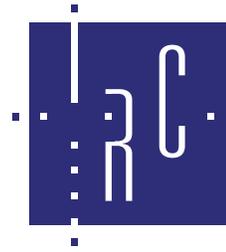


Visualizing Early Washington DC



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Creating an accurate depiction of Washington DC from the days of Pierre L'Enfant (circa 1790) required triangulating multiple points of reference, both in terms of spatial data and the unique perspectives of a collaborative group of researchers. A wealth of new information emerged through the intersecting interests, knowledge bases, and research of a team dedicated to authentically representing the changes that have occurred in the Washington DC area over the time period from 1790-1820. This article details this evolving process of mapping DC by describing the primary "triangulation points" highlighted in the work of four researchers: Dan Bailey, director of the Imaging Research Center (IRC) at the University of Maryland Baltimore County; Peter Chirico, USGS geographer; Donald A. Hawkins, architect and cartographer; and Lindsay Schroader, a Geographic Information System (GIS) specialist working in the IRC.

"You don't know what you have here, do you?"

Peter Chirico remarked quizzically to Dan Bailey and Lindsay Schroader as they showed him their work of the past nine months. They had spent this time georeferencing (using coordinates and a projection system to determine and assign locations) and digitizing hand-drawn maps and other renderings of Washington DC from its earliest days as the nation's capital. Their painstaking efforts toward visualizing the changing landscape of the city had, Chirico explained, created a potential gold mine for future research.

This was not the first time that the question of unknown possibility had been raised in connection with this project. In 2003, Sabin Streeter of Kundhart Films approached Dan Bailey and the IRC with a proposal to recreate Washington DC's Capitol Hill for a documentary film on the architect Benjamin Henry Latrobe. "I literally went to the local public library to pick out a few pictorial history books on early Washington DC. But there was nothing there. Further searches at regional academic libraries were essentially fruitless. At that time, photography had not been invented. Very few people lived in the city, and if you were a professional artist you wanted to live in the big cities of Baltimore, Philadelphia, New York, or Boston – not in a rural, damp, tidal marsh. When the British burned Washington in 1814, much recorded information was lost." Part

of Bailey's motivation for pursuing research on DC was this surprising dearth of knowledge about the time prior to the Civil War. Only at that point did photography finally emerge as a documentary tool, depicting a mature city full of life.

"What hooked me on this quest for information was that the preliminary building of the city over three decades so accurately reflected the times, the country and its people. The city was a portrait of the young country. The country was new. Democracy was raw. The city was a rough work in progress. Nothing was polished. The scale of the city, government, and country was that of a man – not the huge, endless, gray buildings of bureaucracy. You had farmsteads with their outbuildings on the Capitol lawn. The first fence around the Capitol was to keep the cows out of the building! Congressmen came to town for the legislative sessions, many times sleeping three to a room in a boarding house, and working in an unfinished building. It was in these conditions that some of the most important decisions and treaties were made, like the Louisiana Purchase. People were simultaneously envisioning the architectural style of the new government, and involving themselves in shady land development deals. People dreamed, many went bankrupt, and the city prevailed. In making an image of early Washington, I want to engrave on the mind the tangled roots of the country."

These roots, Bailey discovered, were often entangled in inaccurate representations, both of the landscape and of the Capitol. Original artists added Romantic exaggerations to their work, and cartographers depicted the area around the Capitol as finished and orderly. In fact, it was neither. Modern depictions of this era contain their own misrepresentations, as Bailey explained in describing one detail of the acclaimed HBO series, *John Adams*. “Near the end, it’s 1802 and John Adams has lost his re-election bid for his second term as president. There is a cold, gray, dreary shot of him leaving Washington in a carriage for the long trip back to his home in Massachusetts (actually, all of the shots of DC are gray and dreary...). During the shot, his carriage passes in front of a scene of the US Capitol being built.

