Limerick Generating Station
Units 1 & 2

License Renewal Project

Environmental Report

Response to Request for Additional Information (RAI) for the Review of LGS LRA ER, Dated February 28, 2012

Enclosure 2

Book 9 of 11

E2-24: <u>Enclosure 2: Archaeological and Cultural Resources, item A</u>

Submit the references called out in Section 2.10 of the ER for archaeological surveys and the architectural and historical analysis of the Fricks Lock Historic District (CR-2 from the Audit Information Needs). Docketing should follow guidelines from NRC regarding sensitive cultural resources location information. When submitting cultural resources information, do not include maps or coordinates of site location information.

<u>Exelon Response</u>

The references related to the Fricks Lock Historic District called out in Section 2.10 of the ER include the following:

- Abplanalp, K. M. 2010. Historical and Architectural Survey of Frick's Lock Historic District, East Coventry Township, Pennsylvania. Report prepared for Exelon Generation Company, LLC.

- Kingsley, R.B., J.A. Robertson, and D.G. Roberts. 1990. The Archaeology of the Lower Schuylkill River Valley in Southeastern Pennsylvania. Report submitted to the Philadelphia Electric Company, Philadelphia, PA.

- Milner (John Milner Associates, Inc.). 1984b. A Descriptive Report of an Archaeological Investigation for the 220-61 Transmission Line Right-of-Way in Association With the Limerick Nuclear Generating Station, Chester and Montgomery Counties, Pennsylvania. Report submitted to the Philadelphia Electric Company.

- O'Bannon, P. 1987. Architectural and Historical Documentation of the Frick's Lock District, East Coventry Township, Chester County, Pennsylvania. Report prepared for the Philadelphia Electric Company. John Milner Associates, Inc.

As requested, a redacted version of each reference is provided to prevent disclosure of sensitive cultural resources location information. The following list indicates the extent to which the redacted documents are affected.

- Kingsley 1990 – Eleven maps removed
- Abplanalp 2010 – One map removed
- O'Bannon 1987 – One map removed
- Milner 1984b – Two maps removed; Two PA Archaeological Site Survey forms (two pages each) removed

Each removed page has been replaced with a page containing the following words: "This page omitted in accordance with NRC guidelines regarding sensitive cultural resources location information."

HISTORICAL AND ARCHITECTURAL SURVEY

of

FRICK'S LOCK HISTORIC DISTRICT

EAST COVENTRY TOWNSHIP, PENNSYLVANIA

prepared for

EXELON NUCLEAR

FRENS *and* FRENS, LLC
Restoration Architects

March 2010

by

KATHLEEN M. ABPLANALP, Ph.D.

under agreement with

FRENS AND FRENS, LLC
Restoration Architects
120 South Church Street
West Chester, PA 19382

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THIS PAGE OMITTED IN ACCORDANCE WITH NRC GUIDELINES REGARDING SENSITIVE CULTURAL RESOURCES LOCATION INFORMATION

Section One

Summary

In December 2009, Dale H. Frens, A.I.A, of Frens and Frens Restoration Architects, LLC, commissioned Kathleen M. Abplanalp, Ph.D., to conduct a historic resources survey of Frick's Lock Historic District on behalf of his client, Exelon Corporation. The purpose of this survey was to evaluate the integrity and historic significance of architectural resources within the district and to assess the continued viability of the district as a property listed on the National Register of Historic Places. Exelon Corporation, the owner of Frick's Lock Historic District, may use the findings of this survey, as well as input from the Pennsylvania Historical and Museum Commission [PHMC] and relevant stakeholders, to guide it in creating a plan for the future management of the site.

Background

Frick's Lock Village is a National-Register listed historic district in East Coventry Township, Chester County, Pennsylvania.[1] The approximately 18-acre district, which was listed on the National Register on November 21, 2003, is a rural village located one-quarter of a mile from the intersection of Frick's Lock Road and Sanatoga Road. The current nomination for the historic district lists 30 resources, including 15 buildings, ten structures, and five sites dating from the mid-eighteenth century to the late nineteenth century.

Frick's Lock Historic District is contained within property owned by Exelon Corporation. A significant part of Frick's Lock Historic District is contained within an Exclusion Area Boundary (EAB) around Exelon Corporation's Limerick Generating Station in Limerick Township, Montgomery County, Pennsylvania. The EAB for power reactors is defined in Title 10, Section 100.0 of the Code of Federal Regulations and is established as a means of "protecting individuals, including members of the public, in owner-controlled areas" within a specified radius of the generating station. Measures for determining the EAB are outlined in Section 100.11(a) (1) of the Code of Federal Regulations. Exelon designated the EBA for the Limerick Generating Station in 1972.

Prior to its listing on the National Register, Frick's Lock was evaluated for its historic and architectural significance by John Milner and Associates, Inc. In 1987, at the request of then owner Philadelphia Electric Company [PECO], John Milner Associates, Inc. produced a report that included an assessment of certain historic resources in the village.[2] This report, which identified 32 resources - 9 structures and 23 buildings - within a defined area, concluded that Frick's Lock Village met the criteria for listing as a district on the National Register of Historic Places. The Milner report did not address the presence of potential archaeological sites in the village.

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1 Frick's Lock Historic District. National Register of Historic Places. PHMC Key No.: 116261.

2 John Milner Associates, Inc., "Architectural and Historical Documentation of the Frick's Lock Historic District, East Coventry Township, Chester County, Pennsylvania," 1987.

Under the current nomination, Frick's Lock meets National Register requirements for Criterion A because of its associations with an event or events that have made a significant contribution to the broad patterns of history. Specifically, the district has been recognized for its historic associations with the Schuylkill Navigation Company. The district also satisfies National Register requirements under Criterion C because it contains a demonstrated collection of "locally significant examples of 18th and 19th century rural vernacular architecture in East Coventry Township, Chester County, Pennsylvania."[3] The period of significance for the district extends from 1757 to 1930. The early date reflects the settlement of Frick's Lock by Peter Grumbacher, a German farmer. The later date reflects the year at which the Schuylkill Navigation Company stopped operating the canal. The loss of canal traffic signaled the decline of the village as a small but important commercial outpost. It also helped precipitate the village's obsolescence as a location of future settlement. Although several of the identified contributing resources are archaeological sites or ruins, archaeological professionals were not consulted to verify the presence of significant below-ground remains within the district.

Since its acquisition by PECO and Exelon, and its subsequent inclusion within the Limerick Generating Station's EAB, Frick's Lock has been largely unoccupied. During its period of ownership by PECO and Exelon, the village has experienced deferred maintenance as well as acts of vandalism. As a consequence, Frick's Lock Historic has suffered a loss of integrity since its period of significance (1757-1930). This report will address this loss.

Scope of Work

At the request of Exelon, Frick's Lock Historic District was surveyed in December 2009, January 2010, and February, 2010. The survey was conducted to determine if the National Register nomination accurately reflected the history, significance, and integrity of the district since its listing in 2003. The survey examined individual contributing and non-contributing resources listed on the National Register. Findings from the survey have been used to make recommendations about whether discrete buildings, structures, and sites within the district qualify for listing as contributing or non-contributing resources. Findings have also been used to make judgments about the integrity of the district, the proper period of significance for the district, and the appropriate boundaries of the district. In evaluating the resources, all seven aspects of integrity, as defined by the Secretary of the Interior, including location, design, setting, materials, workmanship, feeling, and association have been considered. Conclusions may be used to recommend amendments, if necessary, to the Frick's Lock National Register nomination. The survey also considered discrete resources within the district that were not previously evaluated for inclusion, but which may have significant historic associations with Frick's Lock Village.

This survey does not draw any specific conclusions about archaeological sites within the district. The concentration of historic resources dating to the eighteenth and nineteenth centuries, as well as the relatively undisturbed nature of the site, however, may suggest a high potential for

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[3] Frick's Lock Historic District. National Register of Historic Places. PHMC Key No.: 116261.

archaeological remains. It may be useful for a professional who meets the Secretary of the Interior's qualifications for archaeology to determine if individual resources within the district qualify for listing as contributing resources. It may also be useful for an archaeologist to evaluate the potential of Frick's Lock as an archaeological district.

Section Two

Survey Findings: Evaluation of Listed Historic Resources

Resources within Frick's Lock Historic District will be recognized with the number-letter identifications used in the 1987 John Milner Report. Previously non-surveyed resources will be assigned new number-letter identifications.

B-4: Wagon Shed

This intact stone building sits on a rise on the west side of Frick's Lock Road. The wagon shed, which has two large gable-end bays and dates from the early to mid-eighteenth century, is an important physical component of the district and is associated with the early Grumbacher/Frick farm. The wagon shed, which was probably constructed with locally quarried stone, contributes to the architectural significance of the district. Built during a period that witnessed the arrival of canal traffic in the village, the wagon shed is also important for its indirect associations with the Schuylkill Navigation Company. The building retains a high level of integrity; its walls, roof and floors are well preserved and have not been compromised by the application of modern materials. The wagon shed should retain its listing as a contributing resource to the National Register district.

B-5: Outbuilding

The mid-nineteenth-century outbuilding associated with this site was demolished in 2007. A 1987 survey of Frick's Lock Village conducted by John Milner Associates notes that the building was similar in size, style, and materials to an extant wagon shed to the north.[4] The outbuilding is a significant component of the early Frick farmstead. Its placement along Frick's Lock Road is evidence of the early spatial organization of the farm and the growing need for function-specific buildings during the early to mid-1800s. Above-ground remains of the one-and-a-half story rubble sandstone building survive as a pile of stones. The 2003 National Register nomination lists the outbuilding site as a contributing resource to Frick's Lock Village, although by 2001 the roof framing had collapsed.

The site does not retain sufficient integrity as an architectural resource to convey its association with the district's importance in the areas of architecture or transportation. This resource, however, which is associated with the early Grumbacher/Frick farm, should be evaluated by an archaeologist to determine if its significance and integrity justify its listing as a contributing archaeological site.

[4] John Milner Associates, Inc, "Documentation of the Frick's Lock Historic District," 28.

B-7: Manor House

The Manor House, a stone dwelling that is partially covered with pebble-dash stucco, sits at the highest elevation in Frick's Lock Village. While the original house dates to the early 1800s, mid-to late-nineteenth-century modifications, including a two-story north-facing porch, lend the house the look of a later period. This porch, which marries common Classical Revival features with an anachronistic shed roof, may have been constructed during an 1856 alteration of the house that also included the addition of a bay window on the western elevation. The house also has a one-story porch that extends across the three central bays of the southern elevation. The nineteenth-century tastemaker, Andrew Jackson Downing himself, would likely have approved these embellishments. In his classic work, *The Architecture of County Homes*, Downing noted that in "raising the character of the farm-house, the first step above the really useful, is to add the porch, the veranda, and the bay window, since they are not only significant of real but of refined beauty."[5]

The Manor House provides particular evidence of the village's changing fortunes during the mid-nineteenth century when canal traffic was at its height. The building's owners, who comprised at least three generations of the Frick family, were successful when measured against other area farmers. Their wealth no doubt provided them with the means to improve the Manor House and to update it with finishings that had already gained favor in more populated areas. Census roles indicate that Jacob Frick, the likely occupant of the house in 1850, had real estate valued at $28,000 at this time.[6] Information gleaned from the federal agricultural census indicates that in 1850, John Frick, who succeeded his father as owner of the manor house, owned more arable land than all but one person in East Coventry Township and possessed real estate valued at $15,000.[7] John Frick's success earned him a sketch in the 1881 *History of Chester County*, where he was characterized as a "worthy citizen, and a lineal descendent of a noted ancestry."[8]

The Manor House retains a high level of integrity. Although the condition of the home has been compromised by a lack of maintenance and vandalism, the building preserves most features present during the district's period of significance. The Manor House has strong associations with the Schuylkill Canal Company. A representation of local vernacular design, the house also contributes to the district's significance in the area of architecture. The Manor House should be regarded as a contributing resource to the district.

5 Andrew Jackson Downing, *The Architecture of Country Houses* (New York: A D. Appleton and Company 1850, 141. Reprint, New York: Dover Publications, 1969), 141.

6 Bureau of the Census, Federal Population Schedule 1850; East Coventry, Chester County, Pennsylvania; Roll M432_765; Page: 162A; Image: 329.

7 National Archives, Washington; Record Group 029, National Archives and Records Service, General Services Administration; Federal Decennial Census, 1850, Chester County, East Coventry Township.

8 J. Smith Futhey and Gilbert Cope, *History of Chester County, Pennsylvania* (Philadelphia: Louis H. Everts, 1881), 554.

B-8: Summer Kitchen

The summer kitchen is a two-story stone building covered with an application of pebble-dash stucco. The building, which is located to the west of the Manor House, is in fair condition and retains a high level of integrity; although the chimney had been removed at the roofline, the exterior of the stone and frame kitchen has been minimally compromised by the addition of modern materials. The interior also retains significant historic elements, including its original open cooking hearth. The retention of such a defining feature in a building of this age is telling; it suggests that the owners of the Manor House may have made use of the hearth even after the introduction of cook stoves during the mid-1800s. The kitchen also retains its original box winder staircase to the garret, an area that was possibly used for the storage of food items.[9] The summer kitchen is a significant resource within the village; its presence evidences nineteenth-century trends that favored the transfer of hot cooking rooms outside of the main dwelling. It also evidences later nineteenth-century ideals that promoted the creation of separate spaces for men's and women's work. The Summer House should be regarded as a contributing resource to Frick's Lock Village.

B-9: 1757 House

The 1757 House is the earliest known resource in the village. Constructed for use as a banked farmhouse by Peter Grumbacher, this building originally comprised part of a large farmstead that numbered 119 acres. The two-story, 36' 4" x 20' house, constructed of rubble sandstone and partially covered with stucco, is in poor condition; the western elevation of the gabled roof is partially collapsed, and the interior has suffered substantial damage due to water penetration. The 1757 Grumbacher house nevertheless retains a fairly high level of integrity, with most loss predating the 2003 National Register nomination; the stone house preserves its original form and is largely uncompromised by historically inappropriate materials. Although the interior of the house contains woodwork dating to the nineteenth century, this modernization effort (which was incorporated during the district's period of significance) does not significantly affect the ability of the resource to convey its importance. An intact example of rural Chester County vernacular architecture and a significant component of an early canal-oriented village, the house qualifies for inclusion as a contributing resource to Frick's Lock Historic District.

B-11: Modern CMU Garage

This resource is a concrete block garage with its east wall built on top of a pre-existing rubblestone foundation/retaining wall. The National Register nomination notes that the foundation once supported a mule barn. Verification about the history of the resource as a mule barn is not included in the nomination. While the foundation of the building may be associated with the events for which the district is significant, the building lacks sufficient integrity to justify its inclusion as a contributing resource; with the exception of the eastern elevation, the walls of the building are modern concrete block units.

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9 Gabrielle M. Lanier and Bernard L. Herman, *Everyday Architecture of the Mid-Atlantic* (Baltimore: Johns Hopkins University Press, 1997), 53.

B-12 Elhanan Frick Barn

The stone and frame bank barn is listed on the 2003 National Register nomination as a contributing resource to Frick's Lock Historic District. Likely constructed during the early nineteenth century, the three-bay barn employs a queen-post truss system. The lower level is uncoursed stone and the upper level is timber frame construction. The roof of the barn is slate. The loss of boards on the framed section of the barn and the application of asbestos shingles to this section has modestly compromised the historic character of the building. The barn nevertheless retains a high level of integrity on its exterior and interior. The barn also retains a substantial stone retaining wall at its eastern elevation.

The Elhanan Frick bank barn is strongly associated with the early occupation of Frick's Lock Village and with the Frick family's efforts to establish and manage a productive farm at this site. While the National Register nomination notes that the barn was constructed by Elhanan Frick during the 1850s, the barn may be associated with an earlier period. A 1987 report by John Milner Associates, in fact, dates the barn to the late eighteenth or early nineteenth century.[10] Data from the 1850 federal agricultural census support the argument that the barn may have been in use during the first half of the nineteenth century. This census notes that John Frick, a successful farmer, owned a significant number of livestock, including five horses, ten milk cows, nine heads of cattle, and twenty swine.[11] It is plausible that Frick may have used this barn (which may have been constructed by his father, Jacob) before he constructed his own building in 1857 at the southern end of the district.

The barn is significant for its associations with the development of Frick's Lock as a canal village as well as a small commercial outpost. The barn is also significant for its contribution to the understanding of rural - and especially agricultural - architecture in southeastern Pennsylvania. Because the building retains sufficient integrity to convey its associations with the events for which the district is significant, it should be regarded as a contributing resource.

B-14: Elhanan Frick House/Boxwood

Dating to the mid- to late 1850s, the Elhanan Frick House, or Boxwood Manor, ties its presence in the village to the rising success of the Schuylkill Navigation Company during the middle of the nineteenth century. Built by Elhanan W. Frick, the stucco-covered brick house is significant for its associations with the growth of the canal-centered village, as well as for its contribution to the district's architectural narrative. A merchant and manufacturer, Elhanan Frick evidenced his aspirations to gentility though the construction of a house that was a holdover from the Federal period, but that embraced architectural trends favored by polite society. While Frick himself was the product of a rural farming tradition, the three-story Boxwood Manor was designed to suggest the owner's appreciation for urban civility and a refined aesthetic. Interestingly, Frick's standing as a member of the rural gentry appears to have been ephemeral; he sold his house in

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10 John Milner Associates, "Documentation of Frick's Lock Historic District," 32.

11 National Archives, Washington; Federal Decennial Census, 1850.

1860 and lived the final years of his life as a boarder in the home of his sister, Angeline, and brother-in-law, James Ellis.[12]

The house's second owner, Daniel Hause, was equally committed to establishing his place in the village hierarchy. An 1881 newspaper detailed Hause's efforts at "improving and repairing his property" with the addition of a "large and handsome arbor."[13] A late-nineteenth-century lithograph reveals the house with a vine-adorned arbor on its southern elevation. It also shows the presence of an attractive shrub-filled garden - framed by a picket fence -at the front of the house (see Figure 1).

The integrity of certain features of the house, including the ornamental porch brackets and trim (which have been vandalized), as well as certain window sashes (which have been removed), has been compromised by neglect and vandalism. In addition, the boxwood hedges, which survived through at least 2001, have been removed. The Elhanan Frick house nevertheless preserves its most important and defining characteristics and has sufficient integrity to justify its continued listing as a contributing resource to the district.

<u>B-15: Canal Store</u>

The canal store is a significant contributing resource to Frick's Lock Village. Research suggests that the store's importance to the village was not fully recognized in the 2003 National Register nomination. Positioned directly adjacent to the Schuylkill Canal, the canal store served a thriving commercial enterprise for more than three quarters of a century and stimulated the evolution of Frick's Lock from a small farming community to a village of greater pretensions. A late-nineteenth-century lithograph of Frick's Lock reveals that the store entrance, which faced the canal side of the building and was mounted by a series of steps, provided boatmen with direct access from the locks (see Figure 1). An historic photograph indicates that the store was adjacent to a road that passed over the canal (see Figure 2).[14]

A 1934 travel handbook of Chester County observed the importance of the store to the area. It noted that "no similar commercial enterprise along the Schuylkill Navigation Canal was "more important or better known than Frick's of East Coventry." During the halcyon days of the canal era, the "well known" store was said to be a "scene of unusual activity" and was "open at any hour of the day or night."[15] The National Register nomination notes that the store was in operation through 1922. Information collected for the federal census, however, reveals that

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12 U.S. Bureau of the Census, Federal Population Schedule for 1870; East Coventry, Chester, Pennsylvania; Roll M593_1323; Page: 81A; Image: 166.

13 Chester County Historical Society, Newspaper Clippings File: East Coventry Township Lands, L4.12.1881.

14 Laura Catalano and Kurt D. Zwikl, *Along the Schuylkill River* Charleston, S.C., Arcadia Publishing Company, 2009), 82.

15 Chester County Historical Society, Newspaper Clippings File: Schuylkill Navigation Company, 1919. *Reading Eagle* 18 May, 1919.

David Hause, the building's owner, was employed as a manager of a store in 1930.[16] This finding suggests that store may have remained open up to this period. A 1919 *Reading Eagle* article on the Schuylkill Canal hinted at the eventual fate of canal stores like the one at Frick's Lock. It opined that "with the disappearance of the canal boat may also be mentioned the passing of the lock store, which was an indispensable adjunct to boating."[17]

Purposefully constructed to exploit growing canal traffic, the two-story stone canal store dates to the mid-1800s. Its associations with the events for which the district is historically significant is well documented. The store's associations with region's distinctive vernacular architecture is also well established. While the historic appearance of the building has been compromised by the application of modern stucco and by the removal of certain defining features, such as historic window sashes, the resource nevertheless maintains adequate integrity of location, design, setting, materials, workmanship, feeling, and association to justify its inclusion as a contributing resource to the district.

B-16: Lock Tender's House

The 1820s lock tender's house is listed as a contributing resource on the 2003 National Register nomination. The building is highly significant for its historical associations with the Schuylkill Navigation Company, as well as for its role in the evolution of Frick's Lock from an isolated farmstead to a village that supported local commerce. In early 2008, the lock tender's house was damaged by a fire. The building's integrity has been diminished as a consequence of this fire; wooden components of the building, including the roof framing, as well as window sashes and frames, do not survive. Remaining elements are largely limited to the perimeter stone walls, one interior stone wall, and gable-end chimneys of the original building, and the outer walls of the rear shed addition. The lock tender's house also suffered from a loss of integrity prior to the fire; while the building is currently covered with modern stucco, an historic photo indicates that until at least the 1930s, the outer walls of the house were uncoursed rubble stone, lightly stuccoed over.[18] This photo also indicates that the house originally had nine-over-six sashes on its first story and six-over-six sashes on its second story (see Figure 3).

Although the house does not have the ability to convey its significance in the area of architecture, it does maintain sufficient integrity to convey its associations with the Schuylkill Navigation Company and with the growth of the village as a small center of commerce. The building's integrity of materials and workmanship have been heavily compromised by the fire, but they have not been lost; the stone walls as well as the gable end chimneys survive and clearly reveal the original form and structure of the building. In addition, the lock tender's house retains a high level of integrity of setting, feeling, and association; its location at the edge of the

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[16] U.S. Bureau of the Census, Federal Population Schedule for 1930; East Coventry, Chester, Pennsylvania; Roll 2019; Page: 1A; Enumeration District: 25; Image: 548.

[17] Wilmer W. McElree, *Around the Boundaries of Chester County* (West Chester, Pennsylvania: n.p., 1934), 465.

[18] Reading Area Community College, Schuylkill Navigation System Collection. Appraisal of Schuylkill Navigation Co. Canal for Commonwealth of Pennsylvania: Stone Former Watchman's Dwelling, East Coventry Township, Chester County, 1947.

locks, for example, recalls the central role of the canal in the growth of the village. These aspects of integrity help to compensate for losses to the house's historic fabric. The lock tender's listing as a contributing resource to the district is justified by its well-documented associations with the village's canal history as well as by its overall integrity.

Purposefully constructed to exploit growing canal traffic, the two-story stone canal store dates to the mid-1800s. Its associations with the events for which the district is historically significant is well documented. The store's associations with region's distinctive vernacular architecture is also well established. While the historic appearance of the building has been compromised by the application of modern stucco and by the removal of certain defining features, such as historic window sashes, the resource nevertheless maintains adequate integrity of location, design, setting, materials, workmanship, feeling, and association to justify its inclusion as a contributing resource to the district.

B-17: Plank Frame House

The mid-nineteenth-century house is listed as a contributing resource to Frick's Lock Historic District. Located near the northern edge of the district, the two-and-a-half-story house has a two-story ell addition at its rear elevation. A layer of fiber-cement shingles covers the original German siding on the building.

The house is unusual for the region because of its plank frame construction. Lacking corner posts, the house is framed with vertical planks that are secured at the sill and plate. Diagonal corner braces provide lateral stability. The presence of a plank frame building in the village is curious and may indicate the work of a non-local builder.

Due to vandalism and neglect, the house is in poor condition. The roof and second story floor in the rear addition has collapsed, but a temporary roof and roof framing remains intact. The integrity of the house has also suffered as a result of vandalism and neglect; the front porch, which spanned the first story of the building and was supported by turned posts and ornamental brackets, is missing and an additional porch on the eastern elevation of the house has been removed. The application of shingle siding to the exterior of the house conceals original German siding.

Although the house has suffered a great loss of integrity since its period of significance, its contribution to the understanding of architectural history is significant. Because of the relative rarity of its plank frame construction in Chester County, as well as its ability to inform scholars and the public about regional building practices, the house should be regarded as a contributing resource to Frick's Lock Historic District.

B-18: Ellis/Hoffman Brick House

The two-and-a-half story brick Ellis Hoffman House dates to the mid-nineteenth century. Located near the northern end of the district, the house was constructed during a period that witnessed a heavy increase of canal-related traffic through Frick's Lock Village. Historic atlases identify the house as that of Ellis Hoffman in 1860 and that of David Hause (the longtime proprietor of the canal store) in 1873[19] (see Figures 4 and 5). Although Hause had a long association with the house, he probably never occupied the building; the 1873 atlas marks Hause as the owner of three other buildings in the village, including the large dwelling in which he likely lived, Boxwood Manor.

The Ellis/Hoffman House is in poor condition. The roof of the building has collapsed and portions of the floor on the second story have fallen in. The house has also lost some integrity dating to its period of significance; on the front and side elevations, the first story has been parged. On the rear elevation, the second story has been parged. The front shed-roof porch of the house has also been removed. In addition, sashes in several windows have been removed.

The house nevertheless retains a sufficient level of integrity to convey its associations with the areas for which the district is significant - transportation and architecture. While the integrity of workmanship has been diminished by the loss of historic fabric, the building's integrity of design, setting, feeling, and association are good. This resource is one of four mid-nineteenth-century brick houses in the village. Although modest, it represents an architectural transition within rural Chester County that favored the increasing use of brick in the construction of buildings. The Ellis/Hoffman House should remain a contributing resource to Frick's Lock Historic District.

<u>B-19: Brick House</u>

The circa mid-nineteenth-century Brick House is associated with the transition of Frick's Lock from an isolated agricultural settlement to a village of modest commercial importance. The house, which is located at the northern end of the district, appears as that of James Ellis, Jr. on an 1860 map[20] (see Figure 4). Ellis, Jr. is identified as a store tender in the 1860 federal census.[21] The Brick House was constructed during a period in which canal traffic through Frick's Lock was relatively heavy. Located on a small parcel of land, the house is part of a compact development of mid- to late-nineteenth-century houses and appears to be closely associated with canal and railroad-related activities.

The Brick House retains a good level of integrity. The form and structure of the building have not been compromised by applications of modern materials. In addition, the home's porch, which possesses Eastlake-like stick work between its supports, is intact. Although the porch may be a later addition, it is nevertheless a defining feature of the house and fits within the period of significance for the district. While the house is not individually significant for its design, its presence in the district helps to inform the village's evolution from a mid-eighteenth-century farming settlement to a diversified post-Civil War era community that was highly dependent on the canal for its survival.

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19 T.J. Kennedy, "Map of Chester County, Pennsylvania" (Philadelphia T.J. Kennedy, 1860); H.F. Bridgens and A.R. Witmer, *Atlas of Chester County, Pennsylvania* (Lancaster, Pennsylvania: Safe Harbor, 1873).

20 Kennedy, "Map of Chester County, Pennsylvania."

21 U.S. Bureau of the Census. Federal Population Schedule for 1860; East Coventry, Chester, Pennsylvania; Roll M653_1093; Page: 333; Image: 340.

B-20: Burns Farmhouse

The National Register nomination dates the Burns Farmhouse to between 1882 and 1892. An 1873 map suggests that the house may have been constructed at least ten years earlier (see Figure 5). This map identifies James L. Ellis as the owner of the house at this time.[22] The large size of the house in relation to the smaller dwellings on the south side of Frick's Lock road, as well as the proximity of the house to farmland Ellis purchased in 1853 from the estate of Jacob Frick, his father-in-law, suggests that Ellis may have occupied this building before he sold it to Aaron S. Burns in 1892.

The Burns farmhouse has experienced some loss of integrity following the district's period of significance. A layer of brick-patterned, asphalt sheet siding covers the original German siding, various window sashes have been removed or destroyed, and the front porch, which was supported by wooden posts and brackets, has been removed. The house nonetheless retains a good level of integrity. The plan of the house is largely unchanged. The house also preserves defining features, including much original interior woodwork (including a fireplace mantel with a shallow bracketed shelf and stairs with a circle-end starting step) that help distinguish its owner as a modestly prosperous farmer and businessman. The house is an integral component of Frick's Lock; its construction, as well as survival, provide evidence of the village's changing character and function during the years following the canal boom. The overall integrity of the house, as well as its association with the areas for which the district is significant, justify its continued listing as a contributing resource.

Structure 1: Canal Towpath

Like the canal bed, the canal towpath is a component part of the National Register-eligible Schuylkill Navigation Company from locks 52-53 to locks 54-55. The towpath is also listed as a contributing resource to Frick's Lock Historic District. The towpath, which is located on the east side of the canal, is significant for its associations with the Schuylkill Navigation Company and with the development of Frick's Lock during the nineteenth century. The integrity of the towpath has been compromised by the heavy growth of vegetation at its edges. Historic photos reveal that the path was nearly free of trees and undergrowth when the canal was in operation. The towpath nevertheless retains sufficient integrity to justify its inclusion as a contributing resource to the district. The path's integrity of location and setting are especially high and may compensate for any loss of integrity caused by the intrusion of vegetative overgrowth. It may be useful to consult an archeologist to confirm the presence of specific materials, including stone and earth, that the nomination lists as material components of the towpath.

Structure 2: Canal Holding Basin

The holding basin is a component part of the National-Register eligible Schuylkill Navigation Company from locks 52-53 to locks 54-55. The National Register nomination also includes the

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22 Bridgens, *Atlas of Chester County.*

holding basin as a contributing resource to Frick's Lock District.[23] The nomination notes that the holding basin is an earthen structure. The structure has been filled in and does not exhibit any visible above-ground remains. While the basin's association with the canal is evident, its integrity should be evaluated with the aid of a qualified archaeologist.

Structure 3: Canal Bed

The canal bed in the vicinity of Frick's Lock dates to the mid-1820s. Research suggests that the bed was filled with water through at least 1937, but that it had stopped functioning as a component of a transportation system a decade earlier. Newspaper articles dating to the late nineteenth and early twentieth centuries chronicle the troubles of the canal during this period and even earlier. Indeed, by 1900, the railroad had deprived the canal of so much freight that traffic on the waterway was reduced to just a handful of boats each day.[24] During the early twentieth century, isolated efforts to repair and upgrade the infrastructure of the canal did little to attract more boats to the water. By 1919, "word that the old Schuylkill canal will be used no more, but allowed to fill with mud" signaled the death of the once celebrated waterway[25]

The canal bed is a component part of the National Register-eligible Schuylkill Navigation Company from locks 52-53 to locks 54-55.[26] The canal bed is also listed as a contributing resource to Frick's Lock Historic District. A conduit for canal traffic, the bed has significant associations with the Schuylkill Navigation Company and the development of Frick's Lock as a small commercial hub of local value. Although the National Register nomination identifies the canal bed as a stone, earth, and log structure, an archaeologist should be consulted to both verify the structure's materials and construction, and to determine its eligibility under Criterion D.

Structure 4: Canal Locks Nos. 54 and 55

Canal locks 54 and 55 are paired double locks. With the exception of Laurel Locks, they are the only combined, or double lift locks, on the Schuylkill Navigation Canal. Locks 54 and 55 represent an upper chamber and a lower chamber, respectively. The double locks allowed boats to navigate gradients that were too high to mount with a single lift. In 1846 the Schuylkill Navigation Company widened each of the locks to create parallel east/west adjacent locks that each contained two chambers. The parallel locks accommodated increased traffic on the canal by letting two boats pass through simultaneously. An early 1880s survey of the canal reveals the design of the parallel double lock lift[27] (see Figure 6). A federal census indicates that a

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23 Ibid.

24 The Chester County Historical Society has a newspaper file that contains voluminous clippings documenting the decline of the canal during the late nineteenth and early twentieth centuries.

25 Chester County Historical Society. Newspaper Clippings File: Schuylkill Navigation Company, 1919: L 8.18 1919.

26 SHPO Eligible 02/07/2005; ER No: 2003-8005-029. Key No. 140714.

27 Schuylkill Navigation Company Survey of Locks 54 and 55, 1882-1884, in William Stuart Wells, "The Schuylkill Navigation and the Girard Canal." (masters thesis, University of Pennsylvania, 1989), 126.

tender, James Miller, was operating Frick's Locks through at least 1920.[28] (Miller, who lived with his wife, seven children, and a boarder, presumably occupied the lock tender's house.) An historic aerial photo suggests that the lock structures may have been filled with water through at least 1937.[29]

Locks 54 and 55 are highly significant for their associations with Schuylkill Navigation Company and with the growth of Frick's Lock during the nineteenth century. At lock 54, visible above-ground remains of the structure are limited to stone coping on the walls, stone stairs, and portions of what may be the stone wing walls on the east and west sides of the structure. At lock 55, visible above-ground remains include what may be stone wing walls and unidentified cut stone in the area of the filled chamber.

Canal locks 54 and 55 are listed as contributing resources to Frick's Lock Historic District. The locks are also components of the National Register-eligible Schuylkill Navigation Canal in this area.[30] Locks 54 and 55, as well as related components of the canal at Frick's Lock, should be evaluated as an archeological site for potential eligibility under Criterion D.

<u>Structure 5: Portions of Frick's Lock Road</u>

The National Register nomination incorrectly dates the section of Frick's Lock Road that runs through the district to 1777. The nomination notes that the road was part of a route that ran directly from Heister's Ford to Parker's Ford, through the property of Peter Grumbacher. A thoroughly documented historic survey, however, definitively dates the road through the village to 1856[31] (see Figure 7). This survey, which is accompanied by a detailed map, indicates that Frick's Lock Road commenced at its current location on Sanatoga Road, passed by the residences at the northern end of the district, and after a sharp turn near the canal, continued south past the remaining buildings in the village as well as through the "improved land" of John and David Frick." The 1856 survey and map show that the road terminated at Sanatoga Road, approximately one-half mile south of its starting point.

The 1856 road survey and map are highly revealing and lend new information to the history of the village. These documents show the presence of several non-extant buildings within the National Register boundaries including James L. Ellis's "boat, timber, and steam saw mill" at the northern end of the district, and Elhanan Frick's lumber and coal yard along the canal. The documents also confirm the mid-1850s construction date of E.W. Frick's canal store.

The portion of Frick's Lock Road that passes through the village is important to the history of the district. The road was spine on which the nineteenth-century village was planned and over

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28 Bureau of the Census, 1920 United States Federal Census, East Coventry, Chester, Pennsylvania; Roll T625_1549; Page: 3B; Enumeration District: 28; Image: 1069.

29 Hagley Digital Archives: Dallin Aero Surveys, County ID: ahk, Roll ID: 68 Photo #: 23; 30 November, 1937.

30 SHPO Eligible 02/07/2005.

31 "Proceedings on a Road in the Township of East Coventry," 9 August 1856. Chester County Archives. Clerk of Courts: Road and Bridge Papers, Docket J, pages 278-280.

which agricultural and canal-related goods passed. During the second half of the nineteenth century, the road provided access to John Frick's brick and tile works, located approximately 500 feet south of the southern boundary of the district. By the late nineteenth century, it also carried a stone arch bridge over the tracks of the newly laid tracks of the Pennsylvania Railroad.

Frick's Lock road has a good level integrity. Its course through the village is the same as that reflected on historic maps. The road is currently macadamized. Although the early road was probably dirt, an historic map indicates that it was paved by 1934.[32] Frick's Lock Road should be regarded as a contributing resource to the district.

Structure 6: Stone Arch Bridge spanning Wells Creek Ravine

The National Register nomination dates the stone arch bridge over Wells Creek to 1777, based on a stone in the bridge bearing this date. However, a visual inspection of the bridge does not confirm this finding. The bridge more likely dates to a later period; its erection was probably concomitant with construction of the 1856 road that runs through the village. Like the road, the bridge facilitated the movement of traffic in and out of the village and hastened the development of Frick's Lock during the nineteenth century. The bridge, which was probably constructed of locally quarried stone, retains a high level of integrity. Although the northwest wing wall of the bridge has collapsed into the bed below it, the bridge preserves its structure and historic character. The bridge should remain a contributing resource on the National Register nomination.

Structure 7: Aqueduct

The aqueduct is located at the southern end of the district. The structure carried the canal over Wells Creek ravine. Above-ground remains of the aqueduct are limited to large abutments of semi-dressed stone. The timber walls of the aqueduct, which served as a container for the canal water, are not extant. The National Register nomination dates the aqueduct to between 1820 and 1824. Although there was undoubtedly an aqueduct at this site when the canal was completed during the 1820s, visible extant remains of the Frick's Lock aqueduct date to 1872. During this year, according to a report by the Schuylkill Navigation Company, "the one-span aqueduct below lock nos. 54 and 55 was rebuilt during the last winter, with new abutments, wing walls, and sides."[33]

The aqueduct is a significant component of the Schuylkill Navigation Company's Girard Canal. Although its timber walls are gone, its massive stone abutments survive to document an engineering system designed to carry the canal over a natural waterway. Because of its associations with the development and operation of the canal and its overall integrity, the aqueduct should remain a contributing resource to the district.

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32 Franklin Survey Company, *Property Atlas of Chester County, Pennsylvania. Vol. II.* (Philadelphia: Franklin Survey Company, 1934).

33 "Report of the President and Managers of Schuylkill Navigation Company to the Stockholders, 1873," quoted in William Stuart Wells, "The Schuylkill Navigation and the Girard Canal." (master's thesis, University of Pennsylvania, 1989), 126.

Structure 8: John Frick Barnyard Wall

The mid-nineteenth-century John Frick barnyard stone wall is associated with a barn that was destroyed in 1998. Likely constructed of locally quarried stone, the barnyard wall contained livestock and aided in the production of manure. A portion of the wall has been removed to create access from Frick's Lock Road to the fields east of the village. Although this loss has undermined the integrity of the wall, it has not fatally compromised the historic character of the resource. The wall qualifies for listing as a contributing resource because of its associations with the canal-era village and because of its contributions to the built environment of the district.

Structure 9: Elhanan Frick Barnyard Wall

The National Register nomination erroneously identifies Structure 10 as a stone barnyard wall. This resource is actually a curved retaining wall that joins with a stone barnyard wall to the immediate south. The retaining wall is associated with the Elhanan Frick bank barn and may date to the period of construction for the bank barn. The wall was constructed to create a level surface at the barn's upper threshing level. The wall, which was probably constructed with locally quarried stone, contributes to the significance of the district in the areas of architecture and should be regarded as a contributing resource.

Site 1: John Frick Barn

The John Frick Barn dates to the mid-nineteenth century. The barn was significant both for its design and construction - which summoned Chester County vernacular building traditions - and with the Schuylkill Navigation Canal, a venture that brought relative prosperity to the village. Although above-ground features of the John Frick Barn were completely demolished in 1998, the associated site was nevertheless identified in the 2003 National Register nomination as contributing resource to Frick's Lock Historic District. The site does not maintain enough above-ground integrity to qualify as a contributing architectural resource to the district because it cannot convey its significance. It is recommended that the barn and silo site, which may retain below-ground remains, be evaluated by a qualified archaeologist to determine potential eligibility as contributing resource under Criterion D.

Site 2: Piggery, Heifer, and Blacksmith Shop

Like the John Frick Barn, the site associated with the piggery, heifer, and blacksmith shop does not maintain adequate integrity to convey its significance as a contributing architectural resource to Frick's Lock Village. The above-ground remains of the site consist of nine poured concrete footings that probably supported the piggery, heifer, and blacksmith shop. The site should be assessed by a qualified archaeologist to establish its significance in relation to the district and to determine if it warrants listing as a contributing archaeological site under Criterion D.

Site 3: Stone Quarry

The circa 1775 stone quarry should be regarded as a contributing resource to Frick's Lock

Historic District. The 2003 nomination notes that quarry, which is located in the southwestern area of the village, was a source of stone for many of the buildings and structures in the village. More recent research conducted for the purpose of this survey indicates that the quarry had additional value to the village and was in active use through at least the end of the nineteenth century. According to an 1894 newspaper article, the Pennsylvania Slag and Stone Company of Philadelphia signed a ten-year lease to mine stones from the quarry at Frick's Lock. The company, which transferred the stone via a siding to the Pennsylvania Railroad, considered its lease a "boon" because the "chap rock" at the quarry was "extremely scarce" and was recognized as a superior medium for macadamizing Philadelphia streets. The paper noted that the owner of the quarry, John Frick, would reap considerable profits from his business arrangement with the excavating company. Frick, the *Pottstown News* reflected, would "realize as much from [the lease] as the entire farm is worth at the present market price."[34] The Pennsylvania Slag and Stone Company leased land on both the east and west sides of the railroad tracks and was reported to have employed 50 men at the quarry.

Site 4: Boatyard and Sawmill

An 1860 map reveals the presence of a sawmill within close proximity to the canal.[35] The 1856 survey of Frick's Lock Road also documents a sawmill in this area. There are no visible above-ground remains of a boatyard or sawmill site, however. It is recommended that a qualified archaeologist make a determination about the possible presence of a sawmill or boatyard site within the current district boundaries. If it is established that the resource is located within the district boundaries, research should be undertaken to determine both its relationship to Frick's Lock and its significance to the district.

Survey Findings: Evaluation of Non-Listed Historic Resources

The survey located additional possible historic resources within Frick's Lock Historic District that are not identified in the National Register nomination. Recommendations for these resources are noted below.

B-22: Barn at Burns property

The late-nineteenth or early-twentieth century barn is associated with B-20, the frame house of Aaron Burns. The two-story, gabled-roof frame barn is covered on all sides with corrugated metal siding that postdates the district's period of significance. The metal siding fully obscures the barn's vertical board siding. Although the building appears to be a mixed-use barn, the condition and integrity of the building make the barn's original use and design difficult to determine.

One of several outbuildings associated with the farm, the barn is located just to the north of the Burn' house. A federal agricultural census indicates that in 1927, the property associated with

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34 Chester County Historical Society. Newspaper Clippings File: Pennsylvania Slag and Stone Company: L11.23.1894.

35 Kennedy, "Map of Chester County, Pennsylvania."

the Burns farmstead had one tractor and a three-acre orchard of pear and apple trees.[36] It is reasonable to assume that L. Stephen Overholtzer, the farm owner at the time, used the barn to aid in the operation of his dairy.

The Burns barn does not contribute to Frick's Lock's significance in the area of transportation; by the time the barn was constructed, the Schuylkill Navigation Company's canal had long ceased to be an asset to the residents of Frick's Lock. Because of its poor condition and integrity, it is difficult to determine the architectural significance of the barn; the metal siding not only conceals the building's original materials, it also greatly conceals the form of the building. The extremely poor condition of the barn's interior also limits any understanding of the resource's historic use; the roof, floor, and back wall have collapsed. Because of its poor condition, the barn lacks sufficient integrity to convey any potential significance in the area of architecture. The barn should not be listed as a contributing resource to the district.

Structure 11: Chicken Coop

The chicken coop is located to the southeast of the Burns barn. The coop is elevated off the ground on cinderblocks at the corners. The frame building, which is sheathed with vertical wood board siding, has a shed roof. At its southern elevation the coop has a board-and-batten door. Like many chicken coops of this era, this building has a south facing window to allow for maximum penetration of natural light. The window has six-over-six sashes. The chicken coop retains a good level of integrity. It materials are original to its date of construction and the function of the resource is evident from a visual inspection.

Although the chicken coop is associated with farming operations located on the Burns property, it shares a weak association with the events for which the district is significant: transportation and architecture. The coop likely dates to the early twentieth century and is therefore not historically associated with canal-related activities. A common architectural form that was not locally or regionally distinctive, the chicken coop does not qualify for listing as a contributing resource to the village (see recommendations for evaluation of district in the area of agriculture).

Structure 12: Corn Crib

The grain storage shed is associated with the Burns farm. The shed, which dates to the late nineteenth or early twentieth century, is located between the Burns house and Burns barn. The framed structure is typical of grain storage sheds of this period. Widely spaced horizontal slats, which were employed for ventilation purposes, form the outer walls. The shed is associated with an early-twentieth-century farm and does not contribute to the significance of the district in the areas of transportation or architecture. The shed should not be regarded as a contributing resource to the district (see recommendations for evaluation of district in the area of agriculture).

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36 Pennsylvania State Archives, Harrisburg; record Group 1, Records of the Department of Agriculture; Division of Crop Reporting; Farm Census Returns, 1927, Chester County, East Coventry Township.

Structure 13: Iron Fence at Manor House

This forged iron hairpin fence runs parallel to Frick's Lock Road approximately 15 feet from the Summer Kitchen. It extends north, approximately x feet, from a point just south of the kitchen. The fence, which is interrupted by a walkway that runs east towards the Manor House, may have been part of a larger feature that once contained the "yard" associated with the Manor House and kitchen. Dating to the late nineteenth or early twentieth century, the hairpin fence is a character-defining feature of the district. Its placement at the edge of the Manor House property reflects ideals that governed the use of space during the Victorian era. Indeed, the dwelling's occupants used a simple, yet decorative iron fence to effectively create a suburban "front lawn" in a rural village. By separating the house, kitchen, and immediate land from the surrounding fields, the fence introduced a sense of order to the property. The fence should be regarded as an important small-scale element within the district.

Site 5: Building Site

Historic maps and aerial photographs suggest that there was a building near the bend at the Frick's Lock road.[37] The maps and photographs indicate that the building was on the south side of the road, adjacent to resource B-17. An 1873 map shows the property to be that of David Hause, the owner and operator of the canal store. A 1934 survey map indicates that the building was likely a shed or a barn.[38] It may be useful for an archaeologist to examine this site to make a recommendation about its potential as an archaeological site, based on its history, significance and integrity.

Site 6: Wells Chicken House

The Wells chicken house, which was identified as a building in the 1987 John Milner report, is not extant. Above-ground remains of the resource, which are located to the north of the John Frick barn site, are limited to a concrete foundation. The Wells chicken house, which was constructed during the early twentieth century, does not possess any above-ground integrity, nor does it contribute to the significance of the district in the areas of transportation and architecture. The chicken house is consequentially ineligible for listing as a contributing resource to the district.

Site 7: Lock Tender's House Outbuilding

Historic maps and photos indicate that a frame outbuilding once stood to the north of the lock tender's house. This building is also visible in a late-nineteenth-century lithograph of Frick's Lock Village.[39] An 1856 survey of Frick's Lock Road suggests that the building that once occupied this site may have been used to store coal. The site should be evaluated by a qualified archaeologist.

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37 Kennedy, "Map of Chester County, Pennsylvania"; Bridgens, *Atlas of Chester County, Pennsylvania*; Dallin Aero Surveys, 30 November, 1937.

38 Franklin Survey Company, *Property Atlas of Chester County, Pennsylvania.*

39 Cremers, *Coventry: The Skool Kill District*, 115.

Section Three

Additional Findings

The Frick's Lock Historic District should be evaluated for its significance in the area of agriculture. Research indicates that farming helped sustain Frick's Lock before, during, and after the Schuylkill Navigation Company established a presence in the village. Indeed, information compiled from federal population and agricultural censuses from the mid-nineteenth century to 1930s indicates that historically, farming was one of the primary occupations Frick's Lock residents.

The presence of early agricultural-related buildings at Frick's Lock provides visual evidence of the importance of farming to this community during the late eighteenth and early nineteenth centuries. Scholarly research also confirms that Frick's Lock was an early and productive farming settlement during this period; the village's earliest resident, Peter Grumbacher, cultivated 150 acres of land in the vicinity of his mid-1800s farmstead. Grumbacher's daughter, Catherine, and son-in-law, Jacob Frick, farmed this land into the 1800s. Their heirs continued farming much of the land through the nineteenth century.

The importance of agriculture to residents of Frick's Lock became even more magnified following the gradual abandonment of the canal during the late nineteenth and early twentieth centuries. The prevalence of farmers in and around the village during the late nineteenth century points to a move by residents to embrace work other than that which was directly tied to the canal. A 1902 newspaper article noted that the near cessation of canal traffic had led "boatmen who have found a livelihood upon this inland waterway to turn to another means of making a living, and during the summer they have rented and farmed small tracts of land" in the vicinity.[40] The Pennsylvania railroad's decision to locate a station at Frick's Lock in 1885 may even have been influenced by an understanding that the community would continue to be relevant even after the Schuylkill Navigation Company abandoned operations on the canal. This frame Stick-style station (which is not extant) was located at the southwest intersection of Frick's Lock Road and the tracks. A landlord, at least, saw the benefit of offering "summer boarding at Frick's Lock five minutes' walk from the station."[41] This advertisement was more likely directed toward seasonal farm laborers than summer vacationers. During the year in which the Pennsylvania Railroad established a station at Frick's Lock, residents of the village also rallied to get an "agricultural implement and machine shop" located in their community.[42] These efforts attest to residents' faith in the ability of a farming economy to sustain their community.

Land within John and Jacob Frick's farmstead was being cultivated well into the twentieth century; a federal agricultural census reveals that in 1927, property associated with this farmstead was used to cultivate crops such as corn, wheat, oat, and potatoes. During this year,

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40 Chester County Historical Society. Newspaper Clippings File: Schuylkill Navigation Company, 1902: L.9.18.1902.

41 *Philadelphia Inquirer*, 16 May, 1900: 14.

42 Chester County Historical Society. Newspaper Clippings File: L 4.27.1885.

the historic Frick farmstead, which contained two silos, also had peach and apple orchards and a large number of livestock, including 200 hens and 56 head of cattle.[43]

The presence of a large warehouse at the northern end of the village has diminished the ability of the district to convey its associations with eighteenth and nineteenth-century farming. The Limerick Generating Station, which is located on the east side of the Schuylkill River, has also undermined the ability of Frick's Lock to convey its historical function as a farming community; the plant's massive cooling towers have an obvious adverse visual effect on the village. Noise from the plant also compromises the integrity of feeling.

Frick's Lock nevertheless retains a high level of integrity as an agricultural landscape. The village's integrity of location, design, and association are particularly good; the layout of Frick's Lock demonstrates a conscious effort to apply prevailing methodologies to the planning and siting of discrete farm-related buildings and structures within the village. The neighboring fields, which are still cultivated, also lend the village the appearance of an intact farming community. Based on the above findings, the district should be evaluated for its potential significance in the area of agriculture.

Section Four

Conclusions

Based on the findings of this survey, the current boundaries of Frick's Lock Historic District appear to be appropriate. A majority of resources listed as contributing on the 2003 National Register continue to share an association with the Schuylkill Navigation Company. Many also remain important for their contributions in the area of architecture. Although the justification for the northeast boundary of the district is weak due to the indeterminate location of the boat yard, a contraction or extension of the district boundaries is not currently justified.

Discrete resources within the district should be evaluated for their significance as archaeological resources. Although the National Register nomination lists several archaeological sites as contributing resources to the district, it is unclear if these sites, which presumably contain below-ground remains, have been evaluated by a qualified archaeologist. Until they are, their status as contributing resources to the district should be regarded as indeterminate. Because of the district's concentration of historic resources - which appear to have remained relatively undisturbed since the period of significance - Frick's Lock should also be evaluated as a possible archaeological district.

Finally, Frick's Lock should be evaluated for its possible significance in the area of agriculture. From the mid-eighteenth century until at least 1930, the village functioned as a farming hamlet. Its significance as an agricultural community both contributed to and reflected its significance as a canal-oriented community.

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43 Pennsylvania State Archives, Farm Census Returns, 1927. Chester County.

