

Disclaimer

These minutes reflect the actions taken by the Commission during its March 8, 2024 meeting. Although these minutes have been approved by the Commission, no action authorized by the Commission during this meeting, as reflected in these minutes, shall have force or effect until ten (10) days, Saturdays, Sundays and public holidays excepted, after a copy of these minutes has been delivered to the Governor for review, unless prior to expiration of the review period the governor approves same, in which case the action shall become effective upon such approval. These minutes were delivered to the Governor on March 18, 2024.

PINELANDS COMMISSION MEETING

MINUTES  
March 8, 2024

*All participants were either in-person or present via Zoom conference and the meeting was livestreamed through YouTube: <https://www.youtube.com/watch?v=paoB8BMfG10>*

Commissioners Participating in the Meeting

Alan W. Avery Jr., Dan Christy, John Holroyd, Theresa Lettman, Mark Lohbauer, Mark Mauriello, Jonathan Meade, William Pikolycky, Jessica Rittler Sanchez, Douglas Wallner and Chair Laura E. Matos. Also participating were Executive Director Susan R. Grogan, Deputy Attorney General (DAG) Jay Stypinski and Governor's Authorities Unit representative Alexis Franklin.

Commissioners Absent

Nicholas Asselta & Jerome H. Irick.

Call to Order

Chair Matos called the meeting to order at 9:35 a.m.

DAG Stypinski read the Open Public Meetings Act Statement (OPMA).

Executive Director (ED) Grogan called the roll and announced the presence of a quorum. Eleven Commissioners participated in the meeting.

The Commission pledged allegiance to the Flag.

## Minutes

Chair Matos presented the minutes from the Commission's February 9, 2024 meeting. Commissioner Lohbauer moved the adoption of the minutes. Commissioner Pikolycky seconded the motion.

The minutes from the February 9, 2024 Commission meeting were adopted by a vote of 11 to 0.

## Committee Reports

Chair Matos provided a summary of the February 23, 2024 Policy and Implementation (P&I) Committee meeting:

The Committee approved the minutes of the November 29, 2023 meeting and the minutes of the January 26, 2024 meeting.

Evesham Township presented a proposed trail improvement project at its Black Run Preserve municipal park. The project would provide more accessible and inclusive trails by grading and surfacing the trails with crushed stone, installing accessible parking spaces and installing a bridge in one section of the trail. Due to the extensive area of wetlands and wetlands buffers, the project will require a Memorandum of Agreement (MOA) to allow a deviation from CMP wetlands and wetlands buffer standards. The Committee indicated its support for the MOA. A presentation will be made to the full Commission in April.

The Committee next heard staff recommendations for changes to the project evaluation criteria for Pinelands Conservation Fund (PCF) land acquisition grants, and to the funding structure, along with the anticipated grant program schedule. Staff also discussed adding a new acquisition target area in the Pemberton Township Regional Growth Area and expanding the Belleplain – Peaslee target area in the Pinelands Village of Port Elizabeth – Bricksboro of Maurice River Township. These additions to the acquisition target areas were forwarded from the Climate Committee project to assess the need for Pinelands Management Area boundaries to address climate change impacts. The P&I Committee approved the revised PCF evaluation criteria and acquisition target areas.

Commissioner Lohbauer provided an update on the February 14, 2024 Climate Committee meeting:

Staff updated the Committee on the Board of Public Utilities Dual-Use Solar Pilot Program straw proposal and the status of Senate Bill 2424 (management of publicly owned forested land). Staff then made a presentation summarizing the Pinelands Management Area boundary assessment for climate change hazards and provided recommendations to the Committee. The Committee moved that the recommendations for new or expanded permanent land protection acquisition target areas should be forwarded to the P&I Committee for consideration. Separately, the Committee approved the recommendations for further exploring expanded wetlands buffers and for density transfer in certain Pinelands Villages.

## Executive Director's Report

ED Grogan provided information on the following matters:

- The Fenwick Manor Preservation Plan has been completed, submitted and accepted by the New Jersey Historic Trust. Once the grant agreement is signed, the scope of work and Request for Proposal for construction services will be drafted.
- The Personnel and Budget Committee is scheduled to meet on March 26<sup>th</sup>. The meeting agenda will include a recommendation to delete a number of fixed assets, including the Smart Board in this conference room. A large screen television will replace the Smart Board.
- An education session for Pinelands Area construction code officials and zoning officers has been scheduled for May 15<sup>th</sup> at Stockton University's Kramer Hall in Hammonton. Commission staff will provide relevant information on Comprehensive Management Plan (CMP) procedures and standards. Commission staff provided the necessary paperwork to ensure that training participants will receive continuing education credits from Rutgers University.

Gina Berg, Director of Land Use Programs, provided an update on the following planning matters:

- The Land Use Programs staff and the Science office have been busy developing a grant proposal for the America the Beautiful Challenge, and it will focus on land conservation and stewardship.
- Invitations have been sent to land preservation partners for the 2nd Annual Land Preservation Summit that is scheduled for April 4<sup>th</sup>. The New Jersey Department of Environmental Protection (NJDEP) will highlight changes to its Green Acres funding regulations and the New Jersey Conservation Foundation will review the State Conservation Blueprint. Commission staff will review the structure of the PCF and the upcoming grant round.
- Staff is reviewing the recently released Draft Statewide Water Supply Plan and will provide comment as necessary. The NJDEP is holding a briefing on the Plan that staff will attend.
- Interviews are being conducted to fill two vacancies in the Lands Use Programs Office.

April Field, Chief Permit Administrator, provided information on the following regulatory matters and noted that additional information could be found in the February 2024 Management Report.

- The Commission received an application from the NJDEP, Division of Fish and Wildlife, proposing the removal of approximately 1,600 linear feet of an existing dirt road in the Greenwood Forest Wildlife Management Area. Beavers are creating a dam in an existing culvert of the road, resulting in upstream flooding and impacting those wetlands. A meeting is scheduled with the applicant to discuss the proposal.
- The Dennis Township Board of Education (BOE) submitted information proposing a emergency services communication tower at the Dennis Township Elementary School. The school and the township will both use the tower for emergency communications. The elementary school is located in a Pinelands Village. Staff advised the applicant that the proposal could work if the BOE provided information demonstrating that the tower is an accessory use.
- Members of the public provided information about an illegal dumping matter in Pemberton Township at the February Commission and P&I Committee meetings. Commission staff was notified about improvements to an existing driveway associated with an agricultural operation on February 7, 2024. On February 9, 2024, NJDEP issued a violation letter to the property owner about filling wetlands, the same day Pemberton Township issued a cease and desist order for the driveway improvements. On February 21, 2024, the Commission issued a letter to the property owner advising of the wetlands protection and water quality standards in the Township ordinance and the CMP.

Chair Matos asked if the property owner has responded.

Ms. Field said the Commission has not received a response, but the NJDEP is taking the lead in the matter.

Stacey Roth, Chief, Legal and Legislative Affairs, said the Commission received an appeal of the Kirkwood-Cohansey Water Management Rule amendments that went into effect in December 2023. She said a briefing on the matter will be provided during the Closed Session portion of the meeting.

Brad Lanute, Chief Planner, updated the Commission on the following:

- The State Office of Planning Advocacy (OPA) distributed a draft preliminary plan to state agencies seeking comments by the end of February. As with the prior state plan, it discusses the Pinelands Commission, its planning role in the Pinelands Area, and the Pinelands Comprehensive Management Plan. Staff provided minor, clarifying comments back to OPA that are expected to be incorporated into the draft preliminary plan. The State Planning Commission will likely be acting on the draft preliminary plan in the coming months.
- The Interagency Climate Council continues to be active and busy. Over the winter, NJDEP staff to the Council engaged with all member agencies to brainstorm a work plan for the upcoming two years. As a result, the Council created three working groups:

- A working group on Outreach and Engagement Strategies for the Council;
- A working group on Coordinated State Agency Communications around Extreme Heat; and
- A working group on developing best practices for Climate Vulnerability Assessments

Member agencies were asked to volunteer on at least one working group. As such, a Land Use Programs staff member will be participating on the Vulnerability Assessment Working Group.

Paul Leakan, Communications Officer, said 500 people have signed up for the 35<sup>th</sup> Annual Pinelands Short Course. He also noted that the 2023 Annual Report was included in the packet materials and a brief presentation will be provided later in the meeting.

Commissioner Avery said the Commission is on track to receive the budgeted amount for application fees based on the recent figures in the February 2024 Management Report.

Commissioner Avery asked if the road that the NJDEP is proposing to remove is a private or public road.

Ernest Deman, Supervising Environmental Specialist, indicated that the road is located on a parcel of land owned by the NJDEP and that the road has existed since at least the 1930's.

#### Public Development Projects and Other Permit Matters

Chair Matos introduced a resolution for the change in use of a former school in Washington Township and the construction of a building addition to a public works garage and paved parking area in Stafford Township

Commissioner Avery made a motion Approving With Conditions Applications for Public Development (Application Numbers 1987-1159.064 & 2000-0637.005) (See Resolution # PC4-24-04). Commissioner Lohbauer seconded the motion.

Ms. Field said a stormwater basin was installed as part of the original application for the Stafford Township Public Works building. During the site inspection for the building addition, it was determined that the existing stormwater basin was not functioning properly. She said Stafford Township is required to remediate the stormwater basin by December 31, 2024.

Ms. Field said in order for the change in use application of the school to professional office to meet CMP groundwater quality standards, the existing septic system will be converted to an alternate design septic system. She said the alternate design septic system will treat the wastewater.

Commissioner Rittler Sanchez asked which alternate design system will be installed.

Mr. Deman said Amphidrome Plus.

The resolution was adopted by a vote of 11 to 0.

#### Public Comment on Development Applications and Items Where the Record is Open

No one from the public provided comment.

#### Ordinances Not Requiring Commission Action

Chief Planner Lanute provided an overview of the Ordinances reviewed in the last month:

- Evesham Township submitted its adopted Open Space and Recreation Plan;
- Barnegat Township amended an Ordinance to permit convenience stores in one of its Overlay Zones located in the Pinelands National Reserve (PNR). Barnegat is one of the few municipalities that has elected for the Commission to certify its Master Plans and Ordinances in the PNR portion of the town; and
- The Town of Hammonton adopted a number of Ordinances, one of which amends the density of a six-acre portion of a Redevelopment Plan located in a Pinelands Town.

#### Other Resolutions

Chair Matos introduced a resolution to accept the Fiscal Year 2021 Audit Report.

Commissioner Pikolycky made a motion To Accept the Fiscal Year 2021 Audit Report (See Resolution # PC4-24-05. Commissioner Lohbauer seconded the motion.

Commissioner Avery said an audit is required as part of the Commission's statute and serves as a good policy to ensure that the public's money is spent correctly. He said there were no findings in the FY21 audit and thanked the Audit Committee, Commission staff and the Auditors for their work.

The resolution was adopted by a vote of 11 to 0.

