efforts. These 3D survey CAD products were produced for floor levels 1-3, and contain detail areas such as longitudinal sections, roof plan and site plan, and interior and exterior sectional views (see Figures 15-23).

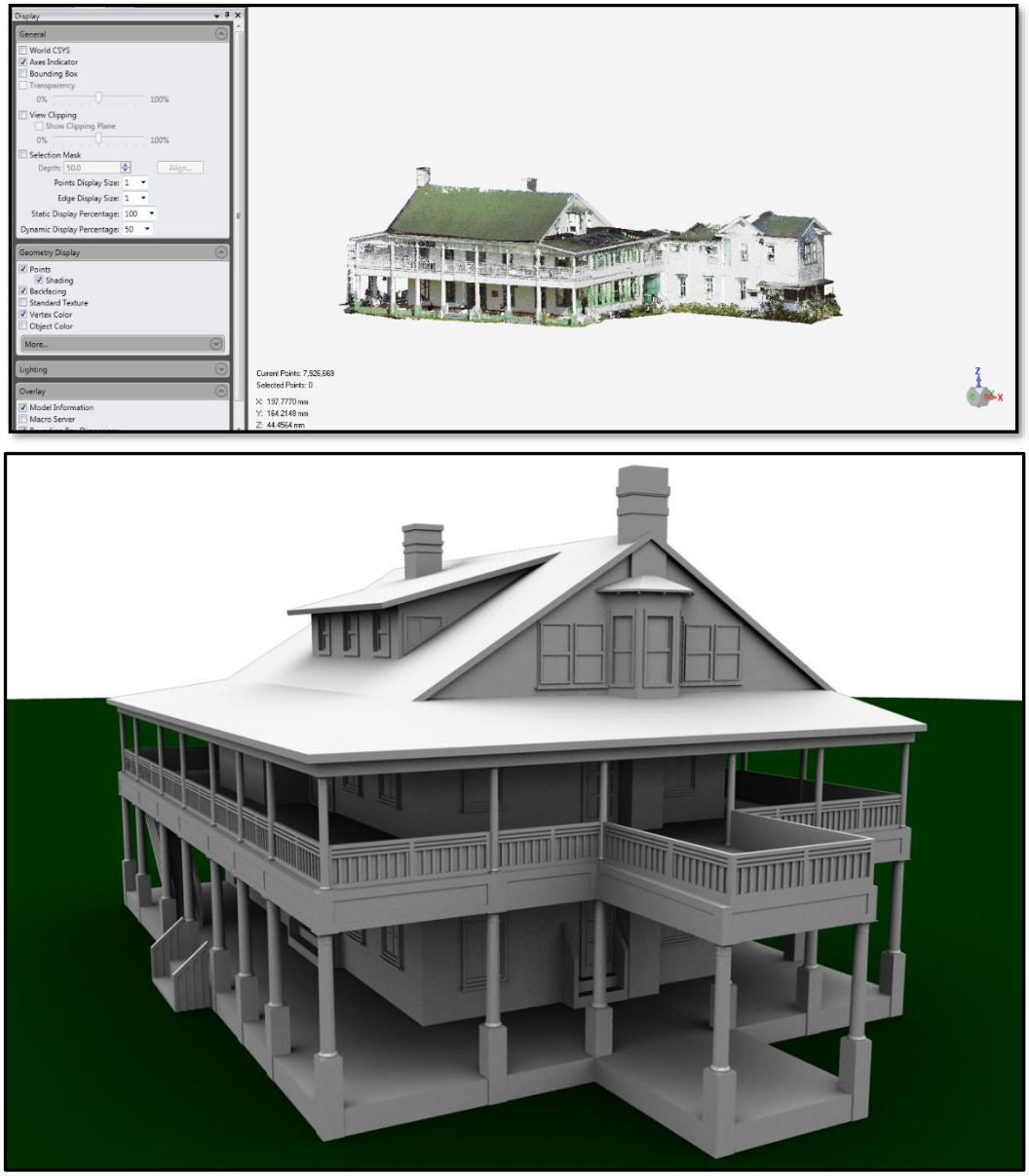


Figure 8. Point cloud of laser scanning data (above) and solid surface 3D CAD render (below) for the Chinsegut Manor House.

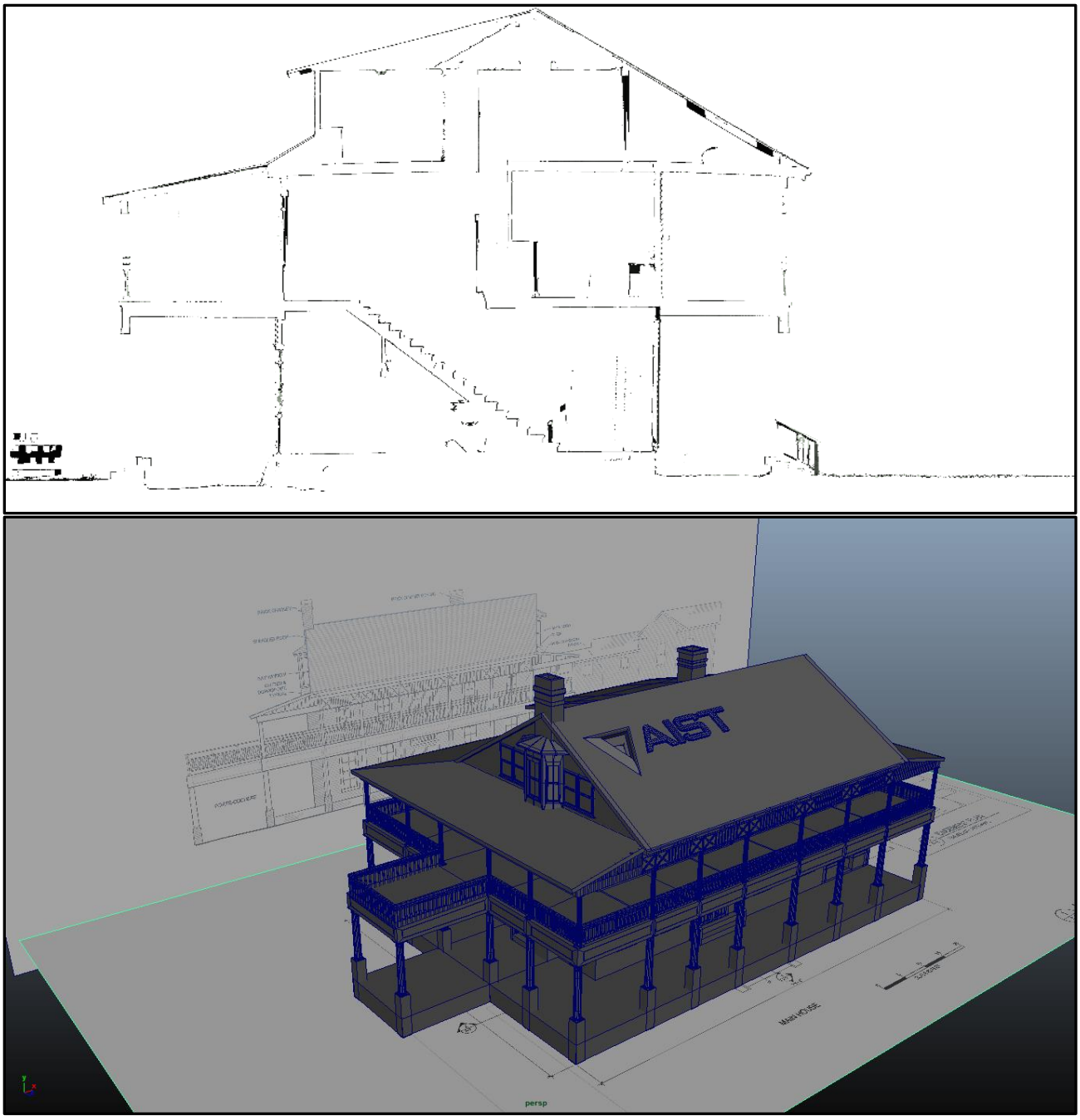


Figure 9. Tomographic slice from laser scan data through section showing through the center of stairs, and interior section of the house (above), and 3D CAD model buildout used for 3D printing and rapid prototyping (below). Measured drawings, sectional details, and 3D rapid prototyping are useful for engineering stabilization and architectural preservation of heritage structures.

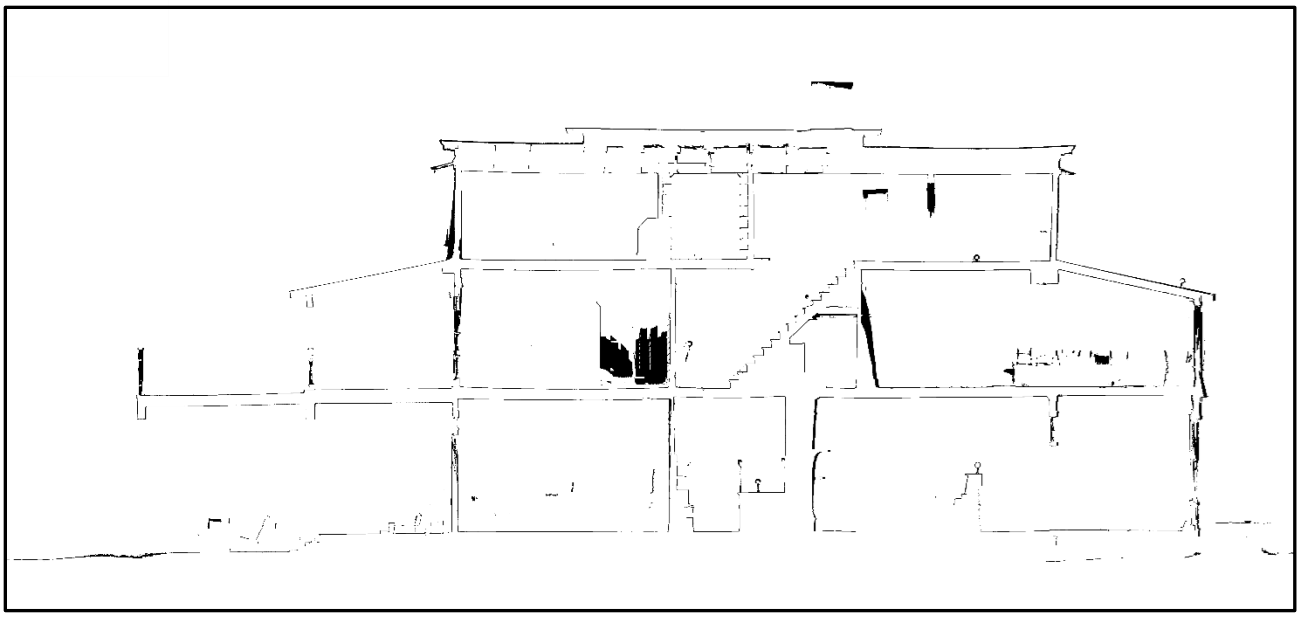


Figure 10. Tomographic slice from laser scan data through section showing through the center of house, and interior section of the house revealing floor levels.