Section Five

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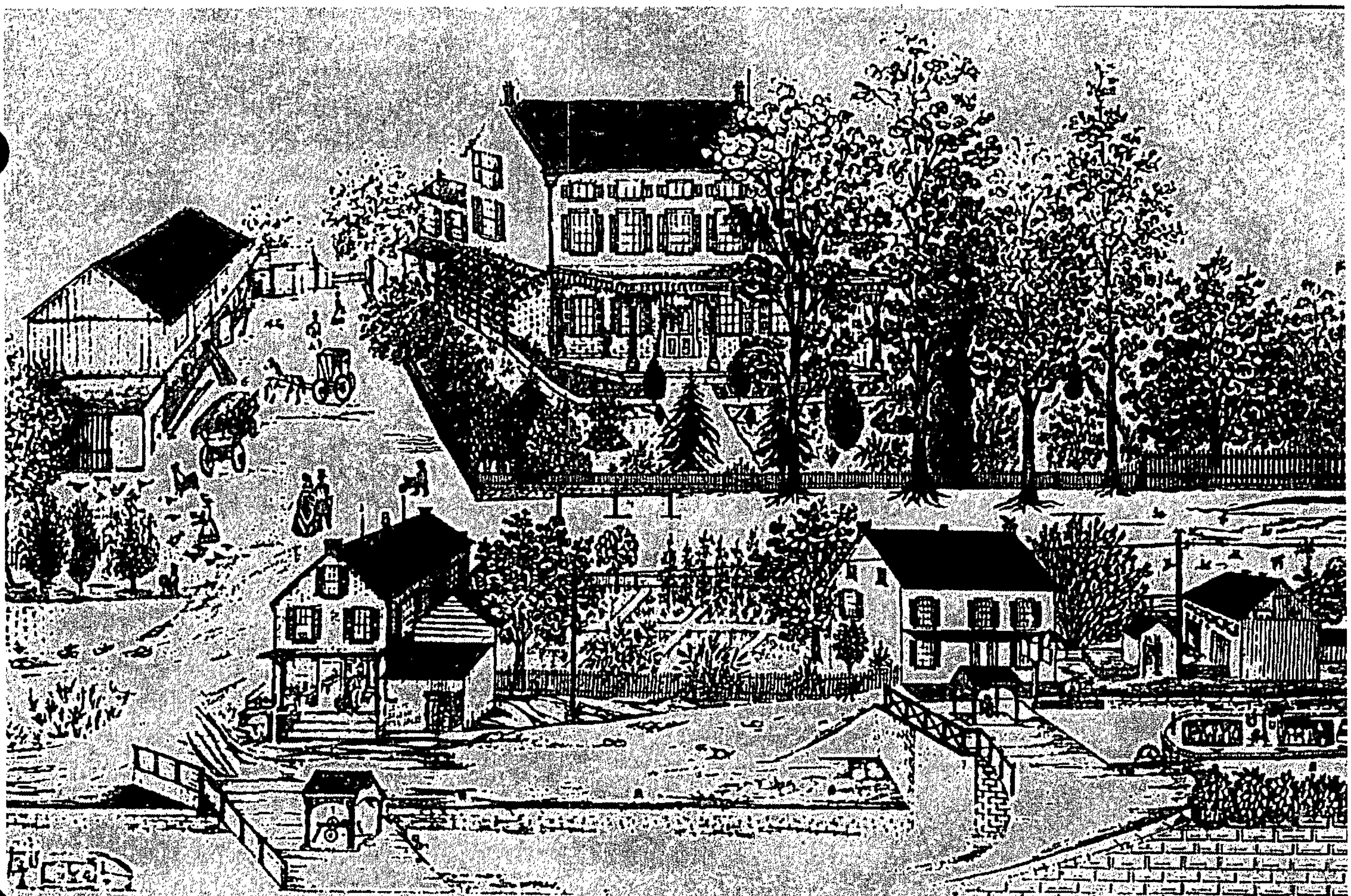

Figure 1. Lithograph of Frick's Lock Village, circa 1860. Reproduced from Estelle Cremers, Coventry: The Skool Kill District, 2003.

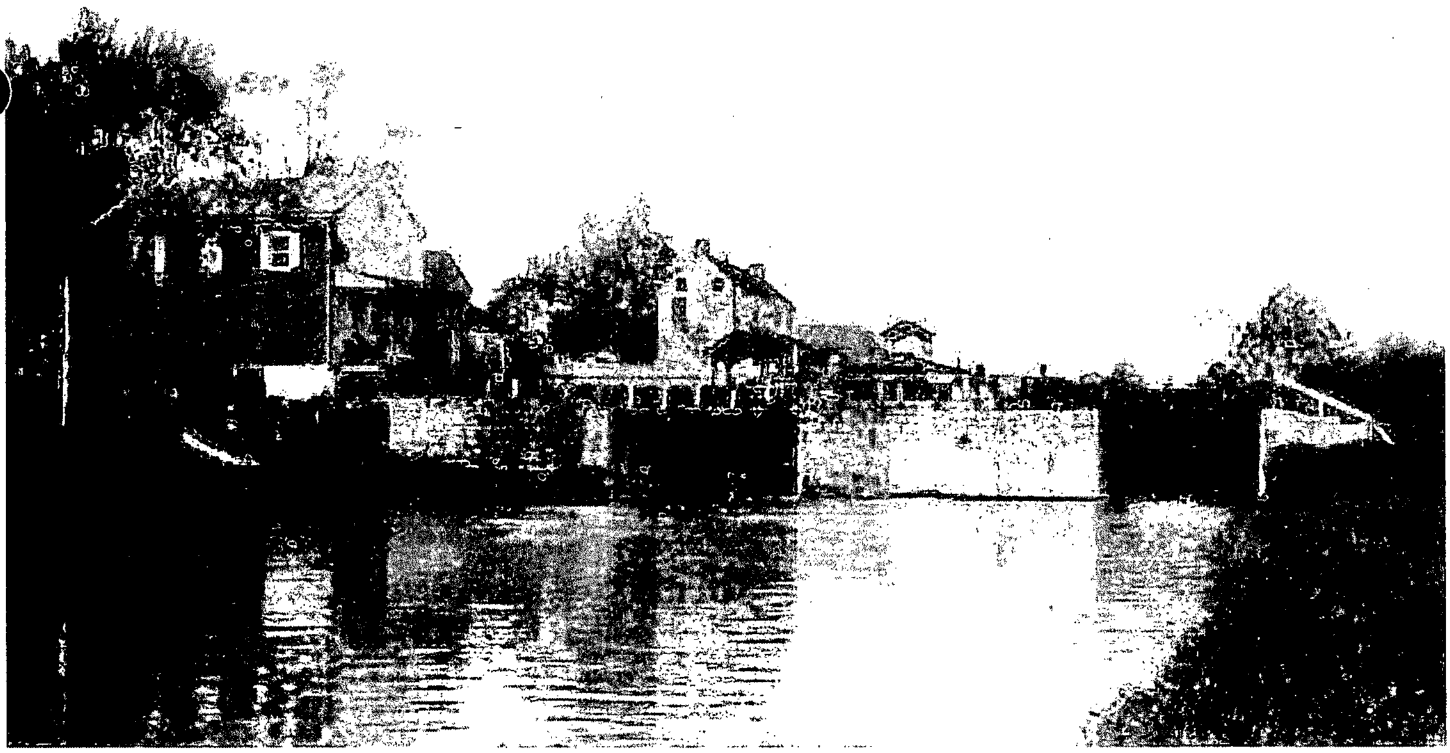

Figure 2. Undated photographs of Locks 54 and 55, with canal store in background. Reproduced from Laura Catalano and Kurt D. Zwikl, Along the Schuylkill River, 2009.

Figure 3. Photograph of Lock Tender's House, 1846. Reading Area Community College, Yocum Library, Schuylkill Navigation Collection.

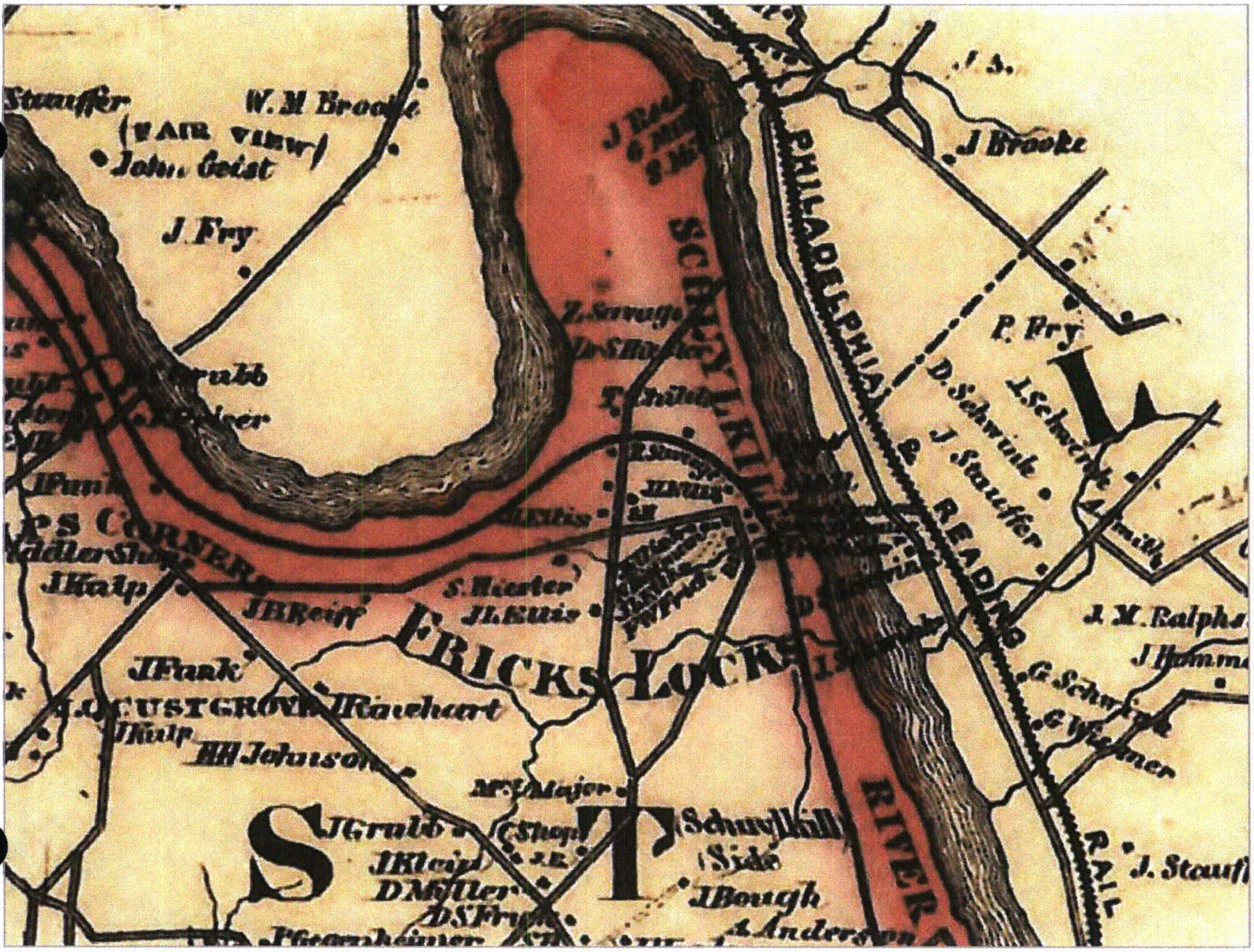

Figure 4. T.J. Kennedy, "Map of Chester County, Pennsylvania," 1860.

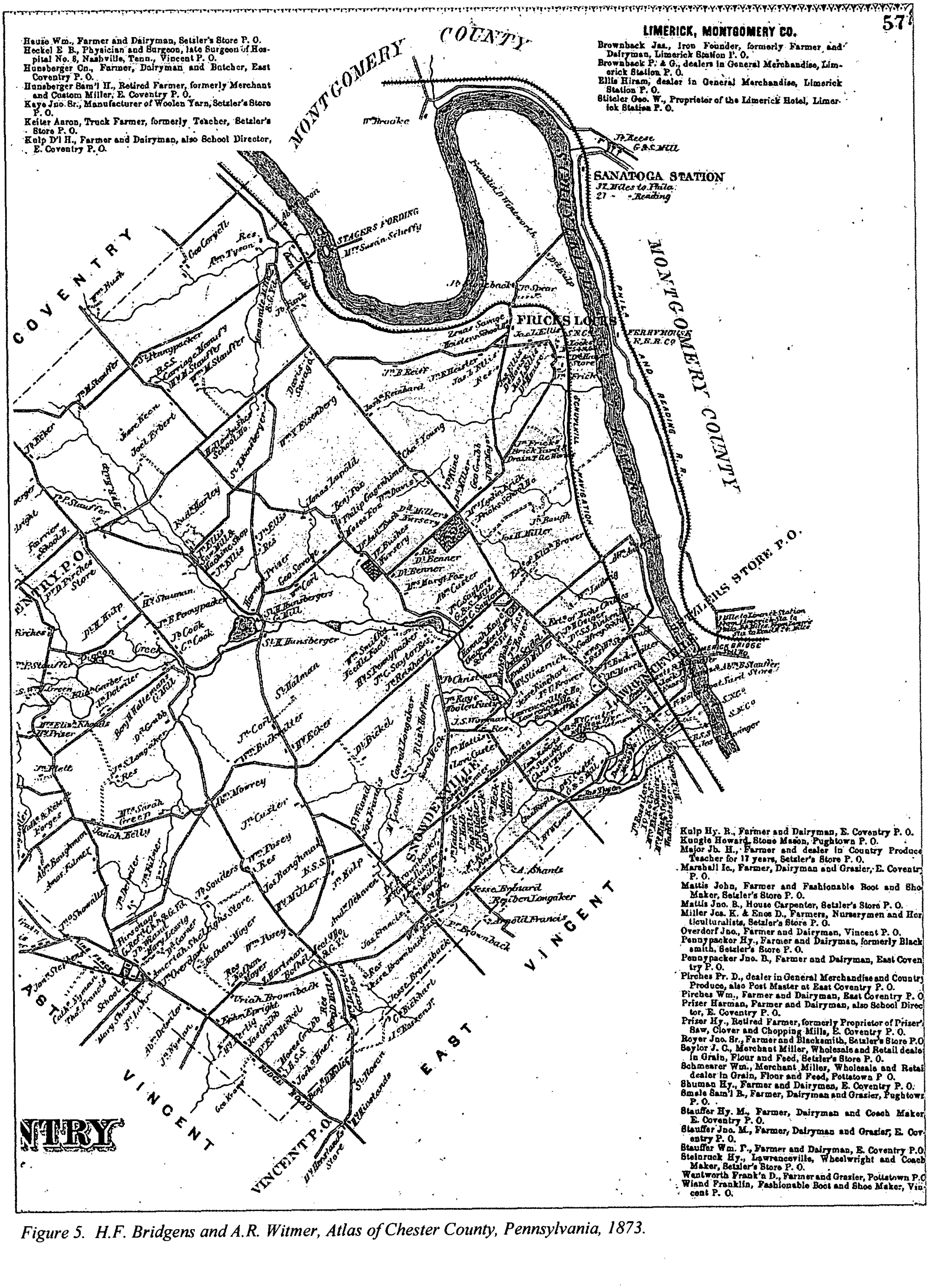

Figure 5. H.F. Bridgens and A.R. Witmer, Atlas of Chester County, Pennsylvania, 1873.

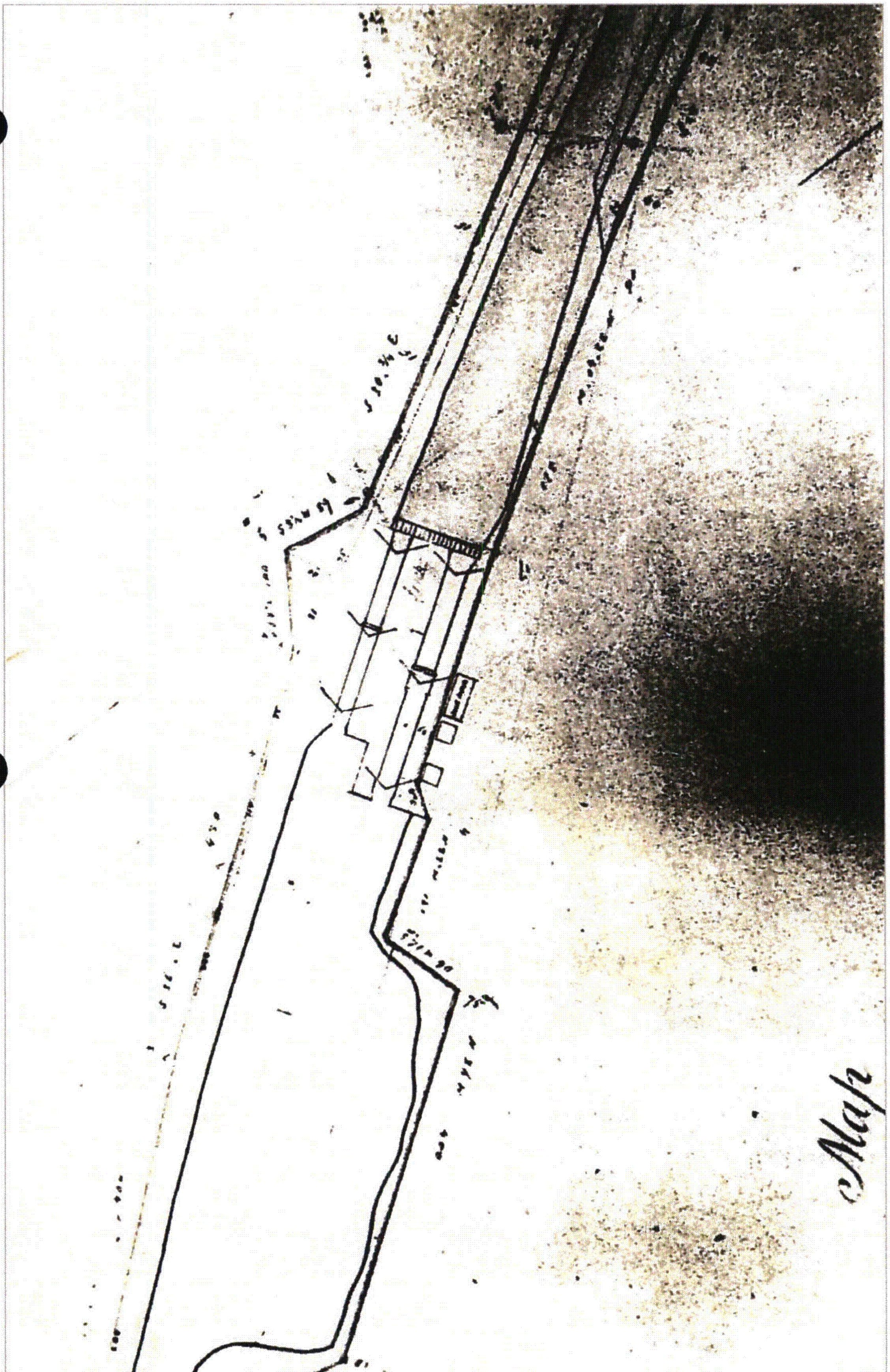

Figure 6. Schuylkill Navigation Company survey of Frick's Locks nos. 54 and 55, 1882-1884. Reproduced from William Stuart Wells, "The Schuylkill Navigation and the Girard Canal," 1989.

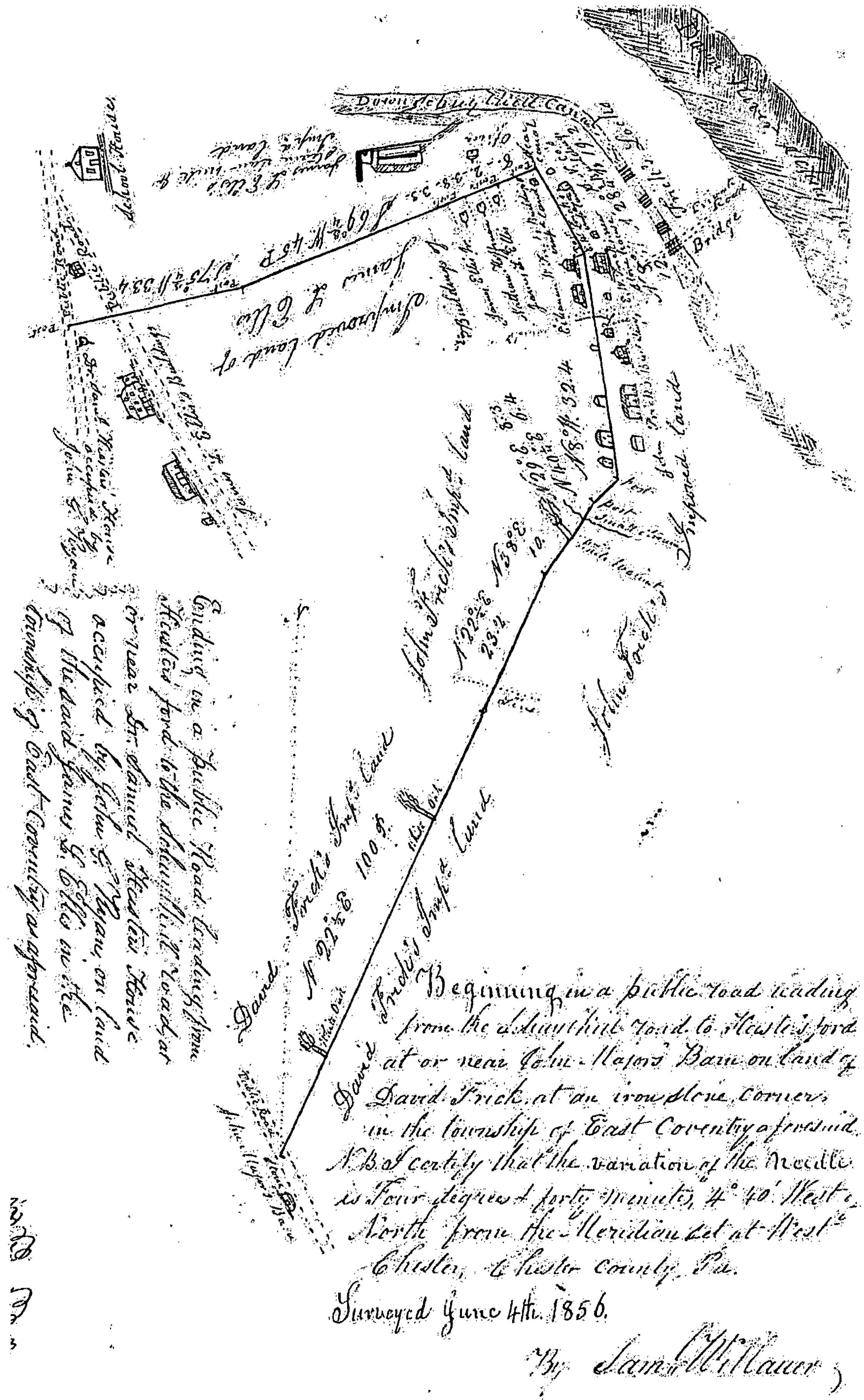

Figure 7. Survey Map of Frick's Lock Road, 1856. Chester County Archives.

THE ARCHEOLOGY OF THE LOWER SCHUYLKILL RIVER VALLEY IN SOUTHEASTERN PENNSYLVANIA

JOHN MILNER ASSOCIATES
ARCHITECTS • ARCHEOLOGISTS • PLANNERS

THE ARCHEOLOGY OF THE LOWER SCHUYLKILL RIVER VALLEY IN SOUTHEASTERN PENNSYLVANIA

prepared for

Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101

by

Robert G. Kingsley, Ph.D.
James A. Robertson, Ph.D.
Daniel G. Roberts

with contributions by

Pam Crabtree, Ph.D.
Elisabeth M. Ervin
Cheryl A. Holt
Henry Kenney
Daniel P. Wagner, Ph.D.

and the assistance of

Karyn L. Zatz
Kenneth M. Joiré

John Milner Associates, Inc.
309 North Matlack Street
West Chester, PA 19380

1990

ABSTRACT

This report presents a synthetic analysis of a large body of archeological data from the Lower Schuylkill River Valley in southeastern Pennsylvania. The data were collected by John Milner Associates during previous Phase I, II, and III archeological investigations in the area, which were conducted in conjunction with the proposed construction of electrical transmission lines associated with the Limerick Nuclear Generating Station. Other sources of data include private artifact collections and the Pennsylvania Archaeological Site Survey files maintained by the Pennsylvania Historical and Museum Commission. The data base includes 184 prehistoric archeological sites.

Analyses were conducted in order to address several problem-oriented research domains. These domains include the generation of an accurate culture history for the Lower Schuylkill Valley, an examination of lithic raw material sources and procurement in the area, the documentation of subsistence and settlement variability in the area, a detailed examination of numerous factors relating to cultural dynamics and societal boundaries, and a preliminary explication of the nature of intra-site structure and function in the area. Analytical approaches and methods included environmental reconstruction, geomorphological and pedological study, statistical analysis, polythetic agglomerative cluster analysis of artifacts and settlement patterns, lithic micro-wear analysis, and intra- and extra-areal comparative research.

Differential continuity and change through time is elucidated within the study area. The first substantial occupants of the area are Piedmont Tradition Late Archaic peoples, which are suggested to be culturally related to Lackawaxen Phase societies on the Delaware River. The Lower Schuylkill Valley was used as a specialized resource base, principally for hunting and probably for plant food procurement as well. Fishing apparently was not conducted, and substantial base camp-type settlements are lacking. Early/Middle Woodland systems appear to be culturally affiliated with the Wolfe Neck Complex of the northern Delmarva Peninsula. This manifestation in the Lower Schuylkill has been designated the Black Rock Phase, ca. 400 BC-AD 200. It is suggested that this phase may be an autonomous or semi-autonomous cultural system related to Wolfe Neck in Delaware. Late Woodland use of the Lower Schuylkill was sporadic and specialized. No large agricultural villages have been recognized and the area was again used primarily for hunting. The area was not substantially occupied by any known Late Woodland society, and the Lower Schuylkill may have constituted a buffer between different Late Woodland systems. Most occupation/use occurred after ca. AD 1,000, and a possible occupational hiatus may have taken place during the late Middle Woodland through early Late Woodland Periods.

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A project of this size, complexity, and longevity can be brought to fruition only through the efforts of many individuals, some of whom may inadvertently be omitted here. This project has been a particularly fulfilling one for many of these people, because an opportunity was provided by the Philadelphia Electric Company (PECo) to draw together in one volume an enormous body of data, much of which was generated during the conduct of six project-specific compliance archeological surveys required as part of the Nuclear Regulatory Commission's and Pennsylvania Utility Commission's licensing procedures for the Limerick Nuclear Generating Station. As such, the present volume does not constitute a compliance archeological report in the strict sense, but rather a regional overview and synthesis of the prehistoric resources of a major drainage system of the southeastern Pennsylvania Piedmont, with data drawn not only from the compliance surveys mentioned above, but also from a wide variety of other sources. The Philadelphia Electric Company is to be commended for its sponsorship and funding of this research effort.

The PECo personnel who made the compilation of this volume possible are, first and foremost, heartily thanked for their continuing enthusiasm and support during the many years of the project. Principal among these are Mr. Walter Payne, Manager of the Berwyn Transportation Center Survey Office and a notable avocational archeologist, whose concern about the effects of the Limerick construction project on prehistoric archeological resources was the principal impetus in making this study possible. Mr. Payne also contributed generously of his time and intimate knowledge of the archeological resources of the Lower Schuylkill River Valley, and his efforts are sincerely appreciated. Similarly, the efforts of Mr. D.S. Frieman, Manager of the Real Estate Department, and Mr. Thomas Clime, Supervisor of the Property Management Section, are acknowledged and appreciated. Both Mr. Frieman and Mr. Clime have maintained long-term commitments to balancing PECo's primary mission of adequately meeting the energy requirements of the Philadelphia region's burgeoning population with concerns for the environment, and their interest in the prehistoric archeology of the Lower Schuylkill River Valley is a logical and sustained extension of that commitment. Last but not least of PECo's personnel, Mr. Stanley V. Heyer, Jr., Supervising Engineer of the Transmission Branch; Mr. Peter Cava, Supervisor of the Construction Branch; and Mr. Anthony L. Milone, Senior Engineer of the Transmission Branch, were also instrumental in the successful completion of the project. Mr. Heyer kindly kept the project team abreast of evolving modifications to PECo's Standard Specifications for the Construction of Transmission Lines, thereby enabling the successful interfacing of construction and archeological concerns. Mr. Cava and Mr. Milone provided the necessary logistical coordination during all stages of field work so that archeological, engineering, right-of-way, and construction timetables could be met successfully. It is through the collective efforts of all of these PECo personnel, and doubtless others, that such a large-scale archeological undertaking, perhaps unprecedented in the electric utility industry in the Middle Atlantic region, could be initiated and successfully completed.

Several avocational archeologists knowledgeable of the archeological resources of the Lower Schuylkill River Valley are also acknowledged with heartfelt thanks. Not the least of these is Ms. Rachel McAvoy, daughter of Ms. Phoebe Gilkyson, one of the avocational "pioneers" of Lower Schuylkill River Valley archeology and whose published work is cited later in this report. Ms. McAvoy provided invaluable information on local archeology and generously provided access to her large artifact collections from numerous sites in the Lower Schuylkill Valley. Also contributing generously of their time and expertise were Mr. Thomas Waters, Mr. John Schrader, Ms. Barbra Aldrich, and Mr. Art Krasley of the Schuylkill Valley Chapter of the Society for Pennsylvania Archaeology. Mr. Waters made available a collection of artifacts previously collected from the Frick's Lock Site by members of the Schuylkill Valley Chapter, and Messrs. Waters, Schrader, Krasley, and Ms. Aldrich each provided the JMA project team with continued benefit of their knowledge of local archeology. The Schuylkill Valley Chapter has become a leading chapter of the Society for Pennsylvania Archaeology, and the forthright and professional approach to archeology by the chapter leadership is hereby recognized and appreciated.

Several consultants were employed by John Milner Associates, Inc. for the specialized expertise they could contribute to the project, and their reports are appended to the present volume. To Dr. Pam Crabtree, Ms. Elisabeth M. Ervin, Ms. Cheryl A. Holt, Mr. Henry Kenney, and Dr. Daniel P. Wagner are extended the sincere thanks of the JMA project team for their thorough and professional efforts on behalf of the project. All of their work was completed in advance of the present volume and, in some cases, well in advance.

Several former employees of JMA assumed supervising positions on various aspects of the project, and were instrumental in its successful completion. Especially noteworthy is Ms. Karyn L. Zatz, who served as Field Supervisor throughout the various field seasons of the project. She also contributed to the present volume, particularly the site descriptions in Section 6.0, and the enthusiasm and diligence with which she embraced the field portions of the project is greatly appreciated. Assisting Ms. Zatz in field supervisory roles at various times were Mr. Kenneth M. Joiré, Mr. Robert F. Hoffman, and Mr. Michael J. Rast, and their respective efforts are also greatly appreciated. Mr. Joiré also contributed to an earlier draft of the present volume.

Field and laboratory technicians involved in the various phases of the project were too numerous to name here. Without the laborious and highly competent efforts of these individuals, however, this project could not have been brought to a successful conclusion. To these many individuals are extended sincere thanks.

Other former and present JMA personnel who contributed significantly to the successful completion of the project include Mr. Thomas L. Struthers, Ms. Betty J. Cosans-Zebooker, Mr. Michael Parrington, Dr. David W. Anthony, Ms. Sarah Jane Ruch, and Ms. Margaret Schoettle. Mr. Struthers, Mr. Parrington, and Dr. Anthony provided administrative, technical, and/or editorial guidance on various aspects of the project, with Mr. Struthers being particularly instrumental in the efficient administration of report review and compliance matters. Ms. Ruch produced the graphics illustrating the present report with her customary skill, and Ms. Schoettle competently and cheerfully entered much of the text into JMA's word processing system.

The present report truly is the result of the collective efforts of the many individuals noted above. The authors, however, must assume responsibility for any shortcomings which may occur in the following pages.

1.0 INTRODUCTION

1.1 History and Nature of the Project

Rapidly expanding energy requirements spurred by explosive population growth and concomitant industrial, commercial, and residential development have recently created the need for considerably expanded electrical power service in many parts of the country. As a result, many new or expanded generating facilities, some of which are designed to generate power through nuclear means, are currently being planned, are now under construction, or are already in operation. Many of these facilities require new or upgraded transmission lines in order to provide the fully expanded services necessitated by burgeoning regional development. One such new facility requiring upgraded lines is the Limerick Nuclear Generating Station, located on the left bank of the Schuylkill River in Montgomery County, Pennsylvania (Figure 1). Some segments of the required Limerick transmission lines were slated for new rights-of-way, but the majority were designed to replace existing transmission lines as part of the overall upgrading of electrical power service.

In all, five new or upgraded transmission lines were required in order to efficiently service the new Limerick Nuclear Generating Station (Figure 1). These include the 220-60 line, roughly paralleling the left bank of the Schuylkill for 7.4 miles between Limerick and the Cromby Generating Station; the 220-61 line, following the same trend between Limerick and Cromby for 8.3 miles, but on the right bank of the Schuylkill; the 220-62 line, which trends for 16 miles in a northeasterly direction between Cromby and the North Wales Substation in Upper Gwynned Township, Montgomery County; the 220-63 line, which emanates at Cromby and roughly parallels the Schuylkill along its left bank for 14 miles to the Plymouth Meeting Substation in Plymouth Township, Montgomery County; and the 5031 transmission line, a 16 mile east-west trending line between Limerick and the Whitpain Substation in Whitpain Township, Montgomery County. The aggregate length of the five transmission lines is nearly 62 miles.

As a result of recommendations made in an earlier archeological report associated with the Limerick Nuclear Generating Station (Holzinger and Humphreville 1972), the Lower Schuylkill Valley Archeological Project had its genesis in 1982 when advanced planning for the design and construction of the five transmission lines got underway. At that time, John Milner Associates was retained by the Philadelphia Electric Company to conduct a limited literature and records search of previously recorded archeological sites in the vicinity of the five proposed transmission lines. The results of this preliminary study were reported by Struthers and Hoffman (1982). Subsequently, JMA was retained to conduct archeological survey, testing and, if necessary, data recovery along the entire aggregate length of the five Limerick transmission lines. The approach to this work involved three phases of archeological field investigation, all standard procedure for compliance archeological investigations of this type. The three phases included Phase I, (an identification/location survey for archeological sites), Phase II (evaluation with regard to the Criteria for Eligibility to the National Register of Historic Places of sites so identified), and Phase III (mitigative archeological data recovery of those eligible sites where adverse effect could not otherwise be avoided). The ensuing field work was conducted at various times between the fall of 1982 and the fall of 1986, and resulted in the issuance of five descriptive reports on the results of the investigations (Zatz 1984; Zatz et al. 1984a, 1984b, 1985, 1989). The purpose of these reports was to satisfy the archeological compliance requirements of the Nuclear Regulatory Commission (NRC), the Pennsylvania Utility Commission (PUC), and the Pennsylvania Bureau for Historic Preservation (BHP) so that design and construction of the transmission lines could proceed as planned. The NRC, PUC, and BHP all accepted the findings of the five reports.

As a result of ongoing consultation between PECo and BHP, however, a commitment was also made by PECo to use the body of data obtained during the Limerick Transmission Line Surveys as a basis to provide an overall synthetic presentation of the archeology of the greater Lower Schuylkill River Valley. The purpose of this synthetic work was to draw together in one volume all available and pertinent data on the archeology of a heretofore poorly understood region of southeastern Pennsylvania, so that the professional and avocational archeological communities would have benefit of the cumulative knowledge for this region, gained both prior to as well as during the multi-year Limerick Transmission Line Survey project. As such, the present volume draws together a large body of multi-disciplinary information on the Lower Schuylkill River Valley, including presentations of a cultural-historical framework for the region, subsistence-settlement systems, lithic raw material usage, cultural dynamics, site structure and function, lithic microwear analysis, floral and faunal analysis, and geomorphological reconstructions. This is the first such compilation of data for the Lower Schuylkill Valley, and it is hoped that the information and interpretations contained in this volume will serve as a springboard for future archeological investigations and subsequent refinement, as new information emerges, of the data and interpretations presented herein.

It is important to note that the present report is not intended to duplicate the information contained in the previous six reports emanating from the Lower Schuylkill Valley Archeological Project (Struthers and Hoffman 1982; Zatz 1984; Zatz et al. 1984a, 1984b, 1985, 1989). Indeed, the present volume, although intended as a complement and follow-up to the previous reports, is nevertheless written to stand alone as a general overview of the archeology of the Lower Schuylkill Valley. In the pages that follow, the reader will not find detailed descriptive information on the nature of the Limerick Transmission Line Surveys, archeological field methods, locations of transmission line support structures, or artifact catalogs. Rather, the reader is referred to the six reports noted above for that level of detail. However, most of the significant findings of the Limerick Transmission Line Survey reports are presented in generalized or summary fashion in the present volume, together with complementary information derived from other sources.

It is hoped that the present volume has gone beyond the normal compliance-generated report in providing an informative synthetic overview of the current state of knowledge in the Lower Schuylkill Valley. If it does, then its success rests largely with the Philadelphia Electric Company in having the foresight, concern, and commitment to an approach to archeological research which not only fulfilled various compliance requirements, but also recognized a responsibility to a wider audience, namely interested professional and avocational archeologists, and the lay public as well.

1.2 Research Framework and Report Objectives

Several specific research questions and general problem domains can be addressed with the data collected through the Lower Schuylkill Valley Archeological Project. However, the extent to which these questions may be effectively answered, and the soundness of any conclusions drawn, are strongly affected by the nature of the data base utilized. A critical discussion of data quality and analytical limitations is presented in Section 10.1. However, a summary discussion of the nature of the data set is in order at this point.

The data base employed in this study consists of some 184 prehistoric archeological sites, and is comprised of "primary" site data and "secondary" site data. The primary data base is comprised of sites actually discovered or otherwise tested, examined, or at least visited during the course of the Limerick Transmission Line Surveys. Many of these sites were newly discovered during the survey, while others had been previously recorded by others but were re-examined during the project. Secondary data include site information recorded or compiled solely by others. The principal source of these data was the Pennsylvania Archaeological Site Survey (PASS) files, maintained at the Pennsylvania Historical and Museum Commission in Harrisburg, and the majority of sites in the present data base derive from the PASS files. Other secondary sources include local informants, landowners, and avocational archeologists. Documentation of artifact collections in the area also resulted in the recordation of site locations. The data base used in this study thus derives from a wide variety of sources.

The several transmission lines investigated during the course of the project cover a wide area, generally emanating from the Limerick Nuclear Generating Station near Pottstown and trending southeastward along the Schuylkill River, or eastward over open country (Figure 1). For purposes of regional analysis and synthesis, it was necessary to define a circumscribed region as the focus of study, which encompassed all surveyed transmission lines but also a substantial portion of the surrounding environs. This area is referred to as the Lower Schuylkill Valley Study Area, and its boundaries are in part arbitrary as well as natural. As shown in Figure 2, the eastern and southern margins of the study area are defined by the limits of the greater Schuylkill River watershed, including its tributaries. The northern and western boundaries are arbitrary. The western boundary is defined by the edges of the relevant USGS topographical maps of this area. The northern boundary was arbitrarily drawn from the intersection of the western boundary and the Berks/Montgomery County line eastward to the limits of the watershed, which coincidentally is also the Bucks/Montgomery County line. Thus, the study area encompasses what is herein termed the "Lower Schuylkill River Valley", from the Borough of Pottstown to the river's junction with the Delaware in Philadelphia. One complete major tributary, portions of two other major tributaries, and numerous minor tributaries are also included. The study area encompasses approximately 495 square miles (1267 square kilometers). This area is herein regarded as sufficiently large to permit meaningful archeological generalizations to be made on a regional scale, yet sufficiently small as to remain manageable and practical as a study area.

The Lower Schuylkill Valley Archeological Project has provided an important opportunity to address several problem areas and research questions currently of interest in Middle Atlantic archeology, as well as to fill a void in the archeological data base of southeastern Pennsylvania. The latter statement is not to imply that previous archeological investigations have been lacking in the region, only that attempts to integrate or synthesize these studies into an overall understanding of regional prehistory have been rare, and none have focused specifically on the Lower Schuylkill Valley. The Schuylkill River in general is far more poorly known archeologically than either the Delaware or Susquehanna Rivers or the Delmarva area, both in terms of numbers and nature of sites in the valley as well as an understanding of these sites. Thus, the presentation of the data herein should go a long way toward correcting this shortcoming and will provide a data base for future study in the region.

Research problems to be addressed in the following pages will be discussed at this juncture. The research problems can be organized into domains based on the scope and nature of the problem or question. That is, research questions range from broad, wide-ranging topics to specific, narrowly-focused problems. Five principal problem domains have been isolated, all of which are systematically interrelated and analytically interdependent. They include: 1) The establishment of a detailed cultural-historical framework for the Lower Schuylkill Valley Study Area; 2) the nature of lithic raw material distributions, procurement, and usage in the study area; 3) subsistence-settlement system variability within the Lower Schuylkill Valley; 4) cultural dynamics in the Lower Schuylkill Valley, and the changing configuration(s) of socio-political-economic systems in the region; and 5) the nature of intra-site structure and function in the Lower Schuylkill Valley. These topics are discussed in turn below.

1.2.1 Cultural-Historical Framework

This topic is straightforward and is prerequisite to the study of cultural dynamics, settlement systems, and cultural change through time. While the general prehistoric sequence in the Lower Schuylkill Valley has been known for some time, and generally parallels that in the Lower Delaware in terms of gross cultural-temporal periods, questions remain regarding the more precise definition of discrete socio-cultural systems or traditions and temporal-cultural phases in the area. For example, artifact analysis to date indicates that Late Archaic Laurentian Tradition artifacts have been found in the area, as well as the more ubiquitous Piedmont Tradition artifacts. The nature of the relationship(s), if any, between these systems has never been understood. Relationships between or among Late Archaic and Terminal/Transitional Archaic systems also remain incompletely understood. Similarly, the precise cultural affiliations of the various Woodland inhabitants of the valley are poorly known, save for general, often presumed parallels with systems in the Lower Delaware Valley. It is conceivable that ties might have also existed with systems elsewhere that have yet to be explicitly recognized. An important problem domain thus requiring explication involves the nature and configuration of human occupations and cultural affiliations through time within the study area. To the extent feasible, this study will attempt to address these kinds of cultural-historical issues. Accordingly, a less generalized understanding of prehistoric occupation in the valley will result.

1.2.2 Lithic Raw Material Distributions, Procurement, and Usage

In concert with numerous previous studies of lithic raw material utilization in southeastern Pennsylvania, one focus of the present study will be an examination of lithic raw material sources, availability, and archeological patterning in the Lower Schuylkill Valley. Geological data and the large archeological data set permits a detailed analysis of raw material procurement, usage, and discard. It has been recognized for some time that lithic raw material preferences varied dramatically in the region throughout the prehistoric past, though an in-depth analysis of raw material patterning in the Lower Schuylkill proper has heretofore never been attempted. The present analysis will provide important data for comparison with previous studies in adjacent areas.

1.2.3 Subsistence-Settlement System Variability

This topic focuses on questions concerning variability in settlement and land use in the Lower Schuylkill and its tributaries. This is considered an important topic, since the Schuylkill Valley differs environmentally in several ways from the Delaware and Susquehanna. Similarly, intra-basin distinctions exist within the main valley, and between the Schuylkill and various tributaries. The problem, stated in general terms, is how different environs were utilized by prehistoric peoples. Analysis will address the extent to which floodplains and/or river terraces were the foci of settlement. Similarly, it is important to understand the nature and use of the vast tracts of upland, non-riverine environment that dominate so much of the study area. Related topics include the nature of utilization of tributary streams versus the use of the main channel of the river. It would appear that land use patterns changed over time, and Archaic Period settlement differs from that during the Woodland. One of the principal goals of this part of the study is the elucidation of how the physiography and hydrology of the Schuylkill drainage basin affected prehistoric economic decision making, scheduling of resource procurement, and the structure of settlement systems.

1.2.4 Cultural Dynamics

Three closely related research topics can be subsumed under this rather broad-based problem orientation, and each is discussed in detail below.

The "role" of the Lower Schuylkill Valley as a socio-political "territory" throughout prehistory is poorly understood. Several important questions revolve around the role or situation of the Schuylkill as a place to live in the past. One question is the extent to which the valley served as a residential territory for discrete socio-political-economic systems through time. The analysis will attempt to test or evaluate ideas regarding "river valley territoriality" that are sometimes invoked in prehistoric settlement studies, where individual river valleys are seen as the foci of individual societal territories (e.g. Kent 1970:31; Witthoft 1961:11; Brashler 1981; Barth 1969). According to this perspective, the Schuylkill might have served as the spatial focus or "center" of a societal territory, and that territory would contrast with other territories/societies in the region, i.e. in the Delaware and Susquehanna Valleys. This condition might have remained relatively stable through time or may have varied. Thus, problems to be addressed include the extent to which the Schuylkill Valley may have served as a societal territory, in whole or in part, and whether territoriality in the valley varied over time. Were some parts of the valley occupied by different systems than others at the same time, for example, in the Upper versus the Lower Schuylkill? Similarly, it is possible that the main channel could have been occupied by different people than the various tributaries, and the entire drainage basin may not have invariably constituted a defined societal realm. Finally, an important question that has never been addressed is whether the valley, or parts of it, were ever unoccupied.

An evaluation of whether the Schuylkill River Valley can be considered a "major" watercourse like the Delaware and Susquehanna is also central to the question of cultural dynamics. This question is obviously related to the foregoing, and turns on whether the river valley was sufficiently substantial to have served as a discrete territory distinct from the Delaware and Susquehanna drainages. Stated differently, it remains to be ascertained whether the Schuylkill basin was large and environmentally productive enough to have sustained permanent settlement, or whether the valley is better considered as "ancillary" or "peripheral" to the Delaware and Susquehanna. Part of the impetus for this topic derives from ethnohistorical accounts of the Lenape and Susquehannock utilizing the Schuylkill as a trade and communication corridor between the Delaware and Susquehanna Rivers, with neither group really regarding the valley as "home" (e.g. Becker 1980a; Hunter 1983). Were there sustained, year-round settlements in the valley, socially autonomous or otherwise, or were the prehistoric occupants of the Schuylkill perennial transients? Settlement analysis will attempt to determine whether the basin was a place of continual habitation by resident groups or simply of repeated use by any number of people.

Finally, comparative analysis of societies and settlement systems in the Schuylkill with systems located elsewhere is also an important research question. To the extent that the above questions can be addressed and a detailed cultural-historical sequence can be established, comparative study of data from the Delaware and Susquehanna Valleys and the Delmarva area will be employed to assess the place and role of the river in the prehistory of southeastern Pennsylvania. As discussed above, temporal/cultural relationships between the inhabitants of the Lower Schuylkill and adjacent rivers or regions have yet to be determined. Analysis will attempt to present a clearer understanding of prehistoric settlement within and relationships between the respective river valleys.

1.2.5 Intra-Site Structure and Function

This is a problem domain that chronically receives somewhat less attention in a report on a regional site survey, and the present report is no exception. Only a small fraction of the sites documented in this study, both newly discovered and previously recorded, have been excavated or even tested. Thus, the nature of intra-site structure is incompletely known in southeastern Pennsylvania, and many inferences regarding site structure and function have been made on the basis of surface collection data. Significantly, the Limerick Transmission Line Survey provided a relatively rare opportunity to extensively test and/or intensively excavate sites of various temporal periods. Phase III data recovery at two sites and an intensive Phase II investigation at a third site conducted during the project yielded features, radiocarbon dates, artifactual and organic remains, and other intra-site spatial data; these investigations are reported in detail herein. Though the excavated data are very limited compared to surface collected data, several inferences can nonetheless be drawn concerning the intra-site organization of space during certain temporal periods in the study area.

With the foregoing as the principal research problems to be addressed in this study, the objectives of this report are to present in summary and graphic fashion information on all sites known to occur in the Lower Schuylkill Valley Study Area. A cultural and environmental context will be established in order to analyze these data and address the research objectives outlined above. Intensive surface survey and Phase II and III excavations at three sites are discussed in detail. The data presented will form the base for the analyses conducted in the final sections, where cultural-historical issues, settlement system analysis, lithic procurement and usage studies, and other topics will be integrated into a synthetic overview of the prehistoric occupations of the Lower Schuylkill River Valley. It must be stressed that this report cannot be regarded as the last word on the prehistory of the Lower Schuylkill, and the various conclusions that are drawn are best considered as preliminary hypotheses or models. These hypotheses are presented as baseline inferences derived from the data at hand, and it is hoped that they will be put to the test through future archeological research in the Schuylkill basin.

2.0 ENVIRONMENT AND ECOLOGY OF THE STUDY AREA

2.1 Hydrology and Physiography

The Schuylkill River constitutes one of the principal tributaries of the Delaware River. The drainage basin encompasses some 1920 square miles, covering portions of ten southeastern Pennsylvania counties (Figure 2). In its approximately 130 mile length, the Schuylkill is fed by nine sizeable tributaries and a large number of smaller streams in a predominantly dendritic drainage pattern. The river traverses several major and minor physiographic provinces throughout its southeastward trending course, and the physical characteristics of the river vary between the various provinces. Despite the appreciable size of the Schuylkill River and its great economic and historical importance in the development of the region, relatively few studies have been conducted that investigate the development and dynamics of the river system or its tributaries. The following discussion will draw upon the extant data in order to develop an environmental overview of the river valley, and to establish an ecological context for the analysis of the archeological data.

Of the nine principal tributaries of the Schuylkill, three lie wholly or partially within the study area, and another joins the river immediately upstream from the western boundary at Pottstown. Beginning at the river mouth, Wissahickon Creek is the first major tributary, and enters the Schuylkill from the north within the City of Philadelphia. Wissahickon Creek is 23 miles in overall length and has an average gradient of 20 feet per mile. The creek drains an area of 64 square miles (Bourquard and Associates 1968:II-7). Perkiomen Creek and its tributaries, principally Skippack Creek, is the largest tributary system of the Schuylkill. Joining the main stem from the north at Valley Forge, the Perkiomen watershed covers 362 square miles. Perkiomen Creek proper is 38 miles long and falls an average of 36 feet per mile (Bourquard and Associates 1968:II-7). The third tributary lying within the study area is French Creek, which flows into the Schuylkill from the west at Phoenixville. French Creek drains an area of 71 square miles, is 22 miles in length, and has an average gradient of 65 feet per mile (Bourquard and Associates 1968:II-6-7). Manatawney Creek enters the main stem at Pottstown, slightly upstream from the study area boundary. This creek is 22 miles long and drains approximately 90 square miles; the average gradient is 32 feet per mile (Bourquard and Associates 1968:II-6).

Five primary tributaries lie upstream from the project area, and include Tulpehocken Creek, Maiden Creek, the Little Schuylkill River, the West Branch of the Schuylkill, and Mill Creek. Size and drainage characteristics of these watercourses vary considerably. Generally, drainage area decreases and gradient increases as one moves up the Schuylkill Valley. For example, Tulpehocken and Maiden Creeks, both located near Reading, each drain over 200 square miles and fall only about 6 feet per mile. Near the headwaters of the river, the West Branch and Mill Creek each drain only about 50 square miles, and have gradients of 55 and 580 feet per mile, respectively (Bourquard and Associates 1968:II-6).

As mentioned, the Schuylkill River traverses several different physiographic provinces between its headwaters in Schuylkill County and its junction with the Delaware River. Figure 3 illustrates the physiographic provinces in the region. The nature of the surface and bedrock geology of these provinces, coupled with events and processes associated with the initial development of the river, determine the physical and hydrological configuration of the river and its tributaries. From the mouth of the Schuylkill to the present-day Fairmount Dam in Philadelphia, the river occupies the Inner Coastal Plain Physiographic Province (Leverett 1957). The Inner Coastal Plain is characterized by extremely low relief, predominantly under 100 feet

AMSL. Fairmount Dam marks the location of the Fall Line, which separates the Coastal Plain from the Piedmont (Figure 3). Below the Fall Line, the Schuylkill can be considered an estuary and is subject to tidal fluctuations (Leverett 1957; Biesecker et al. 1968:5; Toll and Schwager 1983).

Above the Fall Line, the river enters the Piedmont Physiographic Province, which can generally be described as having considerably more relief than the Coastal Plain, with interspersed lowlands, gently rolling uplands, and low hills and ridges (Leverett 1957). From the Fall Line to the junction with Perkiomen Creek near Valley Forge is the Piedmont Uplands Province (Figure 3). Relief is marked, and the valley is often hemmed in by cliffs and bedrock exposures, particularly around the Norristown-Conshohocken-Manayunk area. Bedrock also outcrops in the river bed in this area and flow tends to be fast at such spots. Throughout this section, the Schuylkill follows a gently meandering to straight course (Bourquard and Associates 1968:VIII-11; Delaware River Basin Commission 1982). The principal tributary in the Piedmont Uplands is French Creek, which enters the main stem from the south. Wissahickon Creek flows in part through the Uplands but originates in and drains the Triassic Lowlands (Biesecker et al. 1968:155). Immediately to the south of the study area the topography of the Piedmont Uplands becomes somewhat more diverse. The Chester Valley and Kennett/Hockessin Lowlands display lower relief compared to the adjacent Uplands. These areas are poorly drained, with sinkhole complexes and swampy floodplains along minor drainages (Custer and Wallace 1982:141-142).

Between Valley Forge and Reading, the Schuylkill traverses the Triassic Lowlands section of the Piedmont Province (Figure 3). As the name implies, this region displays somewhat less relief than that in the Piedmont Uplands, and can be characterized as an area of gently rolling hills (Chester County Planning Commission 1963:3; Biesecker et al. 1968:5). The bulk of the present study area occurs in the Triassic Lowlands, and the great majority of archeological sites to be discussed herein are located in this province. The river displays varied hydrology in this area and its course ranges from nearly straight or gently meandering to torturous curves and reverse bends. Though the average gradient of the Schuylkill throughout the Triassic Lowlands and Piedmont Uplands is 2.6 feet per mile (Schuylkill River Project Engineers 1951:10), there are numerous localized areas of much steeper grade as the river cuts through different types of bedrock; riffles and exposed bedrock occur at several locations in this stretch of the river (Chester County Planning Commission 1963:3,19-20; Zandi 1971:10; Delaware River Basin Commission 1982).