Chair Matos introduced a resolution to approve the Commission's 2023 Annual Report.

Commissioner Lohbauer made a motion To Approve the Pinelands Commission's 2023 Annual Report (See Resolution # PC4-24-06). Commissioner Pikolycky seconded the motion.

ED Grogan said the Commission is required by both the Pinelands Protection Act and Executive Order #37 (Governor Cozine) to prepare an Annual Report that is first accepted by the Governor's office and then adopted by the Commission. She said the report is a cooperative effort by each office at the Commission. She said the report details the wide variety of activities the Commission is involved in.

ED Grogan said after decades and multiple iterations through the years, the Kirkwood-Cohansey Water Management rule amendments went into effect on December 4, 2023. She provided numbers related to land protection that occurred in 2023. She reviewed the development

applications by type and location (Pinelands Management Area). She said the Commission approved 30 public development applications. She reviewed the Education and Outreach activities that staff organized with a summer and winter Short Course. The use of social media has allowed staff to raise a greater awareness and appreciation of the Pinelands. Lastly, she said the Commission was awarded grant funding to rehabilitate and preserve Fenwick Manor.

Link to the Annual Report:

[https://www.nj.gov/pinelands/infor/online/annual/Annual%20Report%202023%20\(Final\).pdf](https://www.nj.gov/pinelands/infor/online/annual/Annual%20Report%202023%20(Final).pdf)

Link to the 2023 Annual Report Presentation Slides:

<https://www.nj.gov/pinelands/home/presentations/2023%20Annual%20Report%20Presentation%20for%20PC%20Meeting.pdf>

The resolution was adopted by a vote of 11 to 0.

#### Presentation: Wharton State Forest Visiting Vehicle Use Map

John Cecil, Assistant Commissioner of State Parks, Forests & Historic Sites at the NJDEP, said Wharton State Forest is over 124,000 acres and is home to numerous plant and animal species and includes areas of important cultural significance. He said in the fall of 2022 the NJDEP embarked on a survey to determine how visitors use the forest. The survey was open for six weeks and included a mapping tool to collect spatial data. Many responders were opposed to a permit system; the Department subsequently decided to put that aside and focus on development of a map. More than 500 people attended an open house that was held at the Batsto Visitor Center in January 2024 to review the draft map.

Mr. Cecil reviewed the survey data. He said the data revealed that users would like to see more enforcement, better road maintenance and protection of sensitive areas. He said a main factor for the creation of a map is public safety that depicts where users of the forest should and should not go.

He said the NJDEP has been working closely with the Attorney General's office on enforcement matters, including imposition of higher fines for illegal off-road vehicle use. He said it is a challenge to apprehend people who are not doing the right thing. Park Police are not permitted to chase offenders. The NJDEP continues to look at other ways to catch off-road vehicle riders.

He then reviewed the evaluation of how the NJDEP determined what roads were appropriate for vehicle driving and what roads were inappropriate. He said the analysis began with the same topo maps that the Commission used back in 2017 as the basis for its resolution designating roads in Wharton State Forest for recreational use. He said 200 miles were removed and 200 miles of the 400 miles baseline will remain available for users. He said the public comment period will be extended until April 8, 2024.

Link to presentation slides:

<https://www.nj.gov/pinelands/home/presentations/Wharton%20SF%20Visiting%20Vehicle%20Use%20Map%20SPFHS%20NJDEP%2024Jan2024.pdf>

Commissioner Mauriello commended the NJDEP for taking on the challenge of creating a user map for Wharton State Forest. He said it's not easy task to protect the natural resources and keep the public access open.

Commissioner Rittler Sanchez asked how technology could be used to catch perpetrators.

Mr. Cecil said the first step is to have a map that defines where users can and cannot go and specifies an exit and an entrance. This will allow law enforcement to be in a better position to intercept and apprehend. He said the NJDEP uses cameras now but will place them in sensitive areas. He noted that drones and aircraft do not work as well as one would think.

In response to some questions and comments from Commissioners, Mr. Cecil said the NJDEP is constantly recruiting park police to increase enforcement measures. He said the following programs were at the Open House to offer expertise and guidance on the vehicle use map: Forest Fire service, State Park Police, and Natural Lands Management and Historic Sites. Lastly, he said discussions on increased enforcement related to the use of Class 2 officers will continue with the Attorney General's office.

#### General Public Comment

Harry Harper of Browns Mills, NJ, said he is opposed to the proposed 575-unit residential development on Pole Bridge Road in Pemberton Township. He said although the developer is proposing to restrict a portion of the parcel as open space, the entire parcel should be preserved. He noted that the developer should be required to prepare and submit up to date habitat surveys.

Jonathan Peters, Professor at The City University of New York, said he began researching roads in the Pinelands after reading a report by the New Jersey Department of Transportation on historic roads that didn't list any roads in the Pinelands. He published a paper in the Transportation Research Record of the National Academy of Sciences (Attached). He said roads in the Pinelands are old and were developed in the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> centuries. He said he researched the Wharton papers and found out that Mr. Wharton bought land from private hands but he did not acquire the roads. He said these are the people's roads that were established long before Mr. Wharton purchased the land.

Rocco Spano said he is against closing the people's roads in Wharton State Forest. He said he has been visiting Wharton for the past 50 years.

Jack O'Connor, founder of Pine Barrens Adventures, said that he supports responsible use of the Pine Barrens. He said according to his calculations, only 1% of users participated in the survey. He said the NJDEP knows where illegal activity is occurring. He said this plan hurts the people who ride legally.

Ryan Flynn of Mount Laurel, NJ, said he spent his childhood exploring Wharton State Forest and continues recreating in the forest today. He said he is happy to see the NJDEP engaging with the public, unlike they did with their 2015 map effort. He said he is disappointed by how the

survey results are being processed. He said 72% of survey responders wanted to keep Wharton as is. He noted a discrepancy of the amount of miles within the forest. He said in 2014 the NJDEP requested federal funding for motorized maintenance of 600 miles of roads. He said if survey responders circled more than a 5,000-mile area within Wharton State Forest, the response was disregarded. He said only 182 surveys were used to draw the heat map. He said he hopes that if NJDEP is closing a road, it is for the right reason. He does not support cutting of access to the public's favorite spots in the forest.

Ray Taylor of Tabernacle, NJ, said he spends a lot of time exploring with his dog. He also belongs to a hunting club. He said there is lack of parking areas in the forest and you need to be able to drive to certain portions otherwise you will have to walk for miles. He said he supports keeping access as it is and not creating any new roads.

Len Donovan said he is opposed to closing roads at Wharton State Forest. He said he explores the forest about once a week. He said you cannot explore from the main roads. He supports more law enforcement in the forest. He said in the past three years he has rarely seen Park Police but he has seen them on Route 206. He added that the Park Police always seem to have clean vehicles and if you are patrolling a forest, the vehicle would not be clean.

Ryan Holbrook of Atco, NJ, said road closures will lock the interior of Wharton State Forest and prohibit trappers from trapping predators of species such as the eastern wild turkey.

Samantha Parks of Mizpah, NJ, asked a question regarding Hamilton Township zoning, specifically if the professional planner utilized by the Commission addressed economic challenges in starting commercial entities in predominantly residential zones.

Russell Juelg of NJ Plant Partnership said he supports the NJDEP's decision to gain control of motorized traffic at Wharton State Forest. He said it's well-documented that the traffic in the forest has had a negative impact on rare plant species. He asked the Commission to act on updating the CMP's list of protected plant species, noting that the current list is now obsolete. He provided ways in which the Commission could accomplish updating the list (written comments attached).

Heidi Yeh of the Pinelands Preservation Alliance brought copies of their Annual State of Pinelands report. She highlighted the following in the report:

- Thumbs up to the NJDEP for the public engagement process on the Wharton State Forest vehicle map;
- Additional funding is necessary for the Pinelands Commission to hire more staff;
- Restore Payment in Lieu of Taxes (PILOT) funding for Pinelands municipalities with large amounts of preserved lands; and
- Provide funding to New Jersey parks, as they have fallen behind peer states.

Fred Akers of the Great Egg Harbor Watershed Association said there is renewed legislation that would require counties to assist in the off-road vehicle issue and \$1 million is associated with the bill. He said he has been working with Atlantic City Electric (ACE) for over a year in an effort to

get them to fix guardrails and gates in the vicinity of Gravelly Run natural lands trust property in Hamilton Township. He said ACE has no interest in the protection of their rights-of-ways from off-road vehicle damage. He wanted to raise the issue because it's related to the Commission's transmission right-of-way plan for vegetation management.

Mike Keles of Evesham Township, NJ, requested that the Commission ask Evesham Township to look at alternatives for their accessible trails proposal at the Black Run Preserve that would not include the removal of trees or encroach on wetlands. He suggested that the existing trailhead at Kettle Run West may be a better option for the proposal.

Jason Howell of the Pinelands Preservation Alliance commended the NJDEP for embarking on a vehicle use map with the intent of protecting a globally unique ecosystem. He said if you compare the 2024 draft vehicle use map with the original 1966 map, you will notice the similarity between the two. He said routes cannot cross stream or wetlands. He said he has traversed each route in Wharton and over time some of the roads are now rivers or completely forested.

John Druding of Open Trails NJ said the NJDEP vehicle use map will close half the roads in Wharton State Forest and impact hunters, hikers and kayakers. He said five municipalities have passed resolutions opposing the road closures. He said Open Trails NJ has started a petition raising concerns about the NJDEP's plan and has over 5,500 signatures. He noted that Open Trails NJ has GPS data and photos for each of the proposed road closures, and they are all passable roads. He closed by saying he hoped the NJDEP would focus on enforcement, volunteerism, signage and education.

Heather Muran McGarvey of Shamong, NJ, said she runs the New Jersey Project and does not support the Vehicle Use Map at Wharton State Forest. She said the Forest should remain open and free to the people of New Jersey and especially to those who live close to it, including the children. She said the NJDEP should be concerned about saving the animals from the windmills at sea, instead they are concerned about plants in the forest. She said there are people tied to the Pinelands Preservation Alliance with private interests to close access to the water so that only their kayaks can go in the water. She said the plan to close roads in the forest is not fair.

Erin Keiser-Szabo said the road closures in Wharton State Forest will force people to walk over a mile to access certain spots. She said this will put the disabled community at a disadvantage. She said the NJDEP picks and chooses what user groups can hold a cleanup and many cleanups have been canceled. She said she does not support the road closures in Wharton State Forest.

Joel Diosophen said he agreed with many of the commenters who spoke in opposition of the road closures. He said he is tired of government overreach. He added that he doesn't support the use of drones.

Harvey Mushman said he is a recreation trail user and is against the road closure process. He told the story of a man criss-crossing the sand roads in the Pinelands and destroying his car in the process. He said that man went on to write a book that led to Governor Brendan T. Byrne passing

the Pinelands Protection Act. He said that man is John McPhee, and thousands of people have gone on to explore those sand roads and the road closures will prevent future exploration.