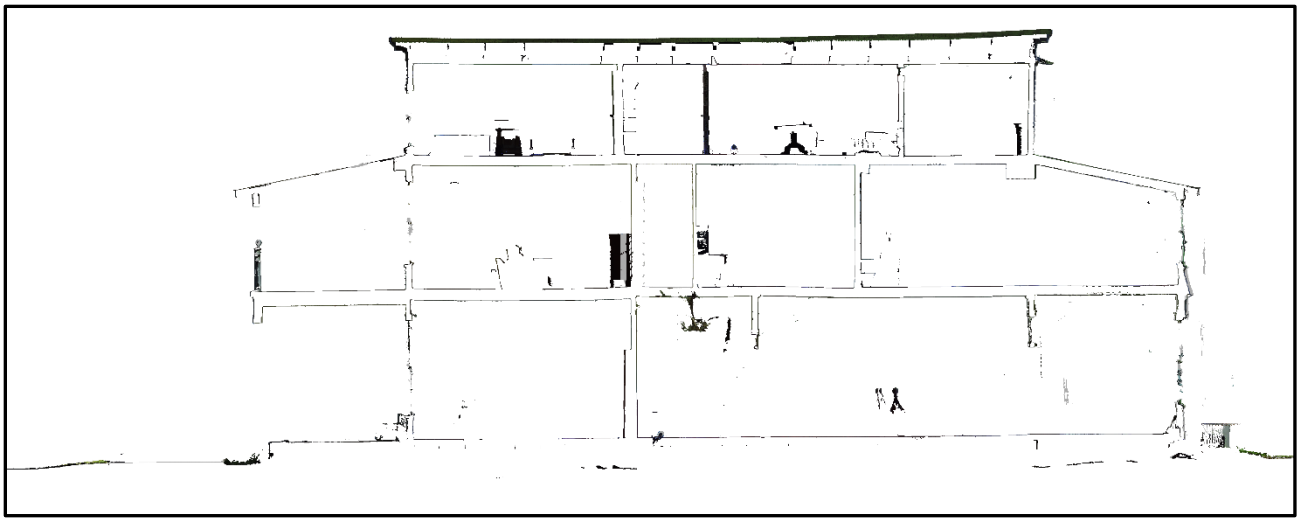


Figure 11. Tomographic slice from laser scan data, showing base of stair area facing north. Noted are areas of floor sag and roof line bowing and deformation.

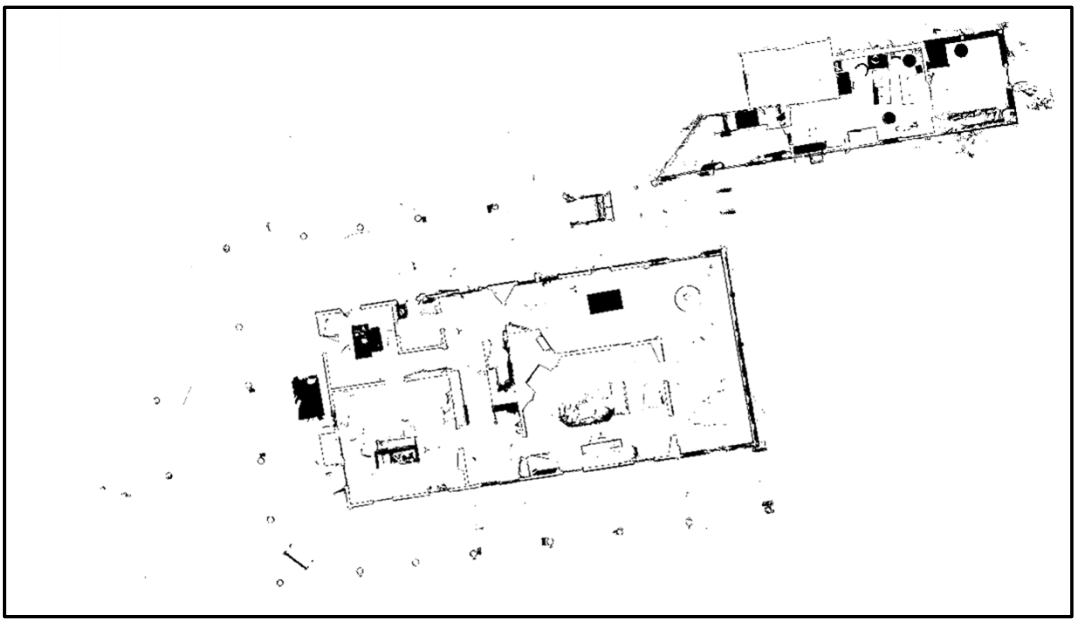


Figure 12. Tomographic slice from laser scan data, showing the first floor.

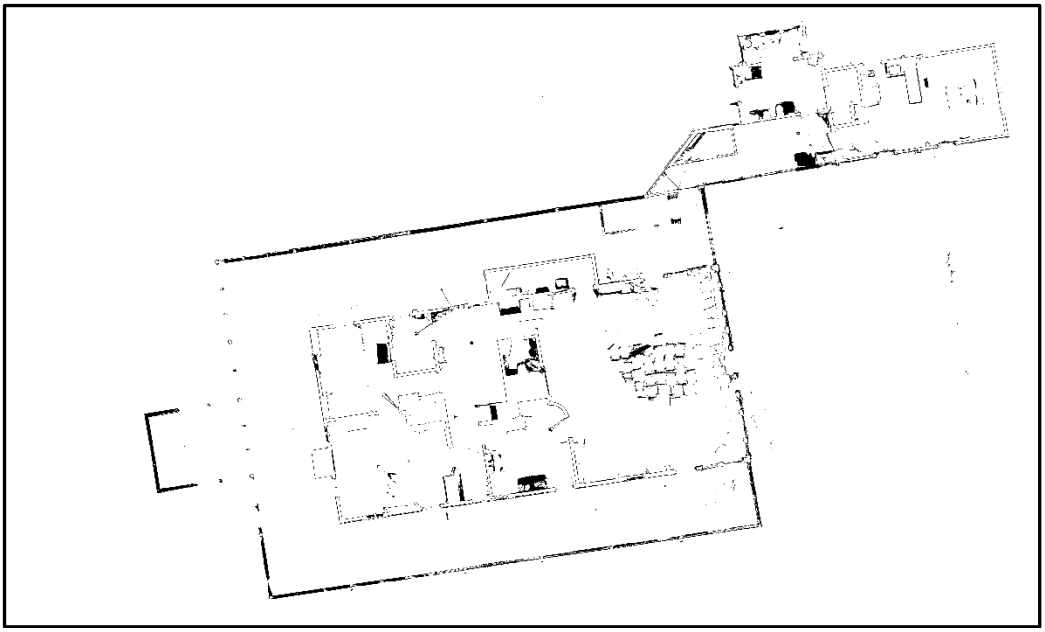


Figure 13. Tomographic slice from laser scan data, showing the second floor.

Figure 14. Tomographic slice from laser scan data, showing the third floor. Noted are areas of significant wall deformation and bowing.

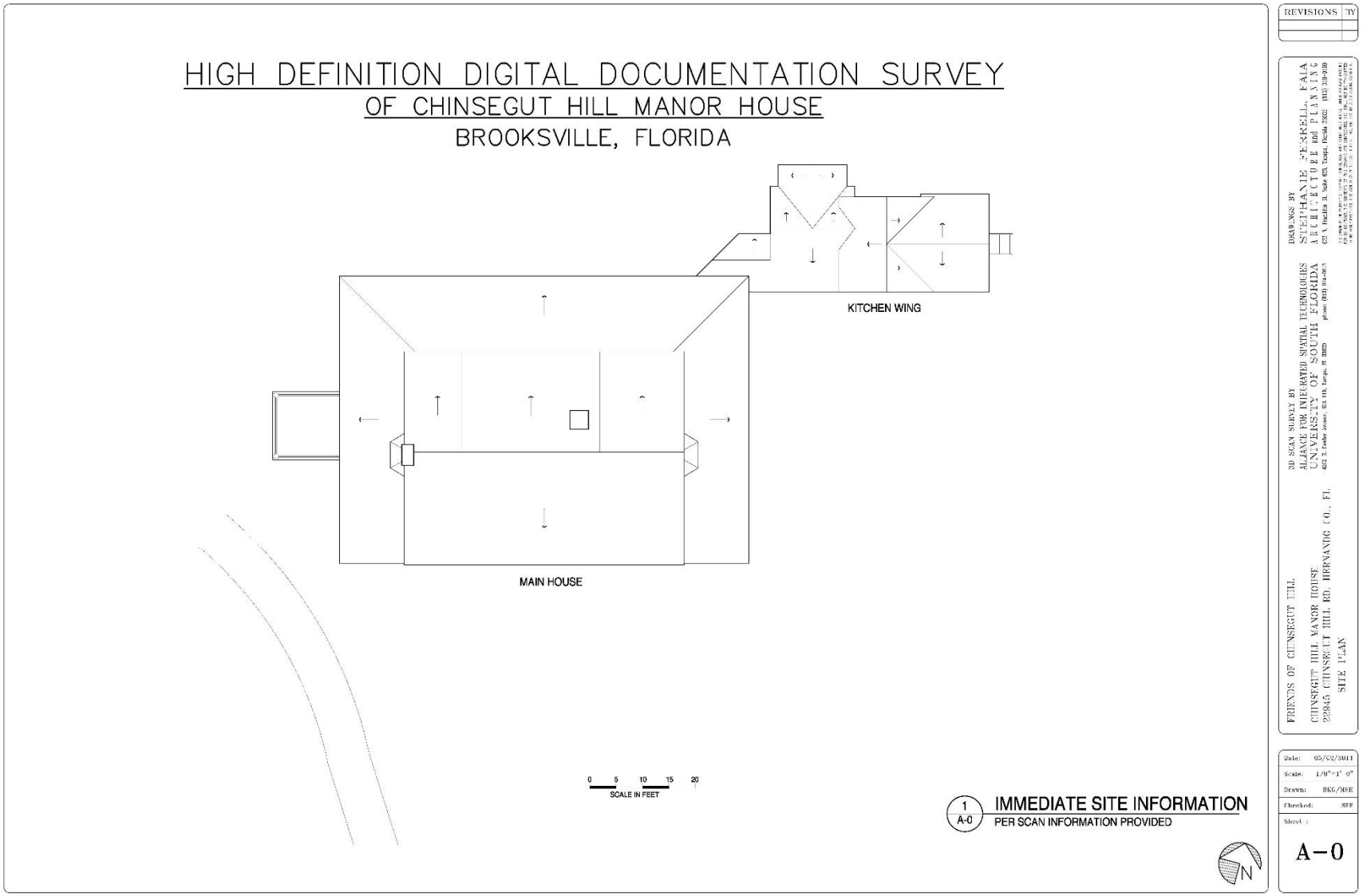


Figure 15. CAD render from 3D laser scanning survey showing the site plan for the main house and kitchen wing.