Particularly noteworthy are the several reverse horseshoe bends between Valley Forge and Pottstown, and an absence of such bends between Pottstown and Reading (Figures 2-4). These deeply incised horseshoes are due in part to the river's downcutting through bedrock formations. Figure 4 shows the bedrock geology of the Schuylkill basin (Parker et al. 1964). Note the prominent reverse bend where the river traverses the juncture of the Brunswick, Lockatong, and Stockton Formations. The Brunswick and Stockton Formations consist primarily of sandstones and shales and are easily eroded; the argillite of the Lockatong Formation is less easily eroded and differential downcutting through these rocks has resulted in the complex reverse bends at this spot in the valley (Chester County Planning Commission 1963:19-20; Bourquard and Associates 1968:II-5). According to the map depicted in Figure 4, the bends immediately upstream occur wholly within the Brunswick Formation and not at a juncture with another formation. However, a map of this vicinity by Berg and Socolow (1978) records narrow bands of Lockatong argillite, as well as very resistant Diabase dikes and sills, cross-cutting the bend near Pottstown (see, for example, Figure 2 in Appendix III). Thus, this bend is the probable result of differential erosion around these various bedrock formations. Further, the bends may also be a partial result of downcutting around fault lines that occur in this vicinity but not further upstream, as suggested by Wagner (Appendix I) (see also discussion below). In any case, these large, incised reverse bends constitute conspicuous features of the river valley and of the surrounding landscape. They are not common elsewhere except for a section of the river immediately above Reading (Figures 2-4).

Two principal tributaries to the Schuylkill occur in the Triassic Lowlands, Manatawney Creek and Perkiomen Creek, as well as Skippack Creek, a sizeable tributary to the latter. Manatawney Creek enters the main stem at Pottstown and drains a portion of the Reading Prong east of the City of Reading (Figures 2-4). Perkiomen Creek and its various tributaries form a dendritic pattern draining most of the Triassic Lowlands between the Schuylkill and Delaware Rivers (Figures 2 - 4) (Biesecker et al. 1968:142). With few exceptions, the Perkiomen drainage lies entirely within the easily eroded soft shales of the Brunswick Formation (Figure 4). Though the average gradient of Perkiomen Creek is 36 feet per mile, most of the drainage appears to be considerably less than that; during low flow periods, the flow is actually rather small (Zandi 1971:19).

Perkiomen Creek and its tributaries flow through a dissected landscape of low rolling hills in nearly straight to gently meandering courses. Overall, drainage in the Triassic Lowlands is good and low order streams are numerous. While groundwater is plentiful, standing marshes and poorly-drained tracts appear to be relatively uncommon. This phenomenon may be a result of the easily eroded shale bedrock formation, which would tend to foster stream development and promote drainage. The Triassic Lowlands may be contrasted in this respect with the Lancaster-Frederick Lowlands, the Piedmont Lowlands subdivision located adjacent to the west. Here, the underlying bedrock is largely comprised of highly soluable limestone and dolomite, which have created indistinct drainage patterns with few small streams and few wet areas; sinkholes are common in areas of limestone bedrock (Carey 1959:1-2; Chester County Planning Commission 1973). This configuration is similar to that noted in the Chester Valley and Kennett/Hockessin Lowlands areas of the Piedmont Uplands, which lie nearby to the east.

At the City of Reading, the Schuylkill flows through a relatively narrow valley between the Reading Prong and South Mountain. The river traverses the Great Valley north of Reading (Biesecker et al. 1968:5). The river valley becomes torturous between Reading and the mouth of Maiden Creek as it cuts through carbonate rocks, faults, and diabase; further upstream, the course straightens somewhat as the river flows through the Martinsburg Shale Formation (Figures 2-4). The river gradient increases in this area. From immediately below Reading to Maiden Creek, the river falls an average of 5 feet per mile; above Maiden Creek, the gradient averages 8.5 feet per mile. While these figures are considerably higher than the 2.6 feet per mile average below Reading, they are considerably less than a gradient of 18 feet per mile further upstream near Pottsville (Schuylkill River Project Engineers 1951; Bourquard and Associates 1968:II-5-6). Maiden Creek and Tulpehocken Creek are the principal tributaries in this area and drain the Great Valley. Their relatively large drainage areas (over 200 square miles) and slight gradients (about 6 feet per mile) testify to the relatively low relief of the Great Valley compared to the more rugged areas of the Schuylkill basin. The most rugged terrain in the basin lies immediately north of the Great Valley. Here, the Schuylkill joins the Little Schuylkill and the other smaller tributaries. Gradients tend to be steep as the river takes on the characteristics of a headwater drainage.

The Holocene and pre-Holocene evolution of the Schuylkill River Valley have played major roles in determining the nature and configuration of the more recent river and attendant landscape. Most of the Schuylkill basin, and all of the present study area, lies south of the limits of the most recent glacial advance. This was the Woodfordian advance of the Wisconsinan glaciation, which occurred approximately 15,000 years ago (Crowl 1980); the southernmost extent of this advance occurs at Stroudsburg on the Delaware River (Leverett 1957). The Schuylkill Valley appears to have served as an important corridor for glacial meltwaters and for the transportation of glacial outwash; gravels attributable to glacial outwash have been found as far downstream as Norristown (Leverett 1957:86).

It appears that the Schuylkill was at one time a freely meandering river, and flowed through an unconsolidated floodplain. At some point prior to the Pleistocene, a dramatic increase in the erosive force of the river occurred, and it began downcutting into the underlying bedrock formations, resulting in an incised channel and several deeply incised meanders. It is uncertain whether this increase in erosion was the result of tectonic uplift or climatic changes (see Appendix II). The lowering of sea levels during the Pleistocene and early Holocene probably also contributed to increased rates of flow and erosion. In any case, downcutting continued until a new base level was reached, whereupon the river probably returned to normal flow and erosion rates. The ultimate result of these developmental processes is a river that is deeply incised in its relatively narrow valley.

The incised meanders in the Schuylkill Valley appear to be of the ingrown type, rather than the entrenched type. According to Ervin (Appendix II), ingrown meanders are characterized by an asymmetrical cross-section with slip-off slopes on inside bends and steep bedrock exposures on the outer edges of the curves. The ingrown meanders on the Schuylkill are attributable to lithology and the river's efforts to downcut through the different types of bedrock formations. The asymmetrical profiles of the meanders attest to lateral erosion by the river during the downcutting process. The prominent reverse bends in the Triassic Lowlands described above are of this nature, as is the bend at Valley Forge at the juncture of the Triassic Lowlands and Piedmont Uplands. The presence of ingrown meanders on the Schuylkill has several important implications. Geomorphological study at one archeological site near Valley Forge demonstrated that normal point bar and floodplain development was inhibited during the pre-Holocene period(s) of incising (see Section 8.0; Appendix II), and it is reasonable to posit that this phenomenon occurred elsewhere in the valley as well. Thus, while the Schuylkill can be fairly described as a "mature" river system (Chester County Planning Commission 1963:1), the developmental history of the river has resulted in fewer and less extensive floodplain tracts than in comparable mature river systems. Concomitantly, the ingrown meanders and incised nature of the valley create areas of steep cliffs bordering the main channel. The presence of these steep slopes can be expected to have had an effect on the nature of prehistoric settlement in the valley; one might anticipate settlement systems somewhat different from what would be expected in river valleys with more extensive floodplains.

As is the case with most large streams, rates of discharge and variation in stream flows is considerable at different points along the river (Schuylkill River Project Engineers 1951). This is primarily due to varying topography and climatic conditions along the course. In the Schuylkill Basin, higher average rainfalls and steeper topography in the northern reaches above Reading produce slightly greater average runoffs per square mile than in the Piedmont or Coastal Plain areas (Bourquard and Associates 1968:II-7). Records demonstrate that a major flood occurs in the Schuylkill Basin on average once every 10 years, and that minor overbank floods occur every three to five years, depending on location in the valley (Bourquard and Associates 1968:VII-1ff). However, the watershed is large and elongated and a major flood in one part of the drainage may constitute only a minor flood elsewhere. Numerous natural factors affect flooding in the Schuylkill Valley, and include narrow valley widths, narrow widths of most floodplain tracts, relatively steep channel gradients, and rugged terrain immediately adjacent to the main channel (Bourquard and Associates 1968:VII-2-3,14). Other factors affecting the nature of runoff and flooding are the lack of natural lakes throughout most of the Schuylkill basin (Schuylkill River Project Engineers 1951) and generally steep gradients of most small tributary streams. The presence, absence, and/or combinations of these factors all contribute to variability in flooding and to the effects of flooding on landforms in particular parts of the river valley. In short, the Schuylkill was a highly dynamic watercourse in the distant past and remains so today. This hydrological dynamism has important implications for understanding prehistoric settlement in the basin.

2.2 Climate and Vegetation

By late Pleistocene times, ca. 18,000 years ago, deglaciation was well underway but would take about another 6000 years to complete (Sirkin 1977:212; Hartzog 1979:15). While the Schuylkill Basin was not actually covered by the Wisconsinan glacier, its climate and initial vegetational succession were strongly affected by the glacial front lying to the north. The climate was cold and moist but began to ameliorate as the glacier continued to recede. Forests in southeastern Pennsylvania at this time were dominated by spruce, pine, oak, birch, and alder; extensive swampy areas occurred in low elevations (Carbone 1976:185). Mammoth and mastodon were present, as were more numerous caribou (Hartzog 1979:15).

Between about 11,000 and 9000 years ago, the brief Pre-Boreal/Boreal Episode evidences the last minor advance of the Wisconsin glacier. However, the climate continued to ameliorate. Coniferous and deciduous forests expanded in southeastern Pennsylvania at the expense of the formerly open, taiga-like habitats (Carbone 1976:187). This episode witnessed the beginning of the end for the Pleistocene megafauna in the region.

The relatively long Atlantic Episode occurred between about 9000 and 5500 years ago. This was a period of warming and drying conditions, though swamps or bogs were still extant in low-lying areas (Carbone 1976:189). Forests dominated by oak, hemlock, and pine were becoming established, with oak gradually surpassing pine as the predominant tree species (Sirkin 1977:215-216). The large Pleistocene mammals were probably extinct by this time. Also, northern ranging animals such as caribou and elk were retreating northward, out of the southern Pennsylvania region; essentially modern fauna was becoming established in the area. The period between 5500 and 2800 years ago is referred to as the Sub-Boreal Episode, which was a lengthy warm interval. The beginning of the Sub-Boreal witnesses the culmination of the mid-postglacial xerothermic, a period of maximum warmth and dryness that begins during the preceding Atlantic Episode (Curry 1980; Carbone 1982; Custer 1984a:89-90). The xerothermic is believed to have had considerable effect on plant and animal communities, as well as human settlement, in the Mid-Atlantic region, largely in the form of moisture stress. During this time, hickory began making inroads in the region and joined oak, hemlock, and pine as the dominant tree species. Large tracts of grassland also characterized this episode (Carbone 1976:189). Faunal species were wholly modern and included white-tailed deer, black bear, muskrat, beaver, rabbit, opossum, and squirrel.

At approximately 2800 years ago, the onset of the Sub-Atlantic Episode marks the establishment of essentially modern climatic conditions in southeastern Pennsylvania. The earlier portions of the episode witnessed a return to somewhat cooler and moister conditions, though these conditions remained favorable for the existence of modern oak-chestnut forests (Carbone 1976:192). The lowlands still supported swamps and bogs, but these were not so extensive as in earlier times. The climate can be considered temperate, and has continued to the present day, reflecting a general ameliorating trend since the beginning of the Sub-Atlantic Episode. Climatic fluctuations have taken place in the past 2800 years, but these have tended to be relatively minor.

With the exception of alterations due to modern human activities, as well as the chestnut blight in the early twentieth century, it has been suggested (Russell 1981:1) that pre-Colonial forests were not very different from modern forest configurations in the region. Vegetation within the study area falls in the Carolinian Biotic Province (Dice 1943:16-18), or the Oak-Chestnut Region of the Temperate Deciduous Forest Biome (Braun 1950). Principal tree species in the area include oak, hickory, white pine, beech, elm, walnut, ash, tulip-poplar, maple, wild cherry, cedar, and sycamore (Kunkle 1963; Jehle and Carr 1983:11). Accounts of early settlers in Montgomery County confirm the presence of these predominant species, as well as a few others (Toll and Schwager 1983:864). Understory vegetation varies with locale, but generally includes dogwood, chestnut sprouts, huckleberry, blueberry, ironwood, maple leaf, viburnum, sumac, poison ivy, spicebush, greenbrier, witch-hazel, and honeysuckle (Kunkle 1963; Jehle and Carr 1983:11). Further contributing to the vegetational diversity of the region are numerous fruit and herb species, such as blackberry, raspberry, elderberry, bayberry, pokeweed, goosefoot, smartweed, wild rose, wild grape, sassafras, holly, sumac, goldenrod, wintergreen, ragweed, wild onion, and several species of mushrooms. Most of these species were utilized by historic Indian and European occupants of the region, and were doubtless available to and used by earlier prehistoric residents as well.

The modern climate of the study area can be described as a humid, continental, long-summer climate with some moderating influences from the Atlantic Ocean. The region experiences frequent seasonal and daily changes in weather, has abundant and dependable precipitation, a warm summer with a relatively long growing season, and a moderately cold winter. The Appalachian Mountains act as a buffer against large, cold air masses, and the Atlantic Ocean tends to moderate extreme temperatures and provides a moisture source in the form of occasional coastal storms (Chester County Planning Commission 1963:53). The freeze-free growing season averages 180 days a year, and the yearly precipitation averages 45.42 inches; the wettest month is August, the driest is February. Average annual temperature is 53.4 degrees (Chester County Planning Commission 1963:54-59).

2.3 Fauna

Reconstructing the configuration of mammal, bird, and fish species in the Schuylkill Basin during the prehistoric past is a difficult undertaking. Detailed studies of wildlife in the region do not exist, and it is virtually impossible to ascertain specific ranges, distributions, or in some cases even habitats for most species. As a result, a discussion of animal life in the region must be limited to a general overview, which is based on modern reports as well as historical accounts. These sources often present conflicting information.

Some of the dominant mammal species present in southeastern Pennsylvania during the late Holocene were mentioned above. These include white-tailed deer, beaver, otter, muskrat, racoon, rabbit, woodchuck, fox, squirrel, porcupine, opossum, and skunk (Russell 1981:6; Jehle and Carr 1983:12). Black bear, timber wolf, mountain lion, and panther were also evidently present (e.g. Pennypacker 1872:72) but are long gone today (Doutt et al. 1977). It is thought that bison once inhabitated parts of southern Pennsylvania (e.g. Guilday 1936), but this possibility remains largely unsubstantiated (Doutt et al. 1977). The presence of elk in the region is problematic. While much of the elk population probably moved northward after deglaciation, herds nonetheless remained in more southerly climes and occurred throughout Pennsylvania (Doutt et al. 1977:19). In historic times, herds of 50 or more were observed to congregate at salt licks, and reportedly migrated during cold weather away from frozen riverine meadows into the heads of sheltered mountain coves, where they would browse on mast, twigs, and buds (Doutt et al. 1977:19). Most of the elk population in Pennsylvania was concentrated in the mountainous regions. However, during severe winters herds would sometimes migrate into the lower reaches of the Susquehanna and Delaware Rivers (Doutt et al. 1977:227). It can be assumed that similar patterns occurred in the more distant past, and that elk were present to some extent in the Schuylkill Valley.

Certainly the most common large mammal in the Schuylkill Basin was the white-tailed deer. Deer are presently abundant in southeastern Pennsylvania and were doubtless more so in the prehistoric past. Deer are semi-solitary animals and travel in small bands believed to be composed of small family groups. They tend to congregate or "yard" at food sources during winter months, particularly in valleys (Doutt et al. 1977:236). Deer have a relatively small home range and an individual may spend its entire life within the confines of a few square miles (Doutt et al. 1977:235).

Numerous species of birds can be found within the Schuylkill Basin. Migratory waterfowl are common, particularly nearer to the lower reaches of the river, and were important economic resources to prehistoric inhabitants. Wild turkeys were once very common in the region, as were wild pigeons (Pennypacker 1872:72); both were also probably important subsistence resources. Other potential food species include grouse and partridge. Bald eagles, ospreys, and turkey vultures were also once very common in the Schuylkill Valley (Pennypacker 1872:74); only the latter remain today in appreciable numbers.

The nature and configuration of fish species in the Schuylkill is difficult to reconstruct. Historic accounts often state that the Schuylkill was exemplary for its many species and large quantities of fish (e.g. Pennypacker 1872; Bean 1884; Nolan 1951), but the extent to which these reports may be exaggerated is uncertain. Also, it is difficult to reconcile and compare statements about the Schuylkill and the Delaware, and one is left to believe that huge amounts of fish were generally present in both rivers. Contemporary reports do little to clarify the situation. For example, Cavallo (1987:III-13-15) documents the presence of numerous species of anadromous and other fish in the Delaware up to the Fall Line at Trenton, and probably further upstream. The extent to which these data may be extrapolated to the Schuylkill is problematic, since the Schuylkill crosses the Fall Line only about five miles from its confluence with the Delaware. It is altogether reasonable to infer that fish species found in the Delaware would also be found in the Schuylkill, but how far upstream remains unknown.

Fish species reported in the Schuylkill include eels, trout, perch, catfish, pike, sturgeon, shad, rockfish, herring, and smelt (Newcomb 1956; Jehle and Carr 1983:12; Cooper 1983). Shad were one of the most plentiful species in the river in the early historic period. Vast numbers of shad were reported in the mid-eighteenth century as far upstream as Pottstown, where a fishery operated (Bean 1884). Shad were sufficiently abundant that early settlers could catch enough during one seasonal run to last until the following year's run (Pennypacker 1872:28). Some species of shad migrate upstream in the spring, others in the fall (Cooper 1983:49-52). Schools of migrating herring, rockfish, and sturgeon are also reported to have ascended the river during the spring, though precisely how far upriver they may have traveled is uncertain. Plentiful lamprey eels range throughout the course of the river (Nolan 1951:263).

3.0. PREVIOUS RESEARCH IN THE VICINITY OF THE LOWER SCHUYLKILL RIVER VALLEY

Although the Lower Schuylkill River Valley has not heretofore been the specific focus of a regional or interdisciplinary archeological study of the kind undertaken here, several important archeological investigations have been previously conducted in the region which are relevant to the present study. This chapter briefly summarizes the nature and results of some of the more salient studies in the Lower Schuylkill Valley or vicinity, in order to provide a research background against which the current study can be viewed.

3.1 Early Studies

In 1945, Phoebe H. Gilkyson published a brief article in the *Pennsylvania Archaeologist* that described areas along the Schuylkill River between Norristown and Pottstown that were known by artifact collectors to consistently produce large quantities of artifacts. This is the first published article focused specifically on the Lower Schuylkill River Valley. Gilkyson (1945:51, 56) related that the towns of Phoenixville, Norristown, and Pottstown, as well as other locations such as the State Hospital at Pennhurst, the mouths of Mingo, Perkiomen, and Pickering Creeks, and the villages of Parkerford and Linfield, have all produced Native American artifacts in abundance. However, Gilkyson also believed that no "permanent settlements" were in evidence. It is significant that Mason (1941), in an earlier article on archeological sites in Chester County, also noted that most of the above areas contain abundant evidence of archeological sites.

Of importance to the present study is Gilkyson's (1945:54-55) mention of the Indian Point Site (36 CH 53), discussed in detail later in this volume. Of this site, Gilkyson (1945:54) notes that it is the "richest Indian site in the Schuylkill Valley," producing material from all prehistoric time periods. She also notes that Dr. J. Alden Mason, Mr. Howard Pennypacker, and Mr. Irving Allott "sunk a number of test pits here but found nothing below the plowline" (1945:55). Based on the numerous sub-plowzone features that were discovered at the site during the course of the present study, Gilkyson's comment is clearly a misconception. Of the site-specific conditions present at Indian Point, Gilkyson (1945:55) makes only passing reference:

> No special kitchen middens have been found, but if [Indian Point] was only a hunting site, it must have been used for many seasons.... [Moreover], there is no spring or stream of water in these meadows, and the residents must have scrambled up and down a steep cliff more than a hundred feet high for their water supply ....

Gilkyson's brief article is important primarily for what it conveys regarding early collector activity in the Lower Schuylkill River Valley. It is quite obvious from her article that collectors have been plying the plowed fields along the Lower Schuylkill for at least the past century, and that literally thousands of artifacts have been dispersed in countless private collections in the area. While some of these collections were observed during the present study, none were fully documented or analyzed. Such an analysis in the future could go a long way toward placing the present study, as well as any subsequent investigation in the Lower Schuylkill River Valley, within a richer cultural context.

In 1941, three avocational archeologists discovered two small rockshelters near Broomall, Pennsylvania that appeared to contain human remains (Mason 1947; Smith 1956). Subsequently, Mary Butler (1947) reported a burial of a woman of about 37 years of age, lying flexed on her side, facing northwest. The skeletal remains rested on bedrock, about 5 or 6 inches below the surface of the rockshelter. The woman was about 5 feet 3 inches tall, had lost 25 teeth prior to her death, and also evidenced arthritis in the cervical and lumbar vertebrae. Although no formal grave offerings were associated with the burial, numerous artifacts were found in the immediate vicinity, including 23 knives or blades, ten drills, five scrapers, 66 triangular projectile points, a sandstone pestle, several hammerstones, and a conical-based, cordmarked ceramic pot (Butler 1947). Also present were several white clay smoking pipes manufactured in England in the last half of the seventeenth century, which provided strong evidence that the woman had been buried at that time. Based on this evidence, Butler (1947:247) concluded that the remains were those of "an important [Lenape] woman, possibly a chieftain's wife, who had done plenty of hard work during her lifetime, but was laid away in the style befitting her rank.

Butler's work is of extreme importance because it is the first of only two Lenape burial sites reported in southeastern Pennsylvania (the second is the Montgomery site, described later in this section). The highly acidic soils of the region, coupled with the three centuries of intensive development, have rendered the preservation of burial sites extremely rare. The location of the Broomall rockshelters is somewhat enigmatic, since it is far removed from any major river: the Schuylkill lies some eight miles to the northeast, and the Delaware approximately ten miles to the south. Accordingly, Butler (1947:247) suggested that the Lenape used the site as a temporary camp for hunting and/or gathering, and that the woman may have died in winter, when the rockshelter provided the only unfrozen ground suitable for burial.

3.2 Regional Perspectives

In the 1950s, archeologists working in the southeastern Pennsylvania region began to direct their efforts toward broader regional perspectives of prehistory. In these efforts, regional data were evaluated in the aggregate, and prehistoric manifestations in the area were placed within broader cultural-chronological patterns which were, for the most part, being developed elsewhere. Two such studies have particular relevance to the Lower Schuylkill River Valley.

The first was conducted by John Witthoft, and was initially published in the pages of the *Pennsylvania Archaeologist* in 1953. This study is one of the truly pioneering efforts at a regional perspective in the Middle Atlantic region, for it formally defines three projectile point types previously recognized only by collectors, and places them in their proper culture-chronological framework, i.e. the Transitional Period, or as it has more recently come to be known, the Terminal Archaic Period.

Working primarily with surface collected data, Witthoft (1953) examined nearly 10,000 specimens of the broad, thin, and frequently asymmetrical projectile points commonly found in southeastern Pennsylvania, previously referred to by collectors as "Berks County points", "butterflies", or "heart-shaped points." He classified the artifacts by formal attributes into three distinct types, and named them for the drainage systems within which the particular types were most common (the Susquehanna, Perkiomen, and Lehigh Broad Spearpoints). Furthermore, Witthoft identified the prevalent lithic materials from which they were made; rhyolite from the Gettysburg vicinity and Pennsylvania jasper from the Allentown vicinity were the overwhelming lithic preference for each of the three types. It is a testament to Witthoft's foresight that the broad spearpoint typology is still commonly utilized by archeologists today, and his temporal and formal definitions of these projectile points have proven to be well-founded throughout the subsequent decades of archeological research.

The second study undertaken with a regional perspective in southeastern Pennsylvania was Mason's (1959) distributional and attributional analysis of Paleo-Indian fluted points in the Delaware Valley. The 1950s were a time of intense interest in the material culture expressions of early man in the New World. Mason's effort, which built upon data published in an earlier article (Mason 1957), as well as on Witthoft's (1952) excavations at the Paleo-Indian Shoop Site located in the Susquehanna River watershed, was the first attempt at a regional analysis of the fluted point tradition in the Middle Atlantic region. As such, his study has some historical relevance to the present study.

Mason's (1959:5-12) findings can be summarized as follows. As of 1959, nearly 100 fluted points were known from the Delaware Valley watershed, which includes part of southern New York State, much of eastern Pennsylvania, and nearly all of New Jersey and Delaware; however, only a half dozen artifacts were reported from the Schuylkill River drainage. Most fluted points derived from upland terrain or bluffs located within ten miles of the Delaware River. "Locally available flinty rock" (Mason 1959:9) was the preferred lithic material, although specimens of quartz and quartzite were also known. The use of non-locally available stone of any kind was extremely rare. While Delaware Valley fluted points vary considerably in size, shape, and workmanship, most have straight, parallel sides and display basal and lateral grinding. Basal constrictions are rare. Fluting occurs for the most part on both faces, and ranges from short, hinge-terminated channel flakes to fully fluted examples.

Mason's work remains the definitive regional perspective on Paleo-Indian in the Delaware Valley. Although McNett (1985) has recently published a significant work on the Shawnee Minisink Site, a Paleo-Indian site located near the Delaware Water Gap, and Carr (1989) has recently re-analyzed some of the Shoop Site material, no one has yet attempted an update on Mason's (1959) regional perspective on the Paleo-Indian Period.

3.3 Problem-Oriented Studies

Beginning in the early 1970s and continuing into the 1980s, archeologists became increasingly concerned with focusing research efforts toward the explication of particular research problems or problem domains presented by the data with which they were working. Archeological studies of this nature were not particularly numerous in southeastern Pennsylvania during this period, though at least three problem-oriented investigations bear brief mention here, as they pertain to the Lower Schuylkill River Valley.

In 1970, Barry C. Kent produced a Ph.D. dissertation at Pennsylvania State University addressing the Archaic Period in an area that he termed the northern Piedmont, i.e. the general region between the Fall Line and the New York Palisades, and the Blue Mountains of Pennsylvania and the Potomac River (Kent 1970:6-7). This study had several ambitious goals, including 1) typological definitions of Archaic Period projectile points and knives, 2) the determination of a relative chronology for the types, 3) the determination of spatial distributions of the types throughout the northern Piedmont, and 4) the use of age-area diffusion and band territoriality models to explain the resultant distributional patterns of the tool types and their presumed users (Kent 1970:18-19). In his study, Kent analyzed and classified approximately 18,000 Archaic Period projectile points and knives residing in numerous collections in the Middle Atlantic region, which constitutes a truly monumental undertaking. While he did produce a definitive typology for Archaic point and knife forms, and was also able to isolate chronological and spatial distributions for most of the types, he was less successful in applying his diffusion and band territoriality models as devices to explain the resultant distributions. The principal reason for this shortcoming is that the data were not sufficiently quantifiable to be adequately or realistically reflective of the rather specific expectations of his ethnographically-based theoretical models. Accordingly, his postulates of the average size of band territories (approximately 500 square miles), band size (approximately 25-50 persons per band), and population density (approximately 5-10 persons per 100 square miles), while largely accurate for the ethnographic case, were not well reflected or demonstrated by the archeological data. Similarly, his conclusions regarding the mechanisms of culture change, i.e. diffusion and migration (Kent 1970:74-77, 90-100), remain difficult to demonstrate with the data. Nonetheless, Kent's early effort to utilize explicit anthropological models in explanations of archeological patterning is laudable.

Another contribution of Kent's study concerns the definition of a series of projectile point types for the Archaic time period. In all, 14 types were defined, most of which exhibit several variants (Kent 1970:123-156). In addition, 24 "plotting areas" were defined (1970:160-165), which are subareas of the northern Piedmont based on drainage systems, mountain ridges, other landforms or, in some cases, arbitrary boundaries. In these areas, relative frequencies and percentages of the occurrences of the various projectile point types were calculated. Interestingly, one of these "plotting areas" (Kent 1970:163) conforms roughly with the Lower Schuylkill River Valley as defined in the present study. While Kent applied specific names to several of his projectile point types (1970:123-155), relatively few seem to have subsequently gained acceptance among archeologists working in the region. Accordingly, such names as the Conodoguinet, Swatara, Piney Island, Duncan's Island, Brandywine, Pequea, Conewago, and Schuylkill projectile points (the latter defined as having a high frequency of occurrence in the Lower Schuylkill River Valley) are to be found predominantly only in Kent's dissertation. This fact seems curious, since a careful reading of Kent's typology reveals that considerable morphological variability is accommodated by the several types and variants, which in turn suggests that a reconsideration of some of these types could go a long way toward the resolution of chronic projectile point typological problems in the region. The likely reason for this lack of use lies not so much in a rejection of Kent's typology, but in the unpublished nature (and hence relative obscurity) of Kent's dissertation.

Another problem-oriented study undertaken in the vicinity of the Lower Schuylkill River Valley is that conducted by Marshall Becker at the Montgomery Site, a Lenape burial ground located in Wallace Township, Chester County. The site was first discovered in 1952, when C.A. Weslager (1956:112-114) conducted subsurface testing near the stump of a large tree which, according to oral tradition, had marked a Lenape site. Weslager succeeded in uncovering a single grave containing numerous beads, three clay pipes, two gunflints, a brass button, and numerous pieces of rusted iron (Becker 1982). In 1978, Becker (1980b, 1982) resumed the work begun by Weslager 26 years earlier. These excavations produced evidence of 15 burials, and subsequent work since 1978 has located an additional seven burials.

All 15 graves excavated in 1978 by Becker were regularly spaced and aligned east-west, with the head pointing east. Unfortunately, most of the skeletal materials were poorly preserved, and in some cases were not preserved at all. Nevertheless, Becker was able to determine the age and sex of some of the burials. Since teeth were preserved in nearly all the burials, Becker was also able to make some observations regarding dental health and diet. Only three or four teeth showed evidence of dental caries, and only one showed signs of periodontal disease. Tooth wear in most cases was remarkably slight, suggesting the consumption of many "raw, slightly cooked, or gritty products" (Becker 1982). Given that two of the deceased were infants, seven were children, and none were definitively identified as older than 25, the relatively good condition of the teeth doubtless indicates that they succumbed to fatal illnesses at early ages, before their teeth began to erode or decay.

Artifacts found in the graves were rather remarkable, and included hundreds of various types of glass beads, some encircling the neck, others in clusters at the waist, suggesting that they were the contents of pouches. Also recovered were clay pipes, gunflints, brass and pewter buttons, brass, bronze, pewter, and iron buckles, brass thimbles and bells, iron knife blades, and at least one shell pendant (Becker 1982). One particularly significant artifact - a silver brooch with a crowned heart design - appeared in one of the seven graves excavated by Becker after 1978. It bore the mark of Cesar Ghiselin, the first known silversmith in Philadelphia, who plied his trade in the silver market of early eighteenth century Philadelphia until his death in 1733 (Becker 1984:29). This brooch is the only piece of trade silver ever found at a Lenape site.

In the early 1980s, the Pennsylvania Historical and Museum Commission and the Pennsylvania Bureau of State Parks jointly sponsored a research program in the southeastern Pennsylvania Piedmont (Jehle and Carr 1983). The goals of this project were essentially twofold: 1) to evaluate the effectiveness of various field techniques utilized on thinly occupied, non-stratified upland prehistoric archeological sites, and 2) to evaluate the significance of such archeological sites. Six upland archeological sites were investigated, all located in three state parks (Evansburg, French Creek, and Jacobsburg). Both Evansburg and French Creek State Parks are located partially within the Lower Schuylkill River Valley.

To test the effectiveness of various field techniques on upland plowzone sites, Jehle and Carr (1983:39-50) employed subsurface test units of two principal sizes, .5 and 1 meter squares. No subsurface features of any kind were found utilizing these sizes of test units. Results indicated, however, that .5 meter units were useful in defining the presence or absence of archeological sites, and also enabled the identification of major activity areas within sites. They apparently were not useful, however, in accurately ascertaining site boundaries with a high degree of accuracy, nor were they of much use in providing information on changes in artifact density across a site.

One meter test units, on the other hand, proved more effective in defining changes in artifact density, enabled the more precise definition of site boundaries and, not surprisingly, produced greater quantities of artifacts (Jehle and Carr 1983:43-44). As a result, Jehle and Carr (1983:44) recommended the use of .5 meter square test units only when the task at hand is to define presence or absence of a site, and recommended the use of 1 meter square units when further evaluation of a discovered site is the required task. These test unit sizes have since been standardized by the Pennsylvania Historical and Museum Commission in the state guidelines for compliance archeological surveys and evaluations.

The archeological results of the testing of the six prehistoric sites were unfortunately meager, generally reflecting the current state of knowledge of such sites in upland settings of the Pennsylvania Piedmont. Sites were ephemeral, frequently with mixed, multiple components generally spanning the Late Archaic through Late Woodland time periods, indicating repeated yet ephemeral use over several thousand years. Deposits were restricted to the plowzone, no features were found and, although spatially discrete activity areas were defined at most of the sites, neither temporal nor functional isolation could be attained (Jehle and Carr 1983:64-88). Most of the sites represented seasonally used hunting and/or food procurement and processing stations, and none of the sites yielded broadly applicable or otherwise significant information. The report concludes with a series of useful management constructs and recommendations with which the Bureau of State Parks can effectively manage archeological resources under its jurisdiction.

3.4 Compliance Studies

In the late 1970s and into the 1980s, implementation of the mandates of the National Historic Preservation Act of 1966 began to take hold on a nationwide basis. During this period, compliance archeological studies were undertaken with increasing frequency, and this trend is continuing at the present. The Limerick Transmission Line Survey project, of course, is one such study. Several other such studies have also been undertaken in or near the Lower Schuylkill River Valley, and have contributed significantly to our knowledge of the prehistoric inhabitants of the region.

As part of the Corps of Engineers, Philadelphia Districts' flood control and public recreation program at Blue Marsh Lake in the Tulpehocken Creek Valley in Berks County, Fred Kinsey initiated an archeological reconnaissance survey of the affected area in 1976. Twenty-three sites were identified by Kinsey (1976) during this survey, nearly all dating to the Late Archaic, and Kinsey presented a predictive model for the location of such sites along the Tulpehocken Creek Valley. The locational criteria recognized by Kinsey (1976:59-60) were five in number, and included hilltop and hillside, swampy floodplains, dry floodplains, terraces along the Tulpehocken, and terraces along tributaries of the Tulpehocken. He found that hilltops, most often associated with nearby springs, comprised the loci for 13 of the 23 sites, and that artifacts from these sites were predominantly made of quartzite. In contrast, floodplain sites most often contained artifacts of jasper and chalcedony. Kinsey (1976:65) hypothesized that the floodplain sites were transient camps occupied in the course of hunting and processing game, and that the hilltop sites were loci of more extended occupation as seasonal base camps.

As a continuation of the same Corps of Engineers Blue Marsh Lake project, Snethkamp, Ebright, and Serena (1982) set out to test Kinsey's hypotheses, as well as other models of Late Archaic settlement patterns and lithic procurement. This lengthy study is multifaceted and detailed, and only the salient points regarding settlement patterning will be summarized here. It was found that there appears to be very little to no Woodland Period occupation of the greater Blue Marsh study area. Rather, the vast majority of sites were occupied during the Late and Terminal Archaic. A locational analysis of sites revealed that there are differences in the use of space within the study area: in general, larger sites tend to be located near Tulpehocken Creek or its tributaries, always on terraces or small knolls, and never more than 100 meters from water. Small sites, yielding less than five artifacts, tend to occur on knolls often 200 meters or more from a water source (Snethkamp et al. 1982:11.07ff). Further, it was found that sites along small first or second order streams are more likely to be single component, while sites along the larger watercourses tend to have multiple occupations. Test excavations at several sites revealed the rather ephemeral nature of occupations in this area: almost no features, postmolds, or other evidence of structures or sustained habitation was found on any of the sites. Also, there appear or be few or no vertically stratified sites in the Blue Marsh area. The Blue Marsh Lake project provides an important comparative data base for the present study from the headwater drainages of the Schuylkill River, and comparisons and contrasts between the study areas will be undertaken in later sections.

Three compliance surveys conducted in the early 1980s by John Milner Associates, Inc. in or near the Lower Schuylkill River Valley have contributed data on the nature of settlement patterning in the southeastern Pennsylvania Piedmont. During a survey of a natural gas transmission line for Texas Eastern Transmission Corporation, Hoffman, Roberts, and Struthers (1982) documented five prehistoric sites along an upland, 10 mile linear right-of-way, partially bisecting the Upper Schuylkill River Valley in an east-west trend. The results of the survey confirmed the general expectations of low site and artifact densities and a predominance of Late Archaic occupation, particularly in the Tulpehocken and Perkiomen Creek areas. The results also confirmed the settlement patterns predicted by Kinsey (1976) and Snethkamp et al. (1982), and indicated highly ephemeral and transient occupations (Hoffman, Roberts, and Struthers 1982:31).

The remaining two surveys conducted by John Milner Associates, Inc. were both in close proximity, namely a portion of the Great Valley in the vicinity of Exton. As part of environmental planning for the proposed Exton Bypass, Roberts, Hoffman, and Meyer (1983) surveyed approximately 12 miles of proposed highway corridor between Route 202 and the Route 30 Downingtown Bypass. One of the surveyed corridors consisted of existing Route 30, while the other was a proposed new alignment lying south of Route 30. Twenty-four prehistoric sites were identified during the survey, a surprising 18 of which were located within 50 meters of either side of highly-developed Route 30. Nearly one-half of the sites were ephemeral flake and core scatters lacking diagnostic artifacts, and nearly all sites were located in upland flats in cultivated fields. Several sites, however, contained more substantial evidence of occupation and use, and three yielded fragments of Late Woodland pottery (Roberts, Hoffman, and Meyer 1983:63). Interestingly, the Exton vicinity is reputed to be the location of Katamoonchinck (or Catamoonskink), an alleged Lenape village (Mason 1941; Wolf and Snyder 1982). Although one of the Exton Bypass sites, located near the intersection of Routes 100 and 30, produced several sherds of Early through Late Woodland pottery, no hard evidence confirming the presence of Katamoonchinck was found. Most of the sites identified during the survey, in fact, appear to date primarily to the Archaic time period.

At the nearby Church Farm School, located immediately northwest of the intersection of Routes 202 and 30, Zatz, Kingsley, and Roberts (1987) recorded 18 prehistoric archeological sites in advance of proposed development of the property by Rouse and Associates. Nearly all of these sites were found to occur on upland flats or small rises, and most were highly ephemeral in nature, with no diagnostic artifacts present. Eight of the sites clearly date to the Archaic Period, particularly the Late Archaic, and four of these also appear to have one or more Woodland components. Significantly, one site dating to the Paleo-Indian Period was recorded (Zatz, Kingsley, and Roberts 1987:6-12), adjacent to but outside of the area of proposed development.

The results of the three John Milner Associates, Inc. surveys noted above, combined with the results of Kinsey's (1976) and Jehle and Carr's (1987) studies and the several transmission line reports produced during the present study, clearly indicate that the interior upland settings of the Lower Schuylkill River Valley vicinity (i.e. those located at some distance from major drainages) were variably utilized during prehistoric times. Most sites are highly ephemeral in nature, indicative of short-term, presumably repeated use over time, largely for purposes of hunting and other food procurement or processing activities. The floodplain and bluffs of the Schuylkill River itself, however, generally witnessed more substantial occupations, as the remainder of this report will attest.

One other study in the Lower Schuylkill River Valley bears note in this overview of previous research, not because it contributed significantly to our knowledge of prehistoric archeological resources in the region, but because of the particular topographic factors which made the conduct of the research extremely difficult, yet informative. The project was undertaken by Struthers et al. (1984) for the Philadelphia Industrial Development Corporation in the Eastwick Urban Renewal Area, located near the confluence of the Schuylkill and Delaware Rivers. This area, situated at the interface of marsh and upland environments, was doubtless an important location for Native American habitation sites throughout prehistory. However, episodes of extremely deep infilling, stream channelization, grading, and other forms of modern land engineering have totally obscured all natural topographic features (Struthers et al. 1984:1), thus necessitating the testing of the property to a depth of nearly 40 feet with a truck-mounted drilling rig. Two coring techniques were used, including an auger, allowing for the extraction of a relatively larger volume of soil which might contain artifacts, and a spoon, which allowed for more precise stratigraphic control. Although no concrete evidence of prehistoric occupation was found, the latter samples were used as the basis for the presentation of two alternate paleogeographic reconstructions (Struthers et al. 1984:16).

The two alternate models were necessitated by the fact that basal sediments extracted by the auger and spoon samples could not be precisely identified. Struthers et al. (1984:24) strongly believe that the basal sediments represented nineteenth century fill deposits. This reconstruction suggests that the project area "would have occupied a low-lying delta-floodplain some distance away from well-drained Pleistocene land surfaces" (Struthers et al. 1984:27) and would not have been a favorable location for prehistoric occupation(s). If, however, the basal sediments were actually part of the naturally-occurring Cape May Formation, then the project area would have been located on "a finger of Pleistocene sands and gravel into the delta-floodplain and would have been an optimal location for prehistoric sites" (Struthers et al. 1984:27). Although the correct interpretation may never be known, Struthers et al.'s (1984) study is significant in that it graphically illustrates the difficulties involved in predicting and discovering locations of prehistoric archeological sites, and in reconstructing paleoenvironmental settings, in areas where extensive land modifications have taken place.

4.0 METHODS OF OVERHEAD TRANSMISSION LINE CONSTRUCTION AND DISTURBANCE TO THE ARCHEOLOGICAL RECORD

4.1 Introduction

As noted earlier in this report, some segments of the Limerick Nuclear Generation Station transmission lines were slated for new rights-of-way, although the majority were designed to replace existing, but outdated, transmission lines. Accordingly, the Lower Schuylkill Valley Archeological Project provided an opportunity to evaluate construction techniques of overhead transmission lines and their effects to archeological sites. Thus, this section of the report focuses on factors of archeological disturbance stemming from the construction of overhead transmission lines.

4.2 Previous Related Studies

Numerous studies have been conducted on the effects that various logging techniques impart to soil structure (Garrison and Rummell 1951; Steinbrenner and Gessel 1955; Dyrness 1965; Fredriksen 1970; Froehlich 1976), water resources (Brown 1975; Patric 1976), and vegetation (Ruth 1967; Klock 1975). All of these studies were undertaken in the context of forest-related logging enterprises, with particular emphasis on soil disturbance and resultant loss. None explicitly address effects to archeological sites and indeed, the latter type of study is conspicuously rare in the archeological literature. However, in 1975, DeBloois et al. investigated the effects of pinyon-juniper chaining methods on archeological sites in the desert southwest, and in 1978, Gallagher conducted a study that measured the effects of scarification techniques (ground preparation for replanting) on archeological sites in the Sawtooth National Forest of south-central Idaho. For the purposes of the present evaluation, the work of Bryant et al. (1982), which evaluated the effects to archeological sites of two yarding techniques (tractor over bare ground and high lead cabling), coupled with the work of Dyrness (1965), is the most relevant.

Bryant et al. (1982:2-5) identify four environmental factors that typically affect the nature and extent of surface disturbance. These factors include degree of slope, soil moisture content, soil type, and type of understory vegetation. In general, the first two factors are the most critical, in that the greater the slope and soil moisture content, the greater will be the effects to the soil surface resulting from disturbance activity. In this regard, Dyrness (1965) notes that disturbance is considerably less during dry conditions when soil moisture content is low. Bryant et al. (1982:2-5) also identify two principal types of disturbance, including immediate direct effects (such as plowing and soil displacement), and delayed or secondary effects (such as loss of soil permeability, resulting in increased erosion). Bryant et al. (1982:2-7) further point out that direct effects by such agents as tractors or plows normally result in the occurrence of one or more of the following three classes of data loss from an archeological site:

Class 1) Artifact breakage and/or modification;

Class 2) Artifact displacement, resulting in alteration of contextual associations with soil strata and cultural features; and,

Class 3) Exposure of artifacts on the surface, resulting in eventual artifact loss.

Of these classes of archeological data loss, Bryant et al. (1982:5-26) consider Class 1 to cause the least amount of data loss, Class 3 an intermediate loss of data, and Class 2 the greatest data loss.

Although not explicitly concerned with archeological sites, Dyrness (1965) established four classes of soil disturbance that are nevertheless quite useful when utilized in conjunction with Bryant et al.'s (1982) three classes of archeological site disturbances. Dyrness' (1965) classes include the following:

Class 1) Undisturbed: litter still in place with no evidence of disturbance;

Class 2) Slightly Disturbed: litter partially removed and undisturbed mineral soil exposed, with litter and mineral soil intermixed at approximately 50 percent of each;

Class 3) Deeply Disturbed: surface soil removed and subsoil exposed, soil surface seldom covered by litter,

Class 4) Compacted: obvious soil compaction caused by heavy equipment.

With regard to the relative effects to archeological sites near the ground surface, Bryant et al. (1982:2-7) point out that Dyrness' Class 2 and 3 disturbances are the most detrimental, with both normally resulting in severe direct effect. Although Dyrness' Class 4 disturbance may result in the direct effect of artifact breakage, its most prevalent type of effect is secondary. That is, compaction normally produces much lower soil permeability, thus resulting in the secondary effect of erosion and run-off and, perhaps, ultimate artifact displacement and/or loss. The technique of clear-cutting (i.e. the total removal of trees), which is frequently used by loggers and also occasionally used during the construction of transmission lines, normally results in compaction of some of the ground surface, and as a result the clear-cut area frequently becomes subject to erosional processes.

In the sections that follow, techniques utilized in constructing overhead transmission lines are evaluated in relation to the classes of soil disturbance set forth by Dyrness (1965) and the classes of archeological data loss defined by Bryant et al. (1982). It is intended that this analysis will be of some benefit to the Philadelphia Electric Company, as well as other utilities, in future planning efforts with regard to archeological resources.

4.3 Types of Overhead Transmission Line Support Structures

In the main, there are three types of transmission line support structures commonly constructed today by utility companies. These include the lattice structure, the railroad overbuild structure, and the tubular steel pole. It should be noted that the Nuclear Regulatory Commission (NRC) or Federal Energy Regulatory Commission (FERC) normally mandates the type of structure to be built, depending on various aesthetic, logistical, and functional factors. The predecessor of these three support structures was the single wooden pole which, although still visible in many rural areas, is rarely newly constructed, primarily because it does not provide sufficient support for today's high voltage lines (Peter Cava, personal communication 1985).

Lattice-type support structures occur in various specific shapes and sizes but, in general, all are supported by four inverted stub-angle pyramids of galvanized steel, each in turn supported by a concrete foundation (PECo 5-7080-D 1986:1). The lattice structures are normally constructed of aluminum, not galvanized steel, and can be pre-assembled in sections either off- or on-site. Although varying in height, depending on specific transmission requirements and localized topographic conditions, most lattice structures are between 65 and 100 feet tall (Figure 5).

The railroad overbuild structure is normally employed in situations where a support structure is required along a currently occupied railroad right-of-way or if joint use of an extant railroad structure is desirable (PECo 1968:3). This structure normally has only two support columns of single-beam galvanized steel construction (Figure 6). Like the lattice-type structure, the railroad overbuild structure is also supported by concrete footings. Again, the height of a typical railroad overbuild structure varies according to specific conditions, but structures as tall as 110 feet are not uncommon.

The final type of support structure is the tubular steel pole, by far the type most commonly constructed today (Figure 7). Tubular steel poles are manufactured in sections and, although they can be pre-assembled elsewhere (PECo 5-7080-E 1986:1), they are normally assembled on-site. Unlike the lattice or railroad overbuild structures, the tubular steel pole normally requires only a single concrete footing. The tubular steel pole can be considered the modern-day analog to the old single wooden pole, although it is not necessarily the cheapest support structure to build. Occasionally, tubular steel poles are placed in multiple-pole configurations, such as in a three pole deadend structure (Figure 8). Tubular steel poles are generally taller than lattice-type structures, frequently attaining heights of 115 feet or more.

The spacing of support structures across the landscape, no matter which type is erected, is largely dependent on local topographic and demographic conditions. However, the general rule of thumb for PECo is to erect as few structures as possible and still have a serviceable and safe line. This goal is in accordance with PECo's (1968:1) written policy which states that a primary goal is "to provide right-of-way which is pleasing in appearance and as unobtrusive as possible, without jeopardizing the high reliability inherent in the Electric Company's transmission system." In order to accomplish this goal, the location and spacing of structures may vary greatly by consideration of several factors, including the avoidance of structure locations on hilltops, the utilization of railroad or limited access highway rights-of-way, the erection of structures at the edge of a wooded area rather than in it, and the utilization of shorter spans and lower structures if structure height is a distinct visual detriment (PECo 1968:3-4). Importantly, effects to archeological sites can frequently be avoided within the rather wide latitude afforded by support structure location requirements (Weir 1986:5, 8; Gilbert/Commonwealth 1988:79). In short, the spacing of transmission line structures is accomplished by careful planning and design tailored to each topographic, demographic, visual, or cultural situation, and not by a rigid incremented spacing regimen.

4.4 Methods and Techniques of Construction

In general, four aspects of transmission line construction can potentially affect the integrity of archeological sites. These four aspects include a) clearing of rights-of-way, b) construction of access roads, c) coring and blasting (when necessary) for concrete footings, and d) installation of counterpoise or ground rods. Each is discussed below.

4.4.1 Clearing of Right-of-Way

In keeping with PECo's (1968:1) policy of creating right-of-way which is "...pleasing in appearance and as unobtrusive as possible...," vegetational clearing is normally kept to a minimum, as long as the safety and reliability of the transmission facility is not compromised. Thus, wherever possible, a policy of "selective thinning" is followed. This practice entails the selective removal of shrubs and brush comprising the understory, as well as the thinning of "danger trees." Danger trees are defined as

> Any tree or shrub which, in whole or in part, exists or grows within the 'danger zone' with respect to power line safety. Where most of the tree falls within the danger zone, the tree shall be removed (PECo 1968:Appendix).

This practice results in less than total clearing of vegetation in most cases. Although the width of the "danger zone" is not specified in PECo's policy, presumably it has a direct relationship to the height and voltage of the transmission line *vis a' vis* the height and proximity of the vegetation. Total clearing of vegetation (i.e. clear-cutting), however, is sometimes required along portions of a right-of-way. Situations which normally require this technique include locations where additional area is needed for the pulling of cable, areas where woods and/or "danger trees" are extremely dense and have no undergrowth to retain, and areas of small but dense understory growth which present potential fire hazards (PECo 1968:7).

4.4.2 Construction of Access Roads

Temporary roads for the provision of access for construction teams are frequently necessary. Such temporary roads are limited by specification to 15 feet in width (PECo S-7080-B 1983:1) and, once constructed, are the only access roads used by construction vehicles. Since much of the equipment necessary for erecting towers is quite heavy, as are the structures themselves (especially if assembled off-site), the roads can be somewhat substantial. Accordingly, the 15-foot wide right-of-way normally is graded to at least one foot below surface, with the spoil piled on either side of the cut, and the cut infilled with ballast rock. After the structures are built and the access road is no longer needed, the ballast rock is removed and the spoil replaced in the roadbed (Zatz et al. 1984a:4; Zatz and Joire' 1986:1). In areas requiring direct access to the public road system, the access road is normally paved with asphalt for a minimum distance of 20 feet from the public road (PECo 1968:5-6).

Temporary roads occasionally are required to provide access across streams or creeks although, in most cases, alternative access from the opposite side is possible. In cases where streams must be crossed, galvanized steel corrugated pipe is laid down, covered with an earth and stone fill, and each stream bank is graded as necessary into the culvert in order to provide sufficient passage (PECo 5-7080-B 1983:1). When such roads spanning creeks have served their purpose for support structure construction, the corrugated pipe is left in place to aid in drainage and in case stream passage is needed in the future.

It should be noted that, once again, it is PECo's stated policy to minimize the impact of construction of such access roads. This is done by locating the access roads so as to interfere with property use as little as possible, and by aligning the access roads at angles which avoid vistas up the transmission line (PECo 1968:6). Every effort is also made to use existing access roads, farm lanes, construction staging areas, or other similar extant facility to gain access to support structure locations. However, such facilities frequently consist only of packed earth, and lack sufficient sub-base to allow the transport of heavy equipment and supplies, thereby necessitating the building of access roads to the specifications noted above.

4.4.3 Coring and Blasting for Concrete Footings

Before overhead transmission structures of any type can be erected, coring must be undertaken to accommodate substantial concrete footings. In the case of lattice support structures, four such footings are required, one for each stub-angle support. Furthermore, two separate coring operations are required for each structure location, the first to drill test holes to determine the presence and/or depth of bedrock, and the second to dig the holes for each footing. Most holes for footings in the southeastern Pennsylvania Piedmont are excavated to bedrock, but occasionally, design depth is reached without encountering bedrock (PECo S-7080-C 1986:1).