Natalie Stone of Tabernacle, NJ, said a users of the forest would like to see more enforcement. She said it's unfair to restrict responsible users and the NJDEP's plan does not solve the problem of illegal riders at Wharton State Forest. She said she would like to see the NJDEP engage with special user groups who can help with cleanups and the construction of barriers. She said this needs to happen in a timely matter.

#### Closed Session

Chair Matos said the Commission will need to meet in closed session to be briefed on a few litigation matters.

DAG Stypinski read the closed session resolution.

Commissioner Lohbauer made a motion to enter into closed session at 11:58 a.m. Commissioner Mauriello seconded the motion.

#### Return to Open Session

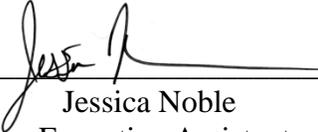
The Commission returned to open session at 12:33 a.m. Commissioner Mauriello left the meeting during the closed session discussion.

Ms. Roth said the Commission was briefed on new and pending litigation matters during the closed session.

#### Adjournment

Commissioner Pikolycky moved to adjourn the meeting. Commissioner Lohbauer seconded the motion. The Commission agreed to adjourn at 12:34 p.m.

Certified as true and correct:

  
\_\_\_\_\_  
Jessica Noble  
Executive Assistant

Date: March 18, 2024

## Identifying Colonial Roads in Southern New Jersey: An Application of Remote Sensing, Field, and Archival Methods to Document the Locations, Condition, and Routes of Critical American Revolutionary War Supply Chains

Jonathan R. Peters<sup>1</sup> , Cameron E. Gordon<sup>2</sup>, and Carl E. Peters<sup>3</sup>

Transportation Research Record  
1–14

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DOI: 10.1177/03611981231175914

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### Abstract

This paper explores the identification, use, and preservation of historic roads in the state of New Jersey that primarily travel through public lands. The authors examine in detail the historical significance of several unpaved routes that continue to exist in Burlington County, NJ, as well as discuss various methods that can be used to identify routes with historical significance and document their physical characteristics. Field research was conducted to establish the current location of these historic routes, using LiDAR, GPS, and geographic information systems methods to estimate their likely date of construction. Further examination and mapping of these routes was undertaken, followed by documentation of the historical events linked to their use, thus establishing historical context. We identified likely routes used as critical Revolutionary War supply routes. The paper concludes with a discussion of appropriate actions that should be considered in the preservation of these routes and offers planners some options in relation to public policy.

### Keywords

geospatial data acquisition technologies, GIS, GPS data, LiDAR, public lands, transportation history

Documentation and identification of historic routes is a growing field of interest for transportation policy makers and historic preservation professionals. Marriott outlines three major categories of historic roads: (a) aesthetic routes, which are roads developed to serve a particular traveler experience, such as scenic enjoyment for leisure, recreation, or commemoration; (b) engineered routes, which are designed to enhance efficiency of travel and the movement of people and goods; and (c) cultural routes that may have emerged in response to evolving local or regional needs and movements (*1*). The first two will have well-established design criteria related to their development as well as a documented period of construction. Cultural routes, however, may have been developed over a considerable period of time and may not have a well-documented design history or date of construction.

Each type of route also has three broad categories of historic value according to Marriott: (a) design, that is,

an innovative or important use of design elements and aesthetic quality in the development of the route; (b) road construction technology, for which the route employed innovative or important construction techniques or materials; and (c) association with important and/or famous events can create a situation where the preservation of the route is important as a cultural marker and/or

<sup>1</sup>Chazanoff School of Business, the College of Staten Island and Doctoral Faculties of Economics and Earth and Environmental Sciences, The City University of New York Graduate School, New York, NY

<sup>2</sup>Tax and Transfer Policy Institute, Crawford School of Public Policy, Australian National University, Canberra, ACT, Australia

<sup>3</sup>New Jersey Society of Professional Land Surveyors & New Jersey Society of Municipal Engineers, Trenton, NJ

### Corresponding Author:

Jonathan R. Peters, jonathan.peters@csi.cuny.edu

provides the opportunity to experience the route and surroundings that witnessed the historical event.

There are many examples of historic routes of various types and values, such as Route 66 or the Selma to Montgomery Highway with important historical associations, or the Bronx River Parkway in New York, the Columbia River Highway in Oregon, and the Going-to-the-Sun Road in Montana as good examples of aesthetic routes with key design features (1).

However, some historic roads are easier to identify and document than others. The Via Appia, begun in 312 BC, still provides a well-preserved example of Roman road building, affording a physical knowledge-base of the specifics of the Roman Empire's well-established practice of using public works to provide for political control, wide-scale military access, and significant trade activity. Sections of this road continue to exist, and the longest section of straight road in Europe remains a 39-mi segment of the Via Appia. Interestingly, the road continues to be used for vehicular traffic, some sections retaining their original paving, and the Italian government has restored several sections to their historic form (2).

There are many other routes, however, that have faded with time and even disappeared. This last type of road—a route that had historical significance but which has now been passed by economically and spatially—is the one that poses special challenges to the historian. The route must first be discovered, then accurately uncovered, appropriately preserved, and its historic role must then be properly interpreted and understood.

This paper examines in detail a set of methods a researcher can employ to identify historic routes, with a field example comprising several historically significant unpaved routes that continue to exist in Burlington County, NJ, parts of which have faded or been lost. The authors discuss various methods that can be used to clearly identify and map such routes, and report on field research conducted to establish the current location of these historic roads and give estimations of their likely date of construction. Further examination and mapping of these routes followed, to document the historical events linked to their use, in particular establishing the role they played, with reference to local industries, as supply routes during the American Revolutionary War. The paper concludes with a discussion of the appropriate actions that should be considered in the identification, preservation, and economic understanding of these routes, and others like them.

### **Burlington County Roads as Historically Significant**

The New Jersey Department of Transportation, in conjunction with the U.S. Federal Highway Administration completed and published the New Jersey Historic

Roadway Study (NJHRS), which attempted to explore and document the existing historic roads that still exist, grouping them into four categories by era of construction. The first—the Early Roads Era (1621 to 1815)—is of interest here (3).

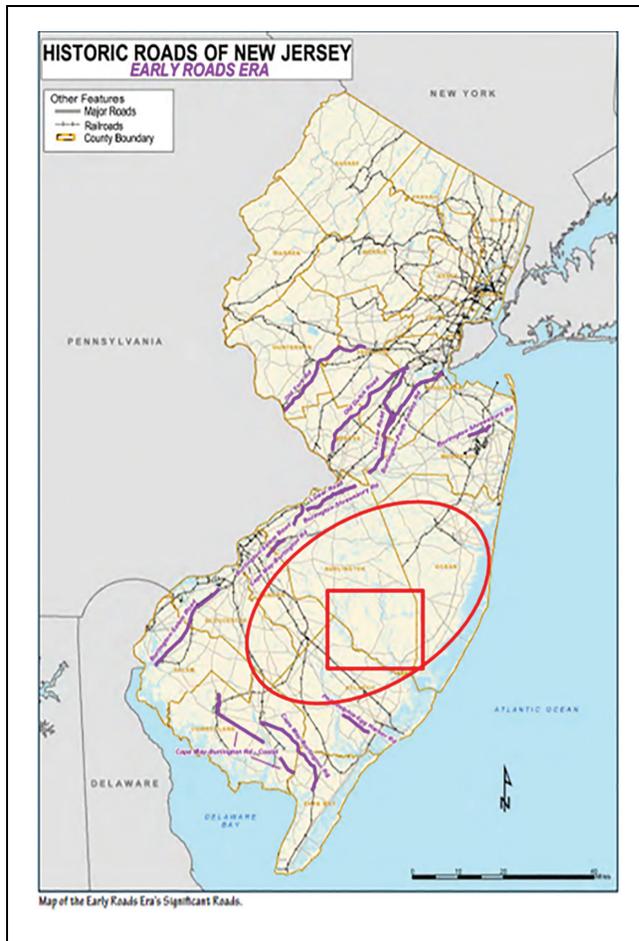
The authors of this paper decided to examine, by county, the reported historic routes that were established in the NJHRS. We then conducted further archival research to examine the reported historic routes based on early map analysis, as used by the NJHRS. We ended up focusing in detail on Burlington County, which remains a fairly pristine area of New Jersey, consisting of large swathes of public land and undeveloped private tracts. Here, several Early Roads Era routes appear to have survived, traversing public lands and also along established rights-of-way through private property. Although actual roads, even unimproved unpaved roads, have often disappeared in parts, the physical environment may be sufficiently untouched to allow for field investigation that can be cross-checked and expanded with archival research.

Figure 1 provides a map as established in the NJHRS of the Early Roads Era routes that still existed and could be documented in 2011 (Early Roads Era routes in purple). Burlington County is reported to have only a few small segments of Early Roads Era roads; in particular, the Burlington–Perth Amboy–Shrewsbury Road and the Cape May–Burlington–Salem Road. These roads are both located in the very north and west of the county, with no Early Era roads indicated in the south or east. We have indicated our general area of research in Figure 1 by a red oval that covers most of eastern Burlington County. Our particular area of research comprised four roads that are located within the red box in Figure 1.

Based on discussions with local historians and consultation with various historical documents, four key early routes were identified in southeast Burlington County as worthy of further investigation. These included (a) Middle Road, (b) Washington–Quaker Bridge Road, (c) Stokes Road, and (d) the Tuckerton Stage Route (see Figure 2). Based on the historical record, it appears clear that these routes were used extensively by the Americans to evade the British blockade and occupation of the area and provide both the Continental Army and local residents with needed supplies of both essential foodstuffs, ammunition and firearms.

### **Accurate Identification of the Historical Routes**

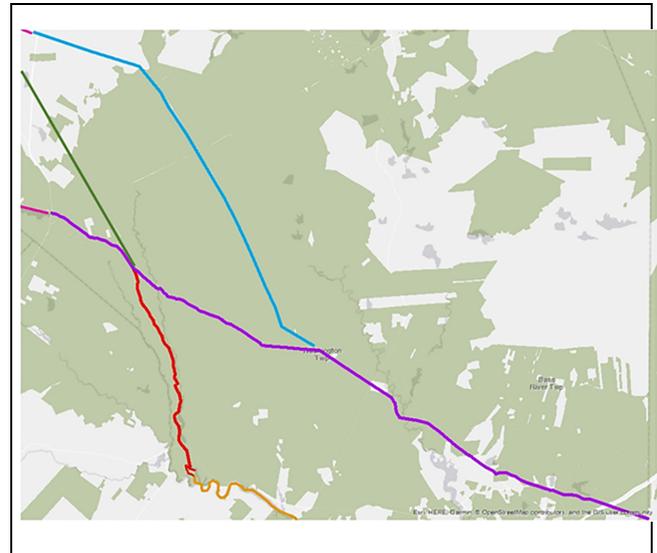
The next research challenge was to examine the specific condition and current characteristics of these routes. Examination of colonial era maps and comparison with



**Figure 1.** Early Roads Era roads identified in KSK Architects Planners Historians, Inc., Armand Corporation, Inc., and Michael Baker, Jr., Inc (3, p. 27). Authors' area of study circled in red and inset location of Figure 2 overlaid on area.

more recent maps, combined with field trips to the area showed that the rough alignments of these early roads continued to exist in the eastern portion of Burlington County. Furthermore, their current physical condition appeared to be quite similar to their condition when initially constructed; that is, passable tracks were present that had mostly never been paved or otherwise improved. This is because the area, known as the Pine Barrens, is protected, with relatively limited development and a large amount of public lands (indicated as shaded green in Figure 2), though regularly used by a range of off-highway vehicles and other leisure users. Oddly enough, this use was apparently regular enough to keep the old routes from totally disappearing into the forest, though not so extensive as to wear them away or alter them out of recognition.