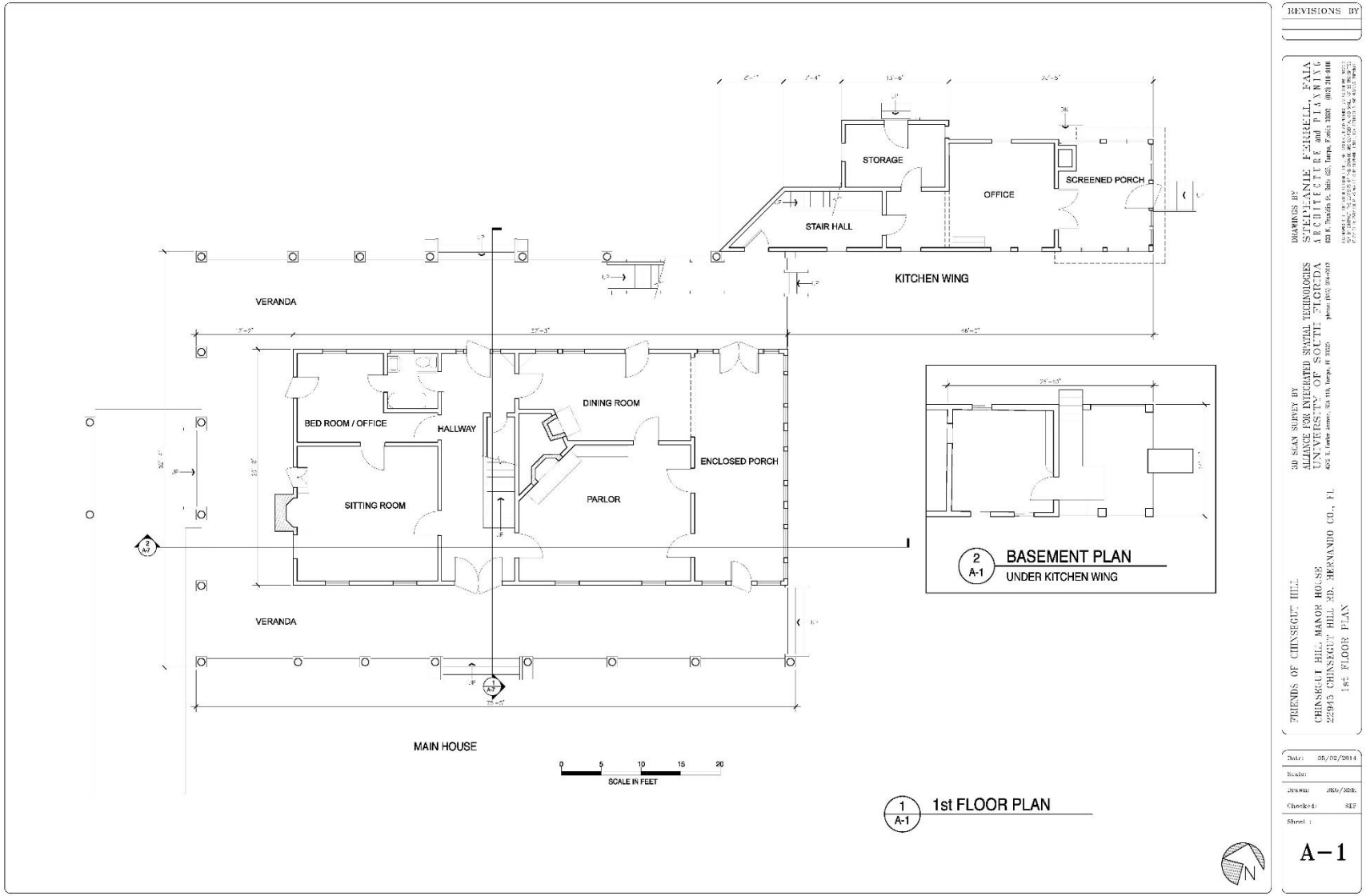


Figure 16. CAD render of first floor.

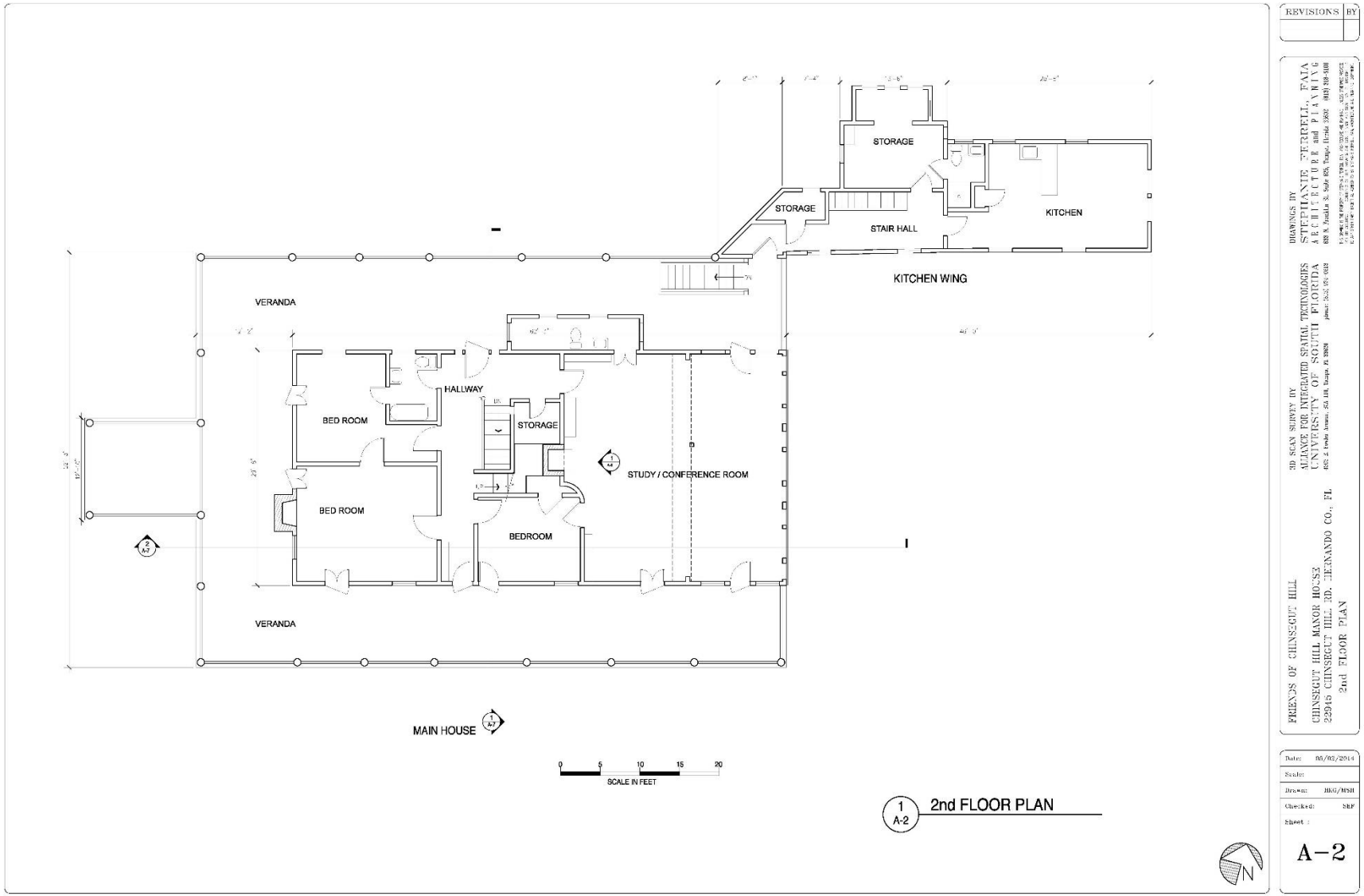


Figure 17. CAD render of second floor.

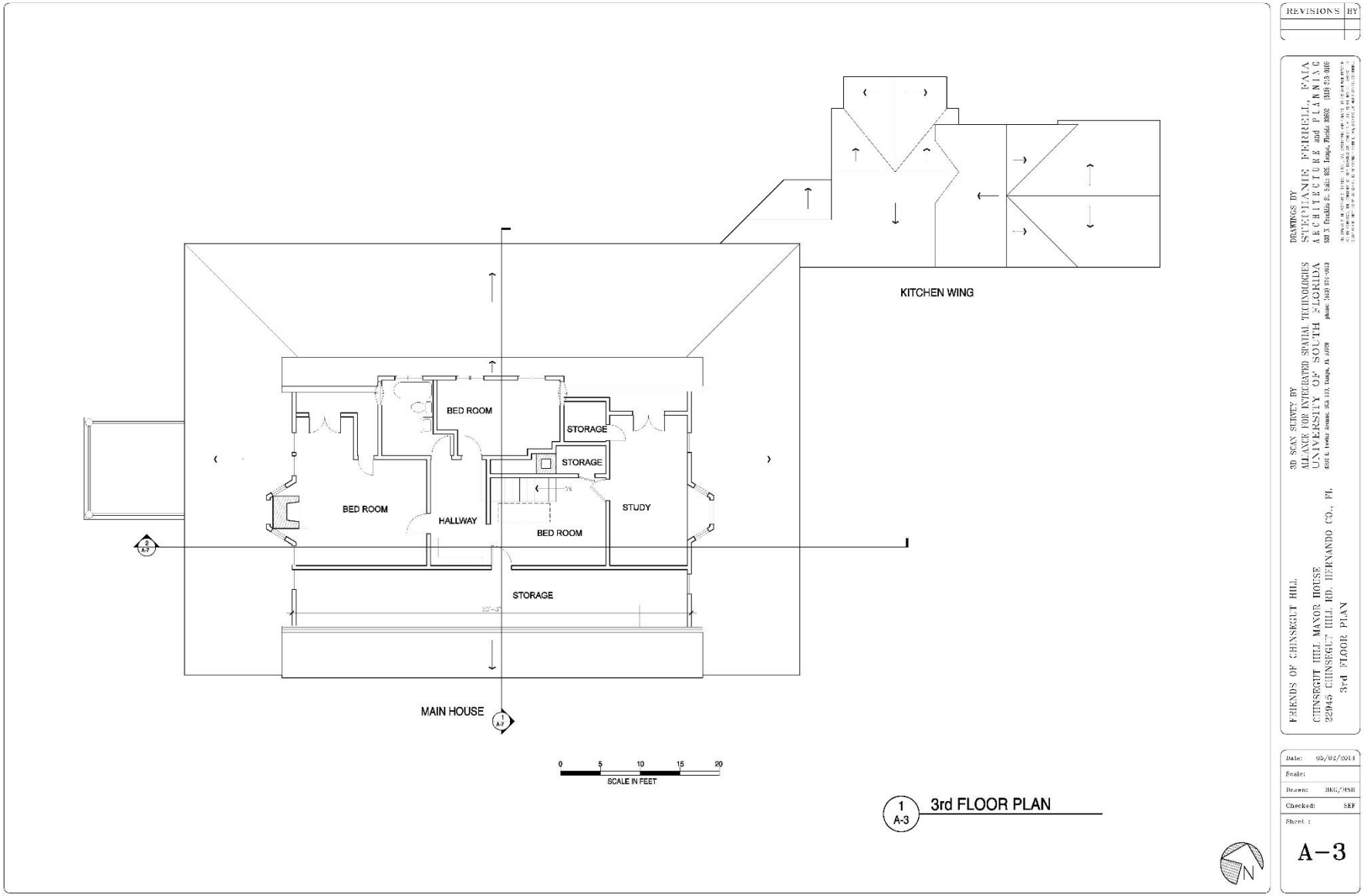


Figure 18. CAD render of third floor.