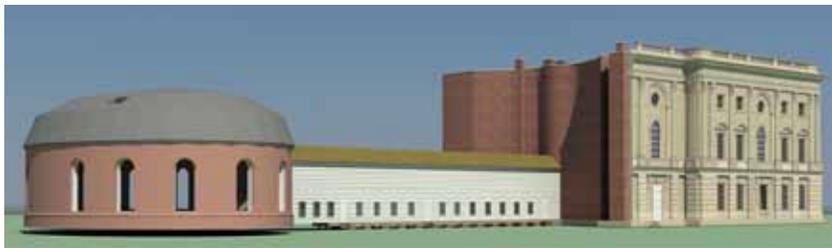


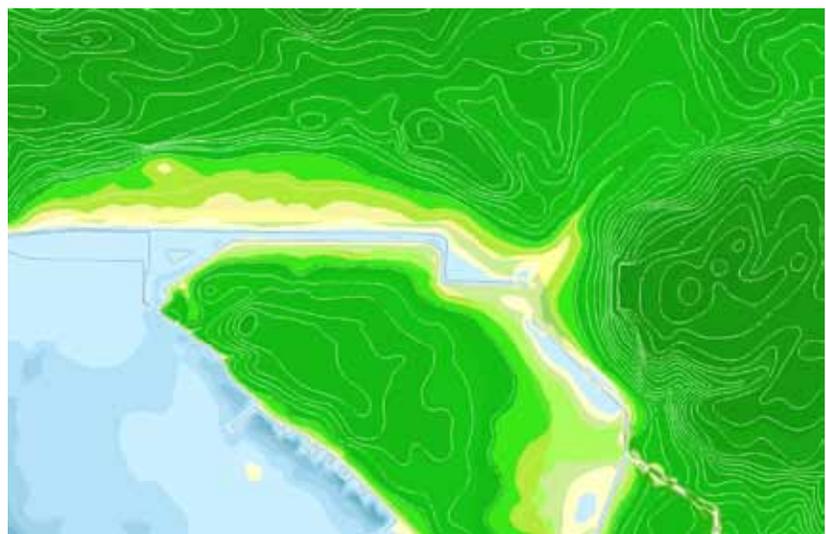
Illustration of how the US Capitol would have looked in 1803. Bailey and Smallwood

This scene is so inaccurate that it’s hard to believe that it made it past the series’ obviously rigorous group of historical scholars. The Capitol is depicted as it looked being built in the mid-1800’s. This was probably due to time constraints and pace of production that images (photographs) of the Capitol’s construction from that period informed the background scene of the Capitol. But I also conjecture that they specifically used those images because they knew that a general audience wouldn’t believe, understand, or even recognize the Capitol as it looked in 1802.”

“I am not a geographer, cartographer, nor a historian. So in truth, I really don’t know what I have here,” Bailey remarked, reflecting on Chirico’s question. What he does have is a commitment to collaborative research. Known for his independent filmmaking and animation work, and most recently for his visualizations of un-built and reconstructed buildings, Bailey’s role in directing the IRC is that of aggregator, pulling together the talents, interests, and knowledge of multiple individuals to collectively achieve sophisticated visualization projects. The primary challenge that he currently faced, having successfully

created a preliminary model of the Capitol itself, was to find or create an accurate and reliable elevation map of early Washington that could be used to establish three-dimensional terrain for the visualization of the Capitol area. The land had changed dramatically in 200 years, as human activity resulted in silting, filling, relocating streams and wetlands, and burying rivers. Contemporary contour data of Washington was of little help with such altered terrain. He needed to establish an accurate baseline of 1790 landscape in order to plot these ever-increasing landscape changes as the early city was built. For this, he turned to two experts: Peter Chirico, a geographer at the United States Geological Survey (USGS) and Donald A. Hawkins, an architectural historian, city planner and avid cartographer.