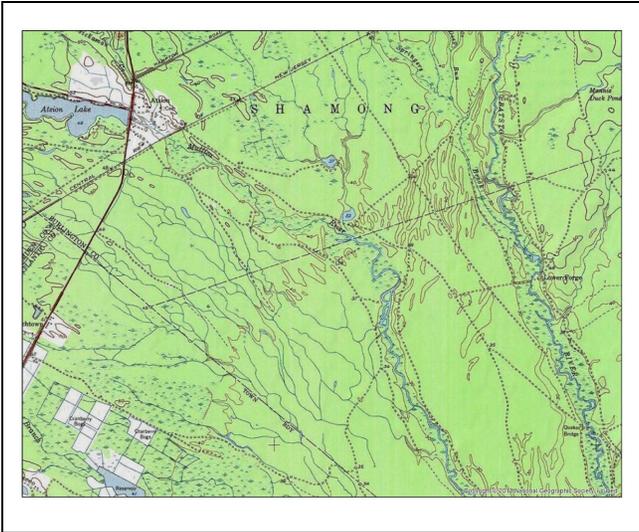
Of course, the mention of a road in a historical record is not tantamount to knowing its exact historic alignment. Identification of historic roads requires both



**Figure 2.** Inset Map I showing the routes of Tuckerton Stage Road (blue), Washington–Quaker Bridge Road (purple), Stokes Road (green), and Middle Road from Atsion to The Forks (red).

secondary research (e.g., thorough searching and analysis of archival information to understand where origins, destinations, and physical interconnections were) and primary research (fieldwork and “ground truth” investigation). In some cases, for example, where some sort of road still exists and its use has been steady, secondary research may be sufficient. But often, direct primary investigation of a route’s location is called for. Even where there is still a road, such digging (sometimes literally) is often needed to surface deviations between the past and present pathway. GPS, geographic information systems (GIS), physical sensing, and big data methods are all being used to aid in more accurately identifying and documenting historic roads (4, 5).

The four roads identified for detailed analysis in this study were located using comparisons with historic maps supplemented by direct field mapping of routes using GPS and GIS methods. One route in particular, Stokes Road, may have been used to supply troops at Valley Forge during the winter of 1777 to 1778. The authors were able to establish the length of time an existing route had been there, based on the earliest map that included that route, as well as conducting a literature review of existing sources to establish likely routes for historic roads. As a secondary source of location, the authors compared historic maps with the United States Geological Survey (USGS) topographical 7.5 min, 1:24,000-scale quadrangle maps both in paper and georeferenced forms that were produced from 1947 to 1992. This allowed us to establish the likely routes of these roads in the period in which the USGS conducted detailed mapping of the region (see Figure 3).



**Figure 3.** USGS topographical quadrangle map example: Atsion, NJ, quad detail.

Note: USGS = United States Geological Survey.



**Figure 4.** Detail of 1860 New Jersey topographical map by publisher H. G. Bond, of the Atsion area (to be compared with Figure 3).

This USGS map was then compared with older historical maps. A section of the 1860 Map of New Jersey published by H. G. Bond (see Figure 4) clearly indicates the location of the Quaker Bridge, which has a well-established construction date in the early 1770s. The map also provides clear indication of the routes of Stokes Road, Quaker Bridge Road, and Middle Road. The former two routes are also indicated on maps from 1834 by Finley and 1845 by Hammond. Middle Road was reported by other sources as being in use for military, commercial, and smuggling purposes in the 1760s to 1780s. All three of these routes are omitted from the NJHRS and yet all three appear to have very long histories of use. The route of the Tuckerton Stage Road, which is documented as in use for stage and cargo by the 1770s, can also be seen. The authors further confirmed these findings by utilizing primary resources located in the office of the Burlington County Clerk's archives that document the legal locations of roads as established at their time of formal creation and recognition (known in the world of surveying and land use as road returns, and discussed in more detail below).

The early maps in many cases indicated the historical locations of early roads, but as reported in the NJHRS, the mapped locations of routes on early maps may have varied from their actual positions. By comparing and analyzing maps from various eras, we could establish with some level of clarity the likely routes of early roads. Some of these routes also have established road easements that aided in this determination. Further—and fortunately—parts of these routes retain in many cases historic route names that help establish their location and use. Finally, several prominent and documented

features with long historical provenance (e.g., towns, bridges, and crossroads) helped us to georeference our historical maps to the current geography.

These locations were then compared with GPS tracks the authors collected in the field using Garmin GPS units and by driving in off-highway vehicles, motorcycles, and/or walking on foot, as needed, following the methods for data collection practices suggested by the New Jersey Department of Environmental Protection (6). These tracks were mapped using ESRI Corporation's ArcMap software and compared with existing official GIS data sources.

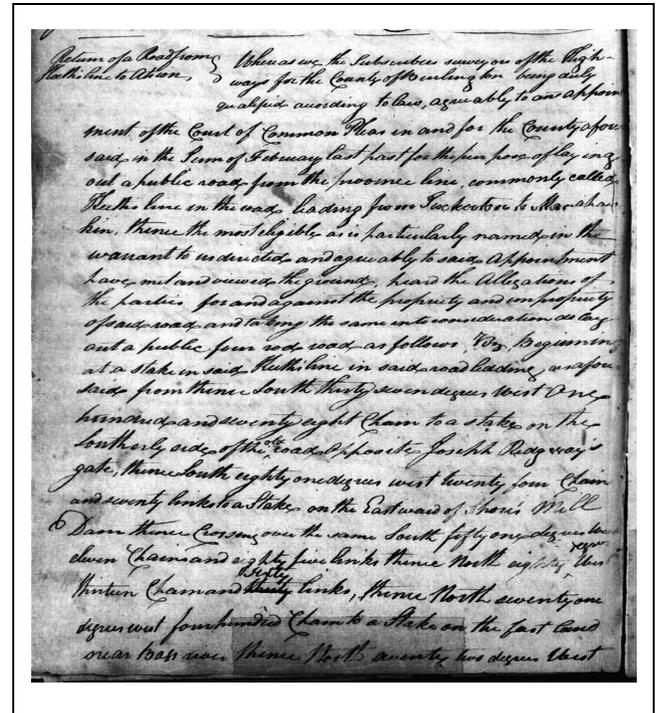
### Locational Inferences Based on the Historical Record

The NJHRS report noted that “few streams were bridged in the seventeenth and eighteenth centuries” (3, p. 22). While bridges of short spans were sometimes constructed, using simple stone or wood spans in what are known as beam bridges as described by Morriss (7, p. 160). The NJHRS further states “If a waterway could not be forded and was too wide to be easily spanned, colonials had to resort to ferries” (3, p. 22). Thus, early roads in this region would probably follow routes that allowed the user to avoid any major stream fords. Quaker Bridge is a notable exception as a bridged route that was well-known, well-documented, and extensively discussed in period documents. It was constructed by the Quaker community in the 1770s to allow travel between the Quaker meetings in Burlington and Tuckerton without the need for fording the Batsto River. Middle Road

provides a major bridge-free route for goods shipment from The Forks to inland points, and is one of the best routes south from the ferries at Philadelphia, Burlington, and Camden (the major urban centers of the time). The authors have traversed this route and it remains open and passable for the full distance from Atsion to The Forks.

A further element that can document the historic location and date of development of a given road would be a recorded public record of a road easement, called a road return, which would generally be found filed with the county clerk. In New Jersey, several high-quality primary historic records still exist from the colonial and early United States periods. New Jersey has a very rich set of historical records of road creation in several counties, with documents that provide very detailed information about the date of dedication, location, dimensions, and surrounding links. The authors researched the county records for Burlington County and found several period documents that establish the date and very specific routes of given public rights-of-way—and we have located several these records. As an example of the high level of historic content contained in public road returns we include the 1798 road return for Quaker Bridge Road (Figure 5). This return, filed on April 7, 1798 memorializes an approximately 30-mi road that stretched and still mostly stretches from the Burlington County border at the boundary, known as the Keith Line (the dividing line between the colonial provinces of East and West Jersey), to the iron works located at Atsion. This road may well have been in use before the date of this road return, and the road return itself references an “old road.” In many cases roads were established with general rights-of-way and there may or may not be a known record of the route as originally surveyed. In addition, road returns may have been lost in fires, floods, or other catastrophic events that destroyed public records. In those cases, the courts in the United States have tended to follow English Common Law that assumes the public dedication was made at some point in time, in spite of a lost road return.

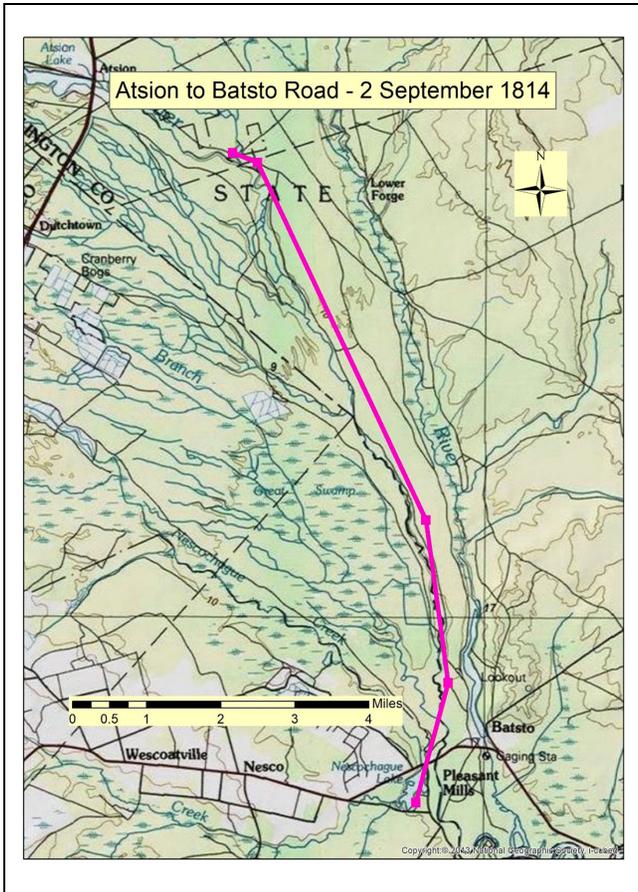
These road returns provide detailed starting points, as well as the route and endpoints of a given surveyed road. Further, they provide a documented “birth certificate” for a given right-of-way. By translating these documents from their historical distance measurements (66-ft “chains”) and bearings (magnetic compass headings) and correcting for compass variation, we can then recreate the historical data as a modern GIS polyline shape of a given road and then locate it based on the stated existing start- and endpoints. There are two additional sources of error based on the time horizon under discussion. First, the Earth’s magnetic pole moves over time; historical bearings are based on the magnetic pole location at the time the data were collected, and local magnetic



**Figure 5.** Extract of the road return for Quaker Bridge Road from the Burlington County, NJ, road returns: Book B, Burlington County Clerk's Office, recorded April 7, 1798.

conditions might alter the bearings. Second, local magnetic anomalies could affect compass headings. Correction factors are known and available to properly adjust the coordinates to fit with current geographic information such as GPS data.