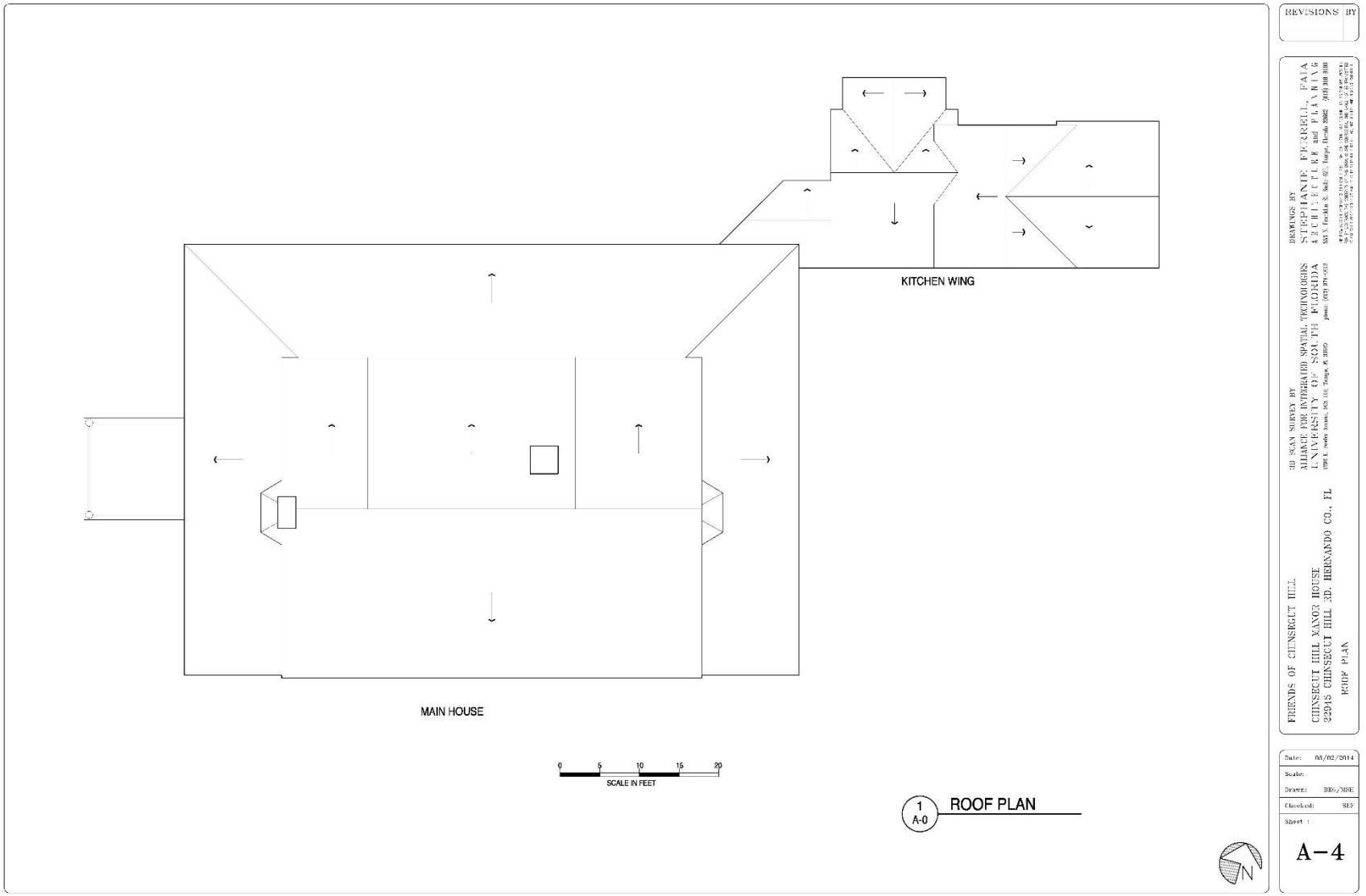


Figure 19. CAD render depicting the roof plan.

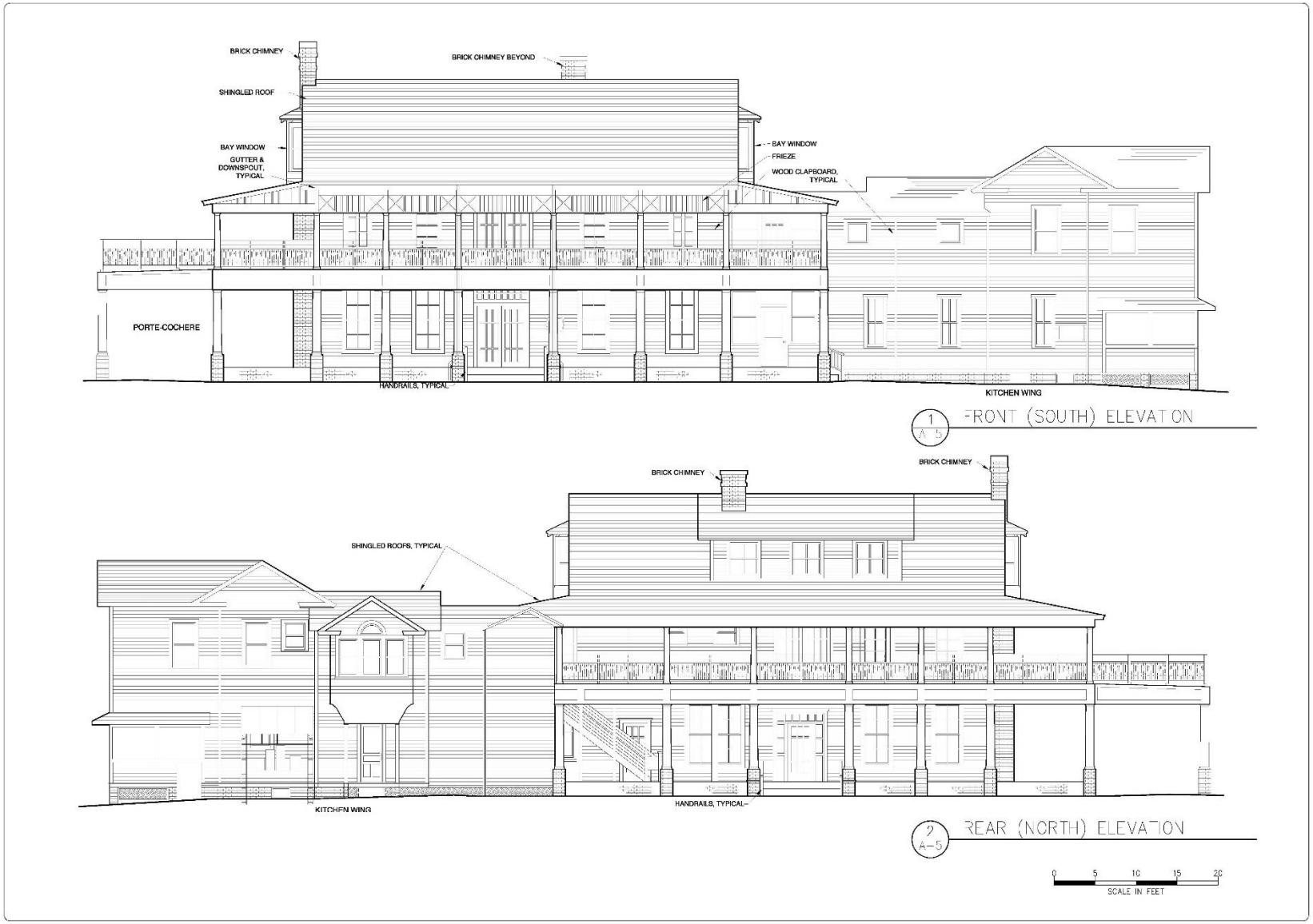


Figure 20. North or Rear Elevation of the Chinsegut Hill Manor House.

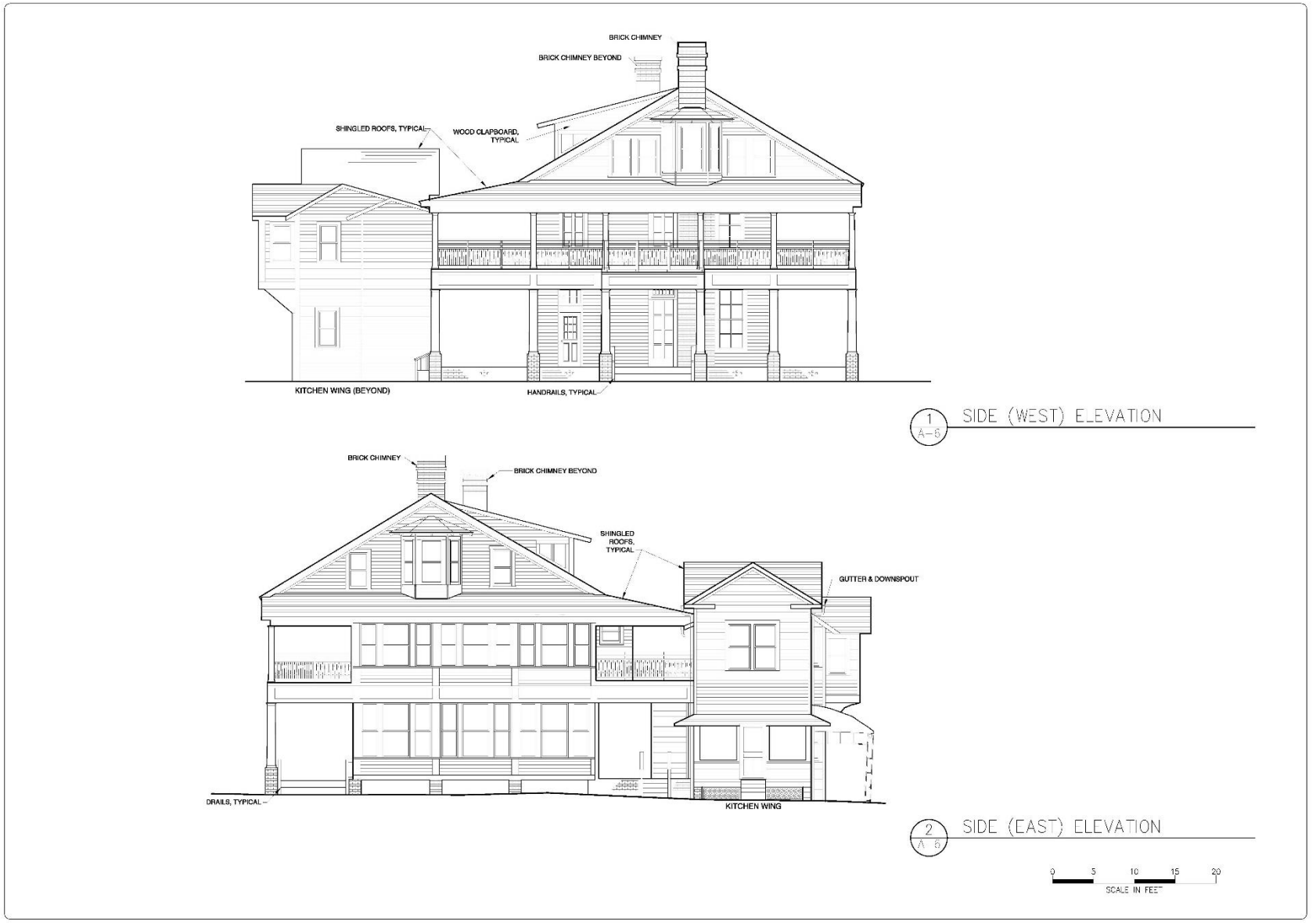


Figure 21. Side (East and West) Elevations of the Chinsegut Hill Manor House.