According to specifications, all excavated holes are to have vertical sides (PECo S-7080-C 1981:1). Although the diameter of the hole varies depending on the type of structure slated for the location (PECo S-7080-C 1986:5), most of the holes excavated for the Limerick transmission lines were between 6-10 feet in diameter (Zatz 1984:3; Zatz et al. 1984a:3; 1984b:3; Zatz et al. 1985:4). The holes are normally excavated using an auger drill, and the holes are then lined with reinforcing bar and/or corrugated or smooth steel casings, and filled with concrete to specification (PECo S-7080-C 1986:1-2).

Several ancillary activities associated with coring for concrete footings occasionally take place as required. First, small diversion ditches or swales can be built in order to prevent rain or surface water from accumulating in the excavated hole (PECo S-7080-C 1986:1). Second, excavated backfill, normally consisting of "clear, dry, well-graded fill material," can be placed "in a graded embankment...in the immediate vicinity of the structures" (PECo S-7080-C 1986:2), and must be tamped in two-foot increments. In cases where grading is undertaken, final grade is required to conform as closely as possible to that of the surrounding area (PECo S-7080-C 1986:2). Finally, although infrequently required, blasting may be necessary if rock impenetrable with an auger drill is encountered prior to achieving design depth. Such blasting is self-contained, however, to deeper subsurface bedrock deposits (Peter Cava, personal communication 1986).

4.4.4 Installation of Counterpoise System

A counterpoise installation entails connecting copper wire to the support structure for purposes of grounding. Only those support structures "where footing resistance measurements by the Power Company indicate such installations are required" (PECo S-7080-G 1983:1) are subject to counterpoise installation. This copper wire is installed at a minimum of 24 inches below grade, and connected to a wire protruding from the concrete foundation. Although the length and pattern of a counterpoise system can vary, in general, such wires are "laid in a longitudinal direction along the line" (PECo S-7080-G 1983:1). The use of a small trencher or narrow blade plow is recommended for excavating to the required 24 inches, and each trench must immediately be backfilled and tamped (PECo S-7080-G 1983:1).

4.5 Methods and Conditions of Archeological Field Investigation

The specific methods employed in the Phase I, II, and III investigations of the Limerick Transmission Line Surveys are discussed in Section 5.0. For present purposes, it is important to note that the entire length of transmission line right-of-way, regardless of support structure location, was subjected to Phase I identification/location survey. In addition, areas where temporary access roads were necessary were also subjected to Phase I survey. Not all archeological sites identified during Phase I were evaluated for National Register significance at the Phase II level. Sites subjected to Phase II were selected according to their location within the right-of-way in relation to proposed support structure locations or their relation to proposed access roads. Phase III data recovery was undertaken only where adverse effect to significant sites could not be avoided. These areas were limited, in all cases, to support structure locations and areas where access roads would adversely affect portions of significant archeological sites. These investigative strategies are similar to those utilized by other researchers in conducting archeological surveys in association with overhead transmission line rights-of-way (e.g. Office of Public Archaeology 1986a, 1986b; Weir 1986:2; Strauss 1987a:1-2, 1987b:1-2).

Of further importance is the fact that the majority of transmission line rights-of-way investigated during the Limerick Transmission Line Surveys consisted of previously existing right-of-way in which transmission lines and support structures were extant prior to the survey. Thus, the proposed lines and support structures were designed as replacements for previously existing facilities and, in some cases, as a new facility paralleling old line. As such, most of the surveyed rights-of-way were cleared when the existing lines were installed between the 1920s and 1960s, and many of the newly designed structures were slated for locations identical with or adjacent to the extant structure locations. Some support structure locations, however, were planned for new loci. As a result, it is important to realize that most of the surveyed areas had previously been subjected to many of the construction techniques discussed earlier in this section. This circumstance is different from many similar surveys (e.g. Ranere and Hansell 1983; Newkirk and Bambrey 1984, 1985; Strauss 1987a, 1987b), in which the transmission line right-of-way was newly designed and, therefore, devoid of extant support structures.

4.6 Disturbance to the Archeological Record

Although the goals of the Limerick Transmission Line Surveys primarily focused on the location/identification, evaluation, and data recovery (where necessary) of archeological sites in preparation for planned future construction of new transmission lines, the results of the survey nevertheless made it possible to provisionally evaluate the types and severity of ongoing and prior disturbance to the archeological record as a result of the construction of existing overhead transmission lines. The following section briefly evaluates each of these previously noted methods of construction *vis a' vis* their effects to archeological sites, where such effects could be detected. The evaluation is presented in relation to Dyrness' (1965) four classes of soil disturbance and Bryant et al.'s (1982) three classes of archeological data loss.

4.6.1 Clearing of Right-of-Way

Clearing of right-of-way, as previously noted, is normally kept to a minimum and undertaken only in areas of heavy vegetational growth where it is not possible to route a transmission line elsewhere. All structure locations, however, must also be cleared of any vegetational impediments to their construction, but these areas are normally only as large as necessary to undertake construction in the footprint of the structure (PECo S-7080-B 1983:1). Clearing operations generally require several types of activities including, as necessary, selective removal of trees and undergrowth, selective pruning or trimming of same, and stump removal. The services of a private tree clearing contractor is usually required who will utilize, as appropriate, small equipment such as a truck and brush chipper. Most of the actual work, however, is undertaken by hand, using chain saws and other tree-cutting implements.

It is important to note that areas of actual disturbance to the archeological record as a result of generalized right-of-way clearing are difficult to detect. Areas of total clearing, of course, can result in rather severe surface, and perhaps subsurface, disturbance, since the clearing crew is required by specification to "clear and *grade* [emphasis added] a 15-foot wide trail to be used as an equipment roadway at locations ..... designated on specific job specification and/or drawing" (PECo S-7080-B 1983:1). The nature and extent of such grading, of course, is left up to the contractor as required by site-specific conditions, but grading of any kind doubtless has the potential to compromise the integrity of archeological sites, particularly those near or at existing grade such as many of the sites located in shallow upland soils in the Lower Schuylkill Valley Study Area. Such clearing techniques normally would result in Dyrness' (1965) Class 3 and Class 4 soil disturbances, and Bryant et al.'s (1982) Class 1, Class 2, and Class 3 archeological data loss.

A specific clearing technique which can be detrimental to localized areas on archeological sites is the occasional practice of uprooting trees, rather than the normal practice of cutting them off flush with the ground surface. Either method is acceptable, according to specification (PECo S-7080-B 1983:2), but uprooting requires permission of the electric company, and in areas with an existing slope of 25 percent or less all stumps *must* be cut off flush with the surrounding grade, with uprooting not permitted. If uprooting does occur, the contractor is bound by specification (PECo S-7080-B 1983:2) and policy (PECo 1968:7) to grade and seed with appropriate ground cover. Such grading and seeding of course, has the potential of increasing the area of more localized archeological disturbance precipitated by the uprooting operation, and would probably result in localized occurrences of Dyrness' (1965) Class 3 and Class 4 soil disturbances, as well as Bryant et al.'s (1982) Class 2 and Class 3 archeological data loss.

Physical evidence of disturbance resulting from clearing activities previously conducted in order to construct the extant Limerick transmission lines is scarce. The only clearing activity directly observed during the archeological investigation was the selective thinning and pruning operation necessary to prevent the encroachment of vegetation into the "danger zone" previously noted and to allow for the access of equipment for new support structure construction. However, as noted above, any grading activity has considerable potential to compromise the integrity of archeological sites, particularly those occurring at shallow depths, in a rather widespread and wholesale fashion. For example, it was observed by Ranere and Hansell (1983:92) during a transmission line survey in the Pinelands of southern New Jersey that "the entire transect had been disturbed by the initial clearing of the right-of-way." However, the Limerick right-of-way was characterized in most places either by cultivated fields or low ground cover which had regenerated after the initial clearing in the early- to mid-twentieth century. Moreover, most of the cleared rights-of-way not presently under cultivation had been subject to plowing at some point in the past. Consequently, although numerous disturbed soil profiles were encountered during subsurface testing, most such profiles were attributed to historical plowing activities, rather than to right-of-way clearing activities undertaken by PECo.

4.6.2 Construction of Access Roads

The construction of temporary access roads has the potential of contributing more severe disturbance to the archeological record than any of the other methods utilized in the construction of overhead transmission lines. As noted previously, the construction of such roads is avoided if at all possible. When necessary, a cut approximately one foot in depth, 15 feet in width, and as long as necessary to traverse between two points, is made. Clearly, in a previously undisturbed area, such a road can seriously disturb or destroy the upper levels of archeological sites extant in the access road right-of-way. In areas previously subjected to plowing, however, of which there were many in the Limerick Transmission Line Survey project area, the potential for adverse effect is somewhat less since plow disturbance normally slightly exceeds one foot in depth. Areas such as previously existing farm lanes, on which temporary access roads are frequently constructed, may be subject to less disturbance as well. Wherever access roads must cross streams, however, the associated laying of corrugated pipe and the grading of both stream banks has the potential to seriously compromise archeological sites which may exist in the vicinity.

The subsequent removal of ballast rock from the temporary access road cut, together with associated grading necessary to restore the area as nearly as possible to its former condition, also can further disturb an existing archeological site, particularly if the restoration process requires relatively deep grading. However, it should be noted that, due to economic considerations, the intent of *all* aspects of temporary access road construction and removal is to do only the minimum necessary to transport heavy equipment over an otherwise inaccessible area. In many cases, in fact, temporary access roads become permanent additions to the landscape at the request of the affected landowner, so that removal and restoration is not undertaken.

No evidence for disturbance from the prior construction of access roads was observed during the transmission line survey. However, one access road was newly constructed at the location of a significant archeological site, the specifics of which are discussed in a later section of this report. Dyrness' (1965) Class 2 and Class 3 soil disturbances can be expected in areas where temporary access roads have been built, as can Bryant et al.'s (1982) Class 1, Class 2, and Class 3 archeological data loss.

4.6.3 Coring and Blasting for Concrete Footings

The coring operations necessary to anchor overhead transmission line support structures, whether of the lattice or tubular steel pole variety, appears to have a very localized effect on the integrity of archeological sites. As noted previously, all excavated holes are normally 6-10 feet in diameter, have vertical walls, and are dug with an auger drill. As a result, there is little or no horizontal disturbance during the coring operation such as occurs in grading or cutting. However, localized grading of the coring spoil which is sometimes necessary to restore the immediately surrounding area to its original condition, especially if sloppily done, can cause more disturbance to the archeological record than the actual coring operation. The occasional need for diversion ditches or swales to keep water out of the excavated hole can also have implications for the integrity of the archeological record, but these are only infrequently necessary. Indeed, none were observed during the Limerick Transmission Line Survey. Similarly, the occasional need for blasting at bedrock levels appears to have little bearing on overlying archeological deposits, since it is self-contained and detonated only at a charge necessary to remove bedrock to approximately the same width as the upper portion of the core (Peter Cava, personal communication 1985). If a simple coring operation without associated grading operations is required, it can be expected that Dyrness' (1965) Class 3 soil disturbance will result, but only in a very localized area. Likewise, although Bryant et al.'s (1982) Class 1, Class 2, and Class 3 archeological data loss will also occur, such losses will only be in a very localized area.

A rather dramatic example of the localized nature of the coring process was found in a section of one of the Limerick transmission lines (220-63) (Zatz et al. 1985). Because portions of this line were slated for the replacement of lattice support structures by new tubular steel poles in the same locations, several test units were placed within the confines (normally near the center) of the existing lattice structure, as well as surrounding it. In several cases, the resultant profiles showed little or no disturbance of any kind and, in one case, an undisturbed portion of a prehistoric archeological site (36 MG 156) was revealed within such confines (Zatz et al. 1985). Clearly, disturbances resulting from the coring operations in this case were quite localized and not extensive.

4.6.4 Installation of Counterpoise System

Since no instances of the installation of a counterpoise system, either associated with extant or newly constructed support structures, were observed during the Limerick Transmission Line Survey, it is not possible to accurately evaluate the extent of disturbance to archeological sites such activity causes. However, the simple fact that small trenches a minimum of 24 inches in depth are excavated either with a plow or trencher implies that rather extensive, although relatively localized, disturbance can occur. This, of course, is especially true with regard to the relatively shallow upland sites in the Limerick Transmission Line Survey project area. It is also not known how frequently counterpoise systems must be installed; however, since none were observed being installed during the investigation, it is assumed that conditions necessitating such systems are infrequently encountered. Nevertheless, it may be prudent to bear in mind the occasional need for such a system which has the potential to expand the area of direct effect some distance away from support structure locations. Such occasional need of a counterpoise system will most likely result in Dyrness' (1965) Class 2 and Class 3 soil disturbance and Bryant et al.'s (1982) Class 2 and Class 3 archeological data loss.

4.7 Strategies for Archeological Testing and Data Recovery

During the several phases of the Limerick Transmission Line Survey, a wide variety of strategies was employed to minimize effect to archeological resources, significant or otherwise, and to beneficially accommodate schedules and logistical considerations in the construction of temporary access roads and coring operations for the construction of support structures. These strategies were implemented to help avoid further disturbance to archeological sites in existing transmission line rights-of-way as a result of the new construction, and involved various levels of intensity, ranging from simple monitoring to full-scale archeological excavation. These strategies are briefly described below.

4.7.1 Monitoring of Right-of-Way Clearing Activities

Vegetational clearing necessary to allow for the access of equipment to core and erect new support structures was undertaken during the project only after all Phase I and Phase II archeological investigations had been completed. This meant that, at the time of the new clearing, all archeological sites in the right-of-way had been identified and evaluated for significance. As a result, areas that required archeological monitoring during clearing activities were previously identified, as were "voids" where monitoring would not be necessary. Moreover, in areas that contained archeological sites, the clearing contractor was only permitted to undertake his work using hand tools such as chain saws and root cutters, and small mechanized equipment such as truck and chipper, all under close monitoring by the archeological team.

The monitoring strategy employed during the initial vegetational clearing operation proved to be quite effective, since the archeological team was able to maintain reasonable control over the techniques utilized for clearing by the contractor. While localized examples of Dyrness' (1965) Class 2, Class 3, and Class 4 soil disturbances and Bryant et al.'s (1982) Class 2 and Class 3 archeological data loss probably occurred, instances of wholesale or widespread disturbance to an archeological site during clearing activities were avoided.

4.7.2 Stripping of Temporary Access Road Rights-of-Way

As noted previously, the rights-of-way of all temporary access roads, as well as the actual transmission line rights-of-way, were subjected to both Phase I survey and Phase II evaluation, as appropriate. This resulted in a level of confidence regarding site presence, absence, and/or significance in the access road rights-of-way similar to that of those in the transmission line rights-of-way. Since the coincidental occurrence of temporary access road rights-of-way and significant archeological sites was present only in areas previously subjected to agricultural plowing, the strategy utilized after the completion of controlled surface survey was to excavate the necessary roadway cut to just above the interface of the plowzone and the underlying subsoil under the guidance of archeological monitoring, with sufficient time granted for the archeological team to shovel-scrape and expose by hand the underlying subsoil and any features or other archeological deposits which might be revealed. In this fashion, long linear expanses of extant subsoil deposits associated with two potentially significant archeological sites were exposed, and the resultant information recovered prior to its disturbance. Once such data were recovered, the construction contractor was permitted to return, infill the cut with ballast rock, grade and/or asphalt as necessary, and proceed with construction of the support structures whose locations could then be serviced by the access road.

It is also important to note that a temporary site-protective strategy was employed at one of the archeological sites (36 CH 53) subjected to the procedures discussed above. Due to the onset of inclement winter weather, data recovery at this site had to be suspended until spring, although the construction schedule for the necessary temporary access road could not accommodate a similar suspension. At the time of suspension of the archeological work, five unexcavated or partially excavated archeological features were exposed, and an additional 20 excavated features had been infilled with clean sand. To allow for the installation of ballast rock for construction of the roadway, one layer of plywood and two layers of one-quarter inch fiberglass matting were laid down in the roadway cut, with the ballast rock deposited on top. Upon resumption of archeological field work in the spring, and after the access road had been used for its intended purpose, a flat bucket gradall was used to remove the ballast rock and fiberglass from the cut. As had been hoped, no damage had been imparted to the archeological features, and no loss of data occurred (Zatz et al. 1985:49; Zatz and Joire' 1986:13).

A similar site-protective strategy was recently used by the New England Power Company to protect two prehistoric archeological sites in Massachusetts (Marquis 1989). In this instance, one foot of "crusher run" (i.e. crushed stone aggregate) was placed directly on top of the two sites as a permanent protective measure, thereby obviating the necessity of archeological excavation as a mitigative strategy (Marquis 1989:6-7). Although the removal of the aggregate is not planned, the archeological sites in question presumably remain undisturbed and well-protected under the aggregate.

4.7.3 Testing and Excavation at Support Structure Locations

During the initial Phase I survey, the entire extent of each transmission line right-of-way was subjected to surface reconnaissance, even though it was anticipated that, aside from areas necessitating the construction of access roads, the areas which would experience the greatest adverse effect would be support structure locations. Similarly, all potentially significant sites located at the Phase I level were subjected to Phase II surface or subsurface testing, or both, regardless of the site's location in relation to support structure placement. However, Phase III data recovery excavations were undertaken only at significant archeological sites which coincided with support structure or access road locations which otherwise could not be avoided.

In nearly all cases, the Phase II subsurface testing at support structure locations consisted of controlled surface collection procedures in plowzone situations, followed by the judgmental placement of test units in areas of high artifact density; such tests measured up to 5x5 feet in size, depending on site-specific conditions (Zatz et al. 1984a:29). This was done both in cases where structures were planned for new locations and where new structures were planned to replace old, extant structures. In most cases, this standard strategy was adequate to evaluate site significance. However, in one case, a different strategy was utilized at the Phase II level, due to the presence of fresh, untreated, and potentially hazardous manure on the surface of the plowzone. In this case five areas slated for the construction of support structures were stripped of plowzone in a manner similar to that previously described for significant sites in temporary access road rights-of-way (Zatz et al. 1984a:47). The only differences between this strategy and that used in temporary access road situations were that 1) roughly circular, localized structure locations, rather than linear swaths, were stripped of plowzone, and 2) the strategy was employed at the Phase II rather than the Phase III level of effort.

4.8 Concluding Summary

In summary, the archeological investigations associated with licensing activities of the Limerick Nuclear Generating Station has enabled a preliminary evaluation of PECo's construction techniques and policies as they interface with the prehistoric archeological record in the Piedmont of southeastern Pennsylvania. This evaluation, although far from quantitative in nature, in turn has allowed for a rough characterizations of the nature and extent of these construction techniques in terms of their potential to disturb archeological sites. These characterizations are as follows.

The initial clearing of overhead transmission line rights-of-way probably has the greatest potential for disturbing archeological sites on a wide scale. This potential stems largely from the fact that the precise nature and extent of effects to soils and archeological sites stemming from such clearing activities are extremely difficult to quantify. While the nature and extent of such clearing is dependent on the specific conditions of the right-of-way, it seems clear that, in heavily vegetated areas, clear-cutting activities can lead to rather wholesale grading and other land altering operations (i.e. Dyrness' (1965) Class 2 and Class 3 soil disturbance and Bryant et al.'s (1982) Class 2 and Class 3 archeological data loss). This also appears evident in the Pinelands of southern New Jersey, where Ranere and Hansell (1983:90) observed large expanses of "bare earth" where clearing activities had at least surficially disturbed the right-of-way through the heavily wooded landscape. Similarly, Strauss (1987b:9-10, 13) observed areas of the New England/Hydro-Quebec transmission line right-of-way where grading, plowing, or infilling had occurred, leaving "small pockets of intact soil." However, it is equally evident that many areas need no clearing, as evidenced by the large expanses of open, cultivated fields in the project area of southeastern Pennsylvania. Similarly, transmission line design and construction through vast expanses of desert areas, such as experienced in the Gonder Line 1 (Newkirk and Bambrey 1984) and Mona Line 1 (Newkirk and Bambrey 1985) rights-of-way of western Utah and eastern Nevada, presumably also require no clearing activities. The key factor in initial clearing, obviously, is the degree to which the immediate area is vegetated. Accordingly, it is of utmost importance in areas of heavy vegetation to conduct archeological reconnaissance surveys prior to right-of-way clearing if potentially severe disturbance to the archeological record is to be avoided. This is especially true in light of observations made along extant overhead transmission lines during the Limerick Transmission Line Survey which revealed that, once secondary vegetation has regenerated in cleared rights-of-way, particularly in areas historically subjected to plowing, it is even more difficult to ascertain the nature and extent of disturbance resulting from such clearing activities.

Temporary road construction necessary for access in some areas for purposes of support structure construction is also a potentially severe threat to the integrity of archeological sites, most likely resulting in Dyrness' (1965) Class 2 and Class 3 soil disturbances and Bryant et al.'s (1982) Class 3 and Class 4 archeological data loss. Such roads of necessity must be constructed with a sub-base sufficient to withstand extremely heavy loads. As noted, they are first excavated and then infilled with ballast rock. Once the transmission lines are constructed, the rock is removed, the cut is infilled, and the whole graded over. Since such roads are designed and engineered for specific purposes, the areas of potential disturbance are readily identifiable by perusing design plans. In this sense, the areas of disturbance are relatively localized and specific in nature, although the precise nature and extent of the last grading operation is probably less localized than the actual excavation of the sub-base trench. Nevertheless, if careful interfacing of design considerations and archeological preservation is followed, the avoidance of severe impact to archeological sites should be a relatively simple matter.

Other activities associated with the construction of support structures have .the obvious potential to disturb archeological deposits, but these activities are of a much more localized nature than those previously noted. The uprooting of large tree stumps during the clearing process can severely disturb archeological sites, resulting in Class 1, Class 2, or Class 3 of Bryant et al.'s (1982) archeological data loss; PECo, however, prefers in most cases that stumps be cut off flush with the ground surface (PECo S-7080-B 1983:2). The coring of holes to accommodate concrete support structure footings will also destroy archeological deposits but again, the area of disturbance is extremely localized, normally between six and 10 feet in diameter. The fact that undisturbed soil profiles were observed during the survey within the confines of an extant four-cornered lattice-type structure certainly attests to the localized nature of this type of disturbance. Blasting necessary when footings are required in areas of bedrock should have virtually no effect on archeological deposits, since presumably no such deposits are present (due to the presence of bedrock), and such blasting is always self-contained within the footing core. Finally, the necessity of counterpoise systems at some support structure locations can, of course, result in some damage to archeological sites, perhaps resulting in Bryant et al.'s (1982) Class 2 and Class 3 archeological data loss, but again, it is relatively localized in extent. However, the fact that PECo specifications (PECo S-7080-G-1983:1) mandate that such systems be installed at a depth of 24 inches or more necessitates that careful archeological planning and survey be conducted of areas wider in extent than the footprint of the structure if disturbance to the archeological record is to be avoided.

Selected thinning and pruning, unless inclusive of ground-altering landscaping activities for aesthetic purposes, is the activity associated with transmission line construction least likely to seriously disturb archeological deposits. Such thinning is normally done with hand tools and perhaps a truck and chipper, and normally is confined to the upper reaches of vegetation which have begun to encroach into the defined "danger zone." The most extensive disturbance to archeological sites resulting from this operation is likely to be tire ruts resulting from the truck and chipper traversing soft or muddy ground. Such activities may result in Dyrness' (1965) Class 2 soil disturbance, and Bryant et al.'s (1982) Class 1 and Class 2 archeological data loss.

It should be noted that many of PECo's transmission line rights-of-way are shared with other utilities that may not adhere to PECo's specifications and/or policies. This fact, unfortunately, may occasionally result in adverse effect to archeological sites which is not due to PECo's activities and, more importantly, is outside of PECo's control. Presumably the utilities which share PECo's rights-of-way have their own specifications and policies, and presumably such activities are subject to similar licensing, permitting, and Section 106 requirements. However, on at least one occasion during the survey, another utility company was observed excavating a trench for an underground utility line in a stretch of PECo's right-of-way where an archeological site had been recently recorded, and prior to its further evaluation. Incidents of this type doubtless are infrequent, but the shared nature of some transmission line rights-of-way obviously does not preclude such occurrences.

In closing, the management of archeological resources potentially affected by transmission line construction has recently become a more widespread planning concern throughout the United States and Canada (e.g. Weir 1986; Peters 1986). The archeological aspect of the Limerick Transmission Line Survey is a noteworthy addition to the growing list of such management and planning activities in the electric utility industry. The Limerick Transmission Line Survey is particularly important in that the area of southeastern Pennsylvania through which the transmission lines traverse is currently experiencing a very high rate of growth and land use, with the concomitant rapid decrease in archeologically undisturbed areas. Consequently, the extant transmission line rights-of-way associated with the Limerick Nuclear Generating Station represent some of the few remaining large-scale linear expanses of landscape which, although subject to some disturbance in the past, are nevertheless relatively undisturbed and, as such, may represent one of the last opportunities to assess the nature and extent of the archeological record on a wide scale in the Piedmont of southeastern Pennsylvania. The efforts of the Philadelphia Electric Company in this regard are to be congratulated.

5.0 METHODS OF DATA COLLECTION

The primary goals of the Limerick Transmission Line Surveys were to locate, identify, and evaluate archeological resources within the PECo rights-of-way, to determine their eligibility or ineligibility to the National Register of Historic Places, and to mitigate adverse effects to eligible sites, if present. Additional problem-oriented research goals were outlined previously. Numerous data collection techniques were employed during the various phases of the project to achieve these various goals. The first stage (Phase I) of the investigation was initiated with a review of known prehistoric sites and existing data relevant to the project area. Subsequent archeological field examination involved a 100 percent survey of the entire rights-of-way, utilizing surface and/or subsurface testing procedures.

Potentially significant sites were re-examined during the second stage of the investigations (Phase II). Both surface and subsurface testing procedures were utilized. The latter were of sufficient intensity to evaluate the integrity and significance of the archeological deposits at each site considered. If adverse effects could not otherwise be avoided, sites recommended eligible to the National Register of Historic Places were then subjected to site-specific data recovery programs (Phase III).

As an adjunct to the field investigations, private collections of avocational archeologists from the Schuylkill River Valley were examined for comparative analysis of local prehistoric material. The present study, as presented in the following chapters, is an in-depth analysis and interpretation of the data generated throughout the investigation. The stages of research and the methodologies employed are discussed in greater detail below.

5.1 Existing Data Review

The review of existing data included an examination of previous archeological work conducted in or near the project area, as well as a review of current maps and historic atlases. The Pennsylvania Archaeological Site Survey (PASS) files at the Pennsylvania Historical and Museum Commission in Harrisburg were consulted for the locations of previously recorded sites. These sites were plotted onto USGS 7.5 minute topographic maps for comparison with the locations of the proposed transmission line rights-of-way. This data review was undertaken prior to the commencement of field work to aid in the field investigations by identifying areas of apparently high archeological sensitivity. Information pertaining to the recorded sites in the project area facilitated the development of testing strategies appropriate to each segment of the right-of-way.

5.2 Collections Research

In addition to the various phases of field work and laboratory analysis described below, avocational archeologists were interviewed and their collections from prehistoric sites in the vicinity of the Limerick Transmission Line Surveys were examined. Many of those interviewed had collected artifacts from the Schuylkill River Valley for years and had amassed significant collections.

Avocational archeologists were encountered in several ways. Landowners questioned during the survey often possessed collections of their own or were able to provide the survey team with names of active avocational archeologists. Others were contacted through the Schuylkill Valley Chapter of the Society for Pennsylvania Archaeology. In other instances, collectors sought out the survey teams in the field

Artifact collections from the region which were known to the survey teams were examined, tabulated, and photographed. The quality of information relating to the provenience of artifacts varied markedly from collection to collection. Diagnostic artifacts were recorded for specific sites when their provenience was known. By analyzing these collections, the survey teams were able to gain a region-wide perspective on the archeological resources in the Schuylkill drainage. Occasionally, collections supplemented data previously generated by field work or resulted in the discovery of previously unrecorded sites.

5.3 Field Methods

5.3.1 Phase I Field Methods

Phase I field survey involved both surface survey and subsurface testing along the proposed transmission line rights-of-way. These rights-of-way consisted of linear corridors linking the Limerick Nuclear Generating Station to several electrical sub-stations throughout Chester and Montgomery Counties. Particular emphasis was placed on testing at proposed structure locations and along proposed access roads located along the transmission lines where potential construction impacts may occur.

Phase I surface survey commenced with a pedestrian reconnaissance of each transmission line right-of-way. Surface collection procedures were implemented in those areas where surface visibility was conducive to locating archeological resources and in assessing site potential. Survey outside of the rights-of-way was conducted if sites potentially extended beyond the limits of the rights-of-way and if previously documented sites were known to exist in close proximity to a particular right-of-way.

Each transmission line segment was sub-divided into linear transects parallel to the right-of-way. A maximum transect interval of ten feet (three meters) between surveyors was maintained by each survey team. Transect intervals were reduced as artifact densities increased or as ground visibility decreased. Transect lengths were variable, depending upon local conditions, but did not exceed one-half mile. The distance and acreage surveyed varied each day according to the number of sites located, and the percentage of ground visibility within and adjacent to the right-of-way.

When an artifact was located, the survey team attempted to define site boundaries. Complete collection and selective (biased) sampling strategies (Hester et al. 1975:20-21) were employed, as appropriate. Selective or biased sampling strategies, i.e. the collection of only culturally and/or temporally diagnostic artifacts and artifacts relevant to defining site boundaries, were only used to sample sites when artifact frequencies were very high and complete collection was impractical. Collection areas were each assigned a locus number and artifacts from each locus were bagged separately with the corresponding locus number recorded.

Site boundaries were determined by the presence, absence, and density of artifacts. A prehistoric archeological site was defined as a location from which three or more artifacts were recovered within 50 feet (15 meters) or less of one another. Phase I loci not meeting established site criteria were defined as field scatters, and single artifacts were termed isolated finds. Sites, field scatters, and isolated finds were plotted onto topographic base maps. Representative photographs of each survey area were taken, as appropriate.

In areas where ground visibility within the rights-of-way was less than 40 percent, subsurface testing was implemented. Subsurface test units were excavated to culturally sterile subsoil horizons by natural levels of soil deposition. Depth of the test units varied according to site topography and soil type. Soil horizons were differentiated on the basis of standardized colors, using a Munsell Soil Color Chart, and by texture, by handling a moist sample of soil from each level and assigning a standardized textural description as presented in Cornwall (1961:120). Soil horizons were numbered consecutively from top to bottom as they were encountered. All excavated soil matrices were passed through one-quarter inch mesh hardware cloth, and all recovered artifacts were bagged according to provenience. A stratigraphic profile for each excavation unit was recorded on standardized field forms. A photographic record of excavation units and other features was made, as warranted.

5.3.2 Phase II Field Methods

Phase II testing was conducted at all sites considered to contain potentially significant archeological resources. Phase II field methods were geared to ascertain site boundaries and assess site integrity and significance. Each site was initially subjected to a second surface collection after sufficient time had elapsed between the Phase I and Phase II surveys to allow additional artifacts to surface. Sites were subdivided and collected by quadrants or measured areas, depending upon artifact densities. Diagnostic artifact types, artifact densities, and artifact concentrations were plotted onto site base maps.

Subsurface tests consisted of the excavation of measured test units 2 x 2 feet in size. These were expanded up to 5 x 5 feet when necessary to reach greater depths or to expose potentially significant archeological features and artifacts. Phase II test units were judgmentally placed in those areas where Phase I and Phase II surface collections and/or Phase I subsurface testing suggested the presence of discrete artifact concentrations, features, or other types of *in situ* deposits. Horizontal control was ensured by locating all units with respect to permanent landmarks or established datum points and concomitantly plotting their locations onto site base maps. Excavation and recordation methods for each unit followed those utilized during the Phase I subsurface testing, including the excavation of all test units to culturally sterile subsoil horizons by natural levels of soil deposition.

5.3.3 Phase III Field Methods

Sites evaluated during the Phase II investigations that were recommended eligible to the National Register of Historic Places, and that could not be avoided by design modifications, were investigated by Phase III data recovery excavations. Sampling designs were tailored to maximize the recovery of archeologically significant data and to conform to the specific right-of-way configuration at each site.

Phase II testing at each site subsequently recommended for data recovery had indicated that each was overlain by plow-disturbed soils. In order to examine and sample all areas that would be directly affected by the construction of access roads and/or the erection of new transmission towers, a mitigative testing program was designed in cooperation with the Pennsylvania Historic and Museum Commission. This program utilized a large scale stripping approach, as described by Hester et al. (1975), and involved a two-stage program for data collection.

First, all areas to be affected by construction were delimited by semi-permanent field markers, subdivided into measured collection areas, and subjected to controlled surface collection. This was done for the purpose of further refining the known distribution of archeological materials. Second, a tracked gradall with a four foot wide bucket was subsequently used to remove all but one or two inches of the plowzone. These stripped areas were then shoveled and troweled by hand to locate undisturbed archeological deposits and features, defined herein as soil anomalies extending into the subsoil.

A grid system, utilizing a five foot interval and a baseline oriented according to magnetic north, was established over each stripped area with the aid of a transit. The center of each structure location was utilized as a primary control datum and the location of each unit was designated by its distance and direction from this primary datum.

All potential cultural features were mapped and photographed in plan prior to excavation. Each feature was then sectioned along an east-west axis and then excavated by hand. The south half of each feature was excavated by arbitrary three inch levels, or less as appropriate, to culturally sterile soils and/or beyond all indications of the observed soil anomaly. Cross-section profiles were cleaned, drawn, and photographed. Soil samples were taken from the remaining face of the cross-section and bagged for flotation processing and laboratory analysis. The north half of each feature was excavated by levels of deposition when present and discernable, and by arbitrary levels in all other cases. Final feature outlines and photographs were then drawn and photographed. Artifact concentrations, primarily comprised of fire-cracked rock, were exposed in place, mapped, and photographed. All artifacts were recorded and bagged by level in both pit features and artifact concentrations.

5.4 Geomorphological Studies

Geomorphological studies were undertaken at the Frick's Lock Site (36 CH 103) and the Point Bar Site (36 MG 56), in conjunction with the respective Phase III and Phase II archeological investigations at these sites. Both of these sites occurred on river terraces and, therefore, analysis was geared toward determining the age and depositional history of each of these landforms. In addition, one upland locale, the Indian Point Site (36 CH 53) was subjected to geomorphological analysis as part of the present study. The results of these specialized studies have been incorporated into the chapters devoted to each of these sites and are presented in their entirety in the appropriate Appendix.

5.5 Laboratory Procedures

All artifacts recovered during the course of the investigations were cleaned, inventoried, and catalogued. Standardized inventory sheets were formulated specifically for the transmission line surveys (see Zatz 1984; Zatz et al. 1984a, 1984b, 1985, 1989). Historic and prehistoric artifacts were classified separately. Historic artifacts were grouped into descriptive functional and morphological types. Ceramic descriptions were based on paste characteristics and decorative attributes.

Prehistoric artifacts were classified into five general categories: chipped stone tools, chipped stone debitage, ground/pecked stone tools, fire-cracked and other culturally modified or transported rock, and ceramics. Chipped stone tools were categorized into types and classes by morphology and, when possible, inferred function. Within each type, artifacts were further classified according to raw material type. Projectile points were described individually in detail on a separate form. Descriptions included morphological and metric attributes, and cultural affiliation when possible. Ground/pecked stone tools were also classified in terms of morphology and inferred function.

Chipped stone debitage was classified into general categories reflecting lithic reduction; debitage types utilized included primary or cortical flakes, secondary flakes without cortex, shatter and other debris incidental to controlled reduction, and formal cores. Like all other lithic artifacts, debitage was also classified according to raw material type.

Prehistoric ceramics were divided into rim sherds, body sherds, basal sherds, and pipe sherds. Ceramic attributes were listed on a separate form and included temper, thickness, and surface treatment. Whenever possible, ceramics were compared with defined types and cultural affiliations were recorded.

Additional tasks completed as part of the laboratory procedures involved the compilation of Pennsylvania Archaeological Site Survey forms, photography of all diagnostic artifacts, and the flotation of soil samples taken from features. The flotation process followed standard techniques. Recovery of the light and heavy fraction was accomplished with one-sixteenth inch mesh hardware cloth. The recovered samples were dried and sorted to remove extraneous non-cultural materials. Charcoal was preliminarily cleaned, sorted, and weighed by provenience prior to submission for radiocarbon dating. Other floral and faunal remains were sent to the appropriate specialists for identification.

6.0 ARCHEOLOGICAL SITES IN THE LOWER SCHUYLKILL VALLEY STUDY AREA

The following is an inventory and brief description of the 184 prehistoric archeological sites in the Lower Schuylkill Valley Study Area. The inventory has been divided into two primary categories of archeological sites: sites discovered and/or investigated during the Limerick Transmission Line Surveys, and all other sites. The latter are comprised predominantly of sites recorded in the Pennsylvania Archaeological Site Survey files at the Pennsylvania Historical and Museum Commission. The sites discovered and/or investigated during the transmission line surveys have been arranged by individual transmission line. Newly discovered archeological sites have been identified with an asterisk; previously recorded sites that were also examined during the present project are so identified under the Level of Testing category. Site locations with respect to the PECo rights-of-way, results of investigations, and recommendations regarding potential significance have been incorporated into the description of each site, where appropriate. All sites have been organized in numerical order by site number and county.

Regarding the information categories, cultural affiliation has been assigned using conventional temporal periods, and interpretations regarding cultural complexes, phases, traditions, etc. are not included. Periods include Paleo-Indian; Early, Middle, Late, and Terminal Archaic; Early, Early/Middle, Middle, and Late Woodland; and Susquehannock (i.e. Contact). The Terminal Archaic Period subsumes all sites otherwise referred to as "Transitional". The use of an Early Woodland, Middle Woodland, and a combined Early/Middle Woodland Period is due to the former two periods often being combined in the PASS file data, as well as empirical evidence suggesting that combining the two is indeed legitimate (see Sections 9.0 and 11.0). Other periods include "Woodland", "Archaic", and "Unknown Prehistoric". The latter is self-explanatory, while the former primarily represent site file entries without further explication. Tabular data and a discussion of site components is provided in Section 10.2.3.

Topographic Settings are also explained in detail in Section 10.2.3, but are for the most part straightforward. Level of Testing refers to the nature of investigation of a site, if known, e.g. surface collected, excavated, phase of investigation, etc. Finally, Comments include summarized pertinent data on sites, if such are available. It should be noted that comments regarding non-transmission line sites are derived from the PASS files and are assumed to be reliable; these remarks have been edited for brevity but have not been edited for content.

6.1 Transmission Line 220-60 Sites

SITE NO: 36 MG 1
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110-120 feet AMSL
PRIMARY SOIL TYPE: Raritan silt loam, 0-3% slope
CULTURAL AFFILIATION: Late Woodland
LEVEL OF TESTING: Tested by Schuylkill Valley Chapter 21 of SPA; Phase I surface survey by JMA
COMMENTS: No diagnostics recovered by JMA; jasper, quartz, and quartzite occur in equal proportions, other materials in minority; jasper point, pottery sherd recovered previously; does not extend into PECo right-of-way

SITE NO: 36 MG 15
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland Slope
ELEVATION: 140-230 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic; Woodland
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Two undiagnostic artifacts recovered by JMA; outside of PECo right-of-way

SITE NO: 36 MG 37 Underpass Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Archaic; Late Woodland
LEVEL OF TESTING: Phase I subsurface testing by JMA
COMMENTS: No diagnostics recovered by JMA; quartz and quartzite debitage in equal proportions dominate lithics; no evidence of site within PECo right-of-way

SITE NO: 36 MG 39 5th Street Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River bluff
ELEVATION: 155-170 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Nine undiagnostic artifacts recovered outside of PECo right-of-way

SITE NO: 36 MG 134*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River bluff
ELEVATION: 180 feet AMSL
PRIMARY SOIL TYPE: Abbottstown and Penn silt loam, 5-10% slope
CULTURAL AFFILIATION: Early, Terminal Archaic
LEVEL OF TESTING: Phase I and Phase II surface survey, Phase II subsurface testing by JMA
COMMENTS: No *in situ* deposits within PECo right-of-way; chert Bifurcate-base point and chalcedony Broadspear recovered by JMA; quartz and quartzite dominate lithics and occur in equal proportions

SITE NO: 36 MG 138*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 130 feet AMSL
PRIMARY SOIL TYPE: Birdsboro silt loam, 0-3% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: No diagnostics recovered by JMA; none of the twenty-three artifacts were located within 15 feet of PECo right-of-way

SITE NO: 36 MG 139*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Mingo Creek terrace
ELEVATION: 100 feet AMSL
PRIMARY SOIL TYPE: Penn and Croton silt loams, 3-8% slope
CULTURAL AFFILIATION: Late Archaic; Early/Middle Woodland
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: No diagnostics recovered by JMA; quartzite lithics predominate; located outside of PECo right-of-way, site has largely been destroyed

SITE NO: 36 MG 140*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 130 feet AMSL
PRIMARY SOIL TYPE: Bowmansville, Penn, and Abbottstown silt loams, 5-10% slope
CULTURAL AFFILIATION: Late, Terminal Archaic; Middle, Late Woodland
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Site located outside of PECo right-of-way; diagnostic projectile points recovered by JMA include Madison, Jack's Reef, Broadspear, and Poplar Island; quartz lithics almost exclusively

SITE NO: 36 MG 141*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 120 feet AMSL
PRIMARY SOIL TYPE: Penn and Penn-Klinesville silt loams, 10-15% slope
CULTURAL AFFILIATION: Terminal Archaic
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Jasper Orient Fishtail and an argillite Broadspear recovered by JMA; overwhelmingly quartz lithics; site appears to have been disturbed, and is not a potentially significant archeological resource

SITE NO: 36 MG 162*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland bluff
ELEVATION: 190 feet AMSL
PRIMARY SOIL TYPE: Abbottstown and Readington silt loams, 1-5% slope
CULTURAL AFFILIATION: Early, Late, Terminal Archaic; Late Woodland
LEVEL OF TESTING: Phase I and Phase II surface survey, Phase II subsurface testing and stripping of plowzone by JMA
COMMENTS: Determined to not be potentially significant due to a lack of *in situ* deposits or features; diagnostic artifacts include Bifurcate-base, Bare Island, Orient Fishtail, Levanna, and Madison projectile point types; quartz is dominant raw material type

SITE NO: 36 MG 163*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 90 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I subsurface testing by JMA
COMMENTS: Only nine undiagnostic artifacts recovered; site does not extend into PECo right-of-way

6.2 Transmission Line 220-61 Sites

SITE NO: 36 CH 43
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110-120 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, dark surface
CULTURAL AFFILIATION: Paleo-Indian
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: One flake and a fluted point found prior to JMA survey; site does not extend into PECo right-of-way

SITE NO: 36 CH 47
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 130-145 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Site destroyed by pipeline construction; Argillite cache recovered previously; no artifacts recovered by JMA

SITE NO: 36 CH 55
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 130 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Early Archaic; Late Woodland
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: No artifacts recovered by JMA; private collection contained numerous triangular projectile points, a clay pipe stem, probable Overpeck Incised pottery, and possible net-marked pottery.

SITE NO: 36 CH 56
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 120-140 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic; Middle, Late Woodland
LEVEL OF TESTING: Phase I and Phase II surface survey, Phase II subsurface testing by JMA
COMMENTS: No diagnostic artifacts recovered by JMA; jasper and quartz are primary raw materials; PECo transmission structure relocated to avoid disturbing site

SITE NO: 36 CH 103 Frick's Lock Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 120-140 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, dark surface
CULTURAL AFFILIATION: Early, Late, Terminal Archaic; Early/Middle, Late Woodland
LEVEL OF TESTING: Phase I, II and III investigations by JMA; subsurface testing by Schuylkill Valley Chapter 21 of SPA
COMMENTS: Large scale stripping of site by JMA revealed presence of features; Late Woodland and Late Archaic radiocarbon dates obtained on features; undiagnostic pottery found in two other features; diagnostic artifacts recovered by JMA include representatives of the Late Woodland (4), Middle Woodland (2), Terminal Archaic (10), Late Archaic (12), and Early Archaic (1) Periods; jasper is primary raw material, quartz and quartzite secondary (see Section 7.0)

SITE NO: 36 CH 105
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland Slope
ELEVATION: 160-180 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic; Late Woodland
LEVEL OF TESTING: Phase I surface survey and subsurface testing by JMA
COMMENTS: No artifacts recovered by JMA; private collection contained probable Overpeck Incised Pottery

SITE NO: 36 CH 106
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, dark surface
CULTURAL AFFILIATION: Archaic; Woodland
LEVEL OF TESTING: Phase I subsurface testing by JMA
COMMENTS: No artifacts recovered by JMA; located outside of PECo right-of-way

SITE NO: 36 CH 111
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110-120 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, dark surface
CULTURAL AFFILIATION: Paleo-Indian; Late Archaic; Woodland
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Poplar Island point recovered by JMA; quartz is primary raw material; site does not extend into PECo right-of-way

SITE NO: 36 CH 382*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 160 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 6-11% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Late Archaic Bare Island point recovered by JMA; quartz is dominant raw material; site partially extends into PECo right-of-way but not at proposed transmission structure location

SITE NO: 36 CH 383*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 150 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam and shaly silt loam, 8-15% slope
CULTURAL AFFILIATION: Early/Middle, Late Woodland
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Two Madison points and one Early/Middle Woodland side-notched point, lithics almost exclusively quartz; portion of site within right-of-way destroyed by railroad construction

6.3 Transmission Line 220-62 Sites

SITE NO: 36 MG 134* (See Transmission Line 220-61 Sites)

SITE NO: 36 MG 135*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 150 feet AMSL
PRIMARY SOIL TYPE: Reaville shaly silt loam, 3-8% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Ten undiagnostic artifacts recovered by JMA; site is not considered to be potentially significant

SITE NO: 36 MG 136*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 160 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 6-10% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I and Phase II surface survey, Phase II subsurface testing by JMA
COMMENTS: Possible Orient Fishtail point of jasper recovered; most lithic artifacts were quartz; no *in situ* deposits or features were uncovered; site determined to be not potentially significant

SITE NO: 36 MG 137*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 260 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, 3-8% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Phase I and Phase II surface survey, Phase II subsurface testing by JMA
COMMENTS: Two quartzite and one chert Poplar Island projectile points were recovered from the surface by JMA; quartz dominates lithics with quartzite and jasper secondary; no *in situ* deposits or features were located within the PECo right-of-way; site determined to be not potentially significant

SITE NO: 36 MG 143*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 275 feel AMSL
PRIMARY SOIL TYPE: Reaville shaly silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Three flakes recovered by JMA; site at extreme edge of right-of-way and not affected by construction

SITE NO: 36 MG 144*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 290 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 6-10% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Eighteen undiagnostic artifacts recovered by JMA; light scatter not considered potentially significant

SITE NO: 36 MG 145*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 180 feet AMSL
PRIMARY SOIL TYPE: Abbottstown silt loam, 3-8% slope
CULTURAL AFFILIATION: Middle Archaic
LEVEL OF TESTING: Phase I and Phase II surface survey, Phase II subsurface testing by JMA
COMMENTS: One quartz Vosburg projectile point and seventeen undiagnostic artifacts recovered from the surface by JMA; not potentially significant due to lack of *in situ* deposits and features

SITE NO: 36 MG 146*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 190 feet AMSL
PRIMARY SOIL TYPE: Reaville shaly silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I and Phase II surface survey by JMA
COMMENTS: Five undiagnostic artifacts recovered by JMA from edge of right-of-way; not considered potentially significant

SITE NO: 36 MG 147*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: Two flakes and a quartz Poplar Island projectile point recovered from surface by JMA; site considered to be not potentially significant

SITE NO: 36 MG 148*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 220 feet AMSL
PRIMARY SOIL TYPE: Readington and Penn silt loams, 5-10% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Light scatter of five undiagnostic artifacts; site not potentially significant

SITE NO: 36 MG 149*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 170 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam
CULTURAL AFFILIATION: Late Woodland
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: A chert Levanna point and an argillite Madison point were recovered by JMA, remaining lithics dominated by quartz; immediately adjacent to and may be part of 36 MG 151; portion of site within PECo right-of-way determined to be not potentially significant due to lack of *in situ* deposits or features

SITE NO: 36 MG 150*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 160-200 feet AMSL
PRIMARY SOIL TYPE: Reaville and Klinesville shaly silt loams, 8-13% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: Sixteen undiagnostic artifacts recovered by JMA; site not located in PECo right-of-way

SITE NO: 36 MG 151*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 180 feet AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Late, Terminal Archaic
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: One jasper Bare Island, one argillite Poplar Island, and one rhyolite Orient Fishtail were recovered by JMA; over half the lithics are jasper; site is contiguous with 36 MG 149; site within right-of-way determined to be not potentially significant due to lack of *in situ* deposits or features

SITE NO: 36 MG 152*
QUADRANGLE: Lansdale
TOPOGRAPHIC SETTING: Upland
ELEVATION: 320 feet slope
PRIMARY SOIL TYPE: Readington and Penn silt loams, 3-8% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Ten undiagnostic artifacts recovered by JMA; light scatter not potentially significant

SITE NO: 36 MG 153*
QUADRANGLE: Lansdale
TOPOGRAPHIC SETTING: Upland
ELEVATION: 350 feet AMSL
PRIMARY SOIL TYPE: Lawrenceville silt loam, 1-5 percent slope
CULTURAL AFFILIATION: Terminal Archaic
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Six artifacts including an argillite Broadspear were recovered during the JMA survey; site previously disturbed

SITE NO: 36 MG 161*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 150 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, 1% slope
CULTURAL AFFILIATION: Late Woodland
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing
COMMENTS: Site produced 147 pottery sherds belonging to one vessel in association with a dark, buried soil; vessel is relatively small and thin-walled, and is smooth on the interior and exterior. Temper consists predominantly of coarse, angular chunks of red shale with a small amount of fine grit. Site determined not potentially significant since additional testing did not reveal evidence of this soil or artifacts within PECo right-of-way

SITE NO: 36 MG 162* (See Transmission Line 220-61 Sites)

6.4 Transmission Line 220-63 Sites

SITE NO: 36 CH 53 Indian Point Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River Bluff
ELEVATION: 115-240 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Paleo-Indian; Early, Middle, Late, Terminal Archaic; Early/Middle, Late Woodland
LEVEL OF TESTING: Phase I, II, III investigations by JMA; Phase III included large-scale stripping
COMMENTS: Early Woodland to Middle Woodland features excavated by JMA during Phase II and Phase III investigations; Features date between 400 BC - AD 250 and include two house pits. Surface survey by JMA produced projectile points diagnostic of the Early Archaic through the Late Woodland Periods; lithics primarily quartz with jasper secondary (see Section 9.0)

SITE NO: 36 CH 116
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Terrace; confluence of Schuylkill River and Perkiomen Creek
ELEVATION: 80 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: No diagnostics recovered by JMA; quartz is primary raw material; site is flood-disturbed

SITE NO: 36 CH 384*
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 120 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: No diagnostic artifacts recovered by JMA, quartz dominates lithics with jasper of secondary importance; site has been disturbed and is not potentially significant

SITE NO: 36 MG 4
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 110-155 feet AMSL
PRIMARY SOIL TYPE: Penn-Lansdale loams, 3-15% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Stemmed point and a flake recovered by JMA; site located outside of PECo right-of-way

SITE NO: 36 MG 8
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110-130 feet AMSL
PRIMARY SOIL TYPE: Penn-Lansdale loams, 3-15 percent slope, moderately to severely eroded
CULTURAL AFFILIATION: Late Archaic; Early/Middle Woodland
LEVEL OF TESTING: Phase I and Phase II surface survey, Phase II subsurface testing by JMA
COMMENTS: Three Bare Island, three Poplar Island, and one Rossville projectile points recovered by JMA; three-fourths of artifacts made from quartz; no potentially significant archeological deposits present within PECo right-of-way; site shows evidence of disturbance

SITE NO: 36 MG 44
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 130-170 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 0-15% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Listed as Locus 26 in JMA survey report; no diagnostic artifacts; lithics almost exclusively quartz and all found outside of PECo right-of-way

SITE NO: 36 MG 74
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 100-140 feet AMSL
PRIMARY SOIL TYPE: Lawrenceville silt loam, 0-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Four undiagnostic artifacts found by JMA; not in PECo right-of-way

SITE NO: 36 MG 104 Dutt #0
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland
ELEVATION: 160 feet AMSL
PRIMARY SOIL TYPE: Lawrenceville silt loam, 0-3% slope
CULTURAL AFFILIATION: Early, Middle, Late Archaic; Woodland
LEVEL OF TESTING: Phase I and II surface survey, Phase II subsurface testing by JMA
COMMENTS: Woodland occupation represented by one potsherd; Archaic projectile point types include Bifurcates, Vosburg, Brewerton Eared-notched, Poplar Island, and Bare Island; almost all lithics are quartz; not potentially significant since testing revealed a lack of *in situ* deposits and features

SITE NO: 36 MG 142*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 8-15% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Five undiagnostic artifacts were recovered by JMA; light scatter lacking potential significance

SITE NO: 36 MG 154*
QUADRANGLE: Norristown
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 110 feet AMSL
PRIMARY SOIL TYPE: Penn-Lansdale loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Six flakes found by JMA; site is outside of PECo right-of-way