If one converts the coordinates from the distance (chains) and bearings (degrees, minutes, and seconds) into meters and decimal degree bearings, then simple geometry will allow us to turn the geographic coordinates into geographic locations in Universal Transverse Mercator coordinates. These locations can be mapped directly or converted into longitude and latitude coordinates. The map in Figure 6 recreates the 1814 coordinates as reported in the road return for the Atsion–Batsto Road (called simply “Road in Washington” in the original records). The reprojected data were located based on existing physical information identified in the road return and we can see a close correlation between the coordinates of the road that indicates a 11.9-km (7.4 mi) road with four straight segments. The existing road is called Batsto River Road in current digital and print maps. Comparing the existing road in 2022 and the coordinates provided in the 1814 road return produced a traverse that exhibited a slight variation in the length of the road and an angular error (i.e., difference between the plotted location and the stated endpoint of about 482 m [1,584 ft])—or about 4.6% of the total length of the



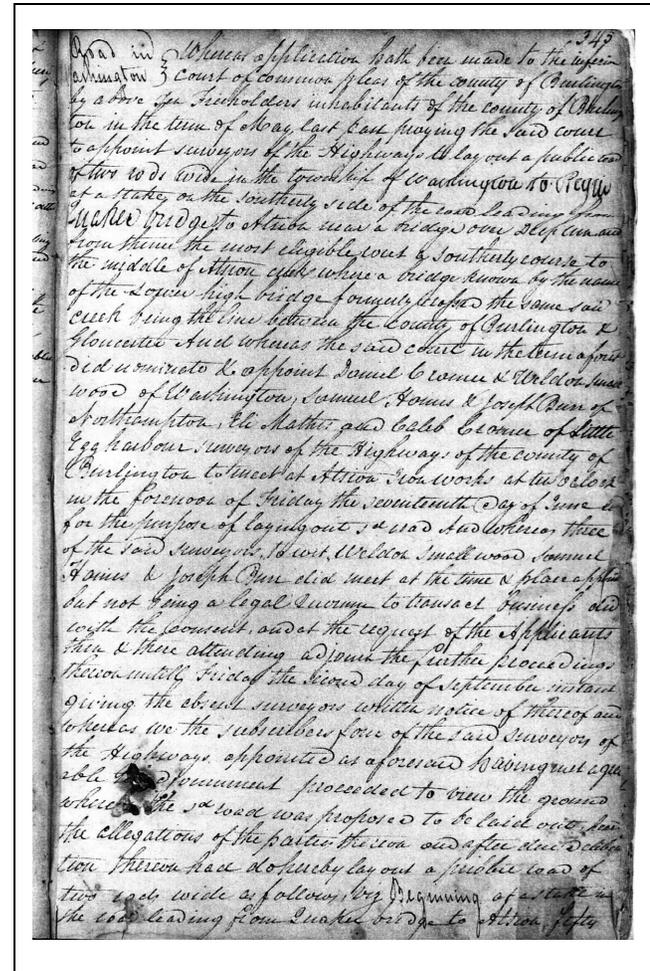
**Figure 6.** Atsion–Batsto road return recreated map based on 1814 road return map.

road—a rather modest error when one considers the technical resources available for surveyors in 1814 (errors such as angular measurements measured to a precision of only  $\frac{1}{4}^\circ$ , linear measurements with a chain divided into 8-in. links, and the potential for localized disturbances to the needle of the magnetic compass) and the challenges of field work in what was then and is still a heavily forested and swampy area. Such difficulties were identified as challenges and have been well understood by the professional surveying community for over 100 years.

An example of how this was done is provided in Figures 6 to 11, providing a visual record of how data from these road returns were cross-checked and integrated with historical maps, GPS data, and field information to come up with adjustments to provide accurate placement of the historical roads relative to their modern alignments.

Figure 6 shows the historic alignment and placement of the Atsion to Batsto Road on a modern map.

Figures 7 to 11 show photographs of the road returns relevant for the particular section of road in question. Figures 7 and 8 show the wealth of contextual

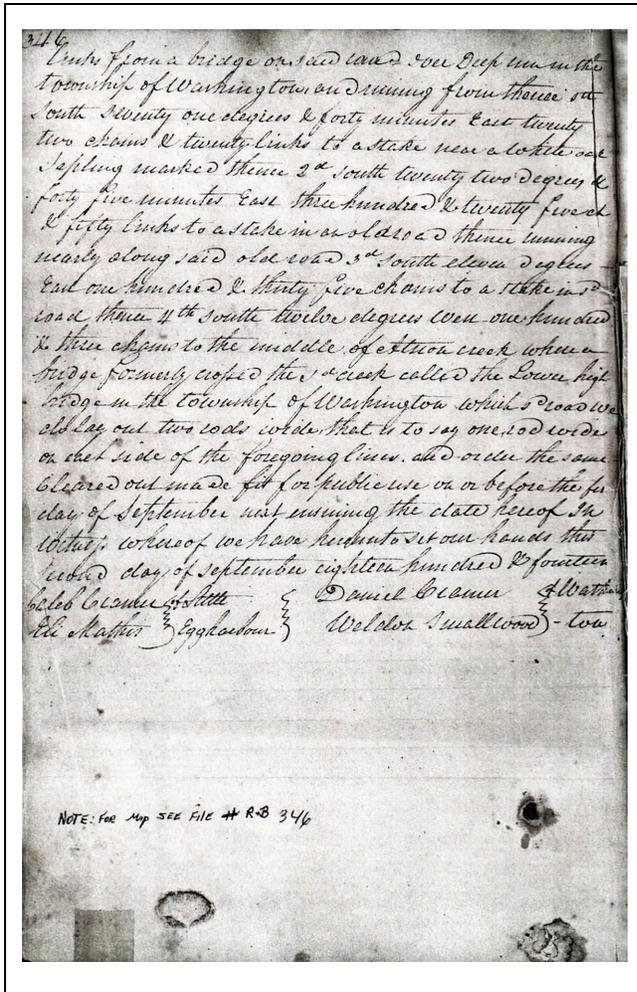


**Figure 7.** Photo-enhanced image of the Atsion–Batsto road return, Burlington County, NJ, road returns: Book B, Burlington County Clerk's Office, Mount Holly, NJ, p. 345.

information provided whereas Figure 9 shows the hand-drawn map of the route contained within the road returns. These maps were especially important for identifying the road routes. All these documents were digitized, enlarged, and clarified, allowing for precise information to be obtained on geographic start- and end-points for the road and other characteristics. Figures 10 and 11 show the enlargements and enhancements of particular road segments that were analyzed further for precise identification of the historical route within the contemporary landscape.

A result of all this analysis is shown in Figure 12, namely, the precise identification of the historic road endpoint in comparison with the current road network. Through systematic identification of other points along the road, its placement in a modern context can be completed.

To summarize, the road returns were photographed and then enhanced to allow for digitization and



**Figure 8.** Photo enhancement by the authors, road returns: Book B, Burlington County Clerk's Office, Mount Holly, NJ, p. 346.

comparison of that information as to the geographic start- and endpoints of a given route's measurements. Hand-drawn detailed maps from the road returns were overlaid on maps from various periods to identify key physical geographic features that will help with establishing the location of a road. Locational information and distance and direction data (recorded in historic chain distance and compass bearings) were collected from the road return text and converted into modern feet/meter distances and degree bearings. Then, adjustments for "drift" before and afterwards were made up to the present day and these were checked against tracking and measurements made during field trips on the actual road. This process both created and validated the historical route maps. Documentary information on these methods, a spreadsheet and a white paper that provides an overview of the process, are available from the authors by request (or from <https://histroads.commons.gc.cuny.edu/>). Figure 13 provides a flowchart that summarizes the entire process.

## Using Global Positioning System Tracks, Remote Sensing, and LiDAR Data to Refine and Validate Mapping

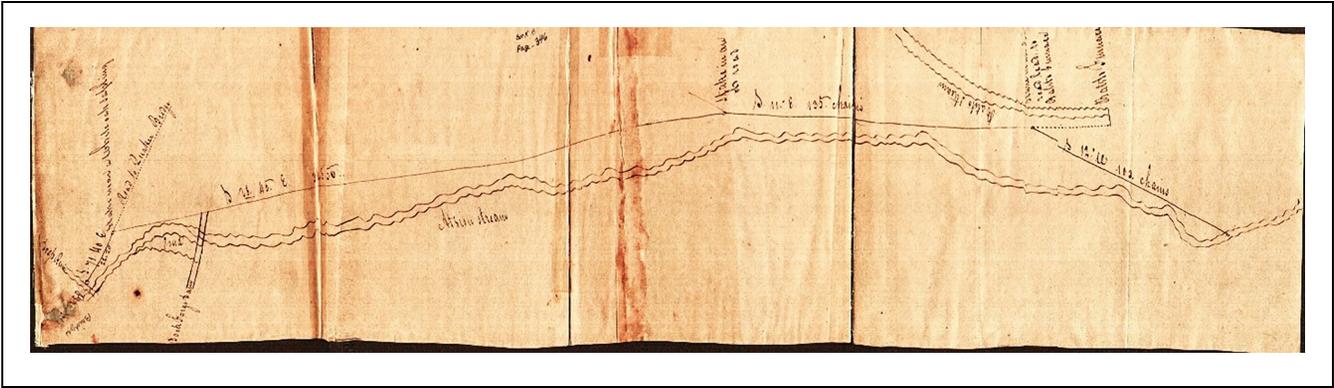
In our field validation of the USGS topographical maps, we found a high degree of correlation between our GPS tracks and the indicated sand roads ('unimproved roads' in USGS parlance). It appears that a good number of sand roads located in Burlington County have very long histories and several of these routes are associated with very historic events and historical figures. The digital USGS topographical maps and the field-collected GPS tracks produced by the authors' team validated that the routes appear to be stable in relation to location and route as compared to the 1947 to 1993 USGS topographical data. Given the dense forest surrounding these routes, it is likely that road users would remain on the established tracks and, thus, by use have preserved the route for future evaluation.