Along with invaluable help and advice about leveraging GIS capabilities to house the potential size of this research effort, Chirico provided crucial elevation information of the city from 1888. He and his group at the USGS had created a relevant database for research into the “cut and fill” activities in the District of Columbia area. The historical elevation model he created representing 1888 topography was developed by digitizing elevation contours, spot heights, and bathymetry data from four sources. The primary topographic contour data were derived from 57 map sheets of the 1:4,800-scale topographic map series by the U.S. Coast and Geodetic Survey published in 1888, with each sheet covering a one square mile area. Once scanned, contours were manually digitized from the source maps. Though this elevation data was from



Detail of Downtown Area: 1888 Washington, DC map produced by Peter Chirico

1888, it provided an accurate reference for the 1790 elevation of the city, because most of the land had not been affected by building activities. The one area that it could not represent was the downtown and National Mall area. For this, Bailey needed earlier information, and he turned to Hawkins and his seminal map of 1791.

Hawkins' 1791 map of Washington DC was drawn from Thomas Freeman and Nicholas King's 1797 "Surface Profile Maps." On these maps elevation was calculated and displayed in profile up to Massachusetts Avenue. Hawkins used a special ruler to follow along and measure the lines, which allowed him to determine and mark every five foot increase and decrease in elevation. After placing dots along each of the surface profile lines, Hawkins drew connecting straight lines between matching elevations. From here, Hawkins interpreted the straight lines he saw on paper and turned them into lines resembling an accurate representation of Washington, DC. He jokingly described this thought process as, "I stood back and said, 'If I were the Earth, what would

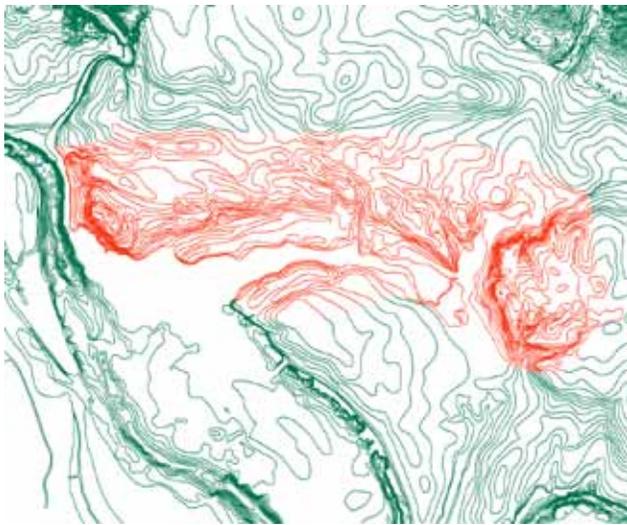
I do?'" In reality, what followed for Hawkins were months spent using the basic tools of tracing paper, pencils and pens to laboriously accomplish what would become a crucial contribution to the Washington DC visualization project.

Within the vaults of the Library of Congress are plats surveyed by Nicholas King in 1797. The Plats show the location of streams, roads, fences, ferries, some land use, and the location, dimensions, and construction materials of most major buildings in 1790. These maps did not cover all of Washington, DC; only the areas with major buildings in use during 1790 or shortly thereafter were surveyed and mapped. Hawkins did discover that many small buildings, most likely tobacco barns, were missing from the King Plats, but this was believed to be due to their lack of continued use. The King Plats were also Don Hawkins' main source for the route of Ferry Road, the main road through DC, and where it once met the Anacostia River.



A topographic map of Washington, DC in 1791 by Donald A. Hawkins

The job of integrating these many points of reference for the IRC’s depiction of Washington DC in four distinct decades fell to Lindsay Schroader, a recent UMBC Geography and Environmental Systems graduate. She began by using Chirico’s 1888 contour lines and a georeferenced map from 1896 to georeference Hawkins’s 1791 topography map and 1791 digitized contour lines. Since Hawkins had more topographical detail within the mall area, Bailey and Schroader concluded that it would be best to remove Chirico’s contour lines around the mall and replace them with Hawkins’ contours. Meticulously, Schroader sewed the grabbed mall section from Hawkins’ lines to what was left of Chirico’s lines, and then merged them for a permanent hold. The decision to use Chirico’s contour lines for the rest of the DC area was based on the fact that the rest of DC did not show signs of land being moved across large areas. There were areas where roads, railroads, reservoirs, and quarries had been cut into the terrain, but these were isolated occurrences that could easily be fixed by hand.