SITE NO: 36 MG 155*
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 80-150 feet AMSL
PRIMARY SOIL TYPE: Birdsboro silt loam
CULTURAL AFFILIATION: Late Woodland
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: A Late Woodland triangular projectile point made from quartz was recovered by JMA, almost all other lithics were also quartz; determined to be not potentially significant due to the lack of *in situ* deposits and features

SITE NO: 36 MG 156* Point Bar Site
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 75 feet AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Early, Middle, Late, Terminal Archaic; Early/Middle Woodland
LEVEL OF TESTING: Phase I and Phase II subsurface testing by JMA
COMMENTS: Artifacts recovered during the course of the testing spanned the Early Archaic through the Middle Woodland periods; however, the vertical distribution of diagnostic artifacts in concert with geomorphological evidence suggest that the cultural deposits have been reworked and/or redeposited by fluvial processes; jasper, quartz, and quartzite occurred in nearly equal amounts (see Section 8.0)

SITE NO: 36 MG 157*
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 100-150' AMSL
PRIMARY SOIL TYPE: Penn-Lansdale loam, 3-15% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I subsurface testing by JMA
COMMENTS: Nineteen undiagnostic artifacts recovered by JMA; artifacts restricted to the plowzone; site not potentially significant

SITE NO: 36 MG 158*
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 130 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 8-15% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I subsurface testing by JMA
COMMENTS: Four artifacts recovered by JMA from creek bank; potential site in PECo right-of-way disturbed by grading associated with construction of a housing development

SITE NO: 36 MG 159*
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland
ELEVATION: 140-150 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: Eleven artifacts recovered by JMA, site not potentially significant due to a lack of features and *in situ* deposits

SITE NO: 36 MG 172*
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 85 feet AMSL
PRIMARY SOIL TYPE: Lawrenceville silt loam
CULTURAL AFFILIATION: Late Archaic; Early, Late Woodland
LEVEL OF TESTING: Phase I and Phase II subsurface testing by JMA
COMMENTS: All artifacts recovered from the plowzone including two Brewerton side-notched points, one full-grooved axe, three sherds of Marcey Creek ceramics, and one Madison point; quartz is primary lithic raw material but with significant amounts of chert, jasper, and quartzite; prehistoric component of site determined not potentially significant due to lack of *in situ*, sub-plowzone deposits

SITE NO: 36 MG 173*
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 95 feet AMSL
PRIMARY SOIL TYPE: Raritan silt loam, 0-3% slope
CULTURAL AFFILIATION: Late Archaic; Middle Woodland
LEVEL OF TESTING: Phase I surface survey and subsurface testing by JMA
COMMENTS: One quartzite contracting stem point and one jasper Jacks' Reef Corner-Notched point recovered by JMA; jasper is primary raw material; site extensively disturbed and not potentially significant

SITE NO: Locus 29
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 150-190 feet AMSL
PRIMARY SOIL TYPE:
CULTURAL AFFILIATION: Late Archaic; Late Woodland
LEVEL OF TESTING: Phase I surface survey by JMA
COMMENTS: Five widely scattered artifacts, including one Brewerton Eared-Triangle and three Madison points located outside of PECo right-of-way; originally classified as a field scatter, site is included here due to the presence of diagnostic artifacts

6.5 Transmission Line 5031 Sites

SITE NO: 36 MG 178*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 240 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, local alluvium, 3-8% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: Twelve artifacts including one Bare Island projectile point made from quartzite recovered by JMA; no features or *in situ* deposits present; site not potentially significant

SITE NO: 36 MG 179*
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 260 feet AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Late Archaic; Late Woodland
LEVEL OF TESTING: Phase I surface survey and Phase II subsurface testing by JMA
COMMENTS: One quartz Bare Island and one quartz Madison projectile point recovered by JMA; nineteen other artifacts found at this low density site; not potentially significant due to lack of *in situ* deposits and features

6.6 Non-Transmission Line Sites

SITE NO: 36 CH 36
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 170 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Unidentified projectile points and celts

SITE NO: 36 CH 37 Warehouse Field Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 160-190 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic; Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 38 Turkey Point House Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC: Schuylkill River bluff
ELEVATION: 110-130 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 39 Anderson Road Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 150-160 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Lanceolate points; chalcedony, quartz, and quartzite present

SITE NO: 36 CH 40
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 200-290 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 41
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 180-200 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderate to severe erosion
CULTURAL AFFILIATION: Archaic; Susquehannock
LEVEL OF TESTING: Unknown
COMMENTS: Lithics consist of jasper and quartzite

SITE NO: 36 CH 42
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Bluff
ELEVATION: 150-160 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 8-15% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 44
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 180-190 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Terminal Archaic; Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 45
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 170-220 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 46
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 210-220 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Early Archaic; Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Bifurcate-base and stemmed points recovered

SITE NO: 36 CH 54
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 105-155 feet AMSL
PRIMARY SOIL TYPE: Bucks silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Early Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Bifurcate-base points reported

SITE NO: 36 CH 75
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope (Rockshelter)
ELEVATION: 120 feet AMSL
PRIMARY SOIL TYPE: Brandywine very stony loam, 25-50% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Grooved axe pulled from exposed stratum at back of shelter

SITE NO: 36 CH 84 Fitzsimmons Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 160-180 feet AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Late Archaic; Middle, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Stemmed and notched projectile points found, as well as Minguannan ceramics; jasper and quartz only reported raw materials

SITE NO: 36 CH 101
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 200-250 feet AMSL
PRIMARY SOIL TYPE: Bucks silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Early, Middle, Late, Terminal Archaic; Woodland
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 102
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 115-120 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Archaic; Woodland
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 104
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 160 feet AMSL
PRIMARY SOIL TYPE: Bucks silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 107
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 120-130 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic; Woodland
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 108
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 130-150 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Archaic; Woodland
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 109
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 220 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 110
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River bluff
ELEVATION: 200-245 feet AMSL
PRIMARY SOIL TYPE: Penn soils, 35-50% slope
CULTURAL AFFILIATION: Archaic; Woodland
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 112
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 220 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 113
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 220-210 feet AMSL
PRIMARY SOIL TYPE: Bucks silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 114
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 100-110 feet AMSL
PRIMARY SOIL TYPE: Made land
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Lies within modern catchment basin, evidently destroyed

SITE NO: 36 CH 115
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River bluff
ELEVATION: 150-160 feet AMSL
PRIMARY SOIL TYPE: Bucks silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic(?)
LEVEL OF TESTING: Unknown
COMMENTS: Six burials reported

SITE NO: 36 CH 143
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE: Worsham silt loam, 0-3% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Stemmed points and an axe recorded; lithics consist of jasper, black chert, and quartz

SITE NO: 36 CH 144
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 110-140 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 145
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland
ELEVATION: 420 feet AMSL
PRIMARY SOIL TYPE: Conestoga silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic; Woodland
LEVEL OF TESTING: Phase I Survey
COMMENTS: Stemmed point, axe, and mano in private collection; lithic assemblage is almost exclusively quartz

SITE NO: 36 CH 146
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 300 feet AMSL
PRIMARY SOIL TYPE: Lindside silt loam
CULTURAL AFFILIATION: Late Archaic; Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Stemmed points, "bird points," and triangular points reported; lithic raw materials consist of quartz, quartzite, and jasper

SITE NO: 36 CH 147
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland
ELEVATION: 350 feet AMSL
PRIMARY SOIL TYPE: Hagerstown silt loam, 8-15% slope, severely eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Stemmed points found; lithics are of quartz, quartzite, and jasper

SITE NO: 36 CH 193 Windolf Site
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 240-270 feet AMSL
PRIMARY SOIL TYPE: Worsham silt loam, 3-8% slope
CULTURAL AFFILIATION: Late, Terminal Archaic
LEVEL OF TESTING: Unknown
COMMENTS: One teardrop, several side-notched, and one Perkiomen Broadspear; wide range of lithic raw material

SITE NO: 36 CH 194 Robinson Site
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE: Glenville silt loam, 3-8% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Bare Island point; quartz, jasper, and quartzite debitage; high frequency of jasper cores

SITE NO: 36 CH 199
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 475 feet AMSL
PRIMARY SOIL TYPE: Glenelg channery silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Two Madison/Levanna points

SITE NO: 36 CH 211 Streeter Site
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 410-420 feet AMSL
PRIMARY SOIL TYPE: Glenville silt loam, 3-8% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Surface collected
COMMENTS: Undiagnostic bifaces found, lithics exclusively quartzite

SITE NO: 36 CH 269 Dutt #1
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Pickering Creek terrace
ELEVATION: 110-140 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Ground stone axe found

SITE NO: 36 CH 278 Dutt #39 (Gresko Cache)
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 100-110 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Not recorded
COMMENTS: Cache of 165+ jasper bifaces, probably broadspear preforms (Witthoft and Mason 1949; see also Witthoft 1948).

SITE NO: 36 CH 295 Dutt #2
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 150-160 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 324
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 300-350 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Chert knife/biface and quartz flakes found on surface

SITE NO: 36 CH 363
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 360 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 364
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 120 AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 CH 436 Ottey Site
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 380 feet AMSL
PRIMARY SOIL TYPE: Glenelg channery silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Subsurface testing
COMMENTS: Quarry site with primary reduction blanks recovered

SITE NO: 36 CH 437
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 380-390 feet AMSL
PRIMARY SOIL TYPE: Glenelg channery silt loam, 8-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: A triangular point and quartz, quartzite, and jasper debitage reported

SITE NO: 36 CH 439 Hares Hill 1 Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: French Creek terrace
ELEVATION: 130 feet AMSL
PRIMARY SOIL TYPE: Rowland and Penn silt loams
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Quartz and jasper lithics recovered including a Bare Island point

SITE NO: 36 CH 440 Hares Hill 2 Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: French Creek terrace
ELEVATION: 140 feet AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Small tributary bisects site; quartz, jasper, and quartzite artifacts recovered

SITE NO: 36 CH 441 Dotts Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 420-440 feet AMSL
PRIMARY SOIL TYPE: Glenville silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Paleo-Indian; Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Fluted point and Poplar Island point reported; chert, jasper, quartz, quartzite, and banded slate present

SITE NO: 36 CH 442 French Creek Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam
CULTURAL AFFILIATION: Late, Terminal Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Diagnostic point types include Poplar Island and a Broadspear; raw materials represented by jasper, quartz, and quartzite

SITE NO: 36 CH 443 Camp Hill #1 Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 260-270 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Various stemmed points found; raw materials include quartz, jasper, and quartzite

SITE NO: 36 CH 450 Cromby Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 200-210 AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic; Late Woodland
LEVEL OF TESTING: Controlled surface collection
COMMENTS: Quartz triangular point, quartz and quartzite debitage, and a ground stone axe reported

SITE NO: 36 CH 451 Camp Hill Village #2 Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 290 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Early, Late, Terminal Archaic; Late Woodland
LEVEL OF TESTING: Subsurface testing
COMMENTS: Diagnostic artifacts include Bifurcate-base points, stemmed points, Perkiomen Broadspears, triangular points, gorgets, and ceramics; quartz, quartzite, and jasper debitage present

SITE NO: 36 CH 452 Reich Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 350 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Late Archaic; Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: One side-notched point, a triangular point, and quartz and quartzite debitage reported

SITE NO: 36 CH 453 Buttonwood Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 220 feet AMSL
PRIMARY SOIL TYPE: Glenelg channery silt loam, 3-15% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Subsurface testing
COMMENTS: Partially eroded, stratified site; Bare Island points, a celt, a grooved axe, netsinkers, and jasper, quartz, and quartzite debitage recovered

SITE NO: 36 CH 454 Birch Run #1 Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: French Creek terrace
ELEVATION: 210 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Terminal Archaic
LEVEL OF TESTING: Subsurface testing
COMMENTS: Much of site eroded; Archaic points and a Broadspear; raw materials include jasper and quartz

SITE NO: 36 CH 456
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: Location uncertain
PRIMARY SOIL TYPE: Glenelg channery silt loam
CULTURAL AFFILIATION: Early, Late, Terminal Archaic; Early, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Diagnostic projectile points include LeCroy, Bare Island, Poplar Island, Broadspears, Rossville, and Madison; wide range of lithic raw materials

SITE NO: 36 CH 457 Immaculata Site
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland
ELEVATION: 525 feet AMSL
PRIMARY SOIL TYPE: Glenville silt loam, 3-8% slope
CULTURAL AFFILIATION: Middle Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Middle Archaic corner-notched points found as well as quartz and jasper debitage

SITE NO: 36 CH 458 Phoenixville Park Reservoir Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 210-230 feet AMSL
PRIMARY SOIL TYPE: Penn shaly silt loam, very shallow, 15-25% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I and II survey and subsurface testing
COMMENTS: No diagnostics; lithic raw materials include quartz, quartzite, and jasper

SITE NO: 36 CH 460
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 235-250 feet AMSL
PRIMARY SOIL TYPE: Penn shaly silt loam, very shallow, 3-15% slope, severe erosion
CULTURAL AFFILIATION: Unknown prehistoric
LEVEL OF TESTING: Phase I and II survey and subsurface testing
COMMENTS: No diagnostics; quartz predominates over jasper, quartzite, and chert

SITE NO: 36 CH 461
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 90 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: No diagnostic artifacts; raw materials dominated by jasper followed by quartz, quartzite, and negligible amounts of argillite and chert

SITE NO: 36 CH 508 Mathews Road Site
QUADRANGLE: Malvern
TOPOGRAPHIC SETTING: Upland
ELEVATION: 270 feet AMSL
PRIMARY SOIL TYPE: Conestega silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Subsurface testing
COMMENTS: No diagnostic artifacts, jasper and quartz dominate lithics

SITE NO: 36 MG 2
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 80-105 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 3
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Perkiomen Creek terrace
ELEVATION: 80 feet AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 5
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Perkiomen Creek terrace
ELEVATION: 70-80 feet AMSL
PRIMARY SOIL TYPE: Bermudian silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 6
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Terrace at confluence of Perkiomen and Skippack Creeks
ELEVATION: 70-100 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 7
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 80 feet AMSL
PRIMARY SOIL TYPE: Raritan silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 9
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 165-180 feet AMSL
PRIMARY SOIL TYPE: Penn-Lansdale loams, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 10
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 90-120 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 11
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 120-130 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Early Archaic; Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Bifurcate-base point, all major raw materials represented

SITE NO: 36 MG 12
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 230-280 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 13
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 165-190 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 8-15% slope, severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 14
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 135-190 feet AMSL
PRIMARY SOIL TYPE: Lansdale loam, thin, 3-15% slope, severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 16
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 130-140 feet AMSL
PRIMARY SOIL TYPE: Raritan silt loam, 0-3% slope
CULTURAL AFFILIATION: Paleo-Indian; Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 17
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland
ELEVATION: 180-200 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 0-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 18
QUADRANGLE: Norristown
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 50-80 feet AMSL
PRIMARY SOIL TYPE: Unknown, presently made land
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Site destroyed by park development

SITE NO: 36 MG 36
NAME: First Avenue Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 150-170 feet AMSL
PRIMARY SOIL TYPE: Klinesville very shaly silt loam, 3-15% slope, severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 38
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River bluff
ELEVATION: 195-210 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Tear-drop and lozenge-shaped projectile points of argillite and quartzite

SITE NO: 36 MG 41
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 110-140 feet AMSL
PRIMARY SOIL TYPE: Birdsboro silt loam, 0-3% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Unidentified projectile points found

SITE NO: 36 MG 42
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 100-150 feet AMSL
PRIMARY SOIL TYPE: Abbottstown silt loam, 0-3% slope
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Hand axe found

SITE NO: 36 MG 45
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 200-250 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 69
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 130 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 73
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Bluff
ELEVATION: 260 feet AMSL
PRIMARY SOIL TYPE: Penn shaly silt loam, 0-3% slope
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Side-notched point of jasper

SITE NO: 36 MG 75
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 370 feet AMSL
PRIMARY SOIL TYPE: Lansdale loam, thin, 3-15% slope, severely eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: None
COMMENTS: One jasper point and a bone awl

SITE NO: 36 MG 78
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 150 feet AMSL
PRIMARY SOIL TYPE: Raritan silt loam, 0-3% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 85 Price Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 220 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, severely eroded
CULTURAL AFFILIATION: Middle, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Site partially destroyed by housing development; Middle and Late Woodland points found, 2 sherds of Overpeck Incised pottery, jasper 90% of assemblage

SITE NO: 36 MG 86 Shirk Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 220-240 feet AMSL
PRIMARY SOIL TYPE: Mount Lucas silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Lackawaxen points; ground stone axes, quartzite dominates lithic assemblage followed by jasper

SITE NO: 36 MG 87 Kulp Farm Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 200 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Archaic points (Lackawaxen?), axes, bannerstones; quartzite dominates lithic raw materials

SITE NO: 36 MG 88 Hendricks Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 220-240 feet AMSL
PRIMARY SOIL TYPE: Reaville shaly silt loam, 3-8% slope, moderately to severely eroded
CULTURAL AFFILIATION: Middle Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Middle Woodland Corner-Notched point found, jasper 90% of raw material

SITE NO: 36 MG 89 Salfordville Rockshelter
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Bluff
ELEVATION: 180 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Quartzite and jasper flakes

SITE NO: 36 MG 93 Clemmers Mill Rockshelter
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Bluff
ELEVATION: 200-220 feet AMSL
PRIMARY SOIL TYPE: Neshaminy very stony silt loam, 8-25% slope
CULTURAL AFFILIATION: Middle Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Fabric-impressed ceramics (Middle Woodland), jasper flakes and a quartz flake found

SITE NO: 36 MG 94 Clemmers Mill Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 180-200 feet AMSL
PRIMARY SOIL TYPE: Chalfont silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic; Middle, Late Woodland
LEVEL OF TESTING: Surface collected
COMMENTS: Archaic and Woodland points found, as well as ground stone axes; jasper and quartz occur in nearly equal proportions

SITE NO: 36 MG 95 Skippack #1
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 490 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Early, Late, Terminal Archaic; Early, Middle Woodland
LEVEL OF TESTING: Surface survey, subsurface testing, and excavation by PHMC
COMMENTS: Predominant lithic materials: jasper, quartzite and quartz. Three loci distinguished within site (Jehle and Carr 1983:58)

SITE NO: 36 MG 96 Skippack #2
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 180 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Surface survey by PHMC (Jehle and Carr 1983)
COMMENTS: Quartz flakes, point base found

SITE NO: 36 MG 97 Skippack #3
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Skippack Creek Terrace
ELEVATION: 120-140 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 0-3% slope
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Surface survey by PHMC (Jehle and Carr 1983)
COMMENTS: Chert, jasper, quartz, and quartzite flakes, and a broken chert corner-notched point, possibly Brewerton, recovered

SITE NO: 36 MG 98
QUADRANGLE: Sassamansville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE: Reaville shaly silt loam 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Stemmed point found, lithic raw materials include jasper and quartz

SITE NO: 36 MG 99
QUADRANGLE: Sassamansville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE: Reaville shaly silt loam, 3-8% slope, severely eroded
CULTURAL AFFILIATION: Late, Terminal Archaic; Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: A stemmed point, a Broadspear, and triangular points reported; largely quartzite lithic assemblage

SITE NO: 36 MG 100
QUADRANGLE: Sassamansville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Stemmed point reported, jasper and quartzite primary raw materials

SITE NO: 36 MG 101 The Black Rock Farm Site
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Schuylkill River Bluff
ELEVATION: 200-250 feet AMSL
PRIMARY SOIL TYPE: Klinesville very shaly silt loam, 0-15% slope, severely eroded
CULTURAL AFFILIATION: Early, Late, Terminal Archaic; Late Woodland
LEVEL OF TESTING: Tested and excavated by PHMC
COMMENTS: Bifurcate-base, Savannah River Stemmed, Broadspear, Contracting Stemmed, Notched and Triangular points reported, quartz is predominant raw material (Jehle and Carr 1983:64)

SITE NO: 36 MG 102 Dutt #M
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland
ELEVATION: 80-140 feet AMSL
PRIMARY SOIL TYPE: Made land
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Site destroyed by construction of a road interchange

SITE NO: 36 MG 103 Dutt #N
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland
ELEVATION: 100-120 feet AMSL
PRIMARY SOIL TYPE: Penn-Lansdale loams, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 106 Shirk II Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 260 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Archaic; Early Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Lithics are primarily jasper followed by chert

SITE NO: 36 MG 108
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 230 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, severely eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Surface collected
COMMENTS: Base of stemmed quartzite point recovered, quartz and argillite debitage also present

SITE NO: 36 MG 109
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 200-230 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 110
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 180 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Terminal Archaic; Early Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Quartzite(?) Fishtail point reported; quartz, black chert, and jasper debitage

SITE NO: 36 MG 111 Martins Farm Site
QUADRANGLE: Lansdale
TOPOGRAPHIC SETTING: Upland slope
ELEVATION: 280 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late, Terminal Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Diagnostics include one Lackawaxen point, one Brewerton Side-Notched point, one Perkiomen Broadspear

SITE NO: 36 MG 112 Murray, Golden Site
QUADRANGLE: Collegeville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 270 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-15% slope, moderately eroded
CULTURAL AFFILIATION: Late, Terminal Archaic
LEVEL OF TESTING: Unknown
COMMENTS: A Brewerton point and a Broadspear are noted

SITE NO: 36 MG 113 Wayland Farm Site
QUADRANGLE: Sassamansville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 240 feet AMSL
PRIMARY SOIL TYPE: Reaville shaly silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Lackawaxen Stemmed points found, almost exclusively quartzite

SITE NO: 36 MG 114
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 80 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, coal overwash
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 115
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland
ELEVATION: 200 feet AMSL
PRIMARY SOIL TYPE: Lansdale loam, thin, 3-8% slope, severely eroded
CULTURAL AFFILIATION: Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 120 Fell Road Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 280 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Middle, Late, Terminal Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Expanding-stem points, straight-stem points, narrow contracting-stem point, Broadspears, Perkiomen Broadspear; predominantly quartzite and argillite

SITE NO: 36 MG 121 Fell Road #2 Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 280-300 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-15% slope, moderately to severely eroded
CULTURAL AFFILIATION: Early, Late Archaic
LEVEL OF TESTING: Unknown
COMMENTS: None

SITE NO: 36 MG 122 XK1 Site
QUADRANGLE: Telford
TOPOGRAPHIC SETTING: Upland
ELEVATION: 340-360 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Middle, Late, Terminal Archaic; Early/Middle, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Expanding-stem points of quartz and quartzite, a quartz tapered-stem point, narrow-stem points of argillite, a jasper Lehigh Broadspear, a Meadowood point made from Onondaga chert, a quartz triangular point, one full-grooved axe, and two bannerstone fragments; all major raw materials represented

SITE NO: 36 MG 123 Garges Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 260-290 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 8-15% slope, severely eroded
CULTURAL AFFILIATION: Middle, Late Archaic; Early, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Quartz expanding-stem and triangular points, quartzite contracting stem points, a Meadowood point made from chert, and a bannerstone

SITE NO: 36 MG 124 Goods Field Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 180-200 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, severely eroded
CULTURAL AFFILIATION: Early, Late Archaic; Early, Middle, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Two chert Bifurcates, eight quartzite narrow contracting stem points, two Snyders points of chert and thirty-four triangular points (17 jasper, 13 chert, 4 quartz); other lithics predominately jasper; gunflints

SITE NO: 36 MG 125 Vernfield Bridge Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: East Branch Perkiomen Creek terrace
ELEVATION: 220-240 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope, severely eroded
CULTURAL AFFILIATION: Late, Terminal Archaic; Early, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Corner-notched, stemmed, and triangular points made from quartz, argillite Broadspears and side-notched points made from chert and jasper

SITE NO: 36 MG 126 Bergheys Bridge Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 220-240 feet AMSL
PRIMARY SOIL TYPE: Klinesville very shaly silt loam, 3-8% slope, severely eroded
CULTURAL AFFILIATION: Late, Terminal Archaic; Early/Middle, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Diagnostic points include a chert Brewerton Side-notched, seven quartzite Koens-Crispin, a jasper Broadspear, four argillite Fox Creek, one chert Snyders Corner-notched, and one quartzite triangle

SITE NO: 36 MG 127 Thompson Road Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 240 feet AMSL
PRIMARY SOIL TYPE: Readington silt loam, 3-8% slope, moderately eroded
CULTURAL AFFILIATION: Late Archaic; Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: One narrow contracting-stem point made from quartzite, one quartz triangular point, one chert and one quartz corner-notched point

SITE NO: 36 MG 128 Metz Site
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 260 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 8-15% slope, moderately eroded
CULTURAL AFFILIATION: Middle, Late, Terminal Archaic; Early, Late Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Artifacts reported include narrow straight-stem points (8 quartzite, 1 quartz), a quartzite contracting-stem point, a jasper Fishtail point and a triangular point of rhyolite; debitage of each type occurs

SITE NO: 36 MG 129
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 200 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope
CULTURAL AFFILIATION: Early, Middle, Late, Terminal Archaic; Early Middle, Late Woodland
LEVEL OF TESTING: Phase I survey
COMMENTS: Wide range of projectile point types reported from site include Bifurcate-base, Vosburg, straight stem, contracting stem, Poplar Island, Bare Island, Perkiomen Broadspear, Rossville, Jacks Reef, and Madison; lithic types include quartzite, quartz, jasper, chert, argillite, and rhyolite

SITE NO: 36 MG 130
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Bluff
ELEVATION: 180 feet AMSL
PRIMARY SOIL TYPE: Klinesville very shaly silt loam, 3-8% slope
CULTURAL AFFILIATION: Middle, Late, Terminal Archaic
LEVEL OF TESTING: Phase I survey
COMMENTS: Vosburg, contracting stem, Bare Island, Broadspears, bannerstones and pestles reported; raw materials include quartz, quartzite, jasper, and rhyolite

SITE NO: 36 MG 131
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 200 feet AMSL
PRIMARY SOIL TYPE: Penn silt loam, 3-8% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I survey
COMMENTS: Quartz, quartzite, and jasper debitage recovered

SITE NO: 36 MG 132
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 140 feet AMSL
PRIMARY SOIL TYPE: Readington and Croton silt loams, 0-5% slope
CULTURAL AFFILIATION: Late, Terminal Archaic, Late Woodland
LEVEL OF TESTING: Phase I survey
COMMENTS: Contracting stem, Bare Island, Broadspear, and Madison projectile point types; raw materials include quartz, quartzite, and argillite

SITE NO: 36 MG 133
QUADRANGLE: Perkiomenville
TOPOGRAPHIC SETTING: Perkiomen Creek terrace
ELEVATION: 140 feet AMSL
PRIMARY SOIL TYPE: Raritan silt loam, 0-3% slope
CULTURAL AFFILIATION: Early, Late Archaic; Early Woodland
LEVEL OF TESTING: Phase I survey
COMMENTS: Projectile point types include Bifurcate-base, Bare Island, and side-notched; raw materials represented by quartzite, quartz, jasper, and chert

SITE NO: 36 MG 160
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 70 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I Survey
COMMENTS: None

SITE NO: 36 MG 171 Fitzcharles Site
QUADRANGLE: Norristown
TOPOGRAPHIC SETTING: Terrace, on Barbadoes Island in Schuylkill River
ELEVATION: 60 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Site impacted by grading

SITE NO: 36 MG 181
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Upland
ELEVATION: 410-420 feet AMSL
PRIMARY SOIL TYPE: Edgemont very stony loam, 8-25% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: Biface and flakes found

SITE NO: 36 MG 183 Abrams Site
QUADRANGLE: Valley Forge
TOPOGRAPHIC SETTING: Terrace
ELEVATION: 70-80 feet AMSL
PRIMARY SOIL TYPE: Bowmansville silt loam
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Phase I survey
COMMENTS: Jasper and quartz debitage; site impacted by force main construction

SITE NO: 36 MG 185
QUADRANGLE: Norristown
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 45-60 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, coal overwash
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: No diagnostics reported; impacted by construction of force main

SITE NO: 36 MG 186
QUADRANGLE: Valley Forge/Norristown
TOPOGRAPHIC SETTING: Schuylkill River terrace
ELEVATION: 55-75 feet AMSL
PRIMARY SOIL TYPE: Rowland silt loam, coal overwash
CULTURAL AFFILIATION: Archaic; Woodland
LEVEL OF TESTING: Unknown
COMMENTS: Ceramics recovered; impacted by construction of force main

SITE NO: 36 MG 187
QUADRANGLE: Phoenixville
TOPOGRAPHIC SETTING: Upland
ELEVATION: 250 feet AMSL
PRIMARY SOIL TYPE:
CULTURAL AFFILIATION: Late, Terminal Archaic
LEVEL OF TESTING: Unknown
COMMENTS: Point types reported include Brewerton Side-Notched, Bare Island, Normanskill, Snook Kill/Koens Crispin, corner-notched, and stemmed; all but one chert point made from quartzite

SITE NO: 36 PH 22 Manatawna Rockshelters
QUADRANGLE: Norristown
TOPOGRAPHIC SETTING: Schuylkill River bluff
ELEVATION: 200 feet AMSL
PRIMARY SOIL TYPE: Not Applicable
CULTURAL AFFILIATION: Late, Terminal Archaic
LEVEL OF TESTING: Excavated
COMMENTS: Three rockshelters are included; Susquehanna Broadspears in two of the rockshelters; other artifacts included an argillite Lackawaxen point, a quartz Bare Island point, a rhyolite point, and a chert point

SITE NO: 36 PH 25 Bell's Mill Site
QUADRANGLE: Germantown
TOPOGRAPHIC SETTING: Upland
ELEVATION: 180-230 feet AMSL
PRIMARY SOIL TYPE: Manor and Chester extremely stony loams, 25-50% slope
CULTURAL AFFILIATION: Unknown Prehistoric
LEVEL OF TESTING: Unknown
COMMENTS: "Chipping feature" containing quartz reported

7.0 THE FRICK'S LOCK SITE (36 CH 103)

7.1 Introduction

The possibility that the Frick's Lock Site (36 CH 103) would potentially be affected by construction of the 220-61 Transmission Line was first recognized during the initial search of the PHMC site files. Over the years, a large number and wide variety of prehistoric artifacts had been collected by avocational archeologists from the cultivated fields of two adjacent river terraces east of the hamlet of Frick's Lock (Figure 9). The site produced artifacts dating from the Early Archaic through the Late Woodland time periods, indicating repeated prehistoric occupations. Based on the reported site boundaries, it appeared that the 220-61 Transmission Line would bisect this large site from east to west.

In the early 1970's, a team of avocational archeologists under the direction of Mr. John Neidly of the Hill School, Pottstown, conducted a surface survey and undertook formal excavations at the site (Thomas Waters, personal communication). Forty-five chipped stone tools and one sherd of cordmarked pottery were recovered. Diagnostic projectile point types included a Madison point and a Levanna point dating to the Late Woodland period, a Rossville point dating to the Early/Middle Woodland period, and two Brewerton Side-notched points dating to the Late Archaic period. Whether or not these occupations were horizontally or vertically discrete was not reported. However, excavations did reveal the existence of a pit feature below the plowzone in one of the excavation units. The feature was approximately 16 inches in depth and contained very small pieces of debitage and charcoal.

The Phase I archeological survey of the 220-61 Transmission Line verified that artifacts occurred within the proposed right-of-way on both river terraces. Construction of two proposed transmission towers and any access roads would directly affect the site and, therefore, a Phase II evaluation was recommended. Results of the Phase II evaluation demonstrated that archeological materials were present below the surface and into the subsoil. The depth of these archeological deposits below the plowzone was shallow and stratigraphically separate prehistoric components were not in evidence. However, the presence of subsurface artifacts, in concert with the site's river terrace location and large size, suggested that subsurface features were likely present. The multi-component nature of the site also suggested that features, if present, might be specific to individual occupations of the site.

A Phase III data recovery program was subsequently implemented to locate and excavate all subsurface features within the proposed areas of impact. On the upper terrace, Phase III investigations were restricted to the area surrounding proposed Structure 1/4, while on the lower terrace they included the area surrounding proposed Structure 1/3 and the proposed access road for this structure (Figure 10). Ten prehistoric features were uncovered. Two were radiocarbon-dated to the Late Woodland Period, and one was dated to the Late Archaic Period. A detailed geomorphological study was also conducted and concluded that both river terraces were suitable for occupation throughout the Holocene (Appendix I).

7.2 Location and Geomorphology

The Frick's Lock Site is located in East Coventry Township directly across the Schuylkill River from the Limerick Nuclear Generating Station (Figure 9). The site is bounded to the west by the hamlet of Frick's Lock and to the east by the west bank of the Schuylkill River. The southern border of the site coincides with a small, first order stream and from here, the site extends northward approximately 2000 feet. The total area of surface scatter covers over 22 acres. This area is located along a straight section of the Schuylkill River, just downstream from an incised meander.

The Frick's Lock Site occupies two river terraces oriented parallel to the Schuylkill River. The lower of the two terraces occurs at elevations between 110 and 120 feet AMSL and lies about 12 feet above the level of the river. This terrace averages 500 feet in width. A trough-like feature marks the western edge of the lower terrace. A steep scarp with a slope of approximately 12 percent runs from the edge of this trough upward 12-15 feet to the second terrace. The second or upper terrace is about 250 feet wide with elevations varying between 130 and 140 feet AMSL. Two local alluvial fans empty onto the lower terrace immediately north of the site, and bedrock uplands lie to the west.

Geomorphological study at Frick's Lock was conducted by Dr. Daniel P. Wagner. The results of the analysis are summarized below, and his report on the site appears in its entirety in Appendix I. The relative ages of the landforms have been inferred from their stratigraphic relationships, soil development, and soil properties. Two major periods of valley filling appear to have occurred, while more local depositional events and erosional processes have also contributed to the evolution of the local landscape.

The first depositional episode is associated with the formation of the upper terrace deposits. Alluvial sedimentation responsible for its genesis probably occurred during the middle Pleistocene. Subsequently, erosional processes undercut the terrace and denuded most or all of the surface of the soils that had formed in the interim. Based on the presence of argillic (Bt) soil horizons on both terraces and evidence for greater soil development on the lower terrace, this erosion probably took place during the late Pleistocene or early Holocene. Since that time the upper terrace has been essentially stable without any substantial addition of colluvial or alluvial surface deposits. The argillic horizon occurs between 27 and 85 centimeters below the surface and, therefore, soils below depths of 25 to 30 centimeters do not contain archeological materials.

The second major depositional event resulted in the accumulation of the lower terrace deposits concurrently with or immediately subsequent to the erosion of the upper terrace. Since the minimum age for the lower terrace deposits must exceed the estimated 10,000 year period of land surface stability needed to form the argillic horizon of the lower terrace soils, this event also occurred during the late Pleistocene or very early Holocene. An early Holocene date is compatible with an age of 9,000 years reported for alluvial fill in northern Pennsylvania and southern New York (Coates 1976).

Much of the lower terrace surface has been stable throughout the Holocene, and flooding has been infrequent. The top of the argillic horizon occurs in the upper levels of the soil profile at about 35 to 40 centimeters below the surface. Had flooding been frequent, a continuously accreting and younger surface would have been witnessed, and soil formation would have terminated at greater depths. Frequent flooding would also not have allowed the existing degree of soil development observed for the lower terrace argillic horizon. Thus, like the upper terrace, archeological materials were not present at depths below about 40 centimeters on the lower terrace.

The trough area, encompassing the western one-quarter of the lower terrace, appears to have been a minor channel or flood scour route until the middle Holocene. The channel was probably fringed on the lower terrace side by a band of swampy vegetation during this period. Thus, access to the lower terrace from the upper terrace may have been restricted or at least hindered by this feature during this time. Subsequently, it became plugged with fine, sandy deposits above which a weak argillic soil horizon developed. This suggests that fluvial deposition within the trough waned beginning about 4,000 years ago. A period of relative surface stability has since persisted.

7.3 Archeological Investigations

Phase I survey of the Frick's Lock Site consisted of a pedestrian surface reconnaissance. Eighty-one undiagnostic artifacts, including 15 chipped stone tools, 59 pieces of debitage, and 5 fire-cracked rocks were recovered from the surface of both terraces.

Phase II evaluation of the Frick's Lock Site included a pedestrian reconnaissance of each terrace and the excavation of thirteen 2 X 2 foot test units. Eight test units were located on the lower terrace and five units were located on the upper terrace (Figure 10).

Surface survey of the upper terrace produced a total of 190 artifacts, and evidence of both Late Archaic and Late Woodland occupations. The Late Archaic component was represented by a single Poplar Island projectile point and the Late Woodland component was represented by a Madison projectile point. Subsurface test results confirmed the presence of Late Archaic and Late Woodland occupations with the recovery of one Bare Island point and one Madison point, respectively. A total of 124 artifacts was recovered from the test units for an average artifact density of approximately six artifacts per square foot on the upper terrace. Differential distribution of artifacts across the upper terrace was suggested by the fact that 68 percent (n=84) of the prehistoric artifacts recovered from the test units came from a single unit (Test Unit 10), which was located just north of proposed Structure 1/4. When this unit is excluded from consideration, the artifact density in the remaining four units on the upper terrace is reduced to 2.5 artifacts per square foot.

Surface survey of the lower terrace also demonstrated evidence of Late Archaic and Late Woodland occupations. The former was represented by one Poplar Island and two Bare Island projectile points, and the latter by one Madison point. A greater number of artifacts was recovered from the surface of the lower terrace (n=304) than the surface of the upper terrace, though artifact density based on the test unit excavations actually suggested a slightly lower artifact density. The eight lower terrace excavation units produced a total of 128 artifacts, or four artifacts per square foot. Unfortunately, no diagnostic artifacts were recovered from these test units. Like the upper terrace, the distribution of artifacts was not consistent among units. In fact, one unit (Test Unit 11), contained nearly 77 percent (n=98) of all artifacts recovered from the test units; excluding this unit, the artifact density for the remaining seven units is only 1.1 artifacts per square foot. The isolated artifact concentrations discovered on each terrace suggested the presence of sub-surface features, although non-artifactual evidence for features in the test units was evidently destroyed by plowing.

Phase III data recovery procedures consisted of controlled surface collection and large scale stripping of the proposed areas of effect to locate subsurface features. On the lower terrace, 7,000 square feet were surface collected and stripped at proposed Structure 1/3 and along the proposed access road for this structure. On the upper terrace, a 2,300 square foot area, including and surrounding proposed Structure 1/4, was collected and stripped. General surface surveys were also conducted outside the direct areas of effect on the lower and upper terraces.

The controlled surface collections were conducted to investigate the potential for horizontal spatial patterning and to assist in locating areas with high potential for subsurface features. Unfortunately, artifact densities were unexpectedly low and attempts to discern spatial patterning in artifact distributions were abandoned. Likewise, isolated artifact concentrations suggesting the presence of subsurface features were not observed. On the lower terrace the surface artifact density (n=118) was only 1.7 artifacts per 100 square feet. On the upper terrace the surface artifact density (n=91) was only slightly higher at 4.0 artifacts per 100 square feet. However, these density ratios do roughly correspond to the densities of prehistoric features on the lower and upper terrace; there are 0.6 features (n=4) per 1,000 square feet and 2.6 (n=6) features per 1,000 square feet, respectively.

Ten prehistoric features were identified during the Phase III data recovery at the Frick's Lock Site, with six occurring on the upper terrace and four on the lower terrace. None of the features on the lower terrace produced artifacts. Feature classes include three post molds and one small, basin-shaped pit (Figure 11). One of the post molds, Feature 4, was radiocarbon-dated to AD 1,540 ± 60. Feature types on the upper terrace included five post molds and one hearth. Four of the post molds, Features 1, 11, 17, and 36, contained artifacts. Features 1 and 17 each yielded a single piece of debitage; Feature 11 contained 10 pieces of debitage; and Feature 36 contained two pieces of debitage, two fire-cracked rocks, and six potsherds. The latter postmold can be attributed to the Woodland Period, as can Feature 17, which was radiocarbon-dated to AD 1,150 ± 150.

The lone hearth, Feature 35 (Figure 11), consisted of a cluster of 120 fire-cracked rocks in a basin-shaped pit measuring 10 inches by 13 inches in plan and six inches deep. A charcoal concentration was present along the northern edge of the hearth. The soil matrix containing the fire-cracked rock was noticeably darker than the surrounding soils and contained charcoal flecks throughout. In addition to the fire-cracked rock, 32 pieces of debitage were recovered. No diagnostic artifacts were found in association with the hearth but a radiocarbon-date of 1,830 ± 120 BC clearly indicates a Late Archaic affiliation. All floral material recovered from flotation samples unfortunately proved to be of modern origin (see Appendix IV).

7.4 Artifact Patterning

Descriptions, frequencies, and metric data on the lithic artifacts from Frick's Lock are provided in Zatz et al. (1984b), and are summarized in Table 1. Representative lithic artifacts are illustrated in Plates 1 and 2. Due to the low density and low frequency of artifacts and features encountered during the Phase I, Phase II, and Phase III investigations, statistical spatial analysis of these data within each terrace is not appropriate. However, comparisons can be made between the combined artifact assemblages recovered during all phases of the investigations of each terrace, and several general conclusions can be drawn.

Several lines of evidence suggest that both terraces were intermittently occupied throughout the Late Archaic and Woodland time periods. As can be seen in Table 1, the only evidence for Early Archaic utilization of the site is a single Bifurcate projectile point found on the upper terrace. Evidence for Middle Archaic occupation is lacking.

Late Archaic projectile point types are equally represented on both terraces; six occur on each terrace. One Poplar Island and five Bare Island points were found on the upper terrace, while three Bare Island, two Poplar Island, and one Genesee-like point occurred on the lower terrace. Conspicuous by their absence are projectile points of the Laurentian Tradition such as Otter Creek, Vosburg, and the Brewerton series.

Transitional/Terminal Archaic point types are slightly more common on the upper terrace (n=5) than on the lower terrace (n=3). Perkiomen Broadspears occur exclusively on the upper terrace although sample size can easily account for this discrepancy. Each terrace also produced a single Dry Brook Fishtail point, which dates to the Terminal Archaic/Early Woodland time periods. The only potential evidence for differential occupation of the two terraces is suggested by the distribution of Middle and Late Woodland projectile points. Eight projectile points attributable to Woodland occupations were found on the upper terrace while only two occurred on the lower terrace.

Furthermore, all potsherds recovered from the site were found on the upper terrace. Unfortunately, most sherds are badly eroded and are not unequivocally diagnostic. Thirteen sherds were recovered, only three of which exceed one centimeter in maximum dimension. Nine are quartz-tempered, and one of these displays exterior cord-marking. Three additional cordmarked exterior sherds are tempered with very fine particles of grit. A final sherd displays interior and exterior cordmarking and mixed temper consisting of quartz and crushed black rock. Temporal and cultural affiliations of these potsherds remains uncertain, though the latter sherd is suggestive of an Early/Middle Woodland placement. Two of the potsherds were found in Feature 31 and six were found in Feature 36. Both features are postmolds located in the northeasternmost extreme of the site where subsurface testing was undertaken. Based on these somewhat limited data, a higher intensity of occupation of the upper terrace during the Woodland Period is therefore suggested.

The classes of tools occurring on each terrace are quite similar. As shown in Tables 2a and 2b, projectile points are the most common tool class and not only occur in nearly equal frequencies on each terrace, but have almost identical distributions when classified by raw material types. Scrapers and Miscellaneous tools, the latter primarily comprised of retouched flakes of various forms, also occur in nearly identical frequencies, while drills and blanks/preforms occur too infrequently to assess differences between the two terraces. The only appreciable difference thus appears to be a higher frequency of jasper and quartz bifaces on the upper terrace.

The overall similarity is also mirrored by comparing the proportions of raw material types for debitage on each terrace and the proportions of raw material types for tools on each terrace. This is illustrated in Tables 3a and 3b, which provide the frequency and proportion of raw materials for debitage and tools on each terrace. Predominant raw materials for both tools and debitage on each terrace include jasper, quartz, and quartzite. Cherts and chalcedony account for a minor proportion of the raw materials occurring at the site while argillite, rhyolite, and other raw material types occur in negligible amounts. Specific comparisons of the proportions of each raw material type are remarkably alike for debitage. And, although there are some differences in the proportions of raw materials when the tools from each terrace are compared, they are minor. In particular, a slightly higher percentage of tools on the upper terrace were made from jasper, while on the lower terrace a slightly higher percentage of tools were made from quartzite; this is not reflected in the debitage profiles.

The lack of significant differences between the upper and lower terrace artifact assemblages is presumably attributable to the fact that both terraces were intermittently occupied over the same periods of time. This also suggests that even if the lower terrace was less intensively utilized during the Woodland Period, this difference was not of a sufficient magnitude to cause any recognizable differences in the artifact assemblages of each terrace.

7.5 Site Interpretation

Based on the diagnostic artifacts (Table 1, Plates 1 and 2; see also Zatz et al. 1984b), there is little evidence that the Frick's Lock Site was repeatedly and/or intensively occupied prior to the Late Archaic Period. More frequent occupation occurred during the past 6,000 years throughout the Late/Terminal Archaic and Woodland Periods. The large areal extent of the site and the large numbers of artifacts collected from its surface over the years suggests that this was a preferred and/or strategically advantageous location and that it was frequently occupied. Phase II and Phase III excavations unfortunately did not reveal archeological data in sufficient quantity or quality to allow detailed reconstruction of differences in the way this location was utilized through time. Though intensive, the excavations were able to sample only a small fraction of this very large site. Thus, interpretations of the relative permanency and/or frequency of the occupations of the site and its function can be made only in the most general sense, and the potential effects of sampling error must be borne in mind.

Classification of the tools found at the site demonstrates a predominance of two tool categories (Table 4). The first and most numerous are projectile points/knives; these tools are best associated with subsistence activities such as hunting and butchering. Projectile points/knives make up 40.1 percent of all tools in the chipped stone tool assemblage (Table 4). Bifaces lacking prepared haft elements and biface fragments make up an additional 27.1 percent of the assemblage and are the second most common class. Generalized tool forms such as these cannot be reliably associated with specific subsistence-related or specific manufacturing activities, since they can be used and/or modified to fit the needs of many tasks. Bifacial blanks and preforms comprise only five percent of the stone tools. The debitage to tool ratio is rather low at 9.35:1 (1654/177). Together, these figures suggest a low intensity of chipped stone tool manufacture.

Scrapers, which constitute 10.7 percent of all chipped stone tools, are the most frequent tool class that can be associated with manufacturing activities. These would include hideworking and possibly the working of bone, antler, and/or wood. More specialized manufacturing tools such as drills, perforators, and gravers are infrequent, as they are for all sites surveyed during the course of the Limerick Transmission Line Survey, and comprise only 1.1 percent of the assemblage. Another 16.4 percent of the assemblage is comprised of Miscellaneous tools, largely represented by retouched flakes of various forms. Again, like the generalized bifaces, these tools can potentially be associated with any number of activities.

Compared with sixteen other sites discovered during the Limerick Transmission Line Survey that yielded more than ten tools, several patterns can be noted. First, the proportions of projectile points, bifaces, and miscellaneous tools are most closely replicated at Sites 36 MG 140, 36 MG 104, and 36 MG 173. These sites are characterized by three of the highest proportions of projectile points; only 36 MG 104 has a substantially higher proportion of projectile points, and that figure appears to be aberrant. Concomitantly, the proportion of bifaces closely approaches the mean value for all sixteen sites. In contrast, these three sites have three of the four lowest proportions of miscellaneous tools.

Here the similarities end, for these are the only tool classes that occur at 36 MG 173, 36 MG 104, and 36 MG 140. At the Frick's Lock Site, scrapers, drills, and preforms/blanks are also present, with scrapers occurring in appreciable numbers. This variety of tool is taken to indicate that a greater variety of activities took place at this site. The presence of formal flake tools, combined with the low proportion of casual flake tools, which comprise the bulk of the miscellaneous tool category, also suggests that the activities associated with formal scrapers were being conducted on a regular or scheduled basis. This phenomenon contrasts with the Point Bar Site, where tools were recycled or modified as needed to complete these tasks (see Section 8.0).

Yet, this complement of tools and debitage does not bespeak of a particular specialized function for the site. Such an assemblage could have been produced by any number of combinations of different kinds of relatively short-term occupations. Concomitantly, the low frequency of subsurface features suggests that intensive and/or extended occupations of the site were not common, at least not on this part of the site.

Perhaps the most significant aspect of the archeological assemblage is the fact that jasper appears to have been the dominant lithic material over a long span of time. Table 1 shows that diagnostic artifacts from the Early, Late, and Terminal Archaic and Late Woodland Periods are present. The high proportion of jasper and low proportion of quartz at the Frick's Lock Site is highly unusual when compared to other regional sites. Out of the 26 sites having more than 25 chipped stone artifacts that were surveyed during the course of the Limerick Transmission Line Survey, the Frick's Lock Site has the third highest percentage of jasper debitage. Concomitantly, the site has the third highest proportion of chert/chalcedony and the third lowest percentage of quartz debitage. In this fashion, the Frick's Lock Site most closely resembles 36 MG 1, 36 MG 151, and 36 MG 173 (see also Section 10.2.2).

The relationship between the high proportion of jasper and low proportion of quartz is most significant because quartz is a locally available raw material while jasper is not. The implication is that jasper would have required transportation to the site for manufacture. Further, jasper is the only material in which debitage occurs in significantly higher proportions than tools made of the same raw material (see Tables 3a and 3b). That is, jasper debitage accounts for 42.4 percent of all debitage while only 29.9 percent of all tools were made from jasper. Again, the implication is that jasper was brought to the site for manufacture in greater amounts than either of the two locally available raw materials (i.e. quartz and quartzite); tools and debitage of these raw materials occur in similar proportions. In contrast, other non-local raw materials such as chert and chalcedony, argillite, and rhyolite were brought to the site in the form of finished tools; debitage is comparatively low in frequency (see Tables 3a and 3b). Of these materials, chert and chalcedony assume the greatest proportions, as noted above.

Evidently, then, jasper was the preferred raw material at some point(s) in time during the past occupation of the Frick's Lock Site. The predominance of jasper and lack of evidence for the procurement, transport, *and* manufacture of other non-local raw materials may suggest that this site was utilized as a stopping point for groups who had recently replenished their supplies of jasper. Patterning of lithic raw material procurement and usage at Frick's Lock and elsewhere is explored in greater detail in the concluding sections.

8.0 THE POINT BAR SITE (36 MG 156)

8.1 Introduction

The Point Bar Site (36 MG 156) was discovered during Phase I survey of the 220-63 Transmission Line. Due to a lack of surface visibility in the vicinity of proposed structure locations 6/5 and 6/6, subsurface testing was conducted. Seven 2 x 2 foot test units were excavated between and in the vicinity of the proposed structure locations (Figures 12 and 13).

All Phase I test units revealed soil profiles demonstrating that the site had never been plowed and was undisturbed by modern agencies. Prehistoric cultural materials were found in subsoil contexts in each test unit. Four hundred forty artifacts were recovered, including 34 fire-cracked rocks, 14 chipped stone tools, 391 pieces of debitage, and one hammerstone. The only potentially diagnostic artifact was a side-notched projectile point made of quartz that is reminiscent of the Brewerton Side-notched type (Ritchie 1971). Reworking has altered the base and blade so that a conclusive typological assessment is not possible.

A Phase II evaluation of the Point Bar Site was recommended due to the presence of what appeared to be undisturbed archeological materials within an extensive alluvial soil deposit. The potential for both features and vertical stratification of archeological materials was high. Eighteen 5 x 5 foot test units were excavated to evaluate the integrity of the archeological deposits at the site (Figure 13). A preliminary geomorphological study was also conducted to establish the age and nature of the river terrace on which the site is located (Appendix II).

Artifacts recovered during the course of the Phase II testing spanned the Early Archaic through the Middle Woodland Periods. However, the vertical distribution of diagnostic artifacts, in concert with geomorphological evidence, suggests that the cultural deposits have been reworked and/or redeposited by fluvial processes.

8.2 Location and Geomorphology

The Point Bar Site is located on the northern side of the Schuylkill River within the boundaries of the Valley Forge National Historical Park in Lower Providence Township, Montgomery County (for general locational information, see Figure 12). The site occupies up to twelve acres of a T-1 river terrace at an approximate elevation of 75 feet AMSL. It is bounded to the north and east by a small, unnamed stream and to the west by a wetland area. Perkiomen Creek, a major tributary of the Schuylkill River, lies .75 miles to the northwest. Its actual confluence with the Schuylkill River is approximately 1.25 miles to the west-northwest.

Two soil types occur on the Point Bar Site. The dominant soil type, Bermudian silt loam, is a deep, well-drained and nearly level soil commonly found on floodplains and river terraces. Consequently, this soil is susceptible to frequent inundation. The second soil type, Bowmansville silt loam, is restricted to the area around proposed structure 6/6, adjacent to the unnamed stream that forms the eastern border of the site. This soil type consists of deep, poorly drained, nearly level soils on floodplains and terraces associated with small meandering streams (Smith 1967).

Analysis of the geomorphology and pedology of the site was conducted by Elisabeth M. Ervin, the results of which are summarized herein and are presented in their entirety in Appendix II. Ervin's analysis of this river terrace demonstrates substantial changes in the fluvial regime of the Schuylkill River during both the Pleistocene and the Holocene. Reconstruction of the depositional sequence was based on a particle size analysis of soil samples taken from four of nine 5 x 5 foot excavation units located in the vicinity of proposed structure 6/5. Soil samples were not taken from strata above 9 to 13 inches below the surface; these appeared to be recent deposits subject to disturbance and/or reworking. A broader perspective of floodplain dynamics was achieved by supplementing the stratigraphic sequence from these test units with data from four core borings along this landform made by Site Engineers, Inc. (Appendix II). Correlations with specific soil strata identified in the four excavation units could only be made among the other five units in the vicinity of proposed structure 6/5; soil layer correlations with the excavation units associated with proposed structure 6/6 and the core borings were not possible.