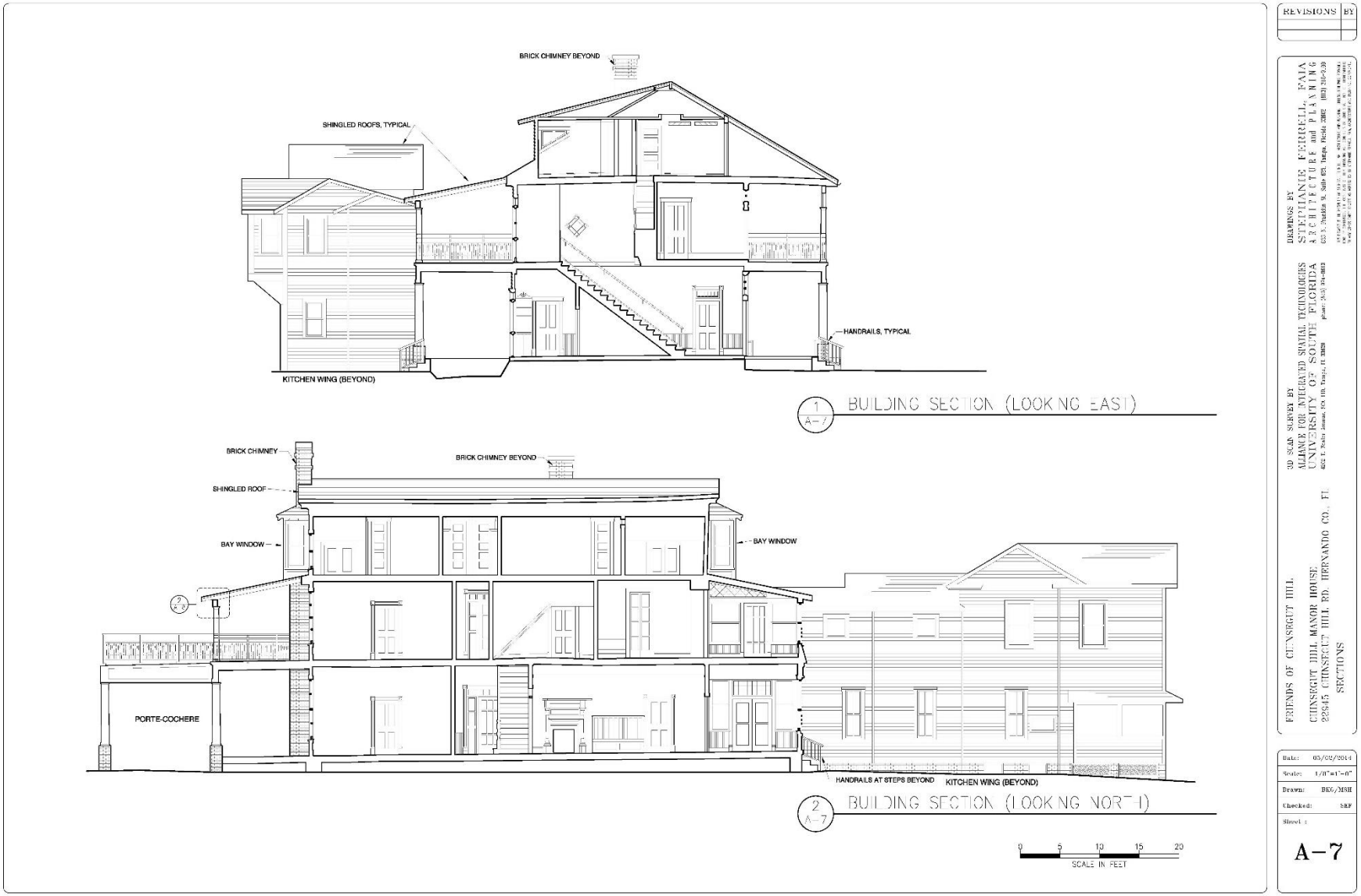


Figure 22. Sectional details from the 3D Laser Scanning Survey of the Chinsegut Hill Manor House.

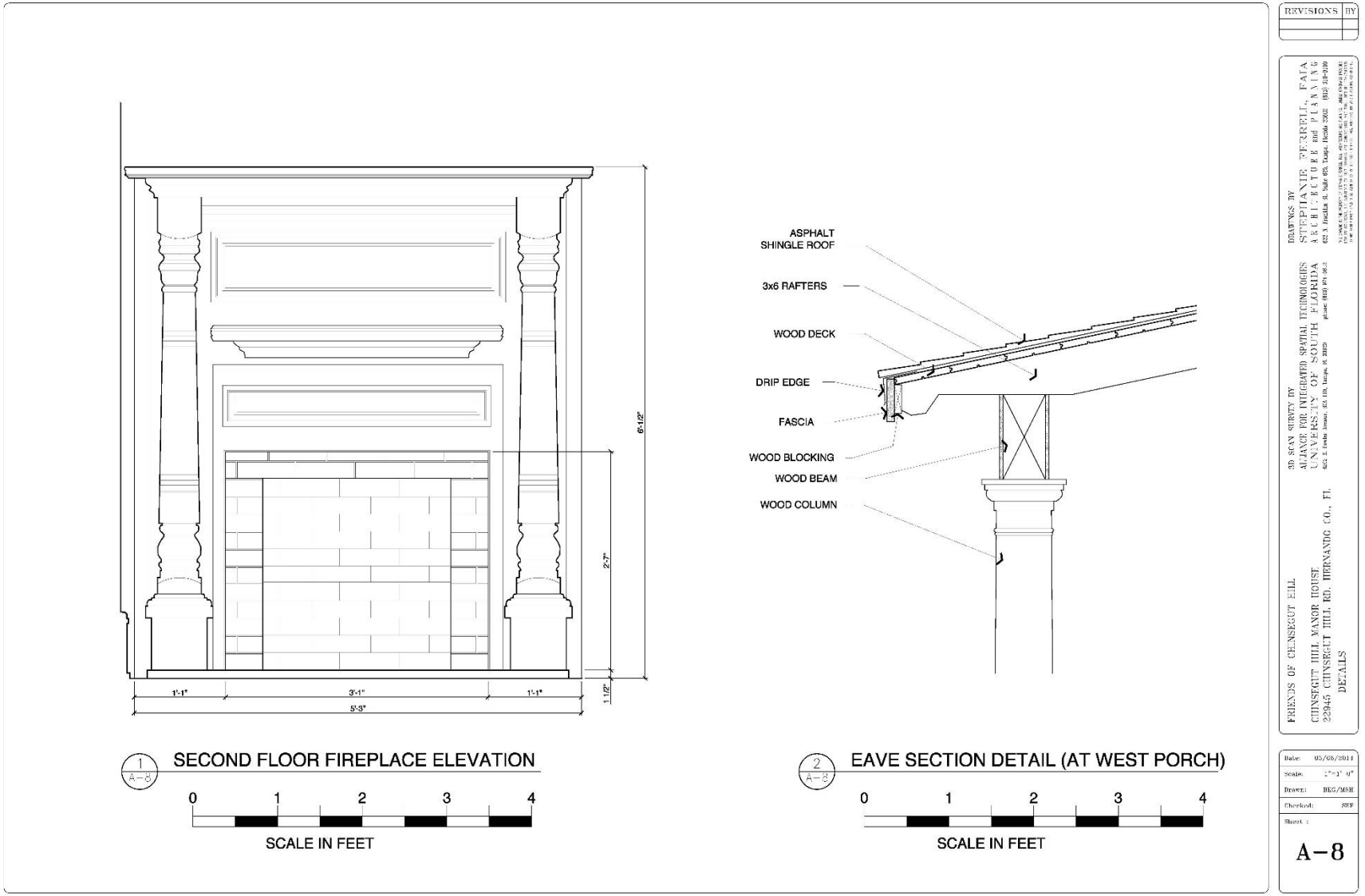


Figure 23. Architectural detail area measured drawings derived from the 3D Laser Scanning Survey of the Chinsegut Hill Manor House.

GPS, GIS and Cartography

The HBIM survey is inclusive not only of the TLS survey data collected but is brought together with other forms of spatial and legacy data in a GIS geodatabase platform. Using the GIS structure, several cartographic products have been created, including a slope model, a digital elevation model, a contour terrain model (landscape and site level), and a digital surface model of the larger site area (Figures 24-32).

The geodatabase includes all of the collected GPS (sub-decimeter data) and GPS photographs. These data will also be presented as a custom Google Earth tool, allowing for direct viewing of all property mapping efforts (Figure 33). The Chinsegut HBIM project was also the subject of a course taught at USF (Advanced Field Methods GEO 6115) and students will continue to use data collected from this survey to develop skills in 3D visualization, cartography and GIS. Site locations contributing to the NRHP listing for this site, including the cemetery and CCC era structures and features have previously been recorded, however our GIS and GPS location survey is more complete and correct, and the cemetery site (He673) plot location was found to be inaccurate in both spatial extent and position. A FMSF update for the site with new plot and spatial GIS information are included with this survey and materials and are provided to the FMSF.

Conclusions

Overall, the tomographic slices and CAD renderings derived from the TLS survey of the Chinsegut Manor House are proving useful in the analysis of 'as built' current condition documentation. These data are useful for future and ongoing prescriptive measures for this structure. In particular, areas of deformation, bowing, sagging, and structural concerns can offer metrological consideration and ability to visualize and identify problem areas using these data. Standard CAD renderings do not reflect these deformities and are not as useful for engineering and prescriptive analytics.

Cartographic products, including web-based, digital geodatabases, and document formats provide an accurate assessment of the present and historic landscape and terrain. Accurate portrayal and understanding of spatial locations of resources is important from both a management perspective and from a research and public interpretive perspective. Having a true understanding for locations and associations of features on the historical landscape help to lessen the potential for management conflicts and allows for the greater protection and preservation of properties. Additionally, analyses of geospatial data, such as DEM and digital surface models (DSM), can prove useful in prospection and archaeological survey, especially when combined with georeferenced historic maps, documents and photographs, such as our landscape assessment tool that allows comparison of georeferenced maps from 1924, 1934, and 1954 environs.

At the landscape level, these aerial LiDAR models can also help examine issues such as erosion and water channelization and have been used to provide precise means of assessing loss and developing mitigation and stabilization strategies (Abby 2014). The Digital Terrain Models (DEMs and DSMs) were produced using a combination of aerial laser scanning (ALS) or LiDAR, terrestrial laser scanning (TLS), and ground truth verification with GPS. ALS data collection and interpretation has been described as one of the most significant innovations for the field of archaeology (Opitz 2013). The AIST at the University of South Florida are integrating ALS with TLS and other techniques to examine large scale landscape areas, with rapid and highly accurate assessments of elevation and surface details possible. At Chinsegut Hill, these LiDAR elevation maps are also useful for depicting relevant historic feature location detail, used as a base map to visualize these data upon and in relation.