The combined contour lines of Don Hawkins (red) and Peter Chirico (green) before Lindsay Schroader sewed and merged them together.



The McMillan Reservoir in NW DC before and after contour change to produce a 1790 terrain..



Lindsay Schroader and Don Hawkins studying sketches by Hawkins of a 1861 Boschke map at the IRC to determine the contour lines for DC reservoirs. Over the locations of the reservoirs Don had hand drawn lines showing his best guess for pre-reservoir terrain

The newly created contour shapefile still included the late 1800s roads and railroads. Methodically, Schroader moved through DC and physically removed each road/railroad cut from each contour line. There were three reservoirs and several quarries within the DC area that also needed to be removed from the contour lines before achieving a good representation of 1790 topography. Schroader’s knowledge of contour line shape, combined with the flow of the topography surrounding these areas, helped her to mold the contour lines until the reservoirs and quarries were no longer visible on the terrain. To help with this process, Hawkins offered an 1861 Boschke map copy to use as a guideline, in which he had lightly sketched what he believed the landscape looked like before the reservoirs were dug.

The water line was the last section of contour lines to be edited. Along much of the coast there were wharfs that did not exist in 1790 and thus had to be removed, which involved not just removing the effects above the water, but also the impact a wharf has below the surface. Once again, point by point, Schroader removed all the contour lines affected by unnatural forces. She used Digital Elevation Models (DEMs) and hillshades

generated from the contour lines to give a more three dimensional appearance to the terrain, merging the separate land and water DEMs with a blend along the overlapping area to generate an accurate and full DEM for 1790.



1790 Arlington County, VA and Alexandria, VA contour lines by Don Hawkins. This area was once a part of the DC diamond.

Both Hawkins' and Chirico's work omitted the part of Virginia that was originally included in the District. All four researchers agreed that this was critical to a complete history of the early city. Schroader directed her attention for the next three months of determining reliable information and digitizing it. To generate contour lines for the section of Virginia that had once been set as a part of the DC diamond, Chirico provided Schroader with a US Coast and Geodetic Survey map from 1885-6 with 20 ft contour lines. She digitized the contour lines from this map and then interpolated between the 20 ft lines to end with a 5 ft interval.

Finding these new lines too generic, Chirico and Schroader agreed to refer to a contour map that Hawkins had hand-drawn of Virginia. When developing this map, Hawkins did not trust the contour lines from reference maps prior to 1970, because they looked like generic lines, with inconsistencies and artistic flair. Between Virginia maps, Hawkins found inconsistencies in the locations of roads, forts, and land features. He found that some of the maps had contour lines appearing more like looping clouds than factual elevation. "If the strokes have a character, they're not the same as the natural," Hawkins explained. "I'm not a great geographer. I don't really know that much about land shapes; I just know, from looking at maps, when somebody has actually been there...I can see when someone didn't measure those topo lines." The resulting Virginia map produced by Hawkins showed contour lines that were more detailed, but very similar in overall terrain shape to those calculated by the US Geodetic Survey in 1885. Schroader then had the difficult jobs of georeferencing Hawkins's Virginia map, digitizing his 10 ft contour lines, and, to achieve interval consistency with the rest of DC, interpolating to end with 5 ft contours. For a complete 1790 contour shapefile, she merged the new Virginia contours with the fixed DC contour lines.

More than 75 maps from Bailey's database required georeferencing as well. Many of the maps were scans of original maps, and were absolutely beautiful and instrumental in visualizing 1790 and 1800 Washington DC. At the same time, many of these maps showed signs of aging (warping, fading, fold lines, etc) which made them difficult to accurately georeference. Through persistence and trial and error, Schroader eventually managed to georeference these maps, including 21 King Plat sketches by Don Hawkins, and 15 photographed copies of the original King Plats. These georeferenced King Plats were instrumental in generating the buildings, transport (mill runs, bridges, ferries), graveyards, fences, and roads in 1790 DC.



