

# LiDAR Imaging of the Great Hopewell Road

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In 1862, James and Charles Salisbury reported having followed a set of parallel earthen embankments from near the Octagon at the Newark Earthworks, south toward Circleville and Chillicothe, for a distance of at least six miles (Salisbury and Salisbury 1862). These earthen walls are part of the Newark Earthworks Complex, which was built roughly 2,000 - 1,800 years ago by the Hopewell culture. In the 1800s these walls, or at least their northern end, were widely recognized by investigators of the time and are depicted on maps made by Walsh ([1815] in Lepper 1998), Atwater (1820), Squier and Davis (1848), and Thomas (1894), for example. On these maps, the walls are shown extending from near the Octagon, southwest toward Ramp Creek &ndash; a distance of about 2,400 meters, or 2 ½ miles. This section of the walls, between the Octagon and Ramp Creek, is now known as the Van Voorhis walls; and has been assigned the OAI site number of 33Li401.

In 1995, Ohio Historical Society archaeologist Bradley Lepper (1995, see also Lepper 1996, 1998, 2006) indicated that he had discovered in aerial photographs, possible trace evidence for sections of what he termed, the Great Hopewell Road &ndash; in areas southwest of Ramp Creek between Newark and Chillicothe. Although that possibility is intriguing, a definitive answer as to whether or not the Road originally linked the Newark and Chillicothe areas awaits ground truthing and further research.

What is certain is that ample evidence exists for the walls north of Ramp Creek. Figures 1-4 show portions of photos taken by Dache Reeves in 1934. Clear photographic evidence of the walls exists from Heath Road (which is now the southern edge of the Newark-Heath airport) to a point well north of the Baltimore and Ohio railroad, where houses and other development encroach on the path of the walls not far from their beginning point at the Octagon. Note the circular enclosure attached to the walls just north of Ramp Creek. Lepper (2006:125) presents an oblique view of this circular feature circa 1920.

Urban sprawl has gobbled-up more of these walls since 1934, but they are still visible in a few areas. Figure 5 is a portion of the 1-foot mosaic imagery recently flown for Licking County. Wall sections are still visible on airport property, in the field south of Heath Community Park, and in the agricultural field just south of the Baltimore and Ohio Railroad line. Unfortunately, the runway complex at the airport destroyed the remains of the circular appendage attached to the walls just north of Ramp Creek. Despite our ability to see these portions of the walls in recent aerial photos, decades of plowing have completely, or near completely, flattened the walls&ndash;except in one area, which we discuss further below.

In January 2008, the authors searched for remnants of the parallel walls north of Ramp Creek, using LiDAR imaging. The result is that we were able to detect a section of the walls. In the remainder of this article we report these findings.

**Background** LiDAR is an acronym for Light Detection and Ranging. It is a remote sensing technology that uses laser light pulses to measure the distance to an object. In concept, LiDAR is similar to radar. Whereas radar uses radio waves, LiDAR uses laser light. Distance is calculated by measuring the time difference between the instant when a LiDAR pulse is sent out and when the reflected signal is received.

To generate models of the earth's surface, distance data are collected using aircraft-mounted lasers that send out between 2,000 and 5,000 pulses per second. These data are combined with GPS (Global Positioning Satellite) data to fix the point of the laser reflection in space. The result is a database of X, Y, and Z coordinate information for each point on the ground. At a LiDAR post spacing of 2 meters (i.e., bare earth elevation points every 2 meters), vertical accuracy is to plus or minus 15 centimeters, or 6 inches.

When plotted, LiDAR data can provide very accurate images of the terrain. For purposes of archaeological research, this offers the possibility of discerning subtle patterns in site and landscape topography that might not be visible by naked eye, or standard photographic techniques. In some cases, these patterns can reveal prehistoric earthwork features.

Realizing the potential of this technology for Ohio archaeology, the authors partnered with The Ohio State University, Newark Earthworks Center in a collaborative effort to use LiDAR data to develop images of known prehistoric earthworks and identify previously unknown earthworks. As mentioned, one of our first efforts was to locate the parallel-walled Road leading from the Newark Octagon toward Ramp Creek.

**Results** Figure 6 shows the Salisbury map of the Newark Earthworks from 1862. Figure 7 shows an enlarged detail from an aerial photograph taken in the 1930s by Dache Reeves. As can be seen, the parallel walls were already becoming difficult to see by the 1930s. Today, aerial photos still reveal sections of the walls, but now they are much less distinct. Figure 8 shows the estimated trajectory of the Road projected onto a LiDAR image of the Newark area.

Using LiDAR imaging, we were able to locate an existing segment of the Road in a woodlot, north of the Newark-Heath airport. Figures 9 and 10 show LiDAR images of the feature. This segment of the walls is known to have existed within the woodlot, but until now it has not been practical to topographically integrate it with the surrounding landscape.

One of the advantages of LiDAR is that, since three-dimensional data coordinate points are collected, we are able to create not only surface maps, but also, profiles of selected areas. Figures 11-13 show the results of a series of profiles taken across the wall segment located in the woodlot. Several things in the profiles are of interest.

To begin with, this portion of the Great Hopewell Road is definitely visible as an existing topographic feature. While two-dimensional aerial photographs give the impression that the walls have been diminished to the point where only soil discoloration might indicate their former existence, the fact is that, at least in the woodlot, the Road still exists as a three-dimensional object.

Examination of the profiles in Figure 12 shows that the Road is bounded by a set of parallel earthen embankments. These walls are roughly 50 meters, or 150 feet apart, and they are not very high &ndash; perhaps averaging 0.3 meters, or 1-foot in height. This height is just barely within the range of detectability in these LiDAR data.

Of considerable interest is that, as shown by Figure 12, the center area of the Road does not extrude vertically from the surface of the earth. Rather, in the area between its flanking walls, the Road appears as a depression along the length of its trajectory. Most likely, the depression between the walls was created when soil was scraped-up to create the parallel walls. Thus, rather than being a built-up road, at a slightly

higher elevation than the surrounding terrain as we are accustomed to seeing with modern roads, this section of the Road is a shallowly excavated feature that is flanked by low parallel walls. In this, the Great Hopewell Road (or at least the Van Voorhis portion of this feature) resembles the cross section profile of the Sacra Via at the Marietta Works in Washington County (see Figure 13). Notably, the Marietta Sacra Via was a Hopewell feature consisting of a set of parallel walls that flanked an excavated pathway, or avenue, that led from the Marietta Large Square, down to the Muskingum River.

**Discussion** From the results reported here, there is little doubt that LiDAR technology offers exciting possibilities. Already, LiDAR is providing us with new perspectives and increased understanding. In connection with the Great Hopewell Road, it is our hope that identification of the Road as a visible, archaeological feature will encourage further investigations not only of this remarkable feature, but of the entire Newark landscape. Although much of the Native American past has been built-over and lost, much remains to be discovered.

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