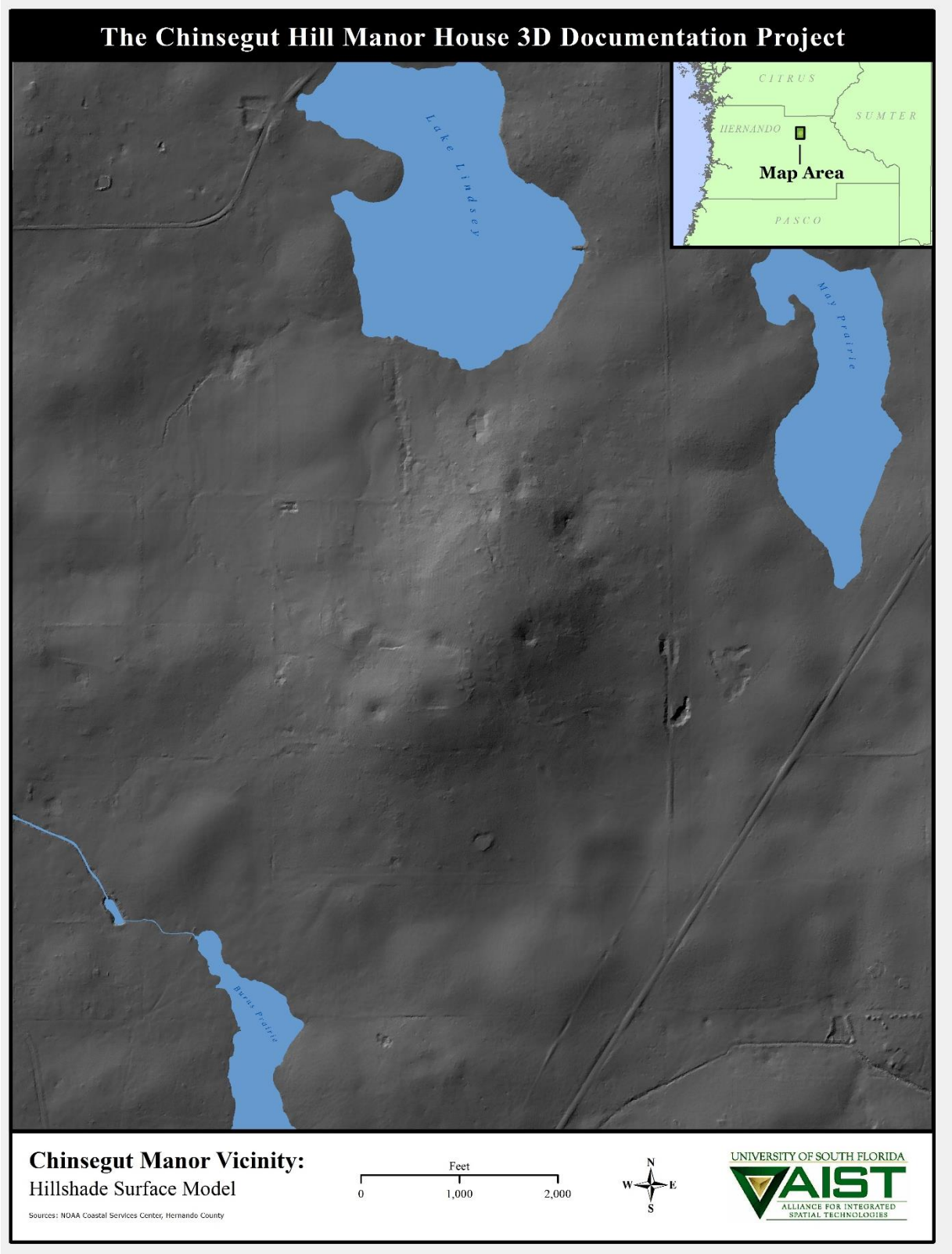


Figure 24. Digital Surface Model (DSM) of the hilltop area derived from aerial LiDAR to reveal ground surface details with hillshade.

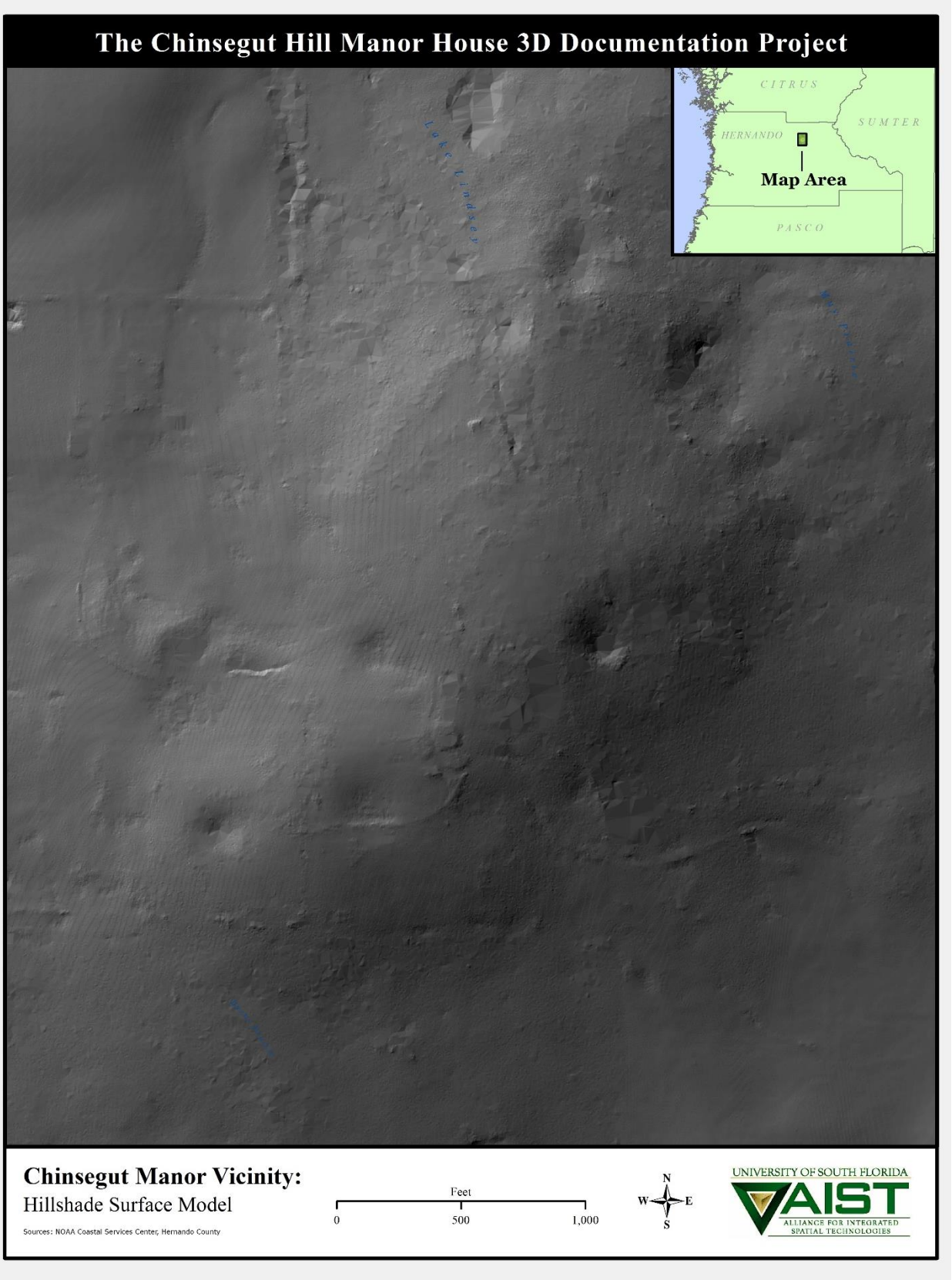


Figure 25. Surface Model (showing house area of hilltop).

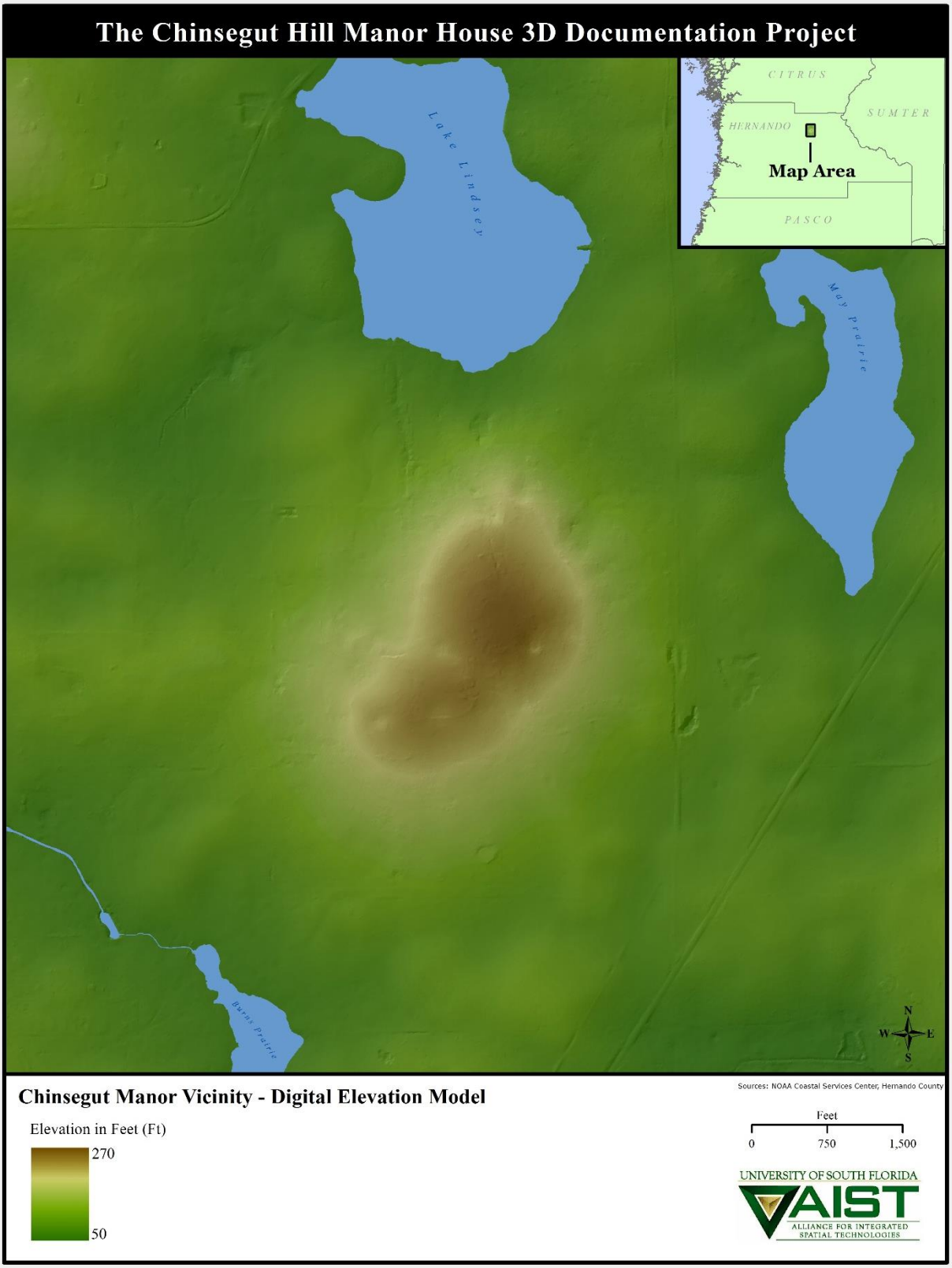


Figure 26. Digital Elevation Model derived from aerial LiDAR, showing entire hilltop landscape.