Pierre L'Enfant's 1791 sketch of his Plan of Washington, DC, georeferenced to the 1790 terrain generated by Lindsay Schroader.

From an Arlington County map and others like it, Don Hawkins had gathered road information and created a sketch of all 1790 roads for the entire DC diamond, which Schroader used to create the roads layer for 1790. Since “Early Roads” did not show great detail in the mall area, she also used Hawkins’s “1790 Topography” map and his “1790 Driveways” map to fill in missing details. She digitized the roads from “Plan of the Town of Alexandria, 1798” by Colonel George Gilpin to get the road information for Alexandria. For 1800 roads, Hawkins’s 1800 DC map and USGS current roads were used as a reference for accurate placement.

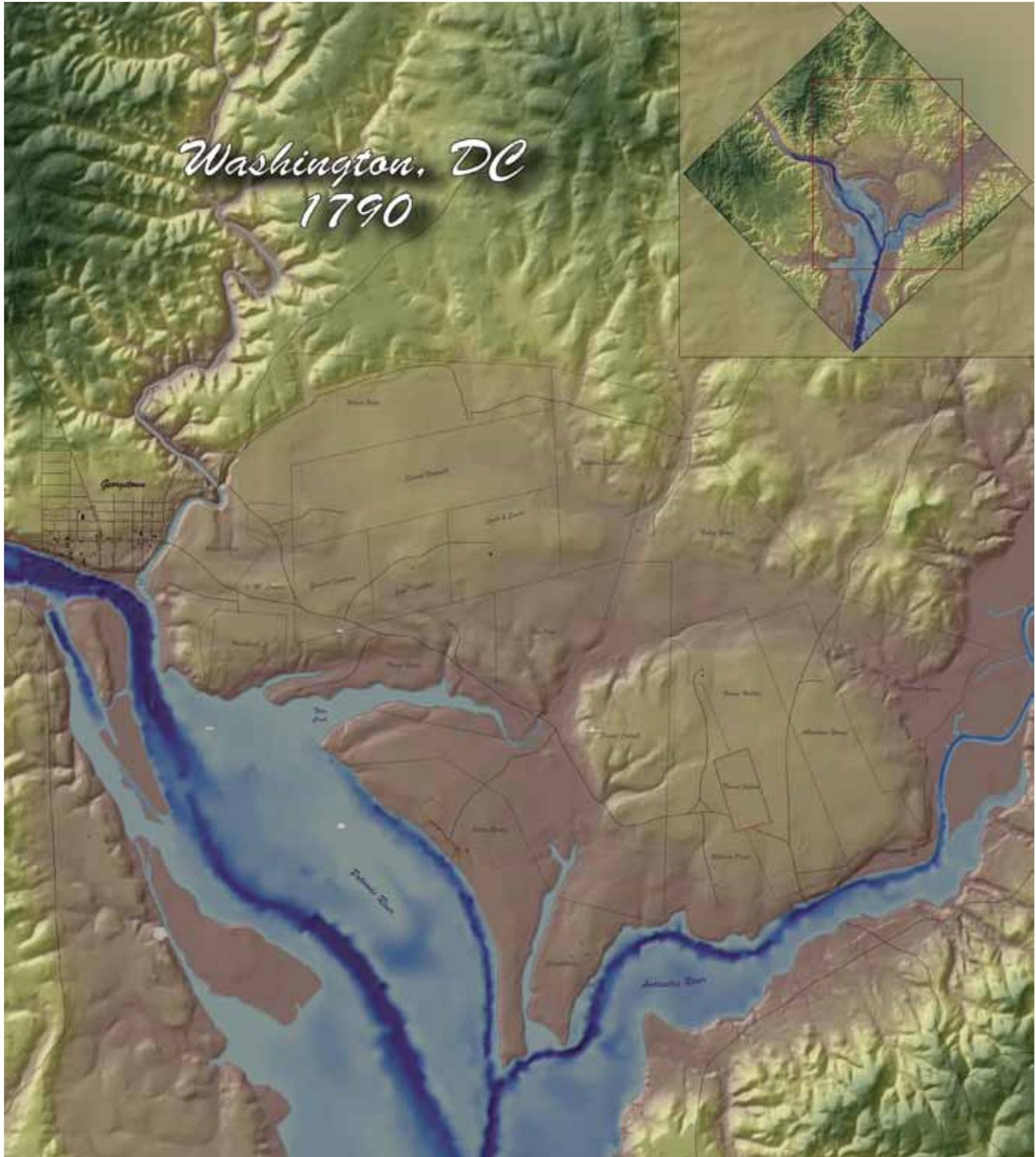
To determine the original landowners in DC, Schroader began by using the “Sketch of Washington in Embryo,” compiled by E.F.M Faetz and F.W. Pratt in 1874. This map, based on historical research conducted by Dr. Joseph M. Toner, showed the property lines and land owners in DC before Major L’Enfant began his survey. Research and papers by John Vlach, Professor of American Studies and Anthropology at George Washington University, raised important questions as to who Thomas Jenkins was, if he really did own property in DC, and where that property resided. Daniel Carroll