Validation of routes via GPS helps to resolve any discrepancies between historic maps, modern maps, and the actual current physical location of transportation assets. Our results in this case indicated a strong degree of correlation between the reported physical locations of the routes on the USGS topographical quads and the field-collected GPS routes. Several routes found in the field do not exist on the USGS maps, however, and that may well reflect new cut roads in the region as opposed to errors in the USGS mapping process. (As an interesting side note, we found considerable variation in some cases between our reported GPS field data and the modern GIS road shapefiles that appear to have been created using computer drawings by the file creator, as opposed to being based on field collection of data.)

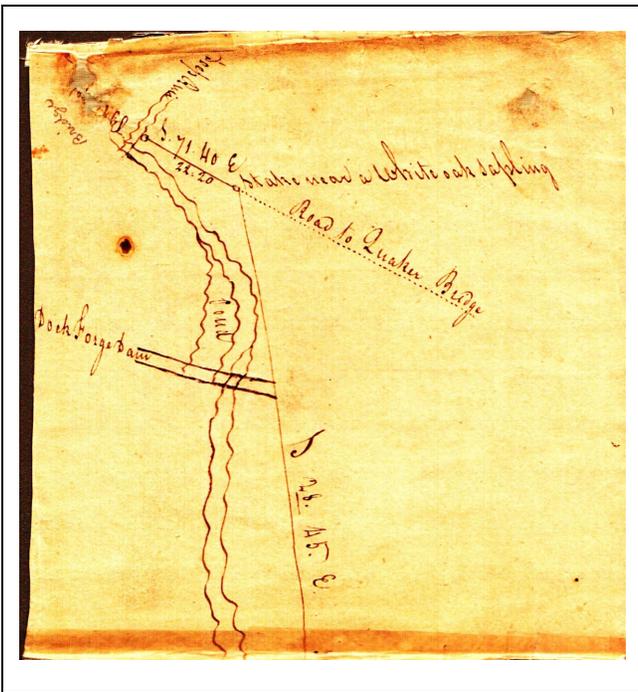
## Field Use of LiDAR Data in Historic Road Analysis

An alternative method of establishing the location of a historic road is the relatively new technology of light detection and ranging (LiDAR). Many governments have invested in having aerial LiDAR imaging performed for large sections of their state or region. These data are collected in the form of millions of data points that are delivered as a point cloud that can be analyzed in several ways. These point clouds contain information on every physical item that is struck by the laser imaging system in a particular geographic area and it provides the location of each point (longitude, latitude, and elevation). One can then filter the data as needed to examine detailed geographic items.

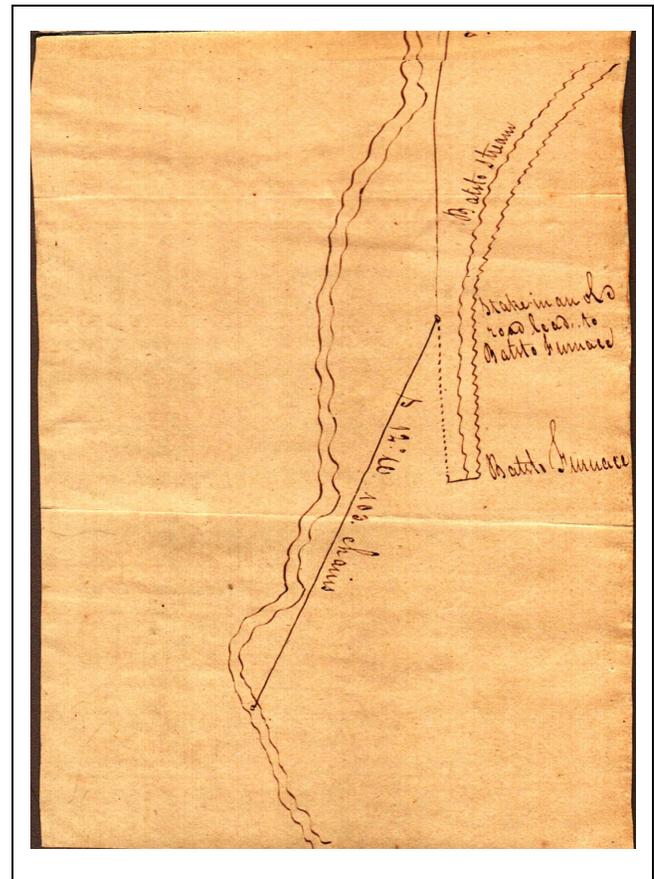
In our case, we obtained aerial LiDAR data from the state of New Jersey, Office of Geographic Information Systems. We then analyzed the data utilizing ESRI's



**Figure 9.** Road Return map of the Astion–Batsto Road. Road Returns: Book B, Burlington County Clerk’s Office, Mount Holly, NJ.



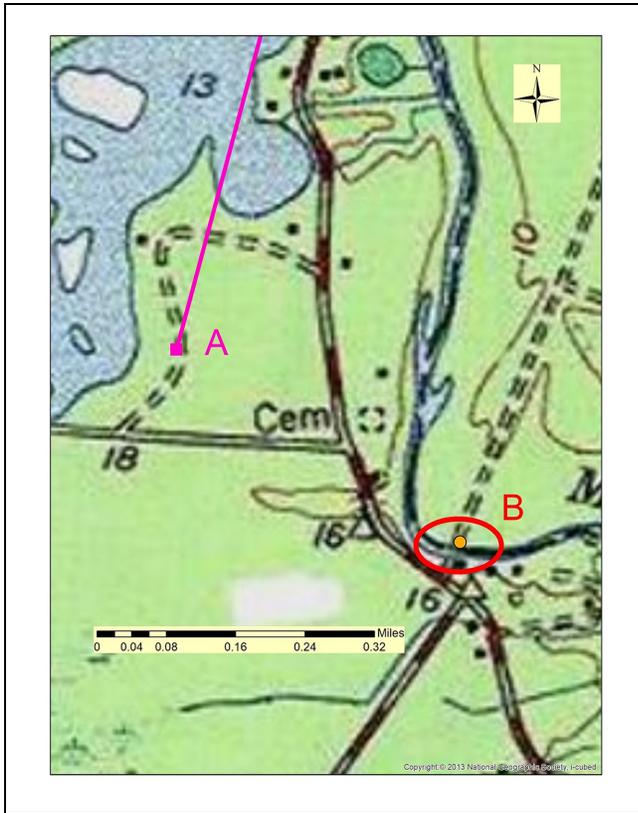
**Figure 10.** Inset map. Details from recorded map: Astion–Batsto road return, Burlington County, NJ, road returns: Book B, Burlington County Clerk’s Office, Mount Holly, NJ, pp. 345–346. Note: Preserved as a separate map.



**Figure 11.** Photo enhancement of the southern map segment by the authors. Road Returns: Book B, Burlington County Clerk’s Office, Mount Holly, NJ.

ArcGIS software, focusing on ground-level returns. In the region under study, the data are reported to be accurate to 5 cm in both the horizontal and vertical range with a 95% confidence interval (8, p. 2). The roads in question have been in use in some cases for over 250 years; as such, many have developed rather prominent “holloways”: worn depressions in the earth that are caused by the repeated use of vehicles, humans, and animals (7, pp. 81–84). By processing the LiDAR data at the appropriate scale, it is possible to locate the positions

of the holloways if they have sufficient depth. In the case of the sand roads of the Pinelands region of New Jersey, we found holloways that varied in depth, with some of the older roads, such as Middle Road, which dates from the 1790s or earlier, exhibiting strong and deep holloways of about 20 to 25 cm. Further, in some cases, the



**Figure 12.** Atsion–Batsto road return recreated map. Terminal end variation and comparison with existing road network.  
 Note: Estimated end at A; known endpoint circled in red at B.

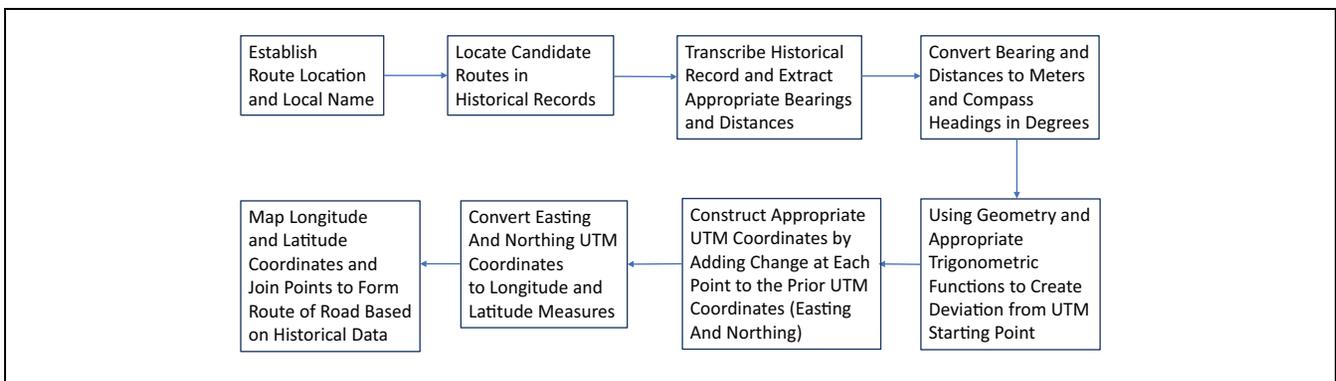
borders of the road were very distinct, such that they provided strong returns in the LiDAR images. Figures 14 and 15 provide examples of LiDAR images of segments of the Burlington County roads, whereas Figure 16 shows a photograph of what the roads there typically look like now.

Other road structures in the New Jersey Pinelands exhibited different returns. One interesting example was a road near the historic Batsto Village that exhibited very

strong, three-part ground returns. This was in sharp contrast to most sand roads, which comprise a quite braided or singular path in the LiDAR ground-level images. Field inspection found that the road in question was on an elevated embankment through a low-lying area that approaches a former bridge crossing. This is in line with the arguments from Morriss, where a trench on either side of an embankment from the removal of material would be expected, which was then used to construct the elevated road bed (7). In the LiDAR image (Figure 15), we can clearly see the elevated road embankment (A) as well as an on-grade road (B) with holloway and certain manufactured canal elements (C) as well as a prominent oxbow swamp on the edge of the Mullica River flood-plain (D). Figure 17 shows the GPS tracks overlaid on the USGS map.