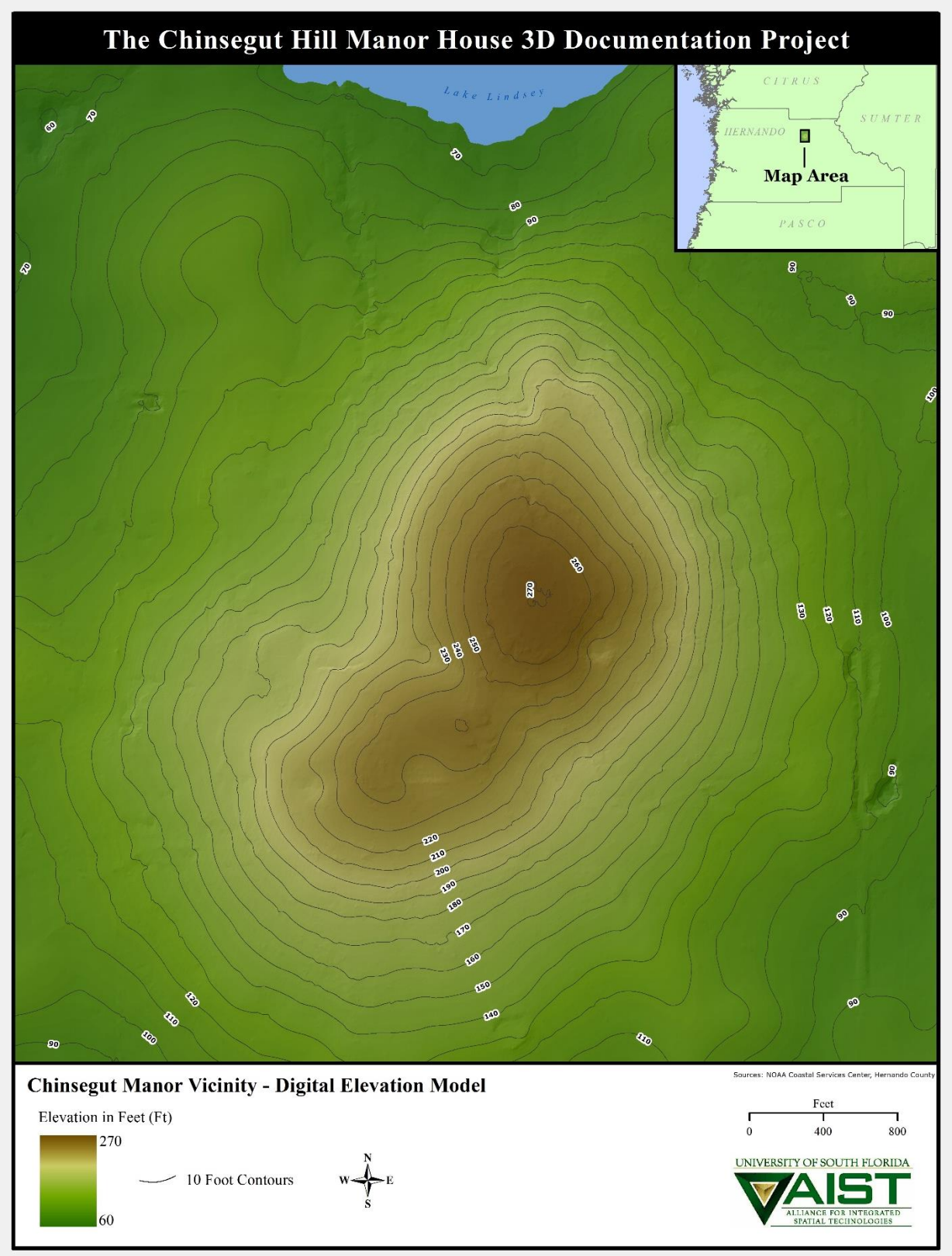


Figure 27. Digital Elevation Model derived from aerial LiDAR with 10 ft. contour depicted across area of the Manor House vicinity.

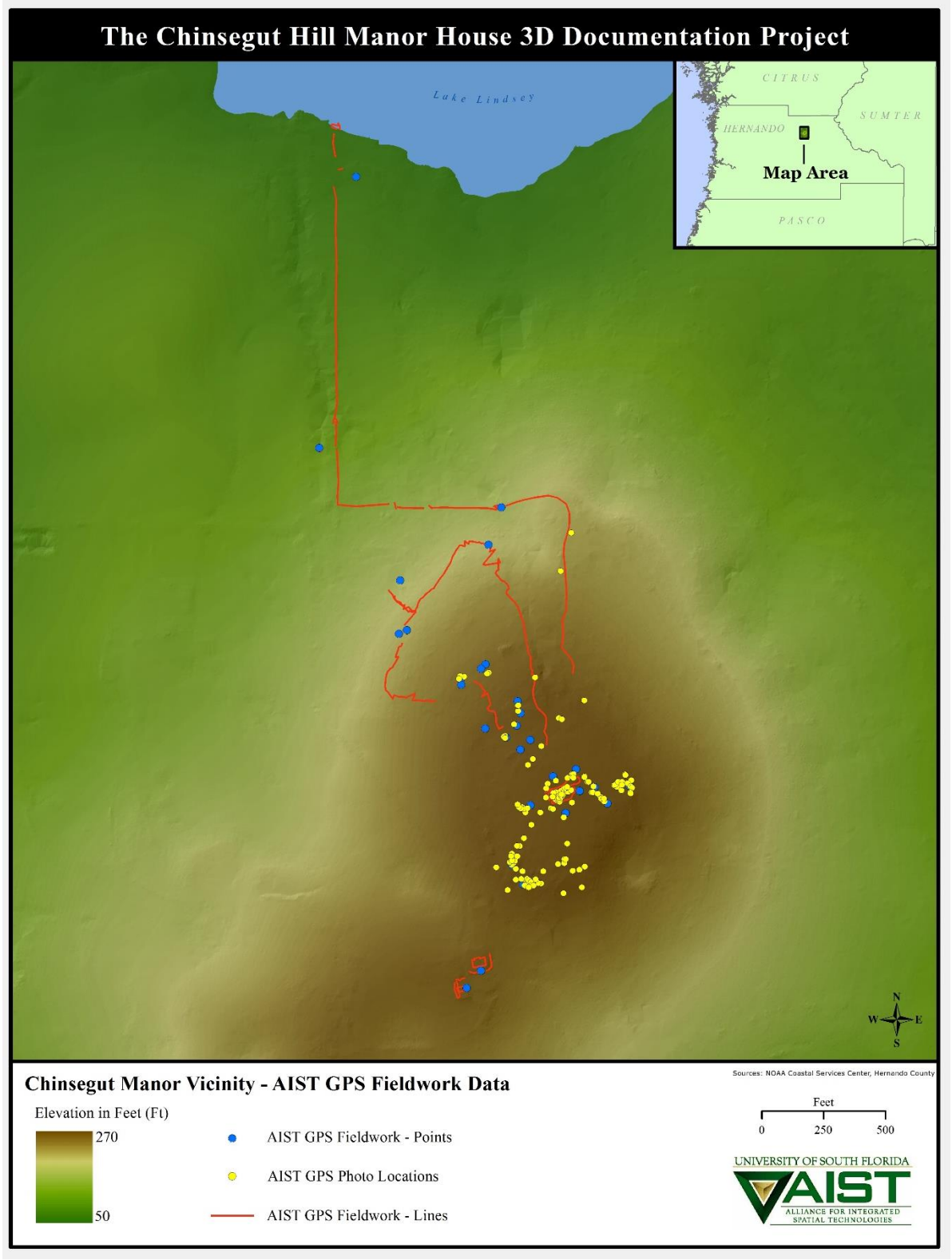


Figure 28. Digital Elevation Model derived from aerial LiDAR with all GPS survey data collected, including GPS photo points and linear data. DEMs allow the visualization of terrain and elevation variation across an area and in relation to noted positional data collected.

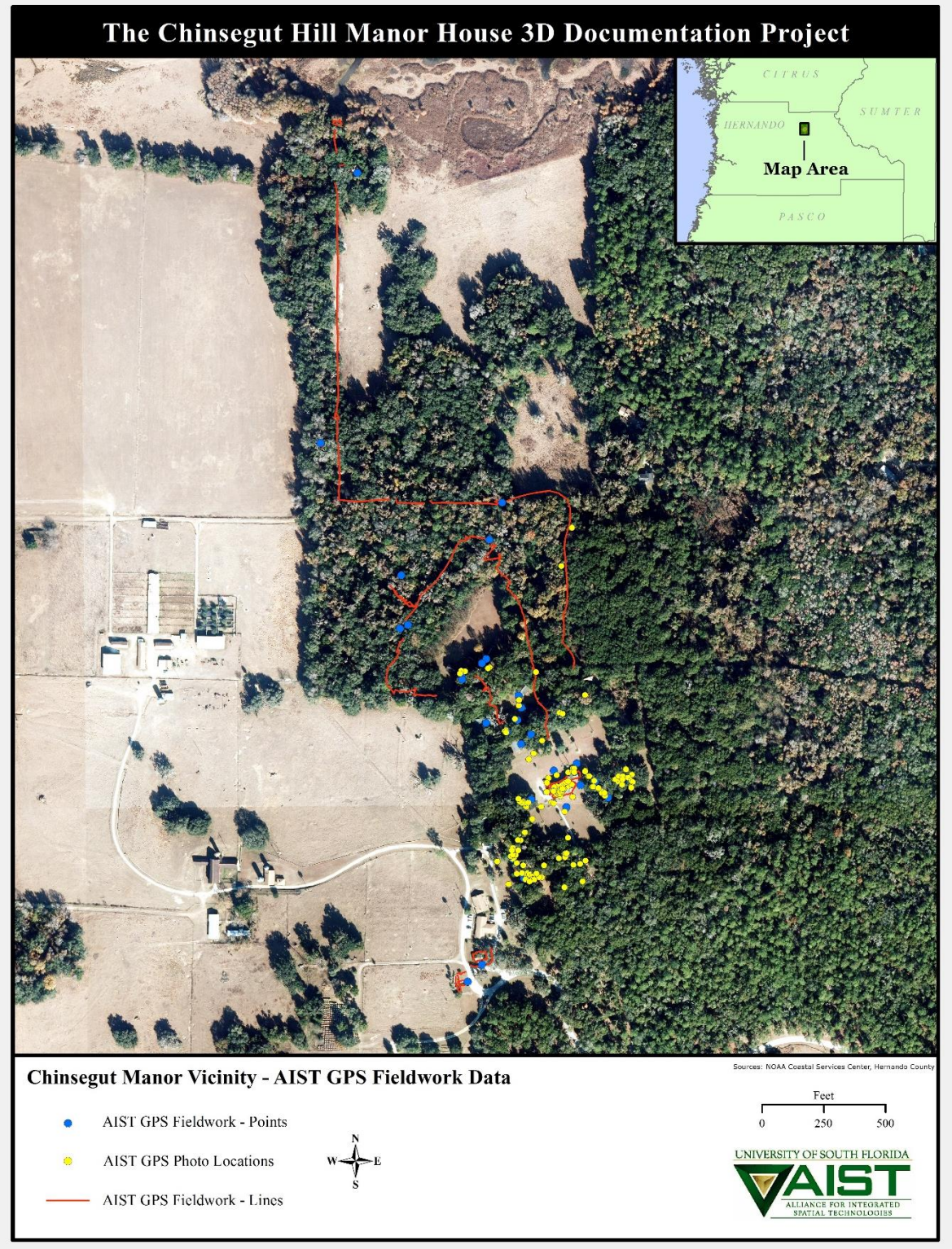


Figure 29. Aerial imagery shown at the same scale as previous figure, with all GPS survey data collected, including GPS photo points and linear data. Aerial imagery is useful in reviewing data in relation to known visual landmark features and can show important information regarding vegetation and other landscape details. Comparison of multiple years of imagery is also possible with noted historic land use changes evident.