Seven distinct soil strata were identified within the sample of four excavation units at the Point Bar Site. As shown in Table 5, Layers VII, VI, and V represent strata characteristic of point bar and channel bar deposits. During the Early to Mid-Pleistocene, the Schuylkill River flowed slightly to the rear of the site, as evidenced by an abandoned channel scar located adjacent to the bedrock ridge north of the site. As bar deposits accumulated along the southern bank of this channel, the river eventually split, and began to flow on both sides of the bar during the Middle to Late Pleistocene. Distinct breaks occur between Layers V and VI and Layers VI and VII, suggesting that these deposits accumulated at differential rates and under different fluvial conditions during this period of time.

During the early Holocene, the channel lying south of the bar deposit became the primary channel of flow, reducing the rate of flow in the old channel north of the site. The old channel then slowly filled with backwater clay and silt deposits as the Holocene terrace began to acrete, and as the old channel was cut off.

Soil Layers I, II, III, and IV represent a series of accretional levee or overbank deposits superimposed upon the bar deposits that underlie the site. These overbank deposits vary in thickness from 1.75 to 3.83 feet and contained almost all of the cultural materials found at the site. According to overbank sedimentation rates calculated in the Delaware River Valley (Ritter et al. 1973), a three meter (10 feet) overbank deposit would take approximately 4,000 years to accumulate. A sedimentation rate of a similar order of magnitude for the Schuylkill River is assumed in the present case for lack of other germane sedimentation rates; based on this extrapolation, these deposits would have been deposited within an approximate 1,500 year span.

Concomitantly, soil development within these deposits is nearly non-existent. A weakly expressed cambic horizon is present in Layer IV in two of the units subjected to detailed soil analysis, and in Layer III in a third unit. Similar soils in Pennsylvania have been found to develop in 200 to 450 years, but these occurred in more recent alluvial contexts (Bilzi and Ciolkosz 1977). Because soil development in levee deposits can occur only if flooding is infrequent and the deposit is exposed to subaerial weathering, it is suggested that relatively stable occupational surfaces at this site were very short-lived. Vegetational cover was probably minimal and subject to frequent inundation and erosion. Further, if stable prehistoric land surfaces did exist for any appreciable length of time, they were largely obliterated by erosion and subsequently replaced by more recent alluvial deposits.

This is an entirely different depositional context from that at the Frick's Lock Site located twelve miles upstream. As discussed previously, a well-developed argillic horizon was present on the lower first terrace of this site at similar elevations (10-20 feet) above the Schuylkill River (Appendix I). The archeological implications of the lack of past stable land surfaces at the Point Bar Site are discussed in detail below.

8.3 Sampling Strategy

Phase I survey at the Point Bar Site consisted of a pedestrian reconnaissance of the entire 220-63 Transmission Line right-of-way between and surrounding proposed structures 6/5 and 6/6. Because of the lack of ground visibility, six 2 x 2 foot test units were placed along the centerline of the proposed right-of-way from a point 200 feet west of the center of proposed structure 6/5 to the midpoint between the proposed footings for structure 6/6. Two of these units were placed at the center of the existing lattice structures, which corresponds to the midpoint between the footings for the proposed two-pole structures. A seventh test unit was placed 20 feet south of the unit directly under proposed structure 6/6. This placement allowed additional testing of the terrace landform, since here the terrace begins to slope towards the small stream located approximately 15 to 20 feet east of proposed structure 6/6 (Figure 13).

Intensive Phase II testing of the Point Bar Site was limited to the two 1,250 square foot areas immediately surrounding the proposed structure locations where direct construction effects were imminent. Construction would involve the dismantling of the two existing structures and erection of the two proposed structures; an existing access road would be used to avoid any other effects.

Nine 5 x 5 foot test units were excavated in the areas of direct effect, resulting in an 18 percent sample of the total area of impact. Each unit was located by implementing a grid-coordinate system for the area surrounding each proposed structure. The datum (North 0-East 0) for each grid was the midpoint between each of the proposed structure footings (also corresponding to the center of each existing lattice structure). The locations of all Phase II test units are depicted on Figure 13. Each unit was excavated according to the methods discussed in Section 5.0. In addition, constant volume flotation samples were taken from each theee inch excavation level.

It should be noted at this point that formal Phase III data recovery was not undertaken at the Point Bar Site due to the discovery that the site areas of effect had been considerably disturbed by fluvial activity. Thus, the important cultural and geomorphological information was recovered at the Phase II level, and Phase III was deemed unnecessary.

8.4 Stratigraphy and Chronology

Although the overall geomorphic evolution of the T-1 river terrace clearly demonstrates that the prehistoric cultural materials at the Point Bar Site are wholly contained within overbank/levee deposits that accumulated during the Holocene, the distribution of these strata is not consistent across all excavation units in the area of proposed structure 6/5. As shown in Table 6, Layer I only occurs in three units (S0-W5, S5-E5, S10-W5); these are located adjacent to each other and occur nearest the river (Figure 13). Layer III occurs in three other units, two of which are adjacent to each other (N5-W25 and S0-W20); the other (N5-E15) is located 35 feet away. This inconsistent expression of Layers I and III suggests that very active processes of erosion, such as scouring and subsequent redeposition, have been operating on the terrace; this observation is consistent with the lack of soil development as discussed above. Further, erosion of Layer III, which represents an episode of short term stability of the land surface by virtue of being a cambic soil horizon, suggests that other former relatively stable surfaces may have been affected by erosion and are therefore missing in the soil profile of the terrace.

Only Layers II and IV occur in all nine units. Layer IV witnessed at least a short period of stability since it is a cambic soil horizon, as previously discussed. Some degree of landform stability for Layer II is also evidenced by the presence of an intact hearth in Unit S10-W5 at a depth of 19 - 24 inches below surface. However, Layer II does not show any characteristics of soil development and the feature may well be an "island" of stability, i.e. a remnant land surface isolated by erosion. Interestingly, this excavation unit was located closest to the river bank. A similar situation involving a localized, residual distribution of artifacts was observed at the Hall 1 Site in Lycoming County, Pennsylvania. Located on a terrace of Lycoming Creek, a small remnant of a Middle Archaic component had been similarly isolated by erosional processes (Kingsley and Joiré 1988:41).

The case for erosional episodes is supported by the vertical distribution of diagnostic artifacts in this area of the site (Table 7). Diagnostic Woodland period artifacts occur primarily in Layers III and IV, with two potsherds occurring at depths assignable to either Layer II or III, and three potsherds assignable to Layer II. Absolute depths below the surface for all of these artifacts range from 11 to 21 inches. All but one of the Terminal Archaic, Late Archaic, and Early Archaic period artifacts occur in Layer II at absolute depths of 9 - 17" below the surface. The exception, a Brewerton Side-notched point, was found between 14 and 17 inches below the surface and is from either Layer I or II. Therefore, with the possible exception of Unit S5-E5, the stratigraphic relationship of the Archaic and Woodland artifacts appears to be reversed. Given the intermittent presence of weakly expressed cambic soil horizons in Layers III and IV, coupled with the fact that erosional processes have removed Layers I and III from some units and the high likelihood that portions of Layers II and IV were subject to active erosion as well, one would not expect to find an unmixed cultural deposit. Yet, the apparent reversal of the cultural stratigraphy is perplexing.

Detailed soil analysis was not undertaken in the vicinity of proposed structure 6/6, and the data recorded for the soil cores are insufficient for comparable analysis. However, the absolute depths at which diagnostic artifacts occur in the area of proposed structure 6/6 seem to contribute to this stratigraphic conundrum (Table 7). Potsherds (n=4) were found between 16 and 22 inches, while bifurcate-base points were found between 13 and 17 inches below surface. This relationship is most clearly expressed in Unit S0-E10, where a potsherd was found at 19-22 inches below surface and a bifurcate-base point at 13 - 16 inches below surface; these depths may correlate with Layers III and IV in the vicinity of proposed structure 6/5.

This inconsistency in cultural stratigraphy is supported by the proportions of artifacts by soil layers and units at proposed structure 6/5. As depicted in Figures 14-18, artifact frequencies show a bimodal distribution in the units where Layer I occurs (S0-W5, S5-E5, S10-W5) (Figures 14-15). Specifically, the percentage of artifacts peaks in Layer I, with a lesser peak in Layer II in these three units. As discussed above, Layer I is missing from all other units at proposed structure 6/5 and, therefore, the cultural materials from this stratum may be missing from the other units, unless some were incorporated into Layer II, or the disturbed soils that lie above the intact overbank/levee deposits on the terrace. A similar situation obtains for the units where Layer III occurs (Units N5-E15, N5-W25, S0-W20) (Figures 15-16) in that artifact proportions are consistently high in Layer III, although the poor correlation between arbitrary levels and the natural stratigraphic layers prevents definitive assignment of some artifacts.

However, even in Layer IV, the deepest and most consistent stratum across the site, the distribution of artifacts is inconsistent. In Unit S0-E20, a bimodal distribution obtains, with distinct peaks within Layer II and in the fourth arbitrary excavation level within Layer IV (Figure 17). In Unit N15-E5, the proportion of artifacts also peaks in Layer II, but there is a gradual decline through Layer IV (Figure 17). An even greater disparity occurs in Layer IV of Unit N20-E10, immediately adjacent to N15-E5. In the former unit, artifact proportions again peak within Layer II but they are almost negligible in all levels excavated within Layer IV (Figure 18). Only in Unit N5-E15 does the proportion of artifacts peak in the first level in

Layer IV with a gradual decline through the rest of Layer IV. Finally, negligible proportions of artifacts occur in the remaining units. Given the close proximity of these units to each other and the low frequency of features, it seems unlikely that this distribution is due to the cultural partitioning of activities. Instead, this distribution is probably best accounted for by non-cultural processes such as erosion and/or redeposition.

The evidence, then, presents a situation in which the cultural deposits have been reworked, redeposited, and/or partially removed from the terrace at the Point Bar Site. Microwear analysis (Appendix VI) performed on a small sample of tools resulted in the suggestion that two of the bifurcate-base points may have been subjected to post-depositional modification. Fluvial transport was suggested but no experimental evidence was cited to support this contention. It should be noted that these points were exposed to rapid heating at high temperatures, and were probably used as projectiles. The striations and extensive bright "polishes" present on these tools could have been produced by a combination of the latter processes (see Robertson 1987 for a description of these types of "microwear" traces). While fluvial processes were responsible for the mixed cultural deposit at the site, they may not have been of a sufficient magnitude to cause obvious macroscopic or even microscopic traces. This would be especially true given the finer overbank/levee sediments present on the terrace, the fact that the artifacts were moved short distances within the same site, and the short periods of time the artifacts were affected. Further, no other specimens exhibited obvious evidence of non-cultural, post-depositional modification, including a bifurcate-base point that was used to work wood.

Despite the fact that the site consists of a stratigraphically mixed deposit of artifacts, the chronological affiliations of the diagnostic artifacts offer a perspective of the differential utilization of this river terrace through time. In fact, the presence of artifacts from specific time periods can supplement the geomorphological evidence to suggest when the river terrace was suitable for occupation and, by extension, when stable fluvial regimes and/or land surfaces occurred in the past.

The presence of three bifurcate-base points indicates the utilization of the site during the Early Archaic period. Dates for this point style in the midcontinent range from ca. 6,900 BC to ca. 6,000 BC (Broyles 1966,1971; Chapman 1975, 1976); a time lag in the northeast is likely. Interestingly, this generally corresponds to the end of the Boreal climatic episode, a period of warmer and drier conditions, and the beginning of the Atlantic climatic episode, a warmer, moister regime. In the Susquehanna drainage, a date of 6,130 BC was obtained from a buried A-horizon at the High Bank Site. Vento and Rollins (1989) have interpreted this date as evidence for a stabilization of the fluvial regime, specifically, a shift from a braided to a meandering condition. Operant geomorphic processes in the Schuylkill drainage are not as well studied (see Section 10.2.1), although the local conditions were evidently stable enough to allow occupation of the terrace.

The Middle Archaic and early Late Archaic periods are represented by an Otter Creek-like point and a Brewerton Side-notched point. Otter Creek-like points have been dated to 4,610 BC (Funk 1965), 4,340 BC (Wellman 1975) and 3,120 BC (Ritchie and Funk 1973) in the northeast. The age of Brewerton Side-notched points is debatable. Traditional dates from sites in New York suggest an age of 2,000 BC, but these sites also have other components and the reported dates may be erroneous; it has been suggested that they date to ca. 2,500 BC or earlier (Ritchie and Funk 1973:50). More recently, dates of 3,680 BC in New York (Calkin and Miller 1977) and 4,140 BC in Pennsylvania (George and Davis 1986) have been obtained, which support an earlier time frame for this type.

Extrapolating from data pertaining to the Susquehanna drainage, a period of relative terrace stability during this time at the Point Bar Site can also be provisionally hypothesized. Radiocarbon dates from A-horizon soils at three sites in the Susquehanna drainage indicate a period of floodplain stability between about 4,600 BC and 4,000 BC (Vento and Rollins 1989) which would accommodate both Otter Creek-like and Brewerton Side-notched components. By contrast, no major unconformities have been observed in the Upper Delaware River Valley. Instead, overbanking appears to have been the dominant alluvial process, entailing a pattern of gentle aggradation, especially after 4,000 BC (Ritter et al. 1973; Kinsey 1975; Dent 1985).

Episodes of more frequent large floods, incision, overbank deposition, and erosion follow during the middle Holocene in the Susquehanna drainage. As Vento and Rollins (1989:43) suggest, flood-induced erosion might account for the paucity of intact Paleo-Indian, Early Archaic, and Middle Archaic sites within the Susquehanna Basin, a situation that does not appear to be precisely replicated in the Schuylkill drainage. Concomitantly, increased overbank deposition on lower terraces also occurred during the middle Holocene, probably in association with the warm and dry conditions of the Sub-Boreal climatic period (ca. 2,500 BC - 1,000 BC) when vegetation cover was apparently reduced, surface runoff increased, and vertical accretion was promoted. Hence, the absence of well-developed, cumulic A-horizons during this period can be attributed to these conditions (Vento and Rollins 1989:44).

Floodplain instability may therefore explain the complete absence of Piedmont or Narrow Point tradition point types at the Point Bar Site. In contrast, projectile points of this period, such as Bare Island and Poplar Island, predominated at the Frick's Lock Site, where they comprise 33 percent of all types. This is significant since the terrace surfaces at the latter site have been stable for about 10,000 years. This is not the result of mere sampling error; Piedmont projectile points are also extremely common in upland contexts such as the Indian Point Site (36 CH 53), 36 MG 140, and 36 MG 162. Thus, the absence of a Piedmont/Narrow Point occupation may be attributed to geomorphic conditions at locations subject to erosion and/or a high frequency of flooding that may have discouraged occupation of the terrace. However, the higher rate of overbank deposition seen in the Susquehanna drainage does not seem to apply to the Point Bar Site. This observation may be due to subsequent erosion as suggested above, or floodwaters may have been diverted into the abandoned channel of the Schuylkill River located to the rear of the site, thereby decreasing the extent of overbank deposition.

A third episode of intermittent stability can be hypothesized for the period dating from about 1,600 BC to AD 1,500. A Broadspear component is represented by a Snook Kill Point, a Lehigh Broadspear, and a contracting stem Broadspear. Dates on Broadspear components range from an early date at the Byram Site of 1,780 BC (Kinsey 1975) to the most recent date of 1,480 BC at the Snook Kill Site (Ritchie 1969a). The later Terminal Archaic/Early Woodland Period is represented by a single Orient Fishtail point; these date to as early as 1,220 BC (Kraft 1970) and as late as 763 BC (Ritchie 1969a). The Greene Point and the Rossville point are Middle Woodland diagnostics that bracket the period from 520 BC (Ritchie 1969a) to AD 450 (Ritchie and Funk 1973).

Again, fluvial trends identified for the Susquehanna drainage are generally consistent with the presence of artifacts during these time periods. Specifically, floodplain stability and A-horizon development seem to be associated with the warm and moist conditions of the Sub-Atlantic climatic period dating from ca. 1,000 BC to ca. AD 200 (Vento and Rollins 1989). At the Point Bar site, however, this stability was not sufficient to have promoted the development of A-horizon soils. To understand whether this is related to very local geomorphic conditions or is indicative of a fluvial regime differing from that of the Susquehanna River requires further detailed investigation. For example, the location of the Point Bar Site immediately downstream from the mouth of Perkiomen Creek suggests that there was a locally high rate of flow here, and perhaps a tendency toward increased frequency of flooding. This phenomenon is discussed in detail in Section 10.2.1.

Data from the Middle Delaware River Valley, specifically the timing of stable regimes, differ from the Susquehanna and Schuylkill scenarios as portrayed above. At Lower Black's Eddy (36 BU 23), active flooding abated between about 2,000 and 800 BC, based on radiocarbon dates. Cultural components associated with a buried organic soil horizon include both Lackawaxen (Piedmont/Narrow Point) and Broadspear occupations. The low frequency of overbank deposition during this period is underscored by the fact that the vertical separation between these two components is minimal and they sometimes even overlap (Schuldenrein 1986; Schuldenrein et al. 1991). Further, a brief period of erosion is followed by a period of vertical accretion lasting until the Late Woodland Period. Early/ Middle Woodland occupations dating to about 500 BC - AD 500 are also present, but are associated with cambic soils rather than an organic A-horizon. Although this phenomenon does not necessarily contradict Knox's (1983) thesis which relates the adjustments of river systems to the direct effects of climatic events (storms and floods) and the indirect effects of vegetation (runoff and erosion) and, by implication, Vento and Rollins' (1989) analysis of Susquehanna River Basin dynamics, it does stress the significance of differences in fluvial dynamics within specific river basins, as well as local variation within drainage basins.

Finally, the absence of unquestionable Late Woodland diagnostics is somewhat surprising given evidence for floodplain stability in the Susquehanna drainage (Vento and Rollins 1989) during the Neo-Atlantic (ca. AD 1,000 - 1,300) period, a Late Woodland occupation in association with a buried organic soil horizon at Lower Black's Eddy along the Middle Delaware River (Schuldenrein et al. 1991), and evidence of occupation during this time at stable terrace locations such as the Frick's Lock Site, and at upland locations throughout the study area. However, frequent floods during the Pacific climatic episode (AD 1,300 - 1,600) may have again resulted in erosion, negating the effects of increased rates of overbank deposition at the Point Bar Site. Late Woodland occupations would not be expected if this hypothesis is true. Alternatively, or in combination with the above, local environmental conditions on the terrace may not have been conducive to occupation.

8.5 Features

A single feature, interpreted as a hearth, was discovered at the Point Bar Site; it was found in Unit S10-W5 at proposed structure 6/5 (Figure 19). Stratigraphically, the hearth is located within Layer II at 19 to 24 inches below the surface. The hearth consisted of a concentration of 78 fire-cracked rocks and 16 unmodified river cobbles and cobble fragments. Sandstone cobbles were evidently preferred since 64 of the 94 (68.1%) fire-cracked rock and cobbles were of this material. The rock concentration measured approximately 2.5 feet in diameter, with minute flecks of charcoal in direct association. Unfortunately, there was not enough charcoal for a radiocarbon sample.

Artifacts found in association with the hearth include 32 pieces of jasper debitage, 82 pieces of quartz debitage, and 13 pieces of quartzite debitage; no diagnostics were found in this unit. The high frequency of quartz is unusual in this area of the site; jasper, quartz, and quartzite occur in nearly equal frequencies in the vicinity of proposed structure 6/5. In contrast, quartz debitage predominates in the area near proposed structure 6/6 (see below). In addition, a hammerstone was found associated with the hearth.

8.6 Artifact Patterning and Analysis

A total of 8,151 artifacts was recovered during the course of the Phase I and Phase II investigations. This figure includes 109 chipped stone tools, 7,279 pieces of chipped stone debitage, 14 small potsherds, 745 fire-cracked rocks, three hammerstones, and one grinding stone. Table 7 provides a listing of all diagnostic materials from the Phase II excavations. The Phase I investigations produced only one possible diagnostic artifact, a heavily reworked side-notched point. Metric and other data on all diagnostic artifacts have been presented by Zatz et al. (1985). Representative lithic artifacts are illustrated in Plate 3.

As is typical of most pottery-yielding sites in the Schuylkill Valley, the ceramic assemblage from Point Bar is meager. Fourteen sherds were recovered, nine of which measure less than one centimeter in maximum dimension. The cultural/temporal diagnostic value of these artifacts is equivocal. Ten very small and eroded sherds are tempered with fine grit. Cordmarking occurs on the exterior of two quartz tempered sherds, while a third, very small quartz tempered sherd displays apparent simple dentate stamped decoration. One fabric-impressed or net-marked example was also recovered, and is tempered with fine grit. Most quartz-tempered pottery is generally reminiscent of similar ceramics found in the study area; the dentate stamped and fabric/net impressed sherds are unusual and may possibly indicate connections with systems on the lower Delaware.

The distribution of artifacts between the two primary areas of investigation is uneven (Table 7). The majority of artifacts were recovered at proposed structure 6/5. Among all Phase II units, only 22.5 percent (n=20) of all chipped stone tools, 14.5 percent of all chipped stone debitage (n=909), and 21.5 percent (n=153) of all fire-cracked rock was recovered at proposed structure 6/6. The overall frequency of artifacts ranged between 65 and 174 artifacts per excavation unit at proposed structure 6/6; the mean number of artifacts per unit was 127. At proposed structure 6/5, artifact frequency ranged from 534 to 1064 artifacts per unit; the mean number of artifacts per unit at this location was 729.

A functional difference between these areas is not apparent and the relative proportions of artifact classes largely reflect those of the site as a whole. The primary difference is that both of the gravers recovered from the Phase II units in these areas were found in the vicinity of proposed structure 6/6; this may be the simple result of sampling error. Bearing this possibility in mind, and given the distribution of soils as discussed above, differential occupational intensity at the Point Bar Site may be attributable to the presence of the more poorly drained soils in the vicinity of proposed structure 6/6.

Despite the similarities in the classes of tools occurring at these two locales, there appears to be a significant difference in the types of raw materials. As shown in Table 8, quartz is by far the dominant raw material discarded in the vicinity of structure 6/6. Jasper and quartzite are next most frequent, while cherts and argillite occur in minor amounts. This raw material profile is very similar to the average proportions of raw material types based on 26 Schuylkill Valley sites surveyed during the course of the Limerick Transmission Line Survey project which yielded more than 25 pieces of debitage. The only difference appears to be a slightly lower proportion of quartzite at proposed structure 6/6.

In contrast, the raw material profile for the Phase II units at proposed structure 6/5 is atypical for the region; the proportions of the three most common raw material types - jasper, quartz, and quartzite - occur in nearly equal proportions. On average, the proportions of jasper and quartzite are significantly higher at the Point Bar Site than those at sites more typical of the region. In addition, the proportion of quartz is the seventh lowest out of the 26 sites with greater than 25 pieces of debitage that were analyzed in detail. As discussed in greater detail in Section 10.2, 36 MG 1 most closely replicates this debitage profile. Other sites surveyed during the course of the Limerick Transmission Line Survey with variously similar debitage profiles include 36 CH 56, 36 CH 103, 36 MG 173, and 36 MG 151.

The reasons for these differing debitage profiles at the Point Bar Site may be partially attributed to the spatial separation between proposed structures 6/5 and 6/6. This distance is approximately 900 feet (274 meters) and the discard of quartz debris and/or manufacture of quartz tools across the site may have varied as is testified by the high percentage of quartz in Feature 1. This interpretation is also supported by the distribution of tools, classified according to raw material, across the site.

As shown in Table 9, a greater proportion of the tools at proposed structure 6/6 was made from quartz. Alternatively, the reduction of jasper and quartzite may have been restricted to the area of proposed structure 6/5. Throughout the study area, jasper and quartzite were less frequently utilized, and therefore, as less frequently used raw materials, the locus of their reduction may have been spatially restricted. Sampling error may also be invoked as a competing hypothesis since the area of proposed structure 6/6 was less intensively utilized and is located on the eastern edge of the site.

Attempts to establish chronological patterns in lithic raw material utilization were unsuccessful due to: 1) the fact that the cultural stratigraphy has been modified by erosion and fluvial reworking, preventing the association of debitage with specific occupations; and 2) the low frequency of diagnostics. The latter manifests itself such that at least four major time periods are represented by a mere 11 diagnostic projectile points. Furthermore, there is little lithic raw material variability among these artifacts. All three Bifurcate-base points, the Lehigh Broadspear, and the Orient Fishtail are made from jasper. The remaining points, including single examples of Otter Creek-like, Brewerton Side-notched, Snook Kill, Contracting Stem Broadspear, Rossville-like, and Greene projectile points, are all made from quartzite. This limited variability is misleading, as can be seen in Table 10, which includes all diagnostic and non-diagnostic projectile points/knives.

8.7 Site Interpretation

From an overall site perspective, and holding constant the distinctions in the differential occupation of the site through time, the discard of tools made from the various raw materials occurring at the site appears largely proportional to the discard of debitage. Comparing the overall site totals (Tables 8 and 9), the proportions of tools made from chert/chalcedony, jasper, quartz, and quartzite approach their respective proportions of debitage. The only glaring exception not attributable to sampling error is argillite tools and debitage; the proportion of argillite tools far exceeds the expected proportion of argillite debitage.

If argillite tools had occurred in proportion to the amounts of argillite debitage, then only four argillite tools would have been expected. When proportions are computed using this figure for argillite tools, and reducing the total number of tools accordingly, the proportions of chert/chalcedony, jasper, quartz, and quartzite tools resemble their respective proportions of debitage even more closely.

The immediate implication of this situation is that argillite tools were brought to and discarded at the Point Bar Site, but were produced elsewhere. This is supported by the low frequency of argillite debitage, which comprises only 4.0 percent of all debitage, and a debitage-to-tool ratio of 22.4:1. Procurement and reduction of argillite likely took place at or in the vicinity of the known argillite quarries located on the Delaware between Lambertville and Frenchtown. The nearest outcrops lie approximately 35 miles away; the most probable transportation route follows Perkiomen Creek north and subsequently the east branch of Perkiomen Creek farther upstream. Closer outcrops may have been utilized but quarries are not well documented (Section 10.2.2).

It is also important to note that 72.2 percent of all argillite tools found at the site are finished projectile points/knives. This indicates a limited role for argillite in terms of raw material utilization patterns. Despite the presence of three bifaces and a blank/preform, very little argillite appears to have been transported to the Point Bar Site. The low frequency of flake tools made from argillite also supports this inference. If argillite did have a circumscribed role, one might also suggest that flake tools are not present because they were neither desired for, nor suited to, the tasks at hand.

The other non-local, quarried raw material, jasper, occurs in a significantly higher frequency than argillite. The proportions of jasper debitage and tools are almost identical to those of the locally available raw materials, quartz and quartzite. Like argillite, jasper quarries are located relatively close to the Point Bar Site. A direct transportation route to quarries in Lehigh County is provided by Perkiomen Creek; the distance involved is approximately 30 miles.

The high frequencies of jasper debitage and tools signal a procurement and utilization pattern that differs markedly from that of argillite. Like argillite, much of the reduction process took place elsewhere, probably at quarry sites. Cortical flakes of jasper are quite rare and account for only 1.6 percent (n=33) of all jasper debitage, and there are no formal jasper cores in the assemblage. Furthermore, the debitage to tool ratio for jasper is 66.9:1 which is somewhat less than the debitage to tool ratios for locally procured raw materials; the debitage to tool ratios for quartz and quartzite are 83.8:1 and 85.4:1 respectively. In concert, these data suggest that most primary reduction, some secondary reduction, and the completion of some tools occurred off-site.

However, the debitage to tool ratio is much higher than that of argillite and the absolute frequency of jasper debitage and tools is also high. Therefore, some jasper reduction, especially later stage reduction, clearly took place at the Point Bar Site. In particular, the large number of casual flake tools (see Miscellaneous Tool Type in Table 10) suggests that bifaces or bifacial cores were transported to the site as a supply for the production of usable flakes. Projectile Points/Knives, in contrast, may have been produced elsewhere or finished at the Point Bar site. As a byproduct of the latter instance, larger waste flakes could have been selected for use and/or retouched as needed. The fact that the sources for argillite and jasper are of similar short distances implies that these procurement and utilization patterns are a matter of cultural choice.

The utilization of quartz and quartzite is similar to that of jasper. Although a greater incidence of on-site tool manufacture is indicated by the higher debitage to tool ratios for these materials, complete reduction was probably infrequent. There are only two formal cores, both of quartzite, and less than one percent of the quartz and quartzite debitage is made up of cortical flakes. Utilization of these two raw materials therefore may have been opportunistic, with reduction occurring as-needed at locations where these materials occur. The only apparent difference between the jasper, quartz, and quartzite debitage and tool profiles is the larger proportions of generalized bifaces and biface fragments made from quartz and quartzite. This may reflect the greater availability of these raw materials. Nevertheless, one can propose that jasper was being used in the same fashion as local/non-quarried raw materials and this is a function of its availability. That is, the quarries are within easy reach and/or within the range of normal foraging activities.

In contrast, the virtual lack of chert/chalcedony and rhyolite is conspicuous. This may also be related to foraging distances or foraging territories. In particular, rhyolite outcrops are located in the Great Valley region of south-central Pennsylvania approximately 80 to 90 miles away, suggesting that this greater distance may have discouraged its regular use and/or procurement. However, outcrops of Rickenbach and Ontelaunee chert are located in the headwater reaches of the Schuylkill River, a distance of only 35 to 40 miles (Snethkamp et al. 1982:6.13). As a matter of speculation, the low frequency of chert may be ascribed to its presence outside of the regularly utilized foraging territory of the Point Bar Site's occupants, rather than by its low accessibility.

As noted above, there do not seem to be any functional differences between the two areas investigated at the Point Bar Site, based on examination of tool types. Projectile points/knives and bifaces dominate the chipped stone tool assemblage (Table 10). This is the typical pattern for all sites (n=16) in the present study area with an adequately large sample of tools (n>10). However, there is one subtle difference from certain other sites. When compared to the four sites in the study area (36 CH 53, 36 CH 103, 36 MG 8, and 36 MG 162) with more than 50 tools (the site with the next highest frequency of tools in the study area has only 31), the Point Bar Site stands alone in totally lacking scrapers. The proportion of scrapers at these other sites varies from 5.0 to 11.8 percent.

Functionally, scrapers can usually be associated with hideworking activities, and to some extent, woodworking and bone/antler working. Admittedly, unifaces other than scrapers and casual flake tools, the latter of which dominate the Miscellaneous Tool category, and various bifacial forms, broken and unbroken, could have adequately performed these tasks. In fact, microwear evidence (Appendix VI) demonstrated that the two tools used to work hide were a broken, reworked Lehigh Broadspear fragment and a reworked projectile point fragment of an unknown type. Likewise, the only other tool with interpretable use wear evidence was also reworked; a Bifurcate base point was transformed into a graver and used for boring wood.

Thus, it appears that broken tools were being modified to perform the immediate tasks at hand. This may also indicate a high incidence of recycling (Schiffer 1975), an activity that Binford (1979) suggests should occur most intensively at field camps and special purpose locales. Concomitantly, the lack of formal scrapers may indicate the lack of intensive or scheduled hide preparation activities which would be expected at permanent or seasonal, perhaps fall/winter, residential camps. Other evidence relating to the function and duration of the occupations at the Point Bar Site is largely speculative. No prehistoric faunal or botanical remains were recovered. The high proportion of projectile points suggests an emphasis on hunting, which in turn suggests that the site functioned as a temporary (i.e. non-residential) hunting camp. Regardless of the exact function of the camp, its transient nature is consistent with the geomorphological evidence which suggests that the river terrace was not conducive to long-term occupations.

9.0 THE INDIAN POINT SITE (36 CH 53)

9.1 Introduction

The Indian Point Site (36 CH 53), also referred to as the Chico Site or the Tunnel Hill Site, has been known to professional and avocational archeologists for years (e.g. Gilkyson 1945). Cultivation over an extensive portion of the site had exposed artifacts in sufficient densities to allow the definition of its approximate location based upon previous collections as recorded in the Pennsylvania Archaeological Site Survey files.

The Phase I archeological survey of the 220-63 Transmission Line demonstrated that portions of this site would be affected if construction proceeded as planned. Because of the high density of prehistoric artifacts collected over the years as well as during the Phase I survey, the possibility existed that intact archeological deposits were present below the soil levels disturbed by modern cultivation. Thus, a Phase II evaluation was recommended. Results of the Phase II evaluation demonstrated the presence of two prehistoric features dating between 100 BC and AD 250.

A Phase III data recovery program was subsequently implemented to locate and excavate all subsurface features within the proposed area of effect. An additional 16 features, including two living floor depressions, were identified. Detailed analysis of these features and the materials they contained suggests that the site was used as a temporary camp during the Early Woodland through Middle Woodland time periods. Other occupations are represented solely by diagnostics collected from the surface or excavated from the plowzone.

9.2 Location and Geomorphology

The Indian Point Site is located approximately one mile north of Phoenixville in Schuylkill Township, Chester County (Figure 20). The site occupies the top of a bluff isolated by an incised, horseshoe meander where the Schuylkill River has cut deeply into the bedrock. This landform has a north-northeast orientation and elevation ranges from about 100 to 240 feet AMSL. The nearest tributary stream of significant size is French Creek, which empties into the Schuylkill River at Phoenixville less than one mile to the south.

The highest elevations occur at the narrow, southern end of the bluff, or neck, where the river meander segments come closest together (Figure 20). Thus, to the north and west, the bluff edge is extremely steep and affords a commanding view of the Schuylkill River Valley to the northwest. In contrast, the bluff slopes gently to the northeast as it descends, thereby providing access to the Schuylkill River. Slopes then increase again as one moves south, back to the neck of the bluff.

Archeological materials are largely confined to elevations above the 150 foot contour north and west of Route 113. The southern border of the site is defined by an intermittent drainage path that cuts across the neck of the bluff top. This area is approximately 3,000 feet in length and 1,600 feet in width, the equivalent of about 110 acres. The 220-63 Transmission Line right-of-way runs northwest across the neck of the bluff between elevations of 220 and 240 feet AMSL. The area of construction effect was a 3.4 acre parcel between existing support structures 1/3 and 1/4 (Figure 21), along the southern, most elevated portion of the site.

The site is located within the Triassic Lowlands Physiographic Province. As discussed previously, this location represents the intersection of the Brunswick, Lockatong, and Stockton geological formations, which has largely determined the nature of the physiography of this area. The river's downcutting through these formations has created the dramatic reverse bends. The bluff location of the site is underlain by the Lockatong formation, which is comprised of resistant, thickly bedded argillite with occasional zones of shale. Geomorphologically, this location represents an upland context. The dominant soils of the site are of the Penn series, mostly Penn silt loams and shaly silt loams. These soils are formed through the weathering of the underlying shale bedrock. Consequently, Penn series soils such as those in the project area are usually quite shallow (Kunkle 1963).

Profiles of the Phase II archeological test units demonstrated that soil depths varied but did not exceed 10 to 28 inches in any one unit. The plowzone or Ap-horizon extended to a depth of 10 to 12 inches. Beneath the plowzone, an argillic Bt-horizon was present except where it had been truncated by plowing. Below these levels, some soil matrix was encountered but the density of fragmented shale parent material was so great that excavation could not continue.

As discussed by Elisabeth Ervin in Appendix III, the minimum required time for the formation of an argillic horizon is several thousand years of weathering. This land surface has therefore been essentially stable for at least 10,000 -12,000 years and there is little evidence of soil accumulation by other processes, such as aeolian or colluvial action. Coupled with the shallow soil depths, cultural materials discarded or abandoned prehistorically would not be vertically stratified to an archeologically discernable degree, even if occupations had been separated by long periods of time. Identification of discrete occupations in this context is therefore dependent upon the presence of subsurface features and/or horizontal stratigraphy.

9.3 Sampling Strategy

The Phase I surface survey of the 220-63 PECO Transmission Line right-of-way confirmed that it crossed a portion of the Indian Point Site. A total of 741 artifacts was recovered from within this 1,000 foot long and 150-foot wide section of right-of-way, including 94 chipped stone tools, 636 pieces of debitage, and 11 pieces of fire-cracked rock. This high density of archeological materials and the fact that artifacts dating from the Paleo-Indian through the Late Woodland Periods had been reported from this site suggested that the prehistoric occupations of the site had been frequent and/or intense. Therefore, the potential for the presence of subsurface features such as hearths and refuse pits was suspected to be high and a Phase II evaluation was recommended.

The Phase II testing strategy was geared toward locating subsurface features. A linear transect of 5 x 5 foot test units, placed at 50 foot intervals, was utilized to sample the right-of-way. Modifications to this strategy were made in the field based upon local field conditions, topography, and the results of other test units. Twenty-one such test units were excavated. Two 2 x 2 foot test units were also excavated.

Two features, discussed in detail below, were found during the Phase II evaluation. The presence of Early Series (Kinsey 1972) pottery in these features and radiocarbon dates of 100 BC, AD 200, and AD 250 suggested the presence of an intact Early/Middle Woodland occupation. In addition to the features, artifacts were found in the plowzone levels of all 23 test units. Eleven test units, in addition to the two units with subsurface pit features, produced artifacts from the subsoil. However, there was no evidence of an intact occupation surface.

By consultation between PECo and the Bureau for Historic Preservation, Phase III data recovery was deemed appropriate and excavation efforts were to be exclusively focused upon additional feature recovery within the proposed area of effect. This area consisted of a 20 foot wide access road to be constructed between the two existing transmission tower structures (Figure 21).

The results of the Phase II excavations demonstrated that the area between Test Unit 14 and the northwest edge of the cultivated field was the only portion of the site within the right-of-way that had consistently high artifact frequencies. Hence, the probability of finding subsurface features was suspected to be highest here. This area was therefore selected as the focus of the Phase III investigations.

Prior to stripping the plowzone from this 605 foot long area, a controlled surface collection was undertaken to more precisely define the spatial configuration of the site along this linear transect. The area to be stripped was gridded into 50 foot long segments approximately 20 feet wide (Figures 21 and 22). All artifacts were collected from each of these areas.

Initial inspection of the surface collection data revealed a distinct drop in artifact density beyond Collection Unit N150-N200. Further excavations were thus not conducted in the area beyond Feature 2 (Figure 22). Elsewhere, no clear patterns in artifact distribution were perceived at the time. The plowzone within the access road right-of-way was then mechanically stripped. The area was then cleaned and troweled by hand, exposing 44 subsurface features. Eighteen of these features were prehistoric in age.

9.4 Analysis of Plowzone Materials

Analysis of the diagnostic artifacts recovered from the surface and plowzone demonstrate the repeated use of this locale through time (Plate 4). As shown in Table 11, bifurcate-base points are the only point variety pre-dating the Late Archaic Period and represent only 5.6 percent of all diagnostic projectile points. The duration of the Bifurcate Tradition in this area is not well documented and may last nearly 1,000 years. If so, this point variety would seem to be not as common as those of other traditions. Side-notched varieties and points of the Brewerton series are the most common, comprising 27.2 percent of all diagnostic projectile points. That they outnumber points of the Piedmont Tradition is somewhat surprising, given the predominance of the latter throughout the region. However, not all side-notched points are necessarily Late Archaic in age.

At Indian Point, Piedmont Tradition points are still numerous since they make up 24.8 percent of the diagnostic chipped stone tools. Likewise, Broadspear Tradition points are fairly common and constitute 11.2 percent of all diagnostic points. Allowing for the fact that the Piedmont Tradition lasted at least twice as long as the Broadspear Tradition, they would appear to be equally represented. Taken as a whole, Archaic Period diagnostics account for 75.2 percent of all diagnostic projectile points collected during the investigations.

Woodland Period projectile points are less common. Fishtail points, including Orient Fishtails, and triangular points each comprise 7.2 percent of all diagnostic points. Point varieties representative of the Middle Woodland period include Fox Creek, Rossville, Eshback, Jack's Reef, and possibly other corner-notched points combined with the single Jack's Reef point. Thus, up to 10.6 percent of all points may be Middle Woodland in age. Overall, utilization as indicated by the proportions of Woodland points seems to have been consistent through time.

Comparison of the frequency of Woodland and Archaic projectile points at the site, allowing for the difference in the duration of each major period (approximately 2,700+ years versus 5,000+ years, respectively), suggests a slightly greater Archaic utilization of the site. Allowing for classificatory discrepancies, diagnostic projectile points were discarded or lost at a rate of

1.9 every 100 years during the Archaic Period and 1.2 every hundred years during the Woodland Period.

Reconsideration of the controlled surface collection data in light of the distribution of prehistoric features revealed that there is some correspondence between them. Specifically, the densities of artifacts on the surface roughly correspond to three groups of features that have been defined for the site. Attempts to correlate specific diagnostic projectile points from the surface collection with the feature groups were unsuccessful due to low frequencies of typable specimens.

The three groups of prehistoric features are depicted in Figure 22. These feature groups, and the rationale behind their definition, are described in detail in a later discussion. For present purposes, it is sufficient to explain that the groups have been defined based primarily on spatial proximity, as well as on the fact that they all appear to relate to the Early/Middle Woodland occupation of the site. Feature Group 1 consists of Features 1, 3, 13, 14, 17, 19 N, and 19 S. These seven features occur between the north 450 foot line and north 550 foot line. Feature Group 2 is comprised of Features 10, 15, 32, 33, and 43 and is located between the north 350 foot and north 400 foot lines. Feature Group 3, the most dispersed group of features, includes Features 2, 28, 35, 36, 38, and 42. All but Feature 2 are located between the north 200 foot and north 300 foot lines; Feature 2 is located just south of the north 200 foot line.

Table 12 presents the frequencies of debitage and tools for each collection area. The frequencies of debitage and tools clearly delineate the units containing Feature Group 1. Debitage is five times greater in the units with these features than the surrounding units that did not contain prehistoric features. Tools also occur in much higher frequencies, three times or more, than in their neighboring units without features.

Debitage frequencies also frame the location of Feature Group 2. Debitage in Unit N350-N400 is 2.4 and 4.0 times as frequent as it is in the adjoining units to the north and south, respectively. The pattern is not as pronounced when tool frequencies are compared, but tools are nonetheless more numerous in the unit containing the features of Group 2.

Only the southern border of Feature Group 3 is clearly reflected by frequencies of surface-collected debitage and tools in this area of the site. Debitage and tool frequencies in Unit N150-N200 are 5.6 and 5.0 times higher, respectively, than those frequencies for Unit N100-N150. In contrast, the increase in the frequency of debitage and tools from Unit N300-N350 to Unit N300-N250 is not as marked. Nevertheless, the presence of subsurface features is suggested by these differences.

Even with the relatively large sample units, the distribution of surface artifacts correlates surprisingly well with the subsurface distribution of features. This fact supports other distributional studies that conclude that the distribution of artifacts on the surface can reflect the distributions of features and artifacts below the surface (Binford et al. 1970; Redman and Watson 1970). These results become even more satisfying in light of the fact that historic and non-cultural features were interspersed among and between the prehistoric features, initially masking all distributional patterning. It suggests that the classification of features is correct.

9.5 Analysis of the Early/Middle Woodland Component

Because excavations focused exclusively on feature recovery, detailed analysis was restricted to artifacts found in subsurface features excavated during the course of the Phase II and Phase III excavations. Materials derived from the surface and plowzone represent mixed contexts, and diagnostic artifacts from the plowzone could not be reliably related to the sub-plowzone features.

Detailed analysis was performed on all artifacts derived from the features at the Indian Point Site, exclusive of those recovered by flotation. Because the features varied quite markedly in volume, there were large disparities in the size (soil volume) and number of flotation samples taken per feature. Frequencies of chipped stone and ceramic artifacts recovered from each feature could not be satisfactorily standardized for inter-feature comparison and were therefore not included in this portion of the analysis. All floral and faunal remains from both flotation and screening were analyzed. The small size and deteriorated condition of the faunal remains precluded any form of classification, even to the general level of Class. The methods and results of the botanical analysis are detailed in Appendix V.

The methods of classification and analysis as they pertain to the lithic and ceramic assemblage followed standard archeological techniques. Pottery sherds were counted and weighed. Temper, paste, surface treatment, and decorative techniques were recorded for each sherd, as appropriate. Individual ceramic vessels were discriminated whenever recognized, although most sherds were unassignable to vessels. Sherds or vessels were ultimately scrutinized for typological assessment.

For the lithic assemblage, tools and debitage were separated and classified according to raw material. A tripartite system of classification was used in the analysis of the debitage. Briefly, the flake types employed in the analysis represent the following activities. Angular flakes are flakes with thick and/or angular cross-sections. Striking platforms are large and usually unprepared. They represent early stage reduction and tasks involving core reduction and rough trimming. More controlled flaking characteristic of the removal of prepared flakes from cores and intermediate to later stage tool reduction is represented by the category of flat flakes. These are flakes with flat, scalene cross-sections and simple or, occasionally, highly prepared striking platforms. The third category is made up of flakes of bifacial retouch. These flakes usually are small, thin, and distinguished by the presence of a bifacial platform. The latter is the remnant edge of the biface being reduced. This type of flake is the exclusive byproduct of bifacial tool production and resharpening.

No attempt was made to distinguish between used and unused pieces of debitage solely on the basis of macroscopic edge damage. Recent research has suggested that the analysis of edge damage alone, in the absence of other use-wear attributes, is not a reliable method of distinguishing between flake scars from use and other processes (Moss 1983; Vaughan 1985). Only artifacts exhibiting formal retouch were therefore classified as tools. Morphological attributes and techniques of production were recorded for each tool and then each was assigned to a standard class and/or type. A sample of artifacts was further subjected to microwear analysis in order to discern function, the methods and results of which are described in Appendix VI.

9.5.1 Artifacts, Radiocarbon Dates, and Chronology

Charcoal from seven different features produced a highly variable series of nine radiocarbon dates. These dates range from 460 BC to AD 920, with eight of the dates ranging from 460 BC to AD 250 (Figure 23). The most recent date, AD 920 $\pm$ 70 from Feature 13, is clearly inconsistent when compared with the others. Although Feature 13 could be a Late Woodland pit, this possibility seems unlikely. Feature 13 contained seven small, thick, interior/exterior cordmarked potsherds similar to others identified as representative of Early/Middle Woodland pottery. In addition, the base of a straight-stemmed point with a narrow blade comparable to the Bare Island type was found in this pit. Bare Island points are thought to be a Late Archaic type (Ritchie 1971) and the co-occurrence of this point type with pottery may suggest this style persists into the Early Woodland period or that it represents recycling activities (Schiffer 1972). In any case, the Early/Middle Woodland pottery suggests that the radiocarbon date should be rejected.

Some of the variability in the dates may be attributable to contamination. The two dates for Feature 2 (AD 250 ± 80; 100 ± 90 BC) do not overlap within two standard deviations and can be considered statistically different. A case for possible differential deposition of this feature will be presented later, though this seems unlikely. Contamination of the radiocarbon sample is a distinct possibility, since 592 of 601 seeds recovered from flotation were not carbonized. Intrusion of more recent charcoal or other organics may therefore explain this discrepancy in radiocarbon dates.

Feature 17 also has an unacceptably wide date range. The dates for Feature 17 are AD 50 ± 80 and 230 ± 120 BC; despite some overlap at two standard deviations suggesting contemporaneity, the large standard deviation for the earlier date makes this situation somewhat suspect. Alternatively, one might suggest temporally separate uses for this feature, though there is no stratigraphic evidence to support such a claim. Indeed, it will be argued below that Feature 17, interpreted as a domestic living floor, represents a single episode deposit. Contamination is always a possibility, for uncharred botanical remains were also present in this feature. However, they were not nearly as common as in Feature 2 and hence, one is left without clear reasons for this disparity in dates.

A more critical issue is that this overall series of dates is neither internally consistent nor particularly in accordance with the chronological placement of the diagnostic artifacts. As shown in Figure 23, even when the dates are seriated utilizing two standard deviations for comparison, no obvious grouping of dates emerges. One alternative would be to suggest that different portions of the site were utilized at different times.

In this scenario, Feature Group 2 (Figure 22) could represent one occupation. Features 10 and 33 have relatively close radiocarbon dates of 390 BC and 460 BC. Feature Group 1, in turn, would represent a separate and slightly earlier occupation. Features 17 and 19S share very similar dates of 230 BC and 120 BC, if the late date (AD 50) for Feature 17 is rejected or ignored. In support of this interpretation, it should also be pointed out that Feature 33 and nearby Feature 32 comprise a pair of features that is spatially proximal to Feature 10, interpreted below as a living floor depression. Likewise, Features 19S and 19N form a feature pair which is also spatially associated with a second living floor depression, Feature 17. Thus, each group of three features appears spatially if not functionally linked, and likely utilized at the same time.

This leaves the date from Feature 1 (AD 200) in Group 1 begging explanation. Because this date overlaps the earlier of the two dates for Feature 17, one might accept all Group 1 dates and hypothesize that this portion of the site, or the site as a whole, was occupied two or more times between about 460 BC and AD 250. If the site functioned as a small, temporary residential camp, and/or as a transient camp during movements within the Schuylkill drainage basin, a multiplicity of radiocarbon dates would be expected. Yet, the disparity in dates from Feature 2 warns against placing too much faith on the radiocarbon dates for interpreting the frequency and/or duration of the site's occupation(s).

The ceramic assemblage does not help clarify the radiocarbon dilemma, though the ceramics are for the most part consistent with the radiocarbon date range. The ceramic assemblage from the Indian Point Site consists of approximately 394 sherds, all but 18 of which derived from feature contexts. Ceramics were recovered from prehistoric Features 1, 2, 10, 13, 14, 15, 19N, 19S, 28, 32, 33, 38, and 42. In addition, historic/non-cultural Features 23, 25, 34, 39, and 40 also yielded sherds, which are evidently intrusive in these contexts. The distribution of sherds in features ranges from one to approximately 252 in Feature 2; with the exception of Feature 2, the mean number of sherds per feature is roughly eight. Absolute frequencies of sherds are difficult to calculate in this assemblage, since much of the pottery is extremely friable and the sherd count tends to increase with each inspection of the material. Most intact sherds are small, generally measuring less than two centimeters in greatest dimension. Also, the assemblage includes a vast quantity of sherds that are accurately categorized as "crumbs", measuring less than 2-3 millimeters in maximum dimension. These tiny sherds are not included in the 394 sherd total.

The Indian Point ceramic assemblage is dominated by exterior cordmarked grit-tempered sherds. Other kinds of surface treatment and tempering materials are rare. However, the assemblage is simultaneously extremely heterogeneous within these parameters. That is, there exists a great deal of variation within the cordmarked/grit tempered sherds, and it is difficult to categorize discrete types or even classes of sherds or vessels; most sherds appear to be unique with regard to the nature of cordmarking, coloration, paste composition, and texture. Accordingly, no attempt has been made to quantify all observed variability among the sherds, since to do so would only serve to obfuscate meaningful patterning. Further, few individual vessels can be reliably discriminated within the assemblage, though it is estimated that at least 20-25 individual vessels are represented.

Two largely reconstructible individual vessels are certainly the most noteworthy examples in the assemblage. Both derive from Feature 2. One vessel (Figure 24, Plate 5) consists of a relatively thin-walled, straight-rimmed, quartz-tempered pot exhibiting cordmarking on the interior and exterior. Interior cordmarking tends toward oblique angle while the exterior displays a criss-cross or "pseudo-cross-hatched" pattern. The pot was manufactured by coiling; three repair holes are present. Particularly interesting are faint, discontinuous horizontal incised lines on the exterior below the lip. In addition to the reconstructed sherds shown in Figure 24 and Plate 5, a large quantity of unreconstructed body sherds and crumbs from this vessel was recovered as well. The second vessel from Feature 2 is an unusual bowl-shaped example (Plates 6 and 7). Vessel walls are rather thick and the paste is heavily tempered with quartz. Cordmarking covers the interior and exterior, and the vessel appears to have been manufactured by coiling. Unlike the previous pot, most of this vessel was reconstructible, and few residual sherds remain.

Analysis of the remaining pottery was frustrated by the total lack of rimsherds for all but the previous two pots. Inspection of the body sherds revealed that the majority of the pottery displays interior/exterior cordmarking and quartz temper. Mixed grit, usually quartz and black rock (probably gneiss), follows quartz in frequency of tempering material. One interior/exterior cordmarked sherd was tempered with sheet mica. A minority of the assemblage shows cordmarked exteriors and smoothed interiors, and no unequivocally smoothed exteriors were noted. Also, no net-marked or fabric-impressed surface treatments were present. Fifty-two very friable sherds from Feature 15 closely resemble the Feature 2 pot with the criss-cross cordmarking (Figure 24, Plate 5), and the sherds clearly represent an individual vessel; a single large sherd from historic Feature 25 also resembles the Feature 2 vessel. Beyond these three pots with the distinctive cordmarking, no other morphological or otherwise meaningful subgroupings of sherds or vessels are apparent.