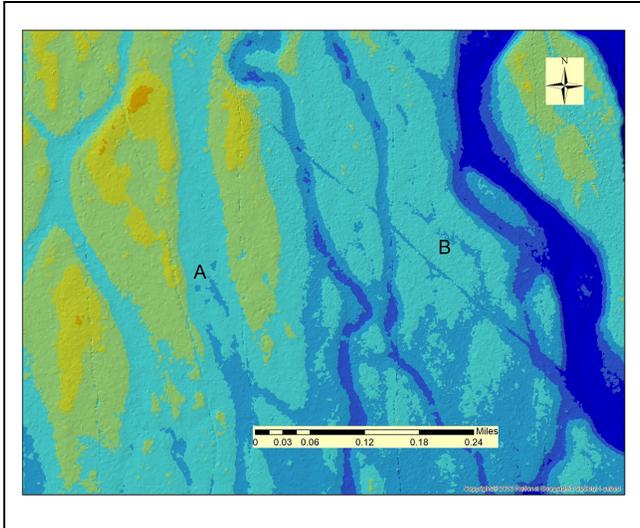
### Historical Context: Burlington County Roads and the American Revolutionary War

Although the methods described thus far were critical to identifying the historic routes, archival research, supplemented by secondary sources, was combined with the mapping to indicate that Middle Road was part of a network of sand roads that were utilized for trade and movement of military material during the American Revolutionary War in southern New Jersey. With the loss of the major trade ports of New York City and Philadelphia in 1777, the American Army was in critical need of supplies. The Continental Congress recognized the key value of smaller ports—some of which were used by smugglers—as key points of entry for military supplies, and on June 24, 1776 authorized the procurement and staffing of “Row Gallies” to protect Little Egg Harbor. Little Egg Harbor provided a key point through which to bring cargo either to be smuggled or in fact captured from British owners by American privateers (government-sanctioned pirates). Numerous manuscript



**Figure 13.** Flowchart of historic route identification using historical records and conversion into bearings, distances, and longitudes and latitudes.

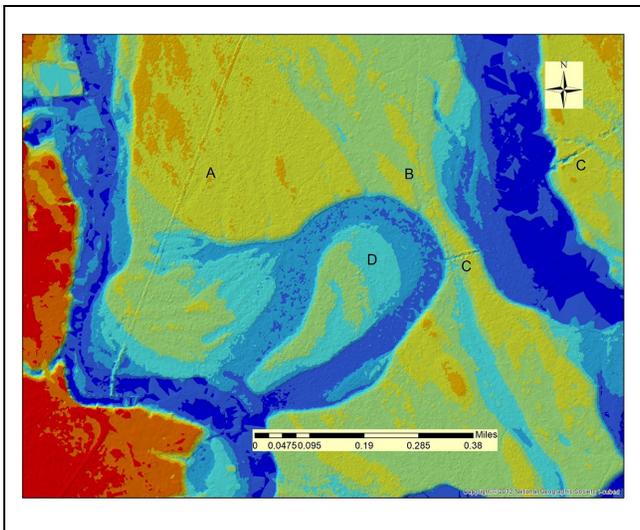
Note: See text, data, and methods compendium for further details.



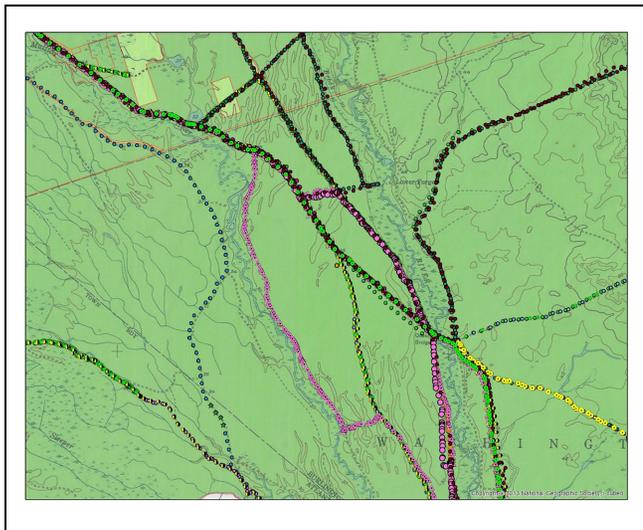
**Figure 14.** LiDAR image of ground returns for (A) Middle Road and (B) Batsto River Road in Wharton State Forest, NJ, based on 2015 DVRPA data.  
 Note: DVRPC = Delaware Valley Regional Planning Commission. Data citation provided as (8)



**Figure 16.** Typical sand road holloway on Middle Road in Wharton State Forest, NJ.



**Figure 15.** LiDAR image of The Forks area, based on 2015 DVRPC data.  
 Note: DVRPC = Delaware Valley Regional Planning Commission; A = elevated road embankment; B = on-grade road with holloway; C = manufactured canal elements; and D = oxbow swamp.

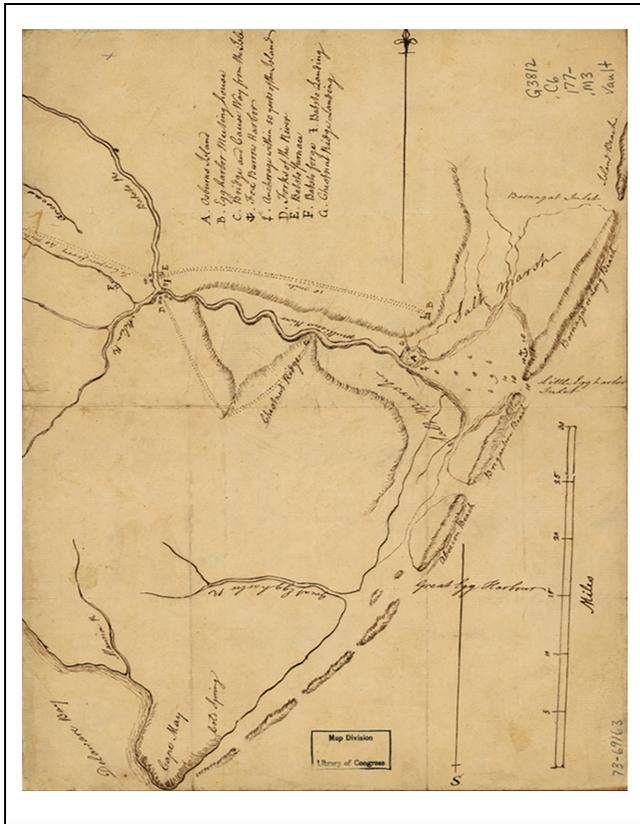


**Figure 17.** Authors' field-collected GPS tracks overlaid on USGS topographical maps: Atsion, NJ, quad area.  
 Note: GPS = global positioning system; USGS = United States Geological Survey.

references exist from the Revolutionary War papers of leading patriots and British leaders about smuggling activity and pirates at Egg Harbor, The Forks, and Batsto Iron Works (several of the relevant manuscripts are cited in Appendix 1).

The two main port areas of interest in Little Egg Harbor were Chestnut Neck and The Forks. These formed

the core of the south Jersey smuggling ports. The location of these activity centers are clearly indicated on the 1770 map (Figure 18; this map was drawn rotated 90° clockwise, with North indicated to the right; the map is shown with North at the top) as well as certain roads that served these areas, including Middle Road, which is indicated as a route to Camden, NJ (indicated as Cooper Ferry), where a ferry operated to bring people and goods to Philadelphia. Of note, the map indicates 40 mi to that location—very, very close to the actual distance on modern roads.



**Figure 18.** Map of south Jersey: The Forks and associated sand roads: a key revolutionary supply system.  
 Note: Map of the coast of New Jersey from Barnegat Inlet to Cape May. Scale ca. 1:32,000. Manuscript, pen-and-ink. Oriented with North to the top.  
 Source: Library of Congress Maps of North America, 1750 to 1789, 1264 A.

Given that the cargo was offloaded from ships, the location of the port facilities utilized could vary based on the water depth in the river and the size of the ship. The Forks of the Mullica River represented the furthest inland point that was commonly reachable by larger vessels for the purpose of moving cargo. Further west and north of that point were not navigable and thus the points of The Forks and Batsto Landing represented the best places to land cargo that was heading to Philadelphia and the surrounding areas, such as Valley Forge. Further, this same route was of value in providing access for the shipment of munitions (in particular cannon balls) from two key iron forges at Batsto and Atsion.

These roads were of crucial significance during the Revolutionary War. The American Army was in critical need of supplies, suffering from the financial frailty of the new American government, which was compounded by the British Army and Navy control and blockade of key ports. However, local colonial traders had a long tradition of skirting British rules by smuggling goods, landing them in remote locations outside of the supervision of the British authorities.

One key port for smuggling was Little Egg Harbor and the Mullica River in Burlington County. With the outbreak of the war, the American government authorized the use of privateers—state-sanctioned pirates—as a key method of obstructing British trade and obtaining necessary goods. The privateers were motivated by opportunity and profit, as goods captured were typically auctioned off, with some military supplies requisitioned for army use. The American government had military warehouses established at key smuggling points to receive munitions and military cargo, such as on Rabbit Island at The Forks (9).

The routes that were used most likely represented the most direct and safe routes for transport, with the major routes identified by local experts as still existing as the Tuckerton Road and the Quaker Bridge Road. In addition, the Middle Road also provided a direct ford-free route to the ferries at Camden, NJ, and then on to Philadelphia. When Philadelphia was held by the British in 1777 to 1778, other routes needed to be utilized to bring cargo further north to supply the American Army at Valley Forge, thus, roads like Stokes Road were probably used.

The Revolutionary War also stimulated increased activity at the local iron furnaces and pressure to provide more refined products to serve in the war effort. The iron furnaces and forges were of such importance to the war effort that its workers were exempted from military service. The commonly reported major trade routes for these activities included the Atsion Road and the Tuckerton Stage Route. These routes exist today in Wharton State Forest and in adjoining lands in Burlington County. The most direct route that avoided any major bridge crossing was the route of Mullica River Road or Middle Road and the western segment of the Quaker Bridge Road. These were identified by local experts as still existing and passable for use today (10).

Scholars note that the forges and furnaces of the area were critical producers of raw and finished materials for producing munitions (such as shot and muskets) and other supplies for the Continental Army. The roads of the Pine Barrens were utilized to move these goods to Philadelphia (9, 11). In addition, significant historical figures such as General Nathanael Greene and Benedict Arnold were actually part owners in privateering ships and the iron works.

These roads were also auxiliaries to various important events—including significant troop movements. The privateer activity so incensed the British command in New York City that a punitive raid was ordered in September 1778. The raid, which arrived at Little Egg Harbor, on October 5, 1778, was able to damage the area of Chestnut Neck, but was unable to reach a further 10 mi upriver to The Forks. Chestnut Neck is well-known today for the actual battle that occurred in this area that

involved a significant force from the Royal Navy under Captain Henry Collins and regular British Army soldiers and New Jersey Loyalist troops under Captain Patrick Ferguson, who were opposed by Count Pulaski of the American Army. The Forks remained largely untouched by this and other engagements and thus became forgotten by history. In fact, The Forks remained the major trading area for the next 3 years of the war with “fully 56% of all sales undertaken in the Little Egg Harbor region ... held at the Forks” (9, p. 133).

Given all of the activity from the Revolutionary War period, we feel confident that our evaluation of the routes in question would meet the standard of historical significance as Early Roads Era routes and thus should be identified as historic and managed appropriately.