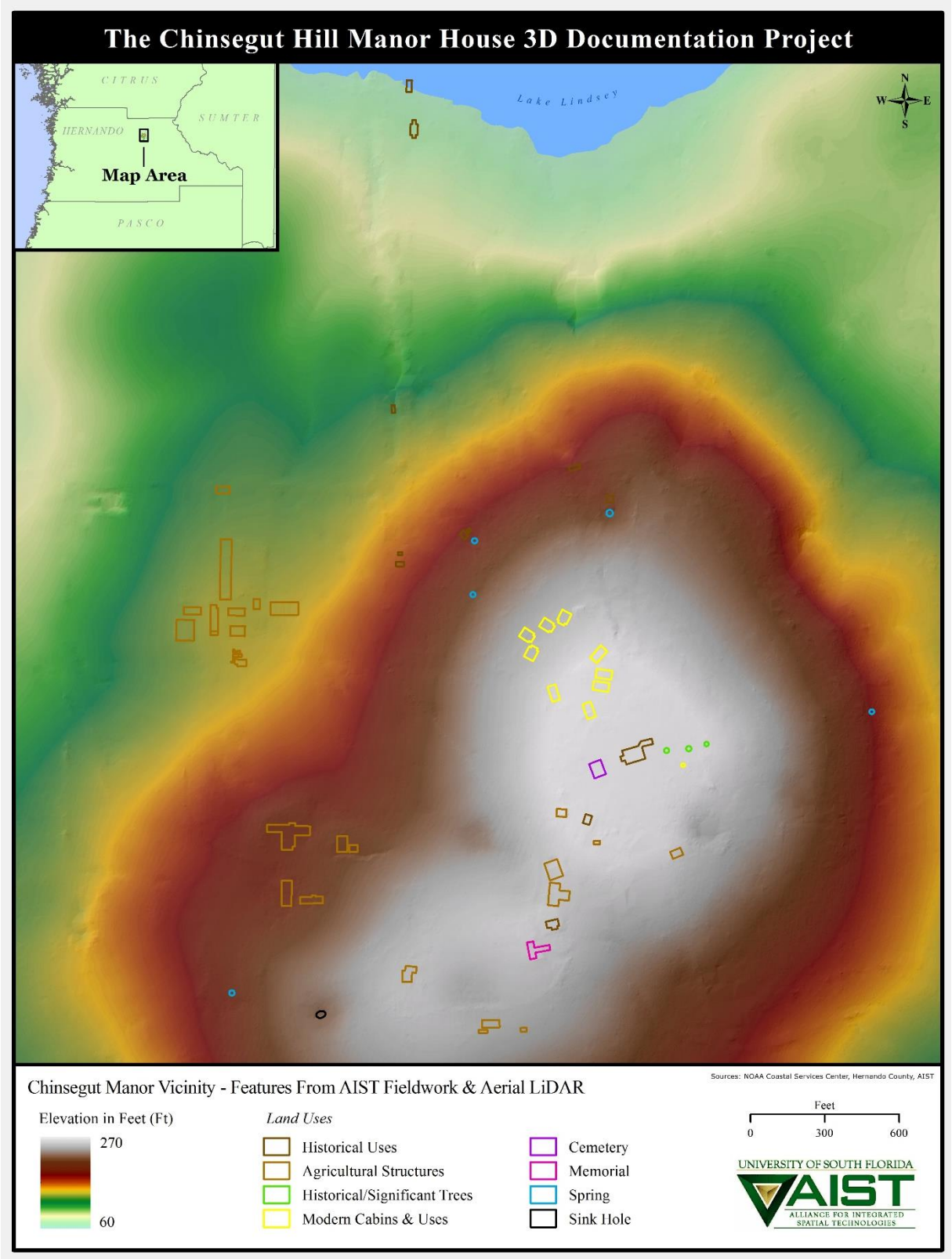


Figure 30. Digital Elevation Model derived from aerial LiDAR with digitized and GPS interpreted survey data included.

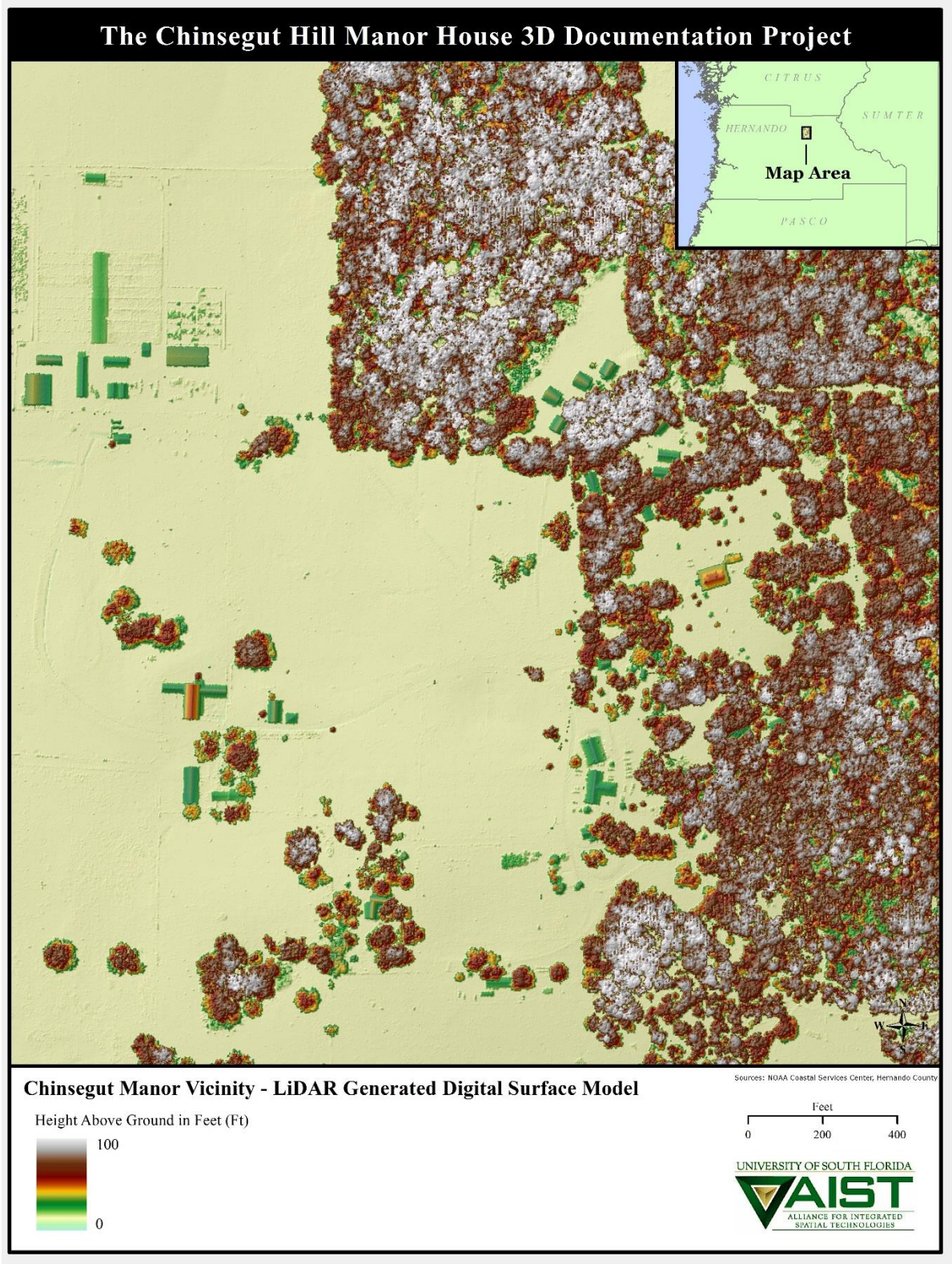


Figure 31. Digital Surface Models (DSM) can be used to depict, extract, and analyze built features and elevated areas, and can also be used to analyze forestry and vegetation aspects, such as tree height and volume calculations.

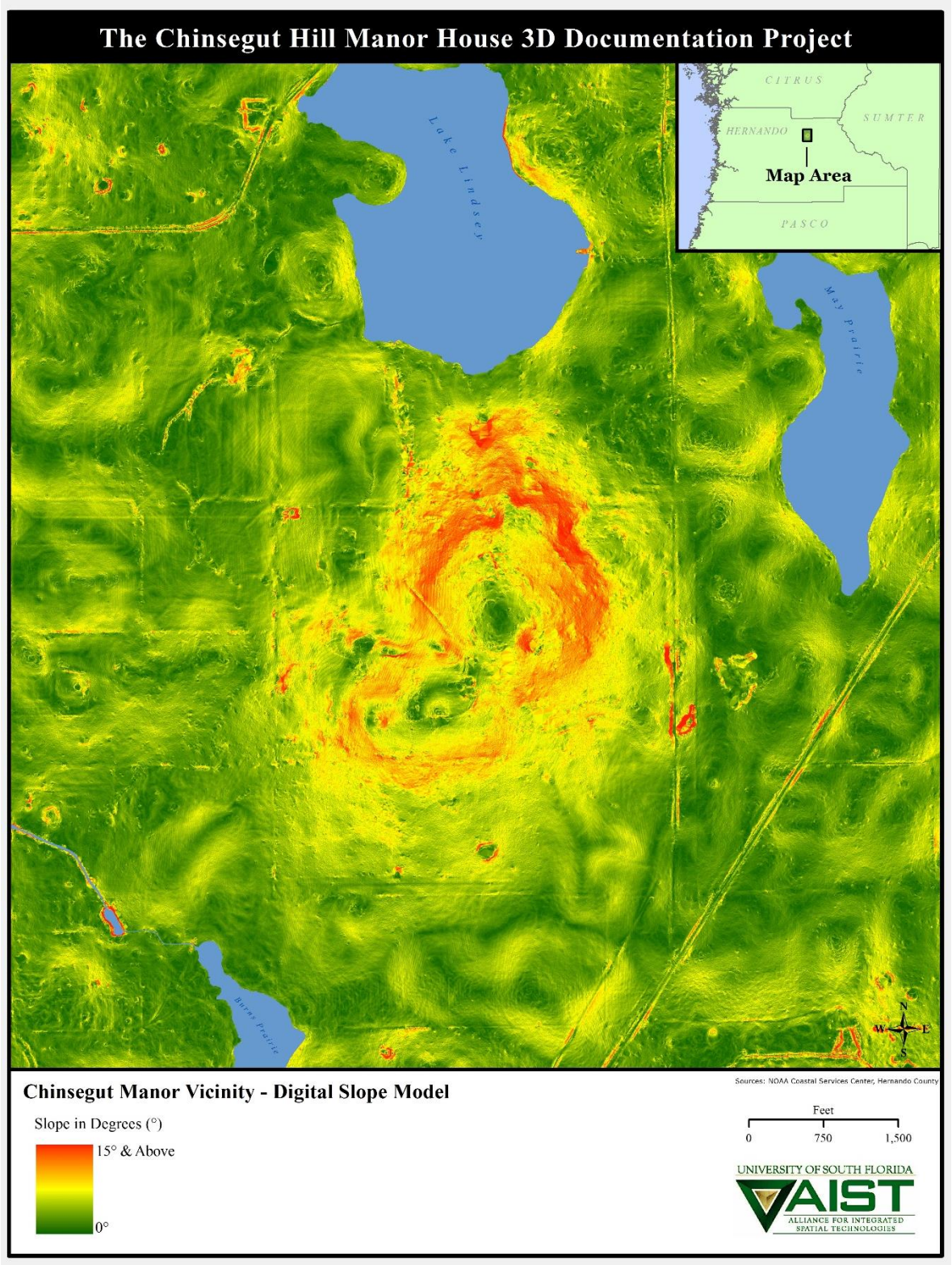


Figure 32. Slope model derived from aerial LiDAR terrain information and showing the larger project area. Areas shown in orange and red are reflective of higher degrees of slope and associated with greater potential for erosion and runoff. Sink and spring features are also seen in the data, as are areas of susceptible road cuts and embankments.

Figure 33. The Chinsegut Hill 3D Documentation Project customized Google Earth application allows viewing of laser scan fly-throughs for the Manor House and CCC house structures, as well as GPS photos of sites and features, and GPS location information. Additionally, terrain details and linked positional layer information can be viewed.

References Cited

Abby, Lehman

2014 Mapping Assessment of Coastal Erosion Using LiDAR and Optical Data, ENVI website: http://www.exelisvis.com/Home/NewsUpdates/TabId/170/ArtMID/735/ArticleID/13820/Mapping-Assessment-of-Coastal-Erosion-Using-LiDAR-and-Optical-Data.aspx.

Huse, Andy and Carl Shiver

2003 *National Register of Historic Places Nomination Form: He496*. Ms on file Florida Master Site File, Tallahassee, Florida.

Murphy, Maurice; McGovern, Eugene; and Sara Pavia

2013 Historic Building Information Modelling – Adding intelligence to laser and image based surveys of European classical architecture. *ISPRS Journal of Photogrammetry and Remote Sensing* 76:89-102.

Opitz, Rachel S. and David C. Cowley (editor)

2013 Interpreting Archaeological Topography: 3D Data, Visualisation and Observation. 5. Oxbow Books, Oxford, UK.

Preservation Resource, Inc.

2013 *Chinsegut Hill Manor House Historic Structures Report*. Ms. on file Florida Master Site File, Tallahassee, FL.

Appendix A: Florida Master Site File Forms and Updates