Four shell-tempered sherds were recovered. One cordmarked sherd recovered from the surface of the stripped area is likely an example of Mockley Cordmarked. The other sherds remain untyped. Two sherds deriving from Phase II Excavation Unit 6 are unusual in that the shell was evidently very finely ground, and the leaching resembles that seen on limestone-tempered pottery. The surfaces of these two sherds are highly eroded. A final large sherd was recovered from Feature 33. This specimen is noteworthy in that it is very thin, very finely made, and displays vertical cordmarking on the exterior and horizontal cordmarking on the interior. The cordmarking is very well executed, and in general does not approximate the more typical sloppy or haphazard cordmarking applied to most other sherds. The typology of this sherd is uncertain.

As noted, the ceramic assemblage displays considerable heterogeneity in overall character, within the limitations of cordmarked surfaces and quartz temper. Despite intensive analysis by several individuals, no refits and few close morphological matches of sherds between features were accomplished; it appears that no sherds from an individual vessel occur in more than one feature. This fact has obvious implications for linking features or occupations on the basis of shared ceramic vessels.

Seven radiocarbon-dated features yielded ceramics, which for the most part consist of the omnipresent interior/exterior cordmarked, quartz/grit-tempered sherds. Feature 33, dated to 460 BC, produced the unusual thin, shell-tempered interior/exterior cordmarked sherd along with more typical quartz-tempered material; it is uncertain whether the date is accurate for the shell-tempered sherd or if it is intrusive into this early feature. Feature 2 yielded the two reconstructible vessels. Most sherds from the bowl-shaped vessel were recovered from near the bottom of this pit, and associated charcoal yielded a date of 100 ± 90 BC. The other pot tended to occur higher in the feature, and charcoal from these levels returned a date of AD 250 ± 80. While the dates and their stratigraphic relationships appear correct, the associated ceramics do not lend clear typological support for two episodes of use/deposition of Feature 2. As discussed above, one of the dates is believed to be erroneous.

Typological determinations and assessments of cultural/temporal relationships of the ceramics are difficult, due principally to the dearth of distinctive sherds or vessels, and the unusual nature of the few distinctive examples, e.g. the bowl and the incised-over-cordmarked vessel. General parallels with interior/exterior cordmarked, quartz/grit-tempered pottery are numerous throughout the region, and include the types Vinette I (Ritchie and MacNeish 1949:100; Ritchie 1969a), Type VIA and VIB at the Abbott Farm (Cavallo 1987; Stewart 1987), Exterior Corded/Interior Smoothed (Kinsey 1972:453), Wolfe Neck (Griffith and Artusy 1977; Custer 1984a), and Susquehanna Series pottery (Smith 1978).

Most radiocarbon dates for the most thoroughly dated type, Vinette I, tend to range somewhat earlier than the Indian Point dates. For example, Vinette I ceramics are dated to 750 ± 100 BC at the Faucett Site in the Upper Delaware Valley (Kinsey 1975). In New York, the most recent date for Vinette I is 563 ± 250 BC from the Morrow Site (Ritchie 1969a). Elsewhere, however, there is evidence for the persistence of Vinette I ceramics into later times. At the Dawson Creek Site in Ontario, where a transition from Vinette I to Vinette II ceramics has been postulated, radiocarbon dates range from 990 ± 70 BC to 370 ± 70 BC (Jackson 1986), the latter date falling near the beginning of the Indian Point radiocarbon series. In southern New England, where Ritchie feels there was a time lag in the spread or adoption of early ceramics, the Lagoon complex is dated between 590 ± 105 BC and 430 ± 80 BC. Even if the 360 ± 100 BC date for Stratum 2A at the Peterson Site on Martha's Vineyard, which yielded both Vinette I and more classic Middle Woodland types (Ritchie 1969b:224-226) is considered, the New England dates are clearly in line with those from southern Ontario.

Closer to Indian Point, late dates have been obtained on interior/exterior cordmarked pottery tentatively identified as Vinette I from the Lower Delaware Valley. For example, a date of AD 330 was obtained on a feature yielding Vinette I pottery at the Lower Black's Eddy Site (Schuldenrein et al. 1991). Therefore, there is ample precedent for the late continuation of Vinette I-like pottery from a wide range of localities in the Northeast. The Indian Point pottery may thus represent such a late persistence, as indicated by the six radiocarbon dates between 460 BC and AD 250.

Ceramics referred to as Types VIA and VIB at the Abbott Farm site complex are grit-tempered and exhibit cordmarking on the exterior, frequently in a criss-cross pattern. Type VIA vessels are cordmarked on the interior, while Type VIB pots have smooth interiors (Stewart 1987:A2-9-11). These ceramics have been compared to similar ceramics from the Williamson Site on the Middle Delaware, which date as early as 800 BC (Stewart 1985). Importantly, however, ceramic distributions at the Gropps Lake Site (Stewart 1987), and data from other sites in the Lower Delaware Valley (Stewart 1985), suggest the persistence of these types into later times when net-marked wares predominate. Unfortunately, clear vertical separation of components and/or directly associated radiocarbon dates supporting the late temporal position of these ceramics are lacking, with the exception of the Lower Black's Eddy date mentioned above. Nevertheless, the late persistence of these Vinette I-like ceramics in the Lower Delaware Valley appears to be a real phenomenon.

Kinsey (1975) notes that his Exterior Corded/Interior Smoothed type appears earliest at the Faucett Site in the Upper Delaware Valley and may be associated with a Late Orient component dated to 810 BC, or to a Meadowood Component. These dates are earlier than the Indian Point series. As noted earlier, exterior cordmarked/interior smoothed sherds are a relative rarity in the Indian Point assemblage.

Typological similarities also exist between the Indian Point ceramics and Wolfe Neck Ware from the Delmarva area. Dates for Wolfe Neck ceramics are generally in line with those of the Vinette I type, and a late persistence of this ware is also in evidence. Custer (1984a:78, 87) places the Wolfe Neck Complex between 600 BC - AD 0, though Wolfe Neck Ware ceramics are postulated to span only 700 -400 BC. Later dates have been obtained from southern Delaware: the Wolfe Neck Site produced dates ranging from 375 BC to AD 330, and the Wilgus Site dates from 290 BC to AD 240 (Custer 1984a:115). In northern Delaware, the Wolfe Neck Complex is believed to be superceded by the Carey Complex ca. AD 0 (Custer 1984a:139ff); late dates on Wolfe Neck Ware have not been obtained in northern Delaware. In any case, typological similarities between Wolfe Neck and the Indian Point pottery are as strong as with Vinette, and the respective date ranges display considerable overlap.

Finally, noteworthy similarities can be observed between the Indian Point ceramics and Smith's (1978) Susquehanna Series, which derives principally from the Lower Susquehanna River Valley below Harrisburg. Two types are identified, Susquehanna Net or Fabric-Impressed and Susquehanna Cordmarked. The former is quartz-tempered and displays coiled manufacture and prominent coil breaks (Smith 1978:23), but the surface treatment does not resemble the Indian Point pots. Susquehanna Cordmarked, however, is cordmarked on the interior and exterior and closely resembles the Indian Point pottery, even to the extent that exterior cordmarking in a "checked design" occurs, as do frequent repair holes (Smith 1978:26-27). Curiously, tempering material is predominantly sand, though micaceous schist and quartz also occur. Taken together, the constellation of attributes shared by Susquehanna Net or Fabric-Impressed and Susquehanna Cordmarked form an attribute set very similar to the Indian Point assemblage. These ceramics are not well dated, but Smith (1978:53) brackets their age between 500 BC - AD 1,000; they clearly post-date earlier wares such as Marcey Creek, Selden Island,

and others. Custer (1984a:87,89) has stated that Susquehanna Series pottery is characteristic of the Wolfe Neck Complex in the northern Delmarva area, while Wolfe Neck Ware *per se* occurs most frequently in southern Delaware. Thus, Smith's proposed date range correlates well with the Indian Point dates, as does the Wolfe Neck Complex.

To briefly summarize, the strongest parallels with the Indian Point ceramic assemblage may be observed with Vinette I, Susquehanna Series, and Wolfe Neck Ware. Morphologically, the Vinette I identification is most secure, though the extent to which this typological identification accurately reflects cultural relationships is uncertain. Logically, connections with Susquehanna or Wolfe Neck groups seem more likely, though the presence of Vinette in the Lower Delaware Valley argues that northward connections cannot be summarily ruled out. In any case, the Indian Point pottery will not be given a separate type/ware designation at this time, but will be referred to simply as "Vinette-like".

Like the ceramic assemblage, the diagnostic lithics from the Indian Point Site features do not help resolve the problem of the widespread radiocarbon dates. The only particularly distinctive point type is an Eshback point from Feature 10. The temporal affiliation of this point may be Archaic, Woodland, or both (Custer 1984a; Kinsey 1972). The probable Woodland affiliation of Eshback points (Kent and Packard 1969; Kinsey 1959) is with Brodhead ceramics, an Early/Middle Woodland type. Curiously, the dates for Brodhead ceramics (Kinsey 1972) fall within the range of the Indian Point dates. More recently, Stewart (1987) identified five Eshback points from the Middle/Late Woodland occupation of the Gropp's Lake Site. While this point type also occurs in Late Archaic contexts at other sites near Gropp's Lake in the Abbott Farm site complex (Perazio 1986), a Woodland affiliation is preferred here.

Other point types are rather non-descript and are dominated by a series of six small stemmed points with triangular blades. Three have slightly contracting stems with round bases and are made from argillite. These may be related to the Rossville type which is typically placed in an Early/Middle Woodland context. Interestingly, Custer (1984a:89,113) notes the occurrence of Rossville points in the Wolfe Neck Complex, as well as other miscellaneous stemmed points. As is the case with Eshback points, the Rossville type may actually cross-cut the Late Archaic through Middle Woodland periods (Custer 1984a; Mounier 1975). Two other specimens are small stemmed points made from quartzite with asymmetric, straight stems, and the sixth is a straight stemmed point with a convex base made from quartz. The former two points bear a formal resemblance to Wading River points in New England. Usually considered a Late Archaic type along with the closely related Bare Island type, a strong case can be made for the type lasting into the Woodland Period. At the Peterson and Pratt Sites on Martha's Vineyard, Wading River points were found in association with Vinette I ceramics (Ritchie 1969b); other similar associations are known.

Radiocarbon-dated stemmed points fitting within the overall range of variation of the stemmed series from Indian Point were recovered from Feature 149 at the Delaware Park Site. This feature is dated to 10 $\pm$ 80 BC. Like Indian Point, the Delaware Park Site has an equally confusing series of radiocarbon dates that range from 1850 BC to AD 640 (Thomas 1981:IX-135). Eleven of the 21 radiocarbon determinations fall within the 460 BC - AD 250 range at Indian Point. Particularly noteworthy is a series of dates ranging between AD 80 and AD 605 that dates a ceramic series compared by Thomas to Vinette I, Kinsey's Exterior Corded/Interior Smoothed, and other Early/Middle Woodland types (Thomas 1981:IV-13). The Delaware Park situation indicates, if nothing else, that the problems of associating precise radiocarbon dates to this type of material assemblage is not unique to the Indian Point Site.

The remaining diagnostic lithics from the Indian Point features include the Bare Island-like point mentioned above, a heavily modified straight stemmed point reworked into a drill or borer, a narrow-bladed, expanding stemmed point, and three notched points with short blades and expanding stems. Comparison of the latter five artifacts with defined types, especially the notched forms, does not reveal any clear or overt similarities. If anything, affinities are strongest with Late Archaic types.

In sum, the radiocarbon dates and diagnostic artifacts from the Indian Point Site, alone or together, do not comprise a perfect match. The range in variation of the dates suggests they be interpreted as evidence for numerous short term occupations. Although it has been hypothesized that separate occupations may be represented by the feature groups, the radiocarbon dates alone cannot be regarded as adequate proof. As a whole, the dates indicate an Early/Middle Woodland time span. The diagnostic ceramic and lithic artifacts are generally consistent with this temporal assignment, though ambiguities have been noted. In particular, stemmed projectile point styles are comparable to Late Archaic through Middle Woodland types. Despite the inconsistencies, it is felt that sufficient coherence exists in the aggregated ceramic, lithic, feature, and radiocarbon data to warrant the formulation of a separate cultural taxon to refer to this manifestation. Accordingly, the term *Black Rock Phase* is proposed to denote the Early/Middle Woodland occupation of the Indian Point Site and probably other sites in the Lower Schuylkill Valley. A rather long date range is indicated, ca. 460 BC to AD 250, though it is hoped that this range may be refined in the future. Diagnostic materials include Vinette I/Wolfe Neck-like ceramics and stemmed Rossville and Bare Island-like points, and possibly Eshback and other notched forms as well. Economic pursuits and other aspects of this manifestation are discussed below. Cultural relationships of the Black Rock Phase will be discussed in detail in Section 11.4.

9.5.2 Seasonality and Subsistence

Preservation of prehistoric organic artifacts at the Indian Point Site was poor. Identifiable animal bone was not recovered. Prehistoric botanical remains were preserved largely as carbonized seeds and carbonized fern macrospores. A total of 939 carbonized specimens, including 500 fern macrospores, 189 pieces of nutshell, 220 seeds, and 30 pieces of charcoal was recovered. The material was analyzed by Cheryl Holt, and a complete discussion and inventory is provided in Appendix V.

As noted above, three distinct feature groups are present on the site. Despite the presence of species unique to each feature group, two of the most common botanical artifacts, fern macrospores and nutshell, occur in all three groups, as do charred ragweed seeds. Three other seed species, which include goosefoot, pennyroyal, and false solomon's seal, occur in the two feature groups containing the house pit/living floor depressions (Groups 1 and 2). Some consistency in the season of occupation, plant collecting habits, or both is therefore evident. Further, the large variety of species, including seventeen native species historically known to have been used as food or for medicinal purposes, militates against the argument that the botanical assemblage represents the accumulated remnants of storage.

In light of these data, the species represented in the botanical assemblage suggest that the Indian Point Site was utilized minimally during the summer and into early fall. Edible berries, including elderberry, serviceberry, bunchberry, and false solomon's seal would have been available from about July through September and into October. Grapes could have been collected between August and November. Starchy seeds from species such as ragweed, pigweed, goosefoot, and knotweed are present as early as September. Nuts also become available during the month of September. The fact that no single species is overwhelmingly dominant by count or weight suggests a generalized strategy of plant food procurement.

Fern macrospores, the most numerous type of botanical ecofact, were recovered from six of the fifteen features. As a food plant, fern shoots would have been collected during the spring. Yet, fern spores do not begin to form until summer. Therefore, they must have been collected during summer or later, perhaps for a purpose other than as a source of food.

Although the various seed species and nuts could have been collected well into the fall and early winter, occupation during these colder months is not strongly supported by the data. First, the quantity of nutshell, 189 pieces weighing 1.1 grams, is negligible. Given the importance of nuts as a storable food source, one might expect that larger quantities would have been introduced into the botanical assemblage. Second, if the site was occupied during the colder months of the year, one would expect an increased necessity for heat. Significant quantities of fire-cracked rock would therefore be expected if a greater number of hearths were used, and/or if they were used for long periods of time. The presence of only four features interpreted as hearths and a mere 68 pieces of fire-cracked rock from all features at the Indian Point Site does not support the hypothesis of cold weather occupation. Further, it cannot be argued that the excavations simply failed to encounter features that functioned as hearths, since only 29 fire-cracked rocks were encountered during the entire controlled surface collection. Likewise, a high frequency of charcoal would be expected if greater quantities of wood had been burned. Preservation and sampling error alone cannot account for the extremely small amount of charcoal (n=30) recovered. It might also be speculated that the site's exposed location on the summit of Black Rock would have also been non-conducive to winter settlement. It is therefore concluded that the Indian Point Site was primarily occupied during the summer and into the early fall.

Beyond utilizing a broad spectrum of gathered plant foods, other hints of the nature of the summer/early fall subsistence strategy are sketchy. Intensive fishing is unlikely since netsinkers and other evidence of fishing are completely lacking at the site. Hunting, like the collection of plant foods, may have been generalized and probably did not involve the intensive exploitation of any one species.

9.5.3 Feature Function

Eighteen prehistoric features were excavated during the Phase II evaluation and Phase III data recovery (Figure 22). Three types of features were observed: post molds (n=3), basin-shaped pit features (n=13), and living floor depressions (n=2). The first feature type, post molds (Features 35, 36,and 43), were a rare occurrence at the site. Two post molds were located at the south end of the site and another was located in the center of the site, nearby but not directly associated with Feature 10, a living floor depression. Two other post molds were considered to be parts of other features and were not recorded separately. One was located in the area where Features 32 and 33 intersected, while the other occurred within Feature 17, a living floor depression. A direct functional relationship is suspected in both instances, although the precise function of the post mold associated with Features 32 and 33 is unknown. None of the post molds contained more than two artifacts; these are probably incidental inclusions.

All of the basin-shaped pit features are relatively shallow. Depths range from 5.5 to 23.0 inches, and only one exceeded 15.0 inches. Even allowing for plow truncation, such shallow depths suggest that underground storage was not the intended function of these features. Pit feature profiles and horizontal plans do not suggest any other obvious function, nor any differentiation in function. The smaller features, measuring up to 3.2 feet in maximum diameter (Features 1, 2, 3, 13, 14, 15, 19N, 19S, 42) tend to have circular horizontal plans (e.g. Figures 25-27, Plate 8). The larger basin-shaped features (e.g. Figure 25) are more ovate in horizontal plan and range from 3.2 feet in minimum dimension to 6.5 feet in maximum dimension (Features 28, 32, 33, 38). Cross-sections are basin-shaped, although the integrity of the boundaries, as defined in the field, varied widely.

It is suggested that at least four features functioned as hearths. Reddened soils and/or definable concentrations of charcoal were present in Features 13, 15, 19N, and 19S. The remaining basin-shaped pits are characterized by soil color differences in the surrounding soil matrix, but none exhibited clear indications of their use as hearths, or for any other function.

All of the basin-shaped pits contained varying amounts of organics, lithic debitage, ceramics, and/or stone tools. Fire-cracked rock occurred in six of these features; the maximum frequency was eight. Nine of 13 pits contained potsherds; however, only two pits, Features 2 and 15, contained more than eight sherds. Five basin-shaped pit features contained fewer than 35 artifacts of all classes, with the dominant artifact class being chipped stone debitage (Features 3, 14, 28, 38, 42). Two features of this group that contained pottery did not contain chipped stone tools. In complementary fashion, three features containing chipped stone tools did not contain pottery. The reason for this mutually exclusive distribution is not clear and may be attributable to sampling error, given the small quantities of each artifact class.

The remaining eight basin-shaped pits (Features 1, 2, 13, 15, 19N, 19S, 32, 33) contained a greater number and variety of artifacts. Each feature produced 50 or more artifacts, including at least one potsherd, at least one chipped stone tool, and at least 25 pieces of debitage. This group of features includes all four basin-shaped pits interpreted as hearths. If hearths are characterized by high frequencies and heterogeneous mixes of artifacts, then it can be suggested that all the features of this group functioned as hearths or as receptacles for trash produced by activities conducted in direct association with hearths.

The last two features are interpreted as living floor depressions. Feature 10 (Figure 28, Plate 9) measures 8.23 feet in length, 5.0 feet in width, and 1.25 feet in depth. Feature 17 (Figure 29) measures 10.0 feet in length, 7.0 feet in width, and 1.73 feet in depth. Both have basin-shaped cross-sections with irregular bottoms. Soils at the bottoms of these features were compacted. A 6.0 inch diameter post mold was observed at the southern end of Feature 17, and both features may have also contained hearths. In Feature 10, a dark organic stain with a dense concentration of charcoal flecks was located in the center of the feature. An area of reddened soil was noted to the south of this stain. A tightly clustered circle of cobbles and fire-cracked rock lay between these stains. In combination, these soil anomalies and the rock configuration present strong evidence for the presence of a hearth. The highest frequency of fire-cracked rock (n=28) at the site also occurred in Feature 10.

The evidence for a hearth is not so clear in Feature 17. In the center of this feature was a silt clay soil type, nearly devoid of organic content. However, charred organics were concentrated within soils along the southern and eastern edges of the feature. The depositional sequence of the feature suggests that the soil in the central area accumulated after the feature had been abandoned. If a hearth had been located within this depression, it may have been cleaned immediately prior to abandonment, leaving only the organic remnants on the edges. Feature 17 also produced 16 fire-cracked rocks, twice the frequency of fire-cracked rock than from any other feature at the site.

Even if these features do not represent houses *per se*, their contents and spatial association with other features (see below) suggest a variety of activities that can be associated with them. Tool manufacture and maintenance is indicated by a high frequency of debitage. These two features alone produced 46.8 percent (n=637) of all debitage (exclusive of flotation) recovered from the features at the Indian Point Site. Not unexpectedly, unfinished bifacial tools and tool fragments were found in both Feature 10 (n=3) and Feature 17 (n=1). The presence of discarded projectile points in Feature 10 (n=3) and Feature 17 (n=2) suggests that hunting implements may have been repaired and rehafted at these loci.

Two hammerstone fragments from Feature 17 and one hammerstone from Feature 10 may also have been used in stone tool manufacture, though they could have been used in food preparation activities such as cracking and/or pulverizing animal bone, nuts, or seeds. Food preparation is likewise indicated by the relatively high frequency of charred nut hulls. Slightly more than three-fourths of all charred nuthulls at the site (77.2 %, n=146) derive from these two features.

Hide working is suggested by two tools found in Feature 19, located immediately adjacent to Feature 17. Microwear analysis (see Appendix VI) revealed that a biface tip was probably used to cut hide, while an unretouched, edge-damaged flake was probably used to scrape hides. Hide working is also suggested by an endscraper found in Feature 17. Bone or wood splitting is inferred for the pieces esquillées, or wedges, found in both Features 10 and 17. Butchering and various other tasks could have been accomplished with the retouched flakes and knives recovered from Feature 10 (n=4) and Feature 17 (n=2). All in all, a wide variety of everyday, domestic tasks can be inferred from the tool assemblage.

Structurally similar features have been interpreted as houses at the Mispillion Site in Delaware (Thomas and Warren 1970). Griffith and Artusy (1975:4) also point out that most of the artifacts recovered from the Mispillion "houses" came from the feature fill rather than from their floors. This was also the case for Features 10 and 17. However, comparisons with the Mispillion features may not be appropriate since that site is dated to the Slaughter Creek Phase of the Late Woodland Period.

A better comparison obtains with "Type B" features from the Delaware Park Site in northern Delaware (Thomas 1981). As discussed above, the occupations at this site appear to overlap with those at Indian Point. Four features were discovered, two of which were radiocarbon-dated. Although both dated features at Delaware Park (1,850 ± 100 BC and 790 ± 65 BC) suggest an earlier temporal placement, notable structural similarities in terms of size do obtain. Specifically, the size of the Indian Point living floor depressions fall within the range of Type B features from Delaware Park and approach the mean for all dimensions. Average length, width, and depth of Type B features at Delaware Park are 10.2 feet, 8.85 feet, and 1.86 feet respectively. Unfortunately, only Feature 94 at the Delaware Park site is thoroughly described. Like Feature 10, a hearth was present at the center. A few possible post molds, both outside and inside the feature, are also mentioned; an eroded area to one side is suggested to have served as an entryway. Like both Indian Point features, the floors of the Type B features were compacted. More recently, a similar living floor depression was discovered at the Clyde Farm Site, and was radiocarbon-dated to AD 1,000 (Custer 1988b:44; Custer and Hodny 1989).

The structural configurations of the house pit/living floor features at Delaware Park, Clyde Farm, and Indian Point do not seem to indicate substantial structures. The term semi-subterranean, as applied to the Delaware Park features (Thomas 1981:V-22), connotes an idea of permanence that seems overstated. Although the size and shape of these features, in concert with the compacted soils found at the base of the features, suggest some sort of prepared living surface, they could hardly have been used as shelter for much more than a nuclear family. The lack of consistent associations of post molds with these features further suggests that superstructures over these living floor depressions, if present, were hardly permanent. Perhaps something similar to a lean-to type structure might be indicated. Finally, substantial structures for coping with colder weather would not be expected at Indian Point if the occupations primarily occurred during warmer weather, as has been suggested above. In this connection, it should be mentioned that a previous suggestion that "pit house-type" structures in the Middle Atlantic region are predominantly cold weather dwellings (Custer and Hodny 1989:59) is not borne out by the Indian Point data.

9.5.4 The Organization of Space during the Early/Middle Woodland Occupation

The spatial distribution of features at the Indian Point Site clearly indicates that three discrete clusters or activity zones are present (Figure 22). Group 1 includes Features 1, 3, 13, 14, 17, 19N, and 19S. The maximum distance between any one pair of features in Group 1 is 5.81 meters which obtains for Features 13 and 3. That is, no feature is more than 19.0 feet from any other feature of the same group. In contrast, the distance between the two closest features in Group 1 and Group 2 (Features 3 and 43, respectively) is 66.64 feet.

The maximum distance between any pair of features (Features 32 and 15) within Group 2 is 14.26 feet. In contrast, the minimum distance between the nearest features of Group 2 and Group 3 (Features 15 and 28, respectively) is 86.29 feet. Again, a clustered group of features exists that is spatially separate from all other features.

The third feature grouping, Group 3, is much more dispersed than the previous two. The central four features, two of which are post molds, are spaced closely together, while the outer two features are somewhat isolated. The latter, Features 2 and 28, are located 36.9 and 38.67 feet, respectively, from the features closest to them of those postulated as comprising Group 3. Yet, the distance of Feature 28 from Group 2, 86.29 feet, suggests that this feature is better associated with Features 35, 36, 38, and 42 than any others. The association of Feature 2 with this group of features is supported by the fact that the topography begins to slope steeply to the southeast immediately beyond this point. Artifact densities also suggest that this area is on the periphery of the site (see Table 12).

To further investigate this spatial patterning, a linear nearest neighbor analysis was performed (Stark and Young 1981). Linear nearest neighbor analysis is a statistical method first developed by geographers to objectively examine patterns of points in space. It is based on a model which postulates that *n* points are placed at random along a line according to a uniform probability distribution. A linear nearest neighbor statistic, which compares the distances between each point and its closest neighboring point in relation to the length of the line, is then calculated to discriminate whether points are clustered, random, or dispersed in their placement on a line. To apply the method, each feature center was selected arbitrarily as the reference for measurements.

The results of this analysis suggest that the features can be considered to be neither clustered nor dispersed. However, certain problems emerged in applying the technique to this particular data set. The linear nearest neighbor statistics defined by Stark and Young are "first order" statistics; they consider distances to each point's closest neighbor. Unfortunately, Stark and Young's (1981:289) approach may indicate a random pattern in a situation where there are in fact two different patterns. That is, Feature Group 3, with its dispersed patterning, may have masked the clustered patterning of Groups 1 and 2. Appropriate higher order linear nearest neighbor statistical methods comparing more distant point pairs could not be found to further investigate this phenomenon. Nonetheless, other kinds data indicate that these groupings, regardless of whether they are statistically dispersed or clustered, do indeed reflect the partitioning of space and activities at the Indian Point Site.

These feature groups are, in fact, reflective of the local topography of the site (see Figure 22). The features of Group 1 (1, 3, 13, 14, 17, 19N, and 19S) all occur at elevations between 6.0 and 13.0 inches above the site datum. Group 2 features (10, 15, 32, 33, and 43) all occur at elevations 9.0 inches and 1.5 feet below the site datum. Group 3 features (2, 28, 35, 36, 38, 42) occur at elevations between 4.29 and 10.29 feet below the site datum, with the central four occurring at elevations between 5.7 and 7.0 feet. The three feature groups are thus vertically, as well as horizontally, separated in space.

The two tightly concentrated feature groups (1 and 2) are each comprised of similar sets of features. Each group has one of the living floor depressions and also has a paired set of basin-shaped features in close proximity. There is also at least one hearth feature in each of these groups. Interestingly, each pair of basin-shaped features and their corresponding living floor (Features 10, 32, 33 and Features 17, 19N, 19S), contained the same basic complement of charred botanical remains, including fern macrospores, nutshell, ragweed seeds, and pennyroyal seeds.

Artifact densities are similar for both of these areas. Ceramics are not particularly abundant and stylistic similarities between these features cannot be drawn. However, the only mica-tempered sherd occurred in Feature 19S, while a sizable fragment of sheet mica was recovered from Feature 1, and small fragments were found in Feature 17. Given that mica was not found in any other part of the site, this association strengthens the case for defining these features as an interrelated group. Although debitage and tools are more frequent in Group 1 than in Group 2, this may simply be a consequence of the greater number of features in Group 1.

Feature Group 3 has a very different composition, with only post molds and basin-shaped pits represented. There are neither hearths nor living floor depressions here either. Given the greater amount of slope in this portion of the site, perhaps it was not a suitable location for a third residential activity area. And, with the exception of Feature 2, very few artifacts were recovered from the features in this portion of the site. Conversely, a house pit in this vicinity could lie outside of the machine-stripped swath.

The close similarity between Feature Groups 1 and 2 is further reflected in certain aspects of the chipped stone assemblage. Looking at Table 13, these two feature groups share an almost identical debitage profile when sorted by raw material type. In both cases, nearly half of all debitage is quartz, another one-fourth jasper, with the remainder comprised of similar small amounts of quartzite, chert, argillite, and rhyolite. This distribution suggests that tools made from these various raw material types were manufactured, repaired, and/or resharpened in nearly the same proportions.

When the tools are classified by raw material type (Table 14), tools made from quartz, jasper, and chert occur in identical proportions (2:1) when the raw material frequencies of Groups 1 and 2 are compared. However, tools made from quartzite are comparatively more frequent among Group 2 features, and tools made from shale and slate occur only in Group 2 features. Within Group 2, three of the four shale tools were found in Feature 10. The other slate tool was found in Feature 33, strengthening its association with Feature 10. The near absence of slate and shale debitage is a consequence of the paucity of retouch on these tools. In contrast, Group 1 produced the only tools made from rhyolite and siltstone. Although these differences in raw material distribution may be interpreted as further evidence for functional interrelatedness within the two groups, the relatively small numbers of tools suggests that sampling error may also be a factor in the distribution.

A low incidence of chipped stone tool manufacture and maintenance is suggested for the entire site during the Early/Middle Woodland occupation. Debitage-to-tool ratios range from 33:1 in Feature Group 1 to 9:1 in Feature Group 3, with an average figure of 24:1 for the entire site. The implication is that few tools were actually manufactured on-site, and most finished tools were evidently brought in. It is unusual that there seems to be no appreciable difference in the debitage/tool ratios of local versus non-local raw material types for which sample size is adequately large. For example, the debitage/tool ratio for locally available quartz is 34:1, while that for jasper, which was presumably quarried to the north, is 35:1. Regardless of the reasons for this concordance, different lithic reduction patterns can be discerned.

Table 15 lists the frequencies and proportions of three flake types for each raw material type. In comparing the differences between quartz reduction and jasper reduction, it can be seen that late stage reduction by-products, especially bifacial retouch flakes, are well-represented in the jasper debitage from both Feature Groups 1 and 2, while they are under-represented in the quartz debitage. Not surprisingly, the proportions of early stage reduction by-products for each respective material type are reversed, with more early stage reduction of quartz. It is clear, then, in both Feature Groups 1 and 2, that jasper tools were brought to the site and resharpened here, or that they were brought to the site in nearly finished form and then completed. In contrast, some tools made from quartz were made on-site. Allowing for the small size of the debitage and tool samples, it would also seem that chert tools and, to a lesser extent, quartzite tools were, like jasper tools, brought to the site as well.

Finally, the frequencies of tool classes from Feature Groups 1 and 2 are strikingly similar (Table 16). Such a similarity would be expected if each feature group was a discrete and functionally equivalent area for domestic activities centered around each living floor feature. That is, the features and the trash they contain were produced in the context of the same suite of domestic activities.

Interpreting the apparent differences in tool frequencies that obtain in comparing Groups 1 and 2 with Group 3 is more problematic due to the small numbers of artifacts. Only the complete lack of projectile points in Group 3 stands out. This suggests that the manufacture and repair of hunting tools may have largely taken place in the vicinity of domestic habitation areas and/or hearths. Other activities may not have been as restricted in space. Based on the microwear analysis of tools (Appendix VI), hide and/or meat cutting is represented by the two tools in Feature 19 from Group 1 that were previously discussed, and a biface tip fragment in Feature 35, a postmold from Group 3. In addition, another tool from Group 3 was used to bore antler or bone. The latter tool is the stemmed point fragment that had been reworked into a drill or borer found in Feature 2. Other activities are also suggested by the wide variety of tools recovered from Group 3 features, including two classes, a graver and a denticulate, that did not occur anywhere else.

9.6 The Indian Point Site in Perspective

The small glimpse of the proposed Black Rock Phase Early/Middle Woodland occupation of the Indian Point Site provided by the subsurface features suggests that exploitation of this portion of the Schuylkill River Valley occurred during the summer to early fall. Occupations were probably brief and subsistence activities may have been geared toward generalized hunting and gathering, although direct evidence for this is scanty.

Activities at the site seem to have been organized around individual living floor depressions, which were probably occupied by individual families. Substantial residential structures are not in evidence and if house structures existed at all, they were no doubt of a temporary nature. Pit features and hearths were produced as a consequence of everyday domestic activities and occur in close proximity to the living floor features. That hunting of reasonably large mammals took place is suggested by the presence of tools used in the cutting and preparation of hides.

The manufacture and maintenance of chipped stone tools was a sporadic activity at the site. Most tools made from jasper and chert were brought to the site in a finished or nearly finished form. On-site manufacture of tools was limited to locally available raw materials such as quartz.

Evidence pertaining to other occupations of the Indian Point Site is restricted to surface finds and materials from the plowzone. Years of cultivation of the shallow upland soils of this blufftop location have obscured or destroyed other traces of prehistoric occupation. Yet, the extremely wide variety of diagnostic projectile point types testifies to its use from Early Archaic times through the Late Woodland period. Of all the projectile point types found during the course of the Limerick Transmission Line Surveys, only two projectile point types, Lehigh and Snook Kill, were not found at the Indian Point Site. However, these types have been reported in private collections from the site. A Paleo-Indian occupation also occurred, based on private collections, but no evidence of such was recovered during the present survey. The intensity of utilization of the large Indian Point Site can be measured by the huge volume of materials recovered by avocational and professional archeologists over the years.

Significantly, the Indian Point Site produced over 62.4 percent of the formally retouched chipped stone tools and 56.4 percent of all debitage recovered from the 56 sites that were investigated or discovered during the Limerick Transmission Line Surveys. This is not due to the extent of the excavations at the site, since the quantity of surface collected materials alone far outstrip those from any other site. Similarly, the Indian Point Site produced the greatest variety of tool classes recovered from any site. Raw materials include rhyolite, a variety of cherts and chalcedonies, argillite, quartzite, jasper, and quartz in ascending order of occurrence for both tools and debitage; this distribution well reflects the overall trend for the entire regional study area, as might be expected at a site used at all times and for the entire range of purposes.

From the perspective of the greater Schuylkill Valley, the volume and variety of cultural material bespeaks of continual use of this locale throughout prehistory. Although it is tempting to ascribe a central role to the site in past settlement systems, such as a repeatedly used central base camp, it is perhaps more prudent to interpret this phenomenon as an indication of the variable role this location must have played in settlement systems in the past. In fact, ethnoarcheological data suggest that residential base camps are re-used for other purposes more often than sites located at more economically or tactically specialized locales (e.g. Binford 1982; Janes 1983). The site's geographic position within a large horseshoe bend in the mid-reaches of the Schuylkill River, with its commanding view of the Schuylkill Valley, was an ideal location for any type of settlement. In effect, all groups of people potentially utilized the site for the entire range of activities within their particular settlement system.

As seen from the perspective of the Indian Point Site, a fixed place utilized differentially through time, the apparent uniqueness and importance that this locale probably assumed in past living systems has been obscured by various site formation processes. Primary among these is the compromise of the integrity of much of the archeological deposits by plowing, as described above. But of equal, if not greater impact, is the fact that such critical locations can be expected to yield extremely complex mixes of archeological remains simply because they are used repeatedly and for different purposes. But rather than marvel at the volume and variety of cultural materials, or reduce interpretations of the roles this site may have played in the past to mere speculation, the Indian Point Site argues for investigating a variety of less complex and/or smaller sites to develop and refine archeological methods of interpretation and analysis, rather than to focus efforts exclusively on large, artifact-rich sites.

10.0 ANALYSIS AND DISCUSSION

10.1 Data Quality, Limitations, and the Nature of Analytical Approaches

Archeological field work conducted during the course of the Limerick Transmission Line Surveys resulted in the collection of a very large volume of data. These data have been described in the preceding pages, and form the basis for the synthetic analyses and summary discussions that follow. It must be emphasized, however, that the present data set, though substantial, is decidedly uneven with regard to data quality and utility for regional synthetic analysis. This statement is, of course, a standard caveat in a large-scale study of the scope undertaken here; indeed, an uneven data set can be considered an inevitable, unavoidable outcome of any large-scale site location survey.

In the Lower Schuylkill Valley Study Area, a myriad of uncontrollable factors account for numerous sampling problems. Such factors include a lack of survey coverage and/or previously collected information for urban or other developed areas, and various landowners or artifact collectors who declined to share information regarding their artifact collections. Other factors affecting the nature of data quality involve the exigencies of compliance-oriented archeology, where research must necessarily focus on defined project areas, areas which may or may not constitute optimal sampling universes for the purpose of generating statistically valid or reliable data sets. During the present project, every attempt has been made to compensate for perceived deficiencies in the primary data collected by JMA through the incorporation of secondary data from various sources, such as informant information, private collections, and the PASS files.

Despite the efforts to minimize sample bias, gaps nonetheless exist in the data base in both the areal and intra-site dimensions. Three predominant forms of areal bias are apparent, and involve 1) incomplete, localized spatial coverage of the study area, 2) potentially incomplete temporal representation in the area, and 3) the existence of sites for which virtually no data - excepting location and prehistoric temporal affiliation - are available, or where such data are vague or dubious. The magnitude of uneven areal coverage can be appreciated through examination of Figure 30, which plots the locations of all 184 sites; Figures 31-33 display subsets of the overall sample. The sample is heavily weighted toward sites lying on the Schuylkill from Norristown to Pottstown, though a respectable number of sites located on tributaries or in upland settings are also recorded. Many but not most of the sites lying along the Schuylkill are sites discovered or relocated during the transmission line surveys. Virtually no sites are recorded along the Schuylkill below Norristown or on Wissahickon Creek; early urban development and a relative lack of documented archeological activity in this area account for the lack of recorded sites. For practical and analytical purposes, the study area can therefore be regarded as beginning at Norristown, rather than Philadelphia. A potentially more detrimental gap in the data base occurs along the lower reaches of Perkiomen Creek. It is well known that a wealth of sites occurs in this area, but they are unfortunately not recorded due primarily to reticence on the part of artifact collectors in the area. This gap in areal coverage no doubt adversely affects the synthetic reconstructions presented later, potentially to a considerable extent.

The problem of recorded sites for which no data exist is especially acute, particularly with regard to many older entries in the PASS files. While 184 sites have been recorded within the bounds of the Lower Schuylkill Valley Study Area, the majority of these lack one or more classes of data originally targeted for analysis. This fact in turn structures the nature of the analytical approaches employed in this study. For example, where interval scale data are required, as in the examination of lithic raw material distributions within and between sites, only sites with reliable samples and counts of lithic materials can be employed. This requirement is not met by the vast majority of sites in the sample. In analyses involving nominal scale data, such as the examination of sites and environmental associations across space and through time, the data are not as incomplete; many more sites may therefore be included with this kind of approach. Overall, however, most of the conclusions and hypotheses to be presented below are based on examinations of selected subsets of the overall data base, principally the primary data generated by the transmission line surveys. These data are more accurate and complete in most cases, simply because these sites were actually visited and verified. The numerous sites known simply as "Unknown Prehistoric" unfortunately can contribute little to the study.

Intra-site data deficiencies are also apparent and revolve around the representativeness of the portions of the sites that have been subject to excavation, and the representativeness of the sample of sites that has been excavated. It is certain that the intra-site data reported above is nowhere near representative of extant site functional variability within the Lower Schuylkill Valley. Indeed, the general lack of reliable functional, seasonal, and chronological data for most temporal periods is definitely the single most severe problem in the data base, since the information is not simply uneven or problematic, it is absent, and this fact places a serious limitation on the reliability of settlement interpretations. This paucity of information requires that settlement patterning suggested by site locational analysis must be further examined or tested with site-specific functional data. Thus, the settlement study conducted below must be regarded as a provisional construct that requires further testing with additional excavated intra-site data.

While the specific data shortcomings and sample biases recognized and acknowledged above cannot be overemphasized, the extant large data base, despite its limitations, nonetheless permits detailed, substantive analyses. As noted, sampling problems are always limiting factors in large-scale site location surveys that generate large data bases. The remainder of this report will attempt to address the research problems outlined at the outset to gain a concise, albeit provisional, understanding of prehistoric adaptation and cultural dynamics in the Lower Schuylkill River Valley, subject to the stated limits and constraints of the data base. As such, most of the conclusions drawn herein should be considered preliminary, or otherwise as working hypotheses to be tested and further refined through future research.

The analyses presented below explore the research problem domains outlined in Section 1.2 to the extent feasible for each occupational period. Five principal problem areas and three sub-areas were identified, and should be briefly reiterated at this time:

1) The establishment of a cultural-historical framework for the Lower Schuylkill Valley Study Area;

2) Explication of the nature of lithic raw material distributions, procurement, and usage in the study area;

3) Documentation of subsistence-settlement system variability within the Lower Schuylkill River Valley;

4) An assessment of cultural dynamics in the Lower Schuylkill Valley, and the changing configuration(s) of socio-political-economic systems in the region. This assessment includes:

4a) Determining the "role" of the Lower Schuylkill Valley as a socio-political "territory" throughout prehistory;

4b) An evaluation of whether the Schuylkill River Valley can be considered a "major" watercourse like the Delaware and Susquehanna;

4c) Comparative analysis of societies and settlement systems in the Schuylkill with systems located elsewhere.

5) A description of the nature of intra-site structure and function in the Lower Schuylkill Valley.

Analysis will commence with a discussion of regional environmental data, and proceed to the archeological data considered most amenable to systematic study and most likely to produce the least equivocal results. This data subset largely consists of the primary data generated through the transmission line surveys. The focus subsequently shifts to incorporate a wider range of sites and data, thereby relying heavily on the secondary data base.

The best individual data categories are the ubiquitous lithic tools and debitage, including temporally/culturally diagnostic artifacts, functionally-specific artifacts, and the numerous different raw material types found in the region. Thus, these data categories are examined in order to elucidate patterned variability as revealed by diagnostic artifacts, to analyze differential raw material usage through time and across space, and to develop a model of lithic source location, accessibility, and procurement applicable to the study area. This lithic-specific construct is followed by a comprehensive analysis of sites in their environmental contexts, i.e. the relationships between sites and environmental variables that may have influenced settlement decisions in the prehistoric past. As discussed previously, the environmental data available for the region are far from ideal, but nonetheless permit the construction of a settlement model based on the sites' proximity to specific environmental features and presumed subsistence resources. Finally, the principal lithic and environmental analyses, in concert with other kinds of less ubitquitous data such as subsistence remains and intra-site spatial structure, form the basis for a holistic study of subsistence/settlement variability, societal/cultural dynamics, and culture change in the Lower Schuylkill Valley. The variables enumerated in the stated problem domains will be addressed to the extent feasible, and conclusions and hypotheses will be advanced.

10.2 Settlement and Land Use Patterns in the Lower Schuylkill Valley

10.2.1 Determinants of Settlement 1: Hydrology and Geomorphology

As described in Section 2.0, the Schuylkill River Valley displays certain physical and hydrological characteristics that are peculiar to the river, and which serve to set it apart somewhat from its two mightier neighbors, the Delaware and Susquehanna. Though general environmental data are rather limited, and few geoarcheological studies have been aimed at correlating archeological potential and the nature of erosion/deposition in the valley, it is nonetheless possible to offer a provisional model of hydrological dynamics in the Schuylkill Valley. This construct is based on the comparatively limited, site-specific geomorphological work conducted at the Frick's Lock and Point Bar Sites, as well as on comparisons with broader studies conducted in the Delaware and Susquehanna Valleys. The provisional model developed here has implications for understanding the nature of settlement in the drainage basin, and may potentially serve as a basis for further geomorphological study in the area.

Several studies attempting to link hydrology and rates of erosion and/or deposition with archeological potential and site formation processes have been conducted in the Delaware Valley. The results of these studies have been recently summarized by Schuldenrein et al. (1991). At the Delaware Water Gap, the Shawnee-Minisink Site has produced evidence that lag gravels were still being deposited during the early Holocene/Paleo-Indian Period, and overbanking became the predominant mode of sedimentation by Early Archaic times (Dent 1985). Overbank sedementary accretion also seems to have been punctuated by erosional episodes, at least on a local level. At the Bachman Site in the Middle Delaware Valley, one massive mid-Holocene erosional event and several minor episodes were documented (Wagner and Wagner 1987). By about 4,000 BC, the river became largely stabilized and entrenched in its present channel. As a general trend, overbank alluviation has been characteristic since, in concert with only minor episodes of erosion. Evidence from the Faucett Site in the Upper Delaware Valley (Ritter et al. 1973) and the Byram Site in the Middle Delaware (Kinsey 1975) corroborate this generalization.

Data from several sites suggest a substantially slowed rate of floodplain aggradation ca. 2,000 BC, near the beginning of the Piedmont Tradition of the Late Archaic Period. At the Faucett Site, there was a gradual decline in overbank sedimentation from approximately 4,000 - 2,000 BC (Ritter et al. 1973). Geomorphological studies at the Lower Black's Eddy Site on the Middle Delaware clearly demonstrate slowed alluviation and the presence of a stable landscape throughout the Late and Terminal Archaic occupations of the site, ca. 2,000 - 1,500 BC (Schuldenrein 1986; Schuldenrein et al. 1991). Schuldenrein et al. (1991) conclude that the evidence for overall diminished flooding intensity throughout the Delaware Valley during the Late/Terminal Archaic Periods suggests the presence of environmental conditions conducive to floodplain stability at this time. Local variability may be in evidence immediately following the Terminal Archaic Period, however, since the Faucett data from the Upper Delaware show an accelerated sedimentation rate during this time (Ritter et al. 1973), while at Lower Black's Eddy increased flood activity apparently promoted erosion of the site surface, or minimally produced an environment not conducive to settlement, since occupations dating to this period are not present (Schuldenrein et al. 1991).

Throughout the Early and Middle Woodland Periods, a renewed episode of floodplain aggradation took place. The magnitude of aggradation was not particularly dramatic and sedimentation rates appear to have increased over those of the Archaic only to the extent that alluviation and soil accretion once again occurred; in fact, evidence suggests that the rate progressively slowed throughout the period (McNett et al. 1977; Ritter et al. 1973; Schuldenrein et al. 1991). By Late Woodland times, the sedimentation rate was once again greatly diminished, and most landscapes were largely stable. Early Late Woodland materials at Lower Black's Eddy were contained in the upper portion of the accretional alluvial sediments, while a dense late Late Woodland occupation occurred on a stable surface which was not buried by subsequent alluvial deposits (Schuldenrein et al. 1991). However, buried Late Woodland strata are not unknown in the Delaware Valley, suggesting local exceptions to this general pattern.

To summarize the foregoing, Schuldenrein et al. (1991) postulate that active overbank flooding in an entrenched Delaware River channel diminished or ceased at least twice during the mid- to late Holocene, which resulted in relatively stable floodplain landscapes. The first period of decreased alluviation occurred during the Late/Terminal Archaic Periods, ca. 2,000 - 1,000 BC, and potentially slightly longer. The second episode occurred during the Late Woodland Period, evidently in the latter portion, probably post-AD 1,200-1,400. Immediately following the Late/Terminal Archaic stable period, an episode of localized flooding and erosion evidently took place prior to the re-establishment of an aggradational overbank flood regime. Otherwise, between the stable episodes, floodplain aggradation occurred at irregular intervals, which was sufficient to promote the build-up of alluvial floodplain deposits.

Several studies of floodplain alluviation and hydrological dynamics have been conducted in the Susquehanna River Valley (e.g. Scully and Arnold 1981; Schuldenrein 1981). The most comprehensive and complex work is that recently conducted by Vento (1987, 1990; Vento and Rollins 1989), which forms the basis for the following summary. Vento conducted extensive trenching operations at numerous locations throughout the Susquehanna drainage basin in an attempt to correlate archeological deposits (or archeological potential) with recurring soil strata, and by extension, to the hydrological and climatic dynamics that conditioned their formation.

According to this research, stable cumulic A-horizons should form only under conditions of relatively little overbank sedimentation or erosion, which must be the result of minimally hundreds of years of fluvial stability; such episodes of fluvial stability are correlated with warm-moist climatic intervals which are the product of changes in atmospheric circulation (Vento and Rollins 1989:9). Evidently, such episodes were rare or absent prior to about 4,000 BC, since the early to mid-Holocene in the Susquehanna drainage was characterized by active alluviation, floodplain aggradation, and erosion (Vento and Rollins 1989:37). While floodplain landscapes were thus not particularly stable for extended periods of time, this fact did not altogether preclude human occupation of these areas. However, the pronounced flooding and concomitant floodplain incision and lateral erosion during the period preceding 4,000 BC may be responsible for the dearth of intact archeological deposits dating to the Paleo-Indian through Middle Archaic Periods in the basin, i.e., evidence of such occupations would likely have been swept away (Vento and Rollins 1989:43-44). By early Late Archaic times, ca. 4,000 - 2,000 BC, there is some evidence to indicate that the warm-moist conditions culminating at the end of the long Atlantic climatic episode fostered floodplain stabilization and the development of A-horizons (Vento and Rollins 1989:36-37). However, during the following Sub-Boreal episode, ca. 2,200 - 1,000 BC, relatively rapid floodplain accretion is once again in evidence.

During the Sub-Atlantic climatic episode, ca. 1,000 BC - AD 150, warm-moist conditions again prevailed, which allowed for a relatively long period of floodplain stability and subsequent A-horizon development; this period is coincident with the Early Woodland and early Middle Woodland Periods, the latter of which is typically associated with the Fox Creek Complex (Vento 1987; Vento and Rollins 1989:9,44-45). Thus, in the Susquehanna drainage diminished alluvial aggradation and relative floodplain stability is characteristic of the Early Woodland through early Middle Woodland Periods. In post-Middle Woodland times, the cool-moist conditions of the Scandic episode, ca. AD 150 - 850, promoted overbank flooding and floodplain aggradation, which often buried the earlier Middle Woodland developed A-horizons. A second interval of prolonged floodplain stability occurred ca. AD 900 - 1,250, during the Neo-Atlantic episode, which is coterminous with the early Late Woodland Clemson Island Culture (Vento 1987; Vento and Rollins 1989:9, 44-45). Clemson Island occupations are posited to be highly correlated with a buried, formerly stable A-horizon typically found approximately 80 - 110 centimeters below the surface on low terraces throughout the greater Susquehanna drainage basin (Vento 1987). Finally, the cool moist conditions of the Pacific episode, post-AD 1,300, effectively arrested A-horizon development, possibly the result of large-scale floods. Rapid vertical accretion of floodplains was promoted and formerly stable early Late Woodland surfaces became buried (Vento and Rollins 1989:45).

It is clear that the reconstructions of fluvial regimes in the Delaware and Susquehanna Valleys do not closely correspond. Prior to the Late Archaic, floodplain aggradation/erosion characterized both valleys. The Late/Terminal Archaic in the Delaware witnessed a period of pronounced floodplain stability and diminished overbanking, while evidence for such a phenomenon is comparatively slight in the Susquehanna. Further, the two episodes do not overlap temporally: stability in the Susquehanna is suggested at ca. 4,000 - 2,000 BC, and in the Delaware at ca. 2,000 - 1,000 BC. In both valleys, however, the stable period is followed by a period of accretion/erosion. More dramatic are the differences between the valleys during the Woodland Period. During the Early and Middle Woodland, the Delaware was active and did not foster the development of A-horizons on stable surfaces, while in the Susquehanna, the reverse appears to have obtained. In both drainages, alluviation again abated during the Late Woodland, though this occurred during the earlier portion of the Late Woodland in the Susquehanna, and the later portion in the Delaware. Resumed alluviation and sediment accretion buried Late Woodland landscapes in the Susquehanna, while the burying of Late Woodland occupations in the Delaware was certainly minimal by comparison. Regarding other potential sources of incongruence in Vento's model, it might be added that some of his inferences regarding moisture and temperature characteristics of certain climatic episodes are at odds with various other climatic reconstructions (see Section 2.0).

Resolution of the differences between these models is beyond the scope of the present endeavor. Rather, the Delaware and Susquehanna data will serve as a comparative backdrop against which hydrology and sedimentation in the Schuylkill are evaluated. It would appear that the Schuylkill does not closely parallel either reconstruction. Studies of the scope described above have not been conducted in the Schuylkill Valley, yet it is clear from general environmental and hydrological data that the dynamics observed in the Susquehanna and Delaware do not obtain here.