### **Implications for Historical Research and Preservation**

The routes under consideration in Burlington County clearly fall in most cases as routes with historical association to important events. Given that these routes have never been paved, their structure and design elements are minimal, but their use in regional history, and ability to allow users to experience a very similar environment to the key periods of use is significant (the Early Roads period, 1651 to 1814, and even later use for liquor smuggling into the 1930s). The limited physical infrastructure and design elements of an unpaved forest route would have very different preservation standards and goals as compared to an engineered aesthetic route. One could easily argue that the lack of these infrastructure and design elements actually contributes to the high level of preservation and excellent historic context as they relate to the period of high significance—in this case, the Revolutionary War.

It certainly helps that these roads are located in a largely undeveloped region of New Jersey in state forest lands and surrounding agricultural and residential land. Our research work has focused on four roads in Wharton State Forest, the largest single tract of unimproved land in New Jersey (125,000 acres) in Burlington County. Inside the boundary of the state forest, over 500 mi of roads, trails, and fire cuts exist. They range in width from single track motorcycle trails and foot paths to minimally constructed sand roads to formal gravel roads and paved sections. The routes continue to exist for various reasons, including public access, historic agricultural activity, and hunting. Recreational users include hikers, mountain bikers, horse riders, kayak and canoe transport, and licensed motor-vehicle users (cars, trucks, and motorcycles). Thus, the existing roads provide visitors with several recreational opportunities and access to a broad range of areas in the forest.

Although this paper has focused on methods for identifying historic roads and the value of conducting thorough fieldwork using LiDAR, GPS, and GIS methods to assist in this task, further discussion as to how best we can preserve these historical assets once they are identified is necessary. Proper preservation and marking of historic roads are of key importance and a clear and actionable preservation plan should be developed. Further, a fuller understanding of the formal establishment of a road and its corresponding legal rights-of-way can support any discussion of the rights of the public to use these roads and that such use may not be curtailed by adjoining property owners.

The goals and practices of historic preservation for a given site can be in conflict with other regional plans, such as economic development or recreational uses. Public access onto the Wharton Forest roads and issues related to their use and the activity of motorized vehicles on existing sand roads and trails might be assumed to undermine preservation. Yet the use of these trails by modern vehicles could, paradoxically, potentially serve to preserve and manage overgrowth of the routes. A sensible management plan might include regular use of the routes to continue to maintain the open rights-of-way, in conjunction with heritage safeguards. Interestingly, documented loss of some significant routes resulting from a lack of use has indeed occurred in the area. A significant portion of the Tuckerton Stage Route has been lost, as the removal of a key bridge and development of a paved alternative resulted in the rerouting of traffic onto a parallel route. Thus, with limited travel and activity, the surrounding forest reseeded the route and, over time, the route was effectively extinguished. In particular, the section from Beaver Run to Bodine Field is reported to be unpassable as of the 1960s and today is largely lost owing to a lack of use. There are numerous similar examples elsewhere in the United States (7; Plates 3 and 7).

Thus, it may be that historic preservation and sensible use of these facilities may fruitfully coexist. In fact, regular use requires management and periodic maintenance, which may, if done properly, actually help preserve a route under the right conditions. This is particularly important for areas of high use and at intersections. These impacts are most pronounced at areas that concentrate activity, such as at river crossings and at geographic choke points. The often-stated desire to eliminate motorized vehicle road use in public parks, for the purposes of returning a given area to its natural state, in some cases may be in direct conflict to the historic preservation of these routes, as a lack of use could lead to the loss of the historic route because of overgrowth. Further, to maintain a route without use would require periodic trail cutting, a significant effort and expense for forest management. Of course, use can be harmful to

preservation as well, but should not automatically be assumed to be so.

There are several useful technological solutions that could be applied to protect and provide additional surface and subsurface strength to historic roads, with minimal impact to the look and functionality of historic roads. In particular, at high-use areas, the deployment of proper subsurface preparation and the use of geotextiles and soil stabilization can create very durable road surfaces that afford significantly better load capacity, while maintaining a surface appearance that is consistent with the historic nature of the road. For example, affordable geogrids can be placed using standard equipment to create a reinforced road that has significantly better wear and strength as compared to unreinforced soils. These technologies should allow the continued use of historic roads while preserving their essential characteristics and routing. Further, these techniques can be applied as needed, with appropriate surface treatment maintaining the historic appearance of a given route (12).

## Conclusions

This article has described a process used to identify, accurately map, and document historically significant roads. Five components were involved (after identifying the area of interest, in this case a set of roads in Burlington County, NJ, that were of importance during the American Revolutionary War): (1) extraction of contextual and geographic data from archival road record research (the “road returns”); (2) comparison of this source data with historical maps from various periods, cross-referenced and then superimposed on one other and then on contemporary USGS maps; (3) adjustment for course variation using appropriate corrections; (4) field measurement and observation of the present tracks and routes using GPS and LiDAR; and (5) validation, confirmation, and finalization of maps, pulling all the various components together. The establishment of the historical routes with a high degree of confidence then allowed for construction of an historical narrative and interpretation of the use and importance of the roads as supply routes during the American Revolutionary War.

Traditionally, the historic preservation community has placed significant weight on documentation via period documents and any photographic evidence, as well as physical inspections of construction methods and materials analysis to provide the strongest evidence of the historic nature of a given facility or corridor (13, 14). Historical maps can provide some insight into the period of construction and likely route of a given historic road, but the information typically has limited detail on the actual route. The methods outlined in this paper utilized

existing historic records, and a technology-enhanced reconstruction of the route then allowed us to more precisely examine the historical records in context to the physical geography. By locating the historical record of a given route, we can then establish with ever greater certainty the location and date of construction or establishment of a given historic route. Further analysis using LiDAR and field inspection via GIS analysis provides additional information about the current conditions and location of historic routes and may well assist in the location of potential sites for future archaeological investigation. Combining the technology-enhanced methods examined in this paper with the traditional methods of the historic preservation community provides a broader set of tools that can be applied to the corridor under consideration.

Although historical records may vary by location and time period, the broad and expanding availability of LiDAR data is allowing very detailed analysis of historical resources that were not generally available even two decades ago. Multiple data warehouses exist that can provide access to high-quality LiDAR data for many areas of the United States. One example is the USGS 3DEP LIDARExplorer web site (<https://apps.nationalmap.gov/lidar-explorer/#/>), which has data from multiple public sources for many states and regions. The ability of LiDAR information to provide very detailed physical information about remote areas is a huge advantage for facilitating a strategic data scan of a given area to identify potential high-value field visit locations.

The process methods outlined in this paper are generalizable to other roads in other areas and at other times, as well as to other historical and physical assets, though there will certainly be unique challenges in each case. The Burlington roads had the advantage of relatively abundant information residing in the field and the historical records, including maps that allowed LiDAR, GPS, and “ground truth” methods to add a great deal of explanatory and adjustment power. This will not always be so, in which case, more speculation and imputation may be necessary. This paper provides some strong confirmation that each of these methods are viable as standalone analysis tools—with multiple methods providing further confirmation of a given research question. Nonetheless, modern technology has greatly increased the ability of the historian or land-use manager to more firmly determine the path, condition, and use of historical roads and other assets. Further, this research has laid out some techniques that are available to researchers and managers, which have significant potential to improve the level of detail, timeliness, and accuracy of the information available about historical assets in a given region.

## Author Contributions

The authors confirm contribution to the paper as follows: study conception and design: J. Peters, C. Gordon, C. Peters; data collection: J. Peters & C. Peters; analysis and interpretation of results: J. Peters, C. Gordon, C. Peters; draft manuscript preparation: J. Peters, C. Gordon, C. Peters. All authors reviewed the results and approved the final version of the manuscript.

## Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The Author (JP) received support from The City University of New York/College of Staten Island with a faculty sabbatical leave grant for the research, authorship and publication of this article.

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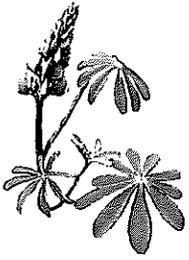
Jonathan R. Peters  <https://orcid.org/0000-0002-6156-6599>

## Supplemental Material

Supplemental material for this article is available online.

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# Partnerships for New Jersey

## Plant Conservation

Scientists, Advocates, Educators and Citizens

Working Towards Protection of New Jersey's Rare Flora

### **Testimony to the Pinelands Commission, March 8, 2024, concerning the CMP list of protected plant species.**

For the sake of any Commissioners who may not yet be familiar with the issue, the Commission's list of protected plant species is obsolete. It lacks scientific justification. There are plant species that are at a level of imperilment that is customarily referred to as "Threatened" that are known to occur within the Pinelands National Reserve but that are not included for protection under the CMP. It seems there are two possible ways to correct this.

First, the State of New Jersey could adopt legislation that recognizes imperiled plant species at the status of "Threatened." If this were to happen, the Pinelands Commission could simply adopt, by reference, the "Threatened" list, just as it did the "Endangered" list. This would not be a perfect solution for a variety of reasons, but it would be a big improvement. Unfortunately, it seems to be impossible to estimate how and when the state might adopt such legislation. Several conservation organizations have drafted a bill to accomplish this, and that bill has had sponsors in recent years, both in the Senate and the Assembly, but the bill never advanced, and, currently, has no sponsor.

The second possibility is that the Commission could rely on its own authority to declare what plants it considers worthy of protection. It seems there are two possible ways to go using this option.

The Commission could simply use the best possible source of information on imperiled plants, the list produced and maintained by the DEP itself in the New Jersey Office of Natural Lands Management. This list is composed of all the plant species of conservation concern in New Jersey, and it is updated as new data indicate the need to do so. It is formulated in accordance with the protocols of NatureServe, a nonprofit organization employing a system used throughout the US and Canada by professional conservationists (see [natureserve.org](http://natureserve.org)). NatureServe classifies and maps biodiversity, and it assesses biodiversity status and threats. It assigns conservation ranks to species that apply regardless of any politically-based statuses. The Commission could hardly be faulted for resting on the authority and conclusions derived from the NatureServe system, as employed by the New Jersey Office of Natural Lands Management.

Alternatively, the Commission could use its own authority to convene a working group composed of local experts in order to create a list of plant species that deserve protection. Using this option, the Commission could create criteria to be used by the working group that might include things in addition to the state status "Endangered" and conservation ranks assigned to any plants being considered. The advantage to this would be that the Commission could retain as protected, some plants that deserve protection, even though the species may not have state status or a conservation rank that designates it as "Threatened."

To give an example, Pine Barrens Reedgrass (*Calamovilfa brevipilis*) has been on the list of protected species since the creation of the CMP, but it doesn't hold the status of "Endangered" nor is it ranked in such a way as to indicate it is "Threatened." A strong argument could be made, however, that it deserves protection by virtue of the fact it is confined to some of our most characteristic Pine Barrens lowland communities; it is a strong indicator of habitat suitable for sometimes cryptic rare species; it is the host plant for a rare butterfly; and the Pine Barrens of New Jersey is the global stronghold for the plant.