and David Burns’ property lines were also changed to reflect information later gathered from several other property owner maps, which agreed with one another and knowledge shared by John Vlach, but not the “Sketch of Washington in Embryo.”

Lack of detailed information on land use and land cover in the area created further challenges for Schroader. The King Plats provided information around the main buildings, but the rest of the land use information was derived from the “City of Washington 1800” map by Tee Loftin, whose primary source was Early Recollections of Washington City, by Christian Hines. These sources, however, described the area only up to just east of the Capitol, so Schroader relied on her knowledge of farming practices and vegetation growth on slopes or flat areas to generate probable land use and land cover for the remainder of the DC area. The result of all these efforts was a highly detailed reference as to how the landscape would have looked in 1790.

Through the collaborative efforts of Bailey, Chirico, Hawkins and Schroeder, early Washington DC – an era previously confined to the shadows of pre-photographic conjecture – is emerging in striking, authenticated detail. With the exciting capability of now being able to overlay Pierre L’Enfant’s city plans onto the original terrain of 1790, the group can finally begin to answer

the tantalizing question, “What did L’Enfant see that led him to design the city as he did?” Currently, work is complete for Washington DC in 1790 and for most of 1800, with the more difficult task of finishing visualizations for 1810 and 1820 to be completed as funding allows.



1790 map of Washington, DC by Lindsay Schroeder at the IRC

The successful collaborative efforts of this dedicated team have created a solid foundation for many new research opportunities. With a GIS map system in place, each building and landscape feature known to exist during this period now has its own entry, which can be easily linked with other databases that include images and oral histories of the early city. The database can also be used in online map systems, like Google Maps, to place viewpoints, buildings, and landscape features. Bailey's original quest to create "the book" that would provide the information missing from the 1790-1820 era has evolved into the hope of realizing projects with broader dissemination that are able to engage the general public in this important story. One such project is an iPhone app that uses GPS and its compass to locate a person's position and bearing. An individual could be on the National Mall and bring up accurate images from that vantage point at different time periods: 1790, 1800, 1810 and 1820.

There are important land-use implications as well, with new, more accurate knowledge of terrain alterations now able to inform development planning. Chirico's research on "cut and fill" and DEM differencing techniques will take advantage of Schroader's work. He now has snapshots of the landscape over 200 years (1790, 1888, and 1999) to work with.

Peter Chirico's question to Bailey and Schroader – "You don't know what you have here, do you?" – illustrates well the enormous and as yet untapped capabilities created by triangulating multiple perspectives in a collaborative research environment. The use of GIS technology to enhance the potential of human intuition serves a more informed understanding of both the history and future of a city like Washington DC. As Dan Bailey points out, "Technology isn't driving the history; it's the other way around."

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