Wagner's geomorphological and pedological analysis at the Frick's Lock Site (see Section 7.0, Appendix I) focused on two terrace formations paralleling the river. The upper terrace is a middle Pleistocene formation, which underwent subsequent surface erosion during the late Pleistocene/early Holocene. The lower terrace was formed during the late Pleistocene, probably coincident with the erosion of the upper terrace. This terrace lies adjacent to the river at an elevation of about 12 feet (4 meters) above river level. Holocene alluvial deposition has been minimal, suggesting relatively infrequent flooding of this landscape. However, flooding was not altogether absent since erosional features were evident on the lower terrace. Also, an abandoned flood chute, probably filled in during the mid-Holocene, separates the upper and lower terraces. The latter features indicate that flood-produced landscape alterations more frequently involved erosion rather than alluvial accretion. It is noteworthy that Late Archaic materials were abundant on the lower terrace, indicating landform stability for at least four to six thousand years.

To the extent that the site-specific research at the Frick's Lock Site may be extrapolated to similar floodplain terraces elsewhere, important implications emerge. The lower terrace at Frick's Lock lies approximately 12 feet above river level, at about 110 feet AMSL. Terrace formations of this general size and relative elevation are characteristic of the valley for a considerable distance up and downstream from the site, on both sides of the river. These terraces are intermittent and alternate with steep cliffs that lack associated floodplains. Terrace formations lying closer to the elevation of the river are very rare, and when present appear to be active flood channels. The minimal Holocene flooding evident at the large Frick's Lock terrace, and the apparent tendency for flooding to promote erosion and scouring rather than sedimentation at lower elevations, argue that the potential for vertically stratified occupations on floodplain terraces in this part of the valley is low at best. This condition may obtain from at least the western boundary of the study area at Pottstown to the river's junction with Perkiomen Creek. There are no alternating episodes of alluvial accretion and floodplain stability in this part of the Schuylkill Valley, and floodplains appear to have been essentially stable throughout the Holocene.

Of particular interest in this connection is a recent geoarcheological study conducted by Vento (1990) in the French Creek Valley and in the Port Providence area, located on the Schuylkill a short distance upstream from the mouth of the Perkiomen. In the latter area, Vento excavated a trench in a T1 terrace which revealed that the historic land surface was buried by up to six feet of coal sands. A cambic B-horizon was then encountered, underlain by a buried A-horizon of unknown age. Artifacts were not discovered. Sands and gravels occurred below the A-horizon. While his results are preliminary, the presence of the buried A-horizon led Vento to conclude that there is "some potential" for buried A-horizons elsewhere in the valley, perhaps associated with human occupations. However, evidence of stacked cultural deposits or A-horizons, such as those observed in the Susquehanna, is clearly lacking. While Vento's preliminary results suggest that buried horizons may be present in the Schuylkill Valley, the integrity of those deposits remains to be addressed, as well as whether the Port Providence locality may be considered typical or exceptional with regard to terrace formation elsewhere. The data presented above suggest that these findings may represent a localized phenomenon and not a general trend. Regarding the French Creek area, a trench in this floodplain failed to produce any evidence of buried A-horizons or potential for buried sites.

Based on geomorphological studies conducted at the Point Bar Site, it appears that a different hydrological dynamic existed below the confluence of the Schuylkill River and Perkiomen Creek. The site-specific conditions observed at this site are complex and have been discussed previously (also see Appendix II), and only relevant points will be summarized here. The Point Bar Site occupies a floodplain terrace immediately downstream from the large horseshoe bend at Valley Forge. Perkiomen Creek empties into the Schuylkill immediately upstream from this meander. Holocene strata overly Pleistocene point bar and channel bar deposits, and the Schuylkill appears to have occupied a channel north of the site from the early to mid-Pleistocene. The river subsequently flowed in a split channel on both sides of the site, with the southern (i.e. present) channel eventually becoming the exclusive course by the early Holocene. As discussed, the Holocene stratigraphy at the Point Bar Site was highly compromised and laterally disjunct across the site area; the strata are the result of alternating episodes of overbank alluviation and erosion. Four distinct artifact-bearing strata were discerned, but artifact associations were extensively mixed within and between the strata. Extrapolating from sedimentation rates calculated in the Delaware Valley (which may not in fact be applicable), it was determined that the cultural strata at the site would have taken at least 1,500 years to accumulate. If one takes into account periods of erosion and scouring, as well as the date range of the recovered artifacts, a longer time span is no doubt represented.

The presence of Early Archaic projectile points at the site suggests that the landscape must have been sufficently stable for some duration during this period, though a prolonged period of stability seems unlikely given the absence of well-developed soils and the displaced nature of the artifacts. A second period of possible relative stability can be inferred by the presence of single Otter Creek and Brewerton projectile points, both of which occurred out of stratigraphic context. If stability is indicated by the presence of these early Late Archaic artifacts, it apparently was not long lasting. It is interesting, however, that the generally accepted temporal range of these artifacts corresponds to Vento's (Vento and Rollins 1989) proposed brief period of stability during the Late Archaic. It is further noteworthy that Piedmont Tradition Late Archaic materials, while omnipresent on terraces upstream on the Schuylkill, are absent from Point Bar. Since these artifacts tend to occur after about 2,000 BC in the region, this fact might suggest the absence of a stable floodplain surface during this period; this corresponds to the Susquehanna pattern but clearly contrasts with that in the

Delaware. This is potentially an important observation, because if all floodplain environments in the Schuylkill Valley below Perkiomen Creek (i.e. not simply at Point Bar) were unstable ca. 2,000 - 1,000 BC, then this constitutes a marked deviation from patterns observed in the Delaware. The presence of Terminal Archaic broadspears at the Point Bar Site further complicates the situation and may indicate some degree of floodplain stability ca. 1,000 BC or perhaps somewhat later; alternatively, the broadspears may represent transient occupations of the site during an unstable episode. Taken together, the evidence suggests that instability during this time at the Point Bar Site could represent either a localized occurrence or a general trend; this phenomenon deserves further study.

Early and Middle Woodland occupations at the site were relatively light and were not associated with any particular stratum or demonstrably stabilized land surface. Thus, patterns in the Susquehanna and Delaware cannot be compared on this basis. A Late Woodland occupation is absent from the site. The reason for this is not known, but it seems unlikely that it was due to the lack of stable occupation surfaces.

To summarize, the Point Bar Site data do not provide a total picture of hydrology and alluviation/erosion in this part of the Schuylkill Valley. Relatively stable landscapes obviously existed at different times at the site, but none of these was of sufficient duration to have promoted soil formation and the development of A-horizons. Erosion and partial truncation of these four strata occurred, and resulted in a bewildering mix of artifactual materials. The important question at this point is the extent to which these data may be generalized to areas further downstream.

If nothing else, geomorphological analysis of the site has demonstrated that this area has been hydrologically very active throughout the Holocene and indeed, even more so during the mid- to late Pleistocene when the Schuylkill changed course. It is possible that the unstable landscapes and jumbled artifacts at the site are the result of localized flood dynamics resulting from the site's close proximity to the mouth of the Perkiomen. The increased volume of flow below the confluence during flood episodes may have produced highly unstable conditions on a local level, i.e. in the vicinity of the horseshoe bend. However, these "unstable" conditions did not altogether preclude settlement, as demonstrated by the high density of sites in this area. It may be posited that people probably used this locality intermittently despite adverse conditions during flood seasons. It is also suggested that the Point Bar Site situation is probably not unique to this particular locality. That is, while all downstream floodplain terraces may not have been as active as that at Point Bar, it is unlikely that prolonged stable surfaces and resultant stratified sites are common anywhere below the mouth of the Perkiomen.

Several lines of evidence support this contention. It will be recalled that the Schuylkill is a narrow, deeply incised river valley and floodplain terraces are correspondingly narrow. Most terraces lie at similar elevations above the river, and no obviously built-up levees are in evidence. Also, the location of the Point Bar Site (i.e. Valley Forge) is near the point at which the river leaves the Triassic Lowlands and enters the Piedmont Uplands, where relief becomes more marked (see Figure 3). Thus, beginning a short distance below Valley Forge, the river flows between steep cliffs and over riffles and exposed bedrock in the Norristown-Conshohocken-Manayunk area, where floodplain tracts are minimal. These physiographic features, coupled with the fast-flow nature of the river, suggest that the potential for alternating episodes of alluviation/stabilization in the lower reaches of the Schuylkill Valley is remote, while the potential for floodplain erosion and scouring is high. In short, the potential for buried, stratified sites in this area is low.

One additional factor which probably contributes to the nature of hydrological dynamics in the Lower Schuylkill Valley should be mentioned. Vento and Rollins (1989:10-11; also Vento 1990) note that the extent to which a river will tend to build stratified alluvial deposits is directly proportional to the size and nature of its tributaries. That is, the larger the tributary, the larger its stream load. Since the vast majority of the tributaries of the Schuylkill are relatively steep first or second order streams, and major tributaries are comparatively few, the overall sediment load transported to the main stem is potentially less than might be expected given a river system of this size. This fact may contribute to the lack of buried deposits/sites.

It thus appears that the narrow, deeply incised nature of the Schuylkill Valley differs considerably from that seen in the Delaware Valley. In the Delaware above the fall line, the valley also has numerous small tributaries and numerous steep banks or cliffs, but not nearly as narrow and incised as those of the Schuylkill. The Delaware is wider, with considerably more bottomland/floodplain. The same observation holds for the Susquehanna Valley, which is much wider and has even more substantial floodplain tracts. Consequently, there is a greater potential in the Delaware and Susquehanna Valleys for vertically stratified archeological sites than in the Schuylkill. This reflects significant differences in rates of flow/deposition/erosion within each of these river valleys. On average, the Schuylkill displays chronically faster rates of flow, a lower potential for alluvial deposition and formation of extensive floodplains, and a higher potential for floodplain erosion. By contrast, the larger rivers tend toward relatively slower flow rates, a greater potential for alluvial deposition/floodplain development, and comparatively lower potential for erosion. Although the foregoing statements may overgeneralize the case, since stability/instability in these rivers is episodic, they do suggest the salient differences between these river systems.

It is apparent that, provisionally at least, the three rivers have differing sedimentation/erosion histories, and that a pan-Holocene pattern of riverine hydrology cannot be assumed for the entire eastern Pennsylvania region. It is certain that pan-Holocene, pan-regional *trends* existed (e.g. Knox 1983), but drainage-specific hydrologic/physiographic factors and varied localized environmental conditions may produce hydrologic and geomorphologic regimes contrary to or otherwise different from what one would expect during certain anticipated stable or unstable episodes. On the basis of the characteristics described above, the depositional patterns seen in the Delaware and Susquehanna Valleys are unlikely to be replicated in the Schuylkill. Rather than protracted episodes of greater or lesser deposition, there probably never were episodes of prolonged deposition punctuated by relatively stable episodes; floodplain landscapes were always relatively stable or erosional, hence the lack of buried occupation strata.

The archeological implications for the study of settlement patterning are significant. It would appear that landscapes in the Lower Schuylkill Valley Study Area were essentially stable (i.e. non-accretional) throughout the Holocene. The potential for buried sites is minimal, increasingly so as one moves upstream in this part of the valley. Therefore, sampling bias in the form of undiscovered buried sites is not a major problem. Further, given the above reconstruction of floodplain environments in the valley, the pronounced trend toward site multicomponency becomes more understandable, i.e. stable landscapes adjacent to the river probably prompted the repeated reuse of the same locales over a long span of time. There was never a need to relocate a settlement as a result of hydrologic or physiographic changes, since few localities ever became uninhabitable or "less inhabitable" due to such processes. Finally, the absence of alluvial stratification aptly explains the characteristic mixed-bag nature of artifact assemblages from most sites in the study area, i.e. they are the simple result of many people leaving their refuse on the same piece of ground for thousands of years.

10.2.2 Determinants of Settlement 2: Lithic Raw Material Procurement and Use

10.2.2.1 Modes and Models of Lithic Raw Material Procurement

Technology can be viewed as the primary cultural subsystem that functions in response to variations in the availability of resources within the natural environment. In turn, such environmental variability factors prominently in the organization of the technological subsystem within particular cultures. Lithic raw materials play a critical role in the organization of prehistoric technology since they are both a procured resource and, after subsequent modification into tools, are the primary means by which other resources are extracted and/or maintained. The flurry of recent publications devoted to the analysis of lithic production systems, especially lithic procurement (e.g. Butler and May 1984; Ericson and Purdy 1984; Vehik 1985), is testimony to the importance of this analytical topic.

Several models of lithic procurement have been formulated to describe the structure of lithic procurement systems and derive implications for settlement. Perhaps the most useful classification is that developed by Luedtke (1976), who divides lithic procurement into two categories, i.e. direct and indirect procurement. Direct procurement implies first-hand access to lithic raw materials while indirect procurement represents materials obtained through exchange, trade, or other interactive processes. Direct procurement can be further subdivided into casual procurement, defined as the acquisition of lithic raw materials during the course of performing other activities, and special trip procurement, or directly accessing known sources, especially quarries, for the express purpose of obtaining lithic raw materials.

Until recently, lithic analysts have tended to emphasize direct, special trip procurement as the primary means by which prehistoric peoples obtained lithic raw materials. Most models developed from this perspective assume that tool replacement costs are directly related to lithic procurement costs (e.g. Goodyear 1979), and/or that raw material procurement time is the most time consuming, and therefore most costly, aspect of tool manufacture and maintenance (e.g. Gould 1978). Typically, optimizing strategies that minimize costs have also been operationalized within these models. In its simplest form, distance is equated with cost and is treated as the independent variable. It is reasoned that the greater the distance between the source and anticipated location of use, the greater the effort to reduce the raw material transported into more cost-efficient forms such as rough bifaces, preforms, or finished tools. Further, the distributions of specific raw materials are expected to fall off rapidly with distance from the source (e.g. Bettinger 1982; Renfrew 1977), usually in a linear fashion. Although there are various permutations of this model relating lithic reduction stages to zones of production (e.g. Ericson 1984:4-5, Tables 1.1 and 1.2) that may appear rather straightforward, interpretations of the relationships between tool and debitage discard and source locations are not always so obvious, and are in fact sometimes contradictory.

Clearly, other variables, such as the relative quality of the raw materials, can affect decision-making during procurement. Gould and Saggers (1985) have considered the effects of varying technological qualities of raw materials and suggest that while raw material choices may not directly minimize procurement costs, they will minimize overall costs in terms of the lithic production system. A more sophisticated version of these cost minimizing models was developed by Goodyear (1979). He suggested that as the distance between critical biotic resources and lithic resources increases, so do tool costs. Portable and technologically flexible technologies were therefore produced in response. In a similar vein, Wiant and Hassen (1985:105) have considered the impact of temporal incongruities of critical biotic resources on the scheduling of lithic procurement activities.

Although not all of these models, nor others that focus on the consequences of scheduling and resource stress on the form of lithic assemblages as a whole (e.g. Torrence 1983), were explicitly designed with special trip procurement in mind, they all relate decision-making in the lithic production system to minimizing costs and risks. However, they perhaps overstate the risks involved in lithic procurement and the complexity of the technological responses to these variables. In some models, the lithic production system even becomes the primary driving force behind settlement decisions (e.g. Gardner 1974; 1980). That the costs of movements over even great distances may be overestimated in some instances is implied by a study in California, in which three decortication flakes from a habitation site were refit to a core from a quarry site located 63 kilometers (39 miles) away (Singer 1984:44). Also, the quantity of raw materials required by a particular lithic production system may be exaggerated, and hence the impact of raw material scarcity on a lithic assemblage, and inferences regarding tool curation, may be misdirected. By contrast, one study estimated that the yearly lithic needs of one family could be collected in one eight-hour day (Luedtke 1976, 1984). Finally, procurement costs may not even be a primary contributing variable in settlement decisions. This is particularly true for areas rich in and/or nearby plentiful lithic raw materials; such is probably the case with the Lower Schuylkill Valley.

Of late, Binford (1979; Binford and Stone 1985) has taken up the cause for casual procurement. He has stated that "raw materials used in the manufacture of implements are normally obtained incidentally to the execution of basic subsistence tasks. Put another way, procurement of raw materials is embedded in basic subsistence schedules. Very rarely, and then only when things have gone wrong, does one go out into the environment for the express and exclusive purpose of obtaining raw material for tools" (Binford 1979:259). The upshot of Binford's position is that special trip procurement is rare and that procurement costs are "not referable to the distance between the source location and the location of use" (Binford 1979:260).

Although there have been numerous criticisms of Binford's embeddedness argument (e.g. Bamforth 1986), championing one mode of lithic procurement over another is decidedly unproductive. In fact, a mix of these strategies is likely with direct, special trip procurement probably practiced from residential sites located near quarries, and embedded, casual procurement practiced during the course of logistic hunting/gathering expeditions from residential camps located at greater distances. Reduction would thus probably occur at a variety of site types and locales away from the residential camp. Assuming that this was the case throughout much of prehistory, a rapid fall-off of raw material frequencies with distance would not necessarily be expected. This would be especially true for a highly logistic settlement system such as the Nunamiut studied by Binford (1978, 1979). In fact, a very circumscribed distribution of tools and debitage of a particular raw material type might argue for limited, special trip exploitation of a local source from residential sites, while the outliers of the distribution, consisting largely of tools, could be the product of logistic camp sites occupied away from the main camp.

Regardless of the logical permutations of this hypothetical lithic procurement model, Binford's point that movements involved in raw material procurement might be structured by factors other than cost minimization, and his downplaying of the potential risks involved, is well taken. The question remains, however, of how one controls for the multitude of factors that potentially affect or are affected by the distribution of raw materials.

The nature of lithic procurement is but one of many inter-related topics examined in the analysis of lithic production systems. Other topics that can be investigated include labor investment in terms of direct costs and exchange, inter-group social dynamics, and social organization. In any analysis it is critical that the structure of the lithic resource base be understood since the location and distance to alternative sources can effect the character of procurement systems, and any other aspect of the system (Ericson 1984:5). That is, any study of lithic raw material procurement and use must necessarily include a comprehensive assessment of potentially available resources as the initial step in the analysis. This potential universe of lithic procurement possibilities forms the only objective means by which actual patterns of procurement can be measured and evaluated (Blanton 1985:116). An explicit geography of lithic resources in the present study area is therefore developed below.

One further aspect of the lithic landscape must also be considered before raw material distributions are interpreted as evidence for cost minimization, exchange, a particular pattern of settlement movements, or other phenomena. The relative accessibility of raw material sources should also be compared and analyzed, since the locations of neighboring sources may directly affect procurement choices independently of cultural or other factors (Sappington 1984). For example, a particular lithic resource, if circumscribed by alternative sources, might have a highly localized distribution despite a long temporal span for its use. In a case study in which several raw material sources were exploited, Sappington and Cameron (1981) documented the simultaneous operation of differing procurement strategies and production systems in Chaco Canyon, New Mexico. Such studies suggest that the results and interpretations of analyses focusing solely on the distribution of single raw materials may be questionable (e.g. Ward and Doms 1984).

Concomitantly, access to raw materials is also constrained by the physical geography of the region, which structures the routes by which raw materials are accessed and transported. Thus, the accessibility of a particular raw material's location may be greater than that of another raw material even though the distance to the latter might be less than to the former. Accessibility can also be affected by culturally defined boundaries which may have changed through time. Therefore, a wide variety of fall-off distributions (Renfrew 1977) can be produced solely as a consequence of distance decay as modified by competing locations of raw materials, their varying degrees of accessibility, and stochastic processes affecting movement within the transportation network.

The consideration of the potential effects of differential access and source distributions is not particularly novel; however, a majority of studies gloss over or relegate such discussions to the background while opting for more intellectually attractive explanations such as trade and exchange (for example, see Custer 1984c). While fall-off distributions can be produced by direct procurement and/or exchange systems (Stewart 1988:52), the demonstration of a fall-off curve does not automatically imply the operation of one or both of these mechanisms. It is the contention of the present authors that the analysis of lithic production systems should be approached in a hierarchical fashion, with raw material source distributions and relative accessibility acting as the primary variables forming the baseline of the analysis. Processes of direct procurement are considered next in explaining distributional patterns, while exchange and other complex cultural responses should only be invoked when other explanations have been ruled out. The present analysis thus places emphasis on the distribution of sources and implications of variable access.

10.2.2.2 Lithic Raw Material Sources Within and Beyond the Study Area

The area encompassed by and immediately surrounding the Lower Schuylkill Valley Study Area, as noted above, possesses a wide variety of lithic raw materials. These include raw materials that are available locally within the study area and lithic types that occur at known outcrops and quarries lying various distances from the study area. The diversity in and proximity to most lithic raw materials renders the Schuylkill Valley of particular analytical interest because the cost of most lithic procurement, even if it was not embedded within other scheduled economic activities, can be assumed to have been minimal. Concomitantly, procurement of materials located at great distances, probably beyond the bounds of the regularly exploited territory, can be closely monitored. In order to better understand the nature of lithic raw material usage in the study area, a detailed discussion of these raw materials and their distribution follows.

Within the boundaries of the Lower Schuylkill Valley Study Area, lithic raw materials are dominated by macrocrystaline quartz and quartzite. Several bedrock formations within the region are comprised largely or partially of quartzite. The three bedrock formations of local interest are the Chickies Formation, the Antietam Formation, and the Harpers Formation. Both the Chickies and Antietam Formations are thickly bedded with the latter a gray, buff-weathered quartzite and the former a light gray, hard quartzite. These two formations are Cambrian in age and are correlated with the Hardyston Formation of the Reading Prong, which lies immediately north of the project area. The Harpers Formation is also Cambrian in age but is primarily phylite and schist with quartzite layers (McGlade et al 1972).

Quartzite is resistant to weathering and erosion; hence, the formations form the sharp ridges separating the Triassic Lowlands from the Piedmont at the southern boundary of the study area, just as the Hardyston Formation marks the boundary of the Reading Prong with the Triassic Lowlands to the north of the study area (see Figures 3 and 4). Ridges also occur in the study area where the Schuylkill River cuts down through the Piedmont onto the Outer Coastal Plain. The Chickies Formation is the most prevalent in the region, forming the bulk of the North Valley Hills and Diamond Rock Hill in Chester County; Mount Misery and Mount Joy at Valley Forge; and two ridges running northeast from Conshohocken to Abington, and Black Horse to Abington (Berg 1978a, 1978b, 1978c, 1978d; Socolow 1978a, 1978b, 1978c; Berg and Socolow 1978). The latter two ridges are bisected by Wissahickon Creek.

Localized outcrops of high quality quartzite may have been quarried prehistorically but have not been documented. However, the prehistoric quartzite quarries discovered in the closely related Hardyston Formation deposits north of the study area increases the probability that the Chickies quartzite was also quarried. Secondary deposits of quartzite boulders produced by erosion and/or cobbles transported and deposited by water may have been exploited as well.

Macrocrystalline quartz, including white vein quartz and quartz crystal, also tends to occur at the edge of the Piedmont Physiographic Province in the south and southeastern portions of the study area. Especially notable are the quartz exposures just south of Phoenixville at the aptly-named ridge of Diamond Rock Hill (Gordon 1959:177). However, hydrothermal veins of quartz also intrude upon the shales of the Triassic Lowlands. Outcroppings of both white vein quartz and quartz crystal are recorded. Most quartz cobbles are derived from quartz veins and could have been procured throughout the area, especially along riverbanks and in shallow stream beds.

References pertaining to sources of cryptocrystalline quartz, generically referred to as chert in the present discussion (see Lavin and Prothero 1987) and variously referred to as chert, chalcedony, flint, and jasper, are notoriously scant within the Lower Schuylkill Valley Study Area. Scattered references have been made pertaining to the presence of cryptocrystalline quartzes, but the vast majority are reports from mines, quarries, roadside exposures, and railroad cuts. Cryptocrystalline quartz materials have been reported in association with the Chickies Formation, especially near the southeastern edge of the study area (Gordon 1959:215).

One formation in the study area that may have chert-bearing outcrops is the Wissahickon Schist Formation, which lies south of and roughly parallel to the Chickies Formation. Known as Broad Run Chalcedony in Delaware, actual outcrops within the study area have not been documented but have been reported from northern Delaware, eastern Maryland and southeastern Pennsylvania (Lavin and Prothero 1981:10). However, chert lenses appear to be rare to non-existent in the northern outcrops of this formation (Lavin and Prothero 1987).

Pebble cherts are present within the Bryn Mawr gravel formations in the extreme southeastern portions of the study area. The Bryn Mawr gravels are remnants of an extensive Pliocene gravel plain which covers high hills in Montgomery and Delaware Counties. As a secondary deposit, the cherts contained within these gravels are extremely weathered. The original sources for these cherts are varied and have not been well studied. These cherts may have been exploited prehistorically.

The Pleistocene-age gravels deposited by the precursors of the present day Delaware River are also restricted to the extreme southeastern portions of the study area (Richards 1957:87:88). Derived from multiple sources, these include the Pennsauken gravel deposits which contain yellow, brown, and tan "jaspers," whitish cherts with brown weathered cortex, and black to light gray cherts. Cobbles from 2.5 to over 10 inches in diameter have been reported (Lavin and Prothero 1987). Probable primary sources for these materials include the Onondaga and Beekmantown Formations, and possibly the Helderberg Group (Lavin and Prothero 1981:14). Other Pleistocene deposits in the Philadelphia area that contain chert include the Bridgeton Formation and the Trenton gravels. In addition, these deposits contain various amounts of quartzite, quartz, argillite, sandstone, and shale cobbles from sources located upstream.

A variety of sedimentary lithic types were utilized prehistorically. Argillite of the Lockatong Formation is the primary type that may have been available to the prehistoric inhabitants of the Lower Schuylkill Valley Study Area. This formation cuts across the Triassic Lowlands through the middle of Montgomery County and into the extreme northeastern portions of Chester County (see Figures 3 and 4). Argillite is also a very minor component of the Brunswick Formation, lying at the base of this bedrock (Glaeser 1966). Substantial outcrops and prehistoric argillite quarries have been documented for the Lockatong Formation in the Delaware and Hudson River Valleys (Didier 1975), but neither suitable outcrops nor prehistoric quarries are known from within the present study area. Argillite cobbles derived from these deposits may have been an alternative source for this material in the local area. Various shales, sandstones, and other sedimentary rocks were also available throughout the study area, particularly in the Triassic Lowlands. Consequently, these latter sedimentary rock types have a broad distribution within the study area.

Overall, the only raw materials available in significant quantities within the confines of the study area are quartz and quartzite. Cherts seem to have been restricted to the southeastern portions of the study area. Some types, such as those associated with the Bryn Mawr Formation, may not have been of a quality or quantity that rendered them suitable to extensive utilization. Formations associated with argillite have a broad distribution within the region but documented quarries and reduction locales are lacking.

Quartz, the most common lithic raw material within the Lower Schuylkill Valley Study Area, is also widely distributed outside of the study area. Shales, sandstones, siltstones and sedimentary rocks other than argillite and hornfels are also common outside the area. Because of their omnipresence and because they represent the low end of quality among the lithic raw materials under consideration, it may be assumed that little effort was likely expended toward procuring and transporting these materials for use within the study area. Quartzite is also rather broadly distributed throughout the region outside the study area. Bedrock sources may have included the Chickies, Harpers, and Antietam Formations, as discussed above, where they outcrop outside the study area. Another possible source for quartzite would have been the Setters Formation. A hard white to light gray quartzite almost indistinguishable from the Chickies material, Setters quartzite forms ridges in nearby southern Chester County (McGlade et al. 1972). Again, none of these formations can be associated with documented prehistoric quarries or reduction locales. Boulder and smaller cobbles could also have been casually utilized.

The only bedrock formation with evidence for prehistoric quarrying activities and intensive quartzite reduction is the Hardyston Formation. This formation is distributed discontinuously within an east-northeast band extending through the Reading Prong and New Jersey Highlands physiographic provinces (see Figure 3 and 4). This formation has a high degree of bedrock exposure (Snethkamp et al. 1982:7.14) and other lithic materials occurring in this formation were also intensively utilized (see below).

The Hardyston Formation becomes increasingly thicker toward the southwest and reaches its greatest thickness on South Mountain, where it attains approximately 700 feet (Aaron 1979:29; Buckwalter 1963). It is here, in the southwestern headwater drainages of the Schuylkill River Valley, that the Robesonia Quartzite Quarry (37 BK 270) is located (Snethkamp et al. 1982). This quarry is approximately 35 linear miles upstream from the westernmost edge of the study area. Snethkamp et al (1982:7.15) list several other locales suggestive of other quarries in this vicinity, and Anthony and Roberts (1987: Figure 4) map several other quarries that exist at various places where the Hardyston Formation is exposed throughout the Reading Prong. Robesonia quartzite is relatively vitreous and individual grains are difficult to differentiate. Colors are generally pastel, with whites and tans dominating over pink and light gray varieties.

Cryptocrystalline lithic resources are relatively abundant outside the study area. The chert-bearing Pleistocene gravels that are of limited distribution in the study area are more broadly distributed over central and southeastern New Jersey, extreme southeastern Pennsylvania, and into northern Delaware. Chert-bearing Pliocene gravels also occur in eastern Burlington, western Ocean, and Monmouth Counties in New Jersey. Known as the Beacon Hill Gravel, a wide variety of cherts occur, including some "jaspers." Cobble size is small but specimens of three to four inches occur with some regularity (Lavin and Prothero 1987). This deposit begins approximately 40 miles from the eastern edge of the present study area.

As discussed above, the Wissahickon Formation contains chert-bearing outcrops in eastern Maryland, northern Delaware, and southeastern Pennsylvania. Part of the Delaware Chert Complex (Wilkins 1976), this particular variety has been referred to as Broad Run Chalcedony. Color is variable, ranging from a very pale yellow, white, and light brownish gray to a yellowish red, strong brown, and grayish brown. Mottled white, tan, and brown specimens have been reported, as have translucent gray samples (Lavin and Prothero 1987).

The two other cryptocrystalline quartz varieties that form the Delaware Chert Complex along with Broad Run Chalcedony are Newark Jasper and Cecil Black Flint. Both are fine-grained cherts associated with an intrusive body of gabbro that outcrops in the same areas along the flanks of the Wissahickon Formation. The primary distinction between these two cherts is color, with the black variety referred to colloquially as a flint and the yellowish brown and brown varieties termed jasper. Chert outcrops are limited to northern Maryland, especially upper Cecil County, and New Castle County Delaware, particularly in the Newark vicinity. Newark jasper is chemically and microscopically distinct from Pennsylvania jasper (Blackman 1974; Lavin and Prothero 1981; Hatch and Miller 1985). The presence of metallic gray magnetite, ilmenite, and/or chromite crystals make this the only "jasper" macroscopically distinct from the Pennsylvania jasper of the Hardyston Formation (Lavin and Prothero 1987). Distance to sources varies but all are of a similar magnitude, with a minimum distance of approximately 25 linear miles from the southern edge of the study area.

Pennsylvania jasper, or more properly Hardyston jasper, is the most well-known and thoroughly researched lithic raw material in the region; archeological interest began in the nineteenth century (e.g. Mercer 1894) and continues to the present (e.g. Hatch and Miller 1985; Anthony and Roberts 1988). This variety of cryptocrystaline quartz is associated with the Hardyston Formation, a Cambrian deposit of sandstones and quartzite that outcrops throughout the Reading Prong north of the study area. Hardyston jasper occurs in a variety of colors and mottled combinations of yellow, brown, and red. Detailed microscopic and chemical analyses have established its distinctiveness (Miller 1982; Lavin and Prothero 1987).

The Hardyston jaspers appear to occur in a relatively continuous line of deposits. Although coarse-grained jasper has been reported as far west as Reading, the area regularly exploited prehistorically seems to extend along a 34 mile corridor from the Fleetwood Quarry Site (37 BK 482) in Berks County to the Delaware River (Anthony and Roberts 1988). Deposits of jasper lying near the surface most commonly occur in the form of boulder fields that represent eroded glacial float deposits. Nodules vary in size from pebbles to boulders up to five feet in diameter. Extensive quarries, which consist of open pits dug into eroded float deposits to depths up to 30 or 40 feet, testify to the great expenditure of energy to acquire this material. From the northern edges of the study area, known quarries lie less than 15 linear miles away. Access by means of Perkiomen Creek and its several tributaries or Manatawny Creek may have promoted direct procurement of jasper from these deposits.

Intimately associated with the Hardyston jaspers are several chert-bearing dolomites and limestones. These include the Cambrian Allentown and Tomstown Formations and various formations of the Ordovician Beekmantown Carbonate Group. These formations are more widely distributed than the Hardyston Formation, occurring not only in the Reading Prong but also within the Great Valley, and into the Blue Ridge Province in a band that extends across the entire state (Lavin and Prothero 1981; Snethkamp et al. 1982). A small patch of Cambrian limestones and dolomites equivalent to the Beekmantown Group and Tomstown Formation also occurs in the Chester and Conestoga Valleys, and in narrow bands in Chester, Lancaster, and York Counties south of the study area; however, chert outcrops in the deposits are not mentioned in the literature (Richards 1957).

The cherts of the Allentown and Tomstown Formations occur in both bedded and nodular forms and are largely black in color. Gray and brownish-gray cherts are recorded for the Richland Formation, the western equivalent of the Allentown Formation (Snethkamp et al. 1982). The closest documented sources of the black cherts of the Allentown and Tomstown Formations appear to be coincident with Hardyston jaspers in the Reading Prong and areas to the north in the Great Valley, as the abundance of chert seems to decrease to the southwest (Snethkamp et al. 1982:7.17). Procurement distance and accessibility of these materials would therefore be of the same order of magnitude as the Hardyston jaspers.

Cherts associated with the Beekmantown dolomites and limestones are somewhat more variable in color, ranging from black to gray to white. In addition to potential sources near those of the Allentown and Tomstown Formations, good exposures have been noted in central Berks County at the border of the Reading Prong and the Great Valley (Snethkamp et al. 1982:7.13). Cobbles are also present along the Schuylkill River and its tributaries that cut through this formation in this area.

The closest source of rhyolite, or more properly meta-rhyolite (Stewart 1984a, 1984b), is found in the Blue Ridge Province in Maryland and southern Pennsylvania. The outcrops of this metamorphosed Precambrian lava span an area of approximately 30 linear miles. A small source also occurs along the Susquehanna River in the Pennsylvania Piedmont. Rhyolite can be found at these outcrops as well as in other contexts, such as in boulder fields near outcrops, occasionally in boulder fields not directly associated with outcrops, and as cobbles in streambeds and terrace deposits. The nearest source of rhyolite along the Susquehanna River is approximately 70 linear miles from the westernmost edge of the present study area.

Argillite and metamorphosed argillite, or hornfels, are contained within the Lockatong Formation, a Late Triassic lithofacies belonging to the Newark Group in central New Jersey and Pennsylvania. A narrow band of this bedrock type originates at Coventryville, just west of the Phoenixville area; two other narrower bands begin somewhat farther north and east of this primary band (see Figures 3 and 4). As the primary band crosses the Schuylkill River it becomes increasingly wider. In Bucks County, the formation splits into two broad bands. From here, the southernmost band extends eastward into New Jersey and the northernmost band extends northeastward into New Jersey (Glaeser 1966).

Exposures of the southern band are particularly abundant where watercourses such as Mill, Neshaminy, and Dyers Creeks and the Delaware River have cut through the formation, beginning about five miles north of Trenton (Didier 1975). This location lies approximately 15 miles from the eastern edge of the study area.

Exposures of the northern band are common along Gaddis Run, Tohickon Creek, and Jacobs Creek in the Point Pleasant, Pennsylvania/Byram, New Jersey vicinity where extensive prehistoric argillite quarry and reduction sites have been investigated (Mercer 1894; Kinsey 1975; Schuldenrein 1986; Schuldenrein et al. 1991). These deposits also extend north to about Frenchtown, New Jersey. Hornfels associated with Lockatong argillite has a much more restricted distribution as it is associated with intrusive diabase dikes, one of which occurs in the same vicinity, but with a more limited distribution (Parker et al. 1974). Distance to the Point Pleasant/Byram area is only about 20 linear miles from the northeastern edge of the study area.

Other sources of argillite are less well known and are located at much greater distances. Argillite lithologically similar to Lockatong argillite occurs in the Heidlersberg Member of the Gettysburg Formation which runs southwest from the Susquehanna River at New Cumberland to the Maryland state line. The quarries at South Mountain mentioned by Witthoft (1953) and Didier (1975) may be part of this formation, though it does not extend as far west as South Mountain *per se*. Custer (1984c) mentions outcrops in western Chester County and eastern Lancaster County but the source location and the type of argillite are not specified. Moreover, the Triassic bedrock types that occur west of the Lockatong Formation (see description above) in this area are the Hammer Creek and New Oxford Formations which do not contain argillite (Glaeser 1966:92, Plate 3). The suggested availability of argillite in this area is therefore questionable.

Finally, ironstone deposits were also utilized prehistorically. Ironstone, an iron-cemented sandstone, is distributed in small patches within the Coastal Plain area, and high quality sources were intensively exploited locally. Sources of ironstone accessible to the inhabitants of the Schuylkill Valley occur in the northern sections of Chesapeake Bay and the Upper Delmarva Peninsula (Ward and Doms 1984). Distance to the best known sources along the Elk

River and the Herring Creek in Maryland are approximately 30 to 35 linear miles from the southern boundary of the study area.

To summarize the foregoing, the overall picture of the lithic landscape presented in the preceding discussion contrasts the dispersed character of the lithic resources within the study area with the availability of point sources (localized outcrops and documented quarries) located to the north, south, and west of the Lower Schuylkill Valley; dispersed sources characterize areas to the east. Specific outcrops of quartz and quartzite within the study area may have been utilized, but their wide distribution suggests that they are best regarded as dispersed sources with locally heavy concentrations. The existence of cryptocrystaline raw materials and argillite are possible and, barring data to the contrary, are limited to dispersed, secondary deposits.

Accessibility to point sources outside of the study area varies widely. Rhyolite is least accessible given the great distance to the source and the fact that it is located in a different drainage basin; routes to gain passage to this area would have required the linkage of a limited choice of paths and/or stream crossings. The other western source material, quartzite of the Hardyston Formation, is a more accessible point source. Not only is it considerably closer, but fewer paths would have been necessary since known quarries are accessed directly through Tulpehocken Creek, a primary tributary of the Schuylkill River. However, given the presence of dispersed local sources of quartzite and the possibility of prehistoric quarries within the Lower Schuylkill Valley, these western sources may not have been utilized to their fullest potential.

The most readily accessible raw materials are the cherts and jaspers (and associated quartzite) located immediately north of the study area near the juncture of the Schuylkill and Lehigh River drainage basins. These outcrops run parallel to a large portion of the northern boundary of the Schuylkill River drainage basin, offering several avenues of access from nearly anywhere in the study area via Perkiomen or Manatawny Creeks. In contrast, jaspers, cherts, and other materials to the south were much less accessible. Not only are these materials located in different drainage basins, but the rugged topography of the Piedmont Uplands may have been less conducive to movement than the comparatively gentle Triassic Lowlands north of the Schuylkill River; the uplands could only be traversed by moving through the narrow stream valleys of the low-order streams that characterize this physiographic subdivision.

Argillite, although nearly as close to portions of the study area as the cherts and jaspers to the north, was probably less accessible. The only truly direct route would have been up the Northeast Branch of Perkiomen Creek and then east along Tohickon Creek to the quarries along the Delaware River near Point Pleasant. Other routes by way of the southeasterly flowing Neshaminy Creek or down the Schuylkill and then up the Delaware River would have been much more circuitous.

10.2.2.3 Lithic Raw Material Utilization Patterns in the Study Area

Investigation of raw material utilization patterns in the Lower Schuylkill Valley was necessarily limited to sites for which accurate counts of debitage and tools sorted by raw material type were available. Information recorded for the vast majority of the 184 sites reported within the study area (see Section 6.0) did not include data on lithic raw materials, did not meet the sample size criteria specified below, or the sample size was not reported. Analysis was therefore geared toward: 1) regional temporal patterning based on projectile point types, and 2) utilization patterns of specific raw materials for the region as a whole, i.e. as they vary through space within the study area. The latter approach considered both tools and debitage; in order to produce an adequate sample, temporal factors were necessarily held constant.

Detailed investigation of temporal patterning by specific site with regard to raw material utilization was neither feasible nor possible. Diagnostic chipped stone tools largely occurred at multicomponent, plowzone sites and actual counts of projectile points by type were infrequently or incompletely recorded, particularly for older entries in the PASS files. A non-site approach (Thomas 1975) was therefore employed. In this type of analysis, cultural items, in this case diagnostic projectile points, are the minimal unit of analysis rather than a site or series of sites. The region can, in an analytical and heuristic sense, be considered a "site writ large."

Projectile points recovered during the Limerick Transmission Line Surveys and projectile point counts gleaned from PASS forms and published literature (e.g. Jehle and Carr 1981) were employed in the tabulation of the region-wide data base. Significantly, the total percentages of raw material types for these aggregated data vary little from percentages based on the Limerick Transmission Line projectile point data alone. Most importantly, this discussion is a preliminary attempt to synthesize data that pertains only to raw material utilization patterns as they apply to and can be inferred from an incomplete sample of projectile points. The goal of the analysis is therefore the generation of multiple working hypotheses about region-wide changes in raw material utilization and settlement intensity through time, solely from the limited perspective of the lithic assemblages. A more exhaustive analysis of the cultural dynamics operating in the study area through time, utilizing these and other variables, is offered in Section 10.2.3.2.

Known types and generic forms were utilized, and in some instances were combined into single categories due to low frequencies or ambiguity in specific type assignation (Table 17). For example, side-notched points included all types not otherwise specified as Brewerton, Normanskill, or Meadowood. It was further assumed that most points in the side-notched category date to the Late Archaic period based on the prevalence of Brewerton Side-notched points among the named types. Corner-notched points form another generic category, to the exclusion of those identified as Jack's Reef Corner-notched or Vosburg. The corner-notched point category was assigned to the Middle Woodland period. Finally, contracting stemmed points and straight stemmed points were lumped with the Poplar Island and Bare Island types, respectively. There is ample precedent for lumping stemmed point varieties (e.g. Kent 1970). However, this was done in the present study due to a lack of specificity in the recordation of point descriptions, rather than as implicit acceptance of typological and chronological schemes that similarly lump stemmed points (Custer 1984a).

The absence of certain established types in Table 17, especially those dating to the Paleo-Indian, Early Archaic (other than bifurcate-base points), and Middle Archaic time periods, is only partially due to the lack of information on raw materials. For example, the total absence of Paleo-Indian points in this table is due to a lack of adequate quantification. Only a few fluted and lanceolate points have been found and are reported from only five sites (36 MG 16, 36 CH 43, 36 CH 53, 36 CH 111, and 36 CH 441). It is also unlikely that more than one or two Paleo-Indian points occurred at each site. Similarly, only two Paleo-Indian points were recorded by Snethkamp et al. (1982) for the Blue Marsh Lake Project, and none were reported by Kinsey (1976) in his preliminary study of the same region.

Other later types may have gone unrecognized and/or were lumped into generic categories (e.g. side-notched, corner-notched) by their classifiers. Conversely, bifurcate-base points are easily recognized. However, the data from the Limerick Transmission Line Surveys suggest that the region-wide relatively low frequencies of early projectile point types other than bifurcates are real, since lumping of point types was kept to a minimum. The virtual absence of Dalton, Kirk, Palmer, Stanly, Morrow Mountain, and Otter Creek points can therefore be ascribed to a significantly lower rate of occupation and utilization of the Lower Schuylkill Valley during these time periods, a pattern that repeats itself at later times. Further upstream, Kinsey (1976) recognized only three Early to Middle Archaic components represented by Palmer-like, Kirk-like, and bifurcate-base points in the Blue Marsh Lake project area. With the exception of bifurcate-base points, frequencies of the other types were low; the few projectile points that were found were made from jasper and chert.

Perplexing is the high frequency of bifurcates. This phenomenon has been noted by Snethkamp et al. (1982) for the Blue Marsh Lake region in the Upper Schuylkill and Turnbaugh (1977) for the West Branch of the Susquehanna. In the present study area this frequency is exceeded only by the frequencies of point types that occur during the Piedmont Archaic and Late Woodland Periods. Further, the percentage of bifurcates in the Blue Marsh region is nearly identical to the percentage recorded in the present study area. Therefore, their numbers are not simply due to their being easily recognized. Potentially significant differences in the way(s) in which the Lower Schuylkill Valley, and other areas, were utilized may exist. Future research should ascertain whether other Early and Middle Archaic types are, in fact, absent from the study area, or rather are simply being misclassified. Similarly, survey strategies may have been biased toward examining locations where peoples of the Bifurcate Tradition commonly lived.

Until further survey work is completed, inferences regarding raw material usage and early settlement strategies in the Lower Schuylkill Valley remain problematic. Bifurcate-base points are almost exclusively made from chert or jasper, suggesting a preference for cryptocrystalline raw materials during this portion of the Early Archaic Period. This may also suggest a rather wide foraging range during this time period, especially if the cherts are types not available locally. A wide foraging range is also suggested by the fact that two of the 18 bifurcates in the present study sample are fashioned from rhyolite. No other point type is represented by more than one rhyolite specimen. In contrast, Kinsey (1976) noted that a number of bifurcates were made out of quartz and quartzite.

The preference for cryptocrystalline raw materials is also apparent during the Late Archaic, as represented by Laurentian (Brewerton Side-notched points and side-notched points in general) and Lamoka point types. More significantly, a local raw material, quartz, begins to be utilized in significant quantities at this time. The use of quartz is also particularly noticeable for Vosburg points, another Laurentian point type. This shift may suggest a less transient presence in the area; longer term residential occupations or an increase in the intensity and/or frequency of resource procurement in the study area could be expected to favor the increased utilization of local materials. As with bifurcate-base points, proportions of side-notched points in the Lower Schuylkill Valley are almost identical to the proportions recorded by Snethkamp et al. (1982: Table 4.04) in the upper reaches of the Schuylkill for the Blue Marsh Lake area.

Dramatic shifts occur in the Late Archaic Period when narrow stemmed points of the Piedmont Tradition (Kinsey 1972) come into vogue. First, even allowing for the classificatory ambiguities inherent with stemmed points, an increase in population is seen. Piedmont Tradition points comprise up to 35.3 percent of all points tabulated for the Lower Schuylkill Valley Study Area. An even more dramatic increase seems to have taken place upstream. Up to 85 percent of all projectile points collected for the Blue Marsh Lake project may be attributed to the Piedmont Tradition (Snethkamp et al. 1982). These figures therefore reflect an intensive use of this and perhaps other headwater regions regardless of the differential time spans associated with individual traditions or point types.

Secondly, quartzite and, in the Lower Schuylkill Valley, argillite become extensively utilized. Fifty-five percent of all Bare Island/Straight Stemmed points (n=55) are fashioned from quartzite. Another 20 percent are made from argillite, and only 15 percent are made from quartz. Lackawaxen Straight Stemmed points appear to be uncommon in the region; however, classificatory bias based on geographic location and/or raw material type has probably resulted in an underestimation of their presence.

Poplar Island/Contracting Stemmed points (n=61), again potentially including a significant number of Lackawaxen Contracting Stemmed points, consist of almost equal numbers of quartzite and argillite specimens. Taken together, 72 percent of these points were made from quartzite or argillite. Like Straight Stemmed points, 55 percent of all Expanding Stemmed points (n=20) are made from quartzite. However, Expanding Stemmed points made of argillite are completely lacking. Instead, quartz is the next most preferred raw material (45%) and comprises all but one of the remaining points. Overall, only 11 percent of all narrow stemmed points are made from either chert or jasper.

The significant cultural preference for non-cryptocrystalline materials during this time period has long been recognized (e.g. Kinsey 1972:339). Argillite and quartzite may have been particularly sought after and/or these materials may have been judged more suitable for the production of narrow, stemmed projectile points. The latter is especially true for the longer bladed types which would have required flake blanks or nodules often exceeding eight to ten centimeters in length; this fact would have limited the amount of usable chert or jasper nodules. Elsewhere, however, narrow-bladed stemmed points were made from these materials, as evidenced at the Bachman Site, which is located less than two miles south of the confluence of the Lehigh and Delaware Rivers near substantial chert outcrops. Here, projectile points manufactured from chert and argillite predominate (Anthony and Roberts 1987). Significant use of jasper during the Late and Terminal Archaic is also indicated by Hatch and Miller's data from the Vera Cruz Quarry (1985). Generally, nodule size limitations would have been less a factor at the jasper and chert quarries known to exist just outside the present study area, due to the greater availability of large pieces of jasper and chert.

During the Late Archaic Period, quartz is utilized at a moderate and constant rate for projectile points. However, quartzite was clearly the preferred raw material overall, and could have been procured locally and within the middle reaches of the Schuylkill Valley west of the study area, where it is the predominant raw material utilized during this period (Snethkamp et al. 1982: Table 8.01). Local cryptocrystalline materials were not utilized to an appreciable extent. Procurement of materials from areas to the south, southwest, and southeast (e.g. jasper, ironstone, chert, rhyolite) is not strongly indicated either.

As discussed, procurement outside the Schuylkill Valley to the north and east appears to have been geared toward argillite. The Delaware River, as a major watercourse, may have been shared as a transportation route and a corridor of interaction by several territorial groups. These groups may have been located on different segments along the river, with territories extending away from the Delaware River. Regarding jasper and chert, the Lehigh Valley and/or the actual chert and jasper quarries may have been controlled by one or more inter-related groups, who could have restricted access to the resources of this drainage basin.

If a pronounced degree of territoriality obtained during this period, then the greatest variety of raw materials should be found at sites located along the Delaware River, since sites would be occupied by both "foreign" and "indigenous" groups with access to a diversity of raw materials. However, this does not mean that raw material variety need be consistently high at any one site. Proximity to quarry areas, especially argillite, must be accounted for, as well as the use and re-use of particular locations by the same territorial group. This observation therefore pertains to Delaware River corridor sites as a whole. A further implication is that fall-off curves for particular raw material types may be misleading. As Anthony and Roberts (1988:135-139) have pointed out, one potential effect of the Delaware River acting as a transportation corridor would be to depress the overall frequency of jasper in lithic assemblages, even at sites in areas near jasper quarries. That is, groups moving up and/or down the Delaware River would tend to transport raw materials from other areas to these sites, where high proportions of jasper would be expected if jasper were the only available raw material.

Pooled data for sites located within specific territories such as the Lower Schuylkill Valley should conversely show evidence for a high utilization of local raw materials, since access to other territories would have been restricted. Only non-local raw materials with unrestricted access such as those available along major transportation and/or interaction arteries like the Delaware River should show up in appreciable quantities. Because argillite outcrops parallel the Delaware River, utilization of this raw material would far outpace other raw materials such as the jaspers and cherts of the Hardyston Formation whose outcrops are oriented inland, away from the river and perhaps within the bounds of a territorial group. Fall-off curves for lithic raw materials would therefore be dramatically affected not only by physiographic boundaries, but also by societal/territorial boundaries and shared transportation arteries.

Both Kent's (1970) pioneering study and the Blue Marsh Lake data (Snethkamp et al. 1982) can be regarded as supportive of the case for territoriality during this period. In both the Blue Marsh Lake project area and the Schuylkill River drainage between Blue Mountain and Manatawny Creek, local raw materials prevail, with quartzite predominating. The primary difference between these data sources is the higher percentage of chert recorded by Kent. The reason for this is unknown since the areas considered overlap to a great degree. Nevertheless, chert, like quartzite, is a locally available raw material within the portions of the Reading Prong and Great Valley crossed by the upper reaches of the Schuylkill River.

Concomitantly, the proportions of argillite and rhyolite are significantly higher in the Swatara Creek drainage basin, a tributary of the Susquehanna River. Although local quartzites predominate, argillite and rhyolite comprise 28 and 13 percent of all projectile points respectively in the Swatara Creek region, while in the Upper Schuylkill they each comprise two percent or less of all projectile points (Kent 1970:193). Sources for argillite and rhyolite occur in the South Mountain vicinity southwest of the Susquehanna River. This suggests that people in the Swatara drainage were not only located closer to and had greater access to these raw material sources, but that a societal/territorial boundary between the Swatara and Tulpehocken drainages may have impeded the spread of argillite and rhyolite into the latter, which is a headwater drainage basin of the Schuylkill.

Following the Piedmont Tradition, raw material utilization patterns do not shift dramatically. Certain broadspear components in the Lower Schuylkill Valley, primarily those associated with the Koens-Crispin projectile point type, display continued use of quartzite (n=8) and argillite (n=3), as previously. Lehigh points, which are typically made from jasper, and Snook Kill points, which are typically made of chert, are poorly represented. One Lehigh point in the sample is made from jasper, a second Lehigh point is made from quartzite, and the single Snook Kill point is made from quartzite.

The regional distribution of Lehigh points centers around the Lehigh and Upper Delaware Valleys, while Snook Kill points are found principally in eastern New York (Kinsey 1972: 349). The low frequencies of these types could be interpreted to support retention or maintenance of the Late Archaic territorial boundaries alluded to above. Concomitantly, the presence of argillite and quartzite Koens-Crispin points probably suggests occupation of the Lower Schuylkill Valley by a group more closely related to societies occupying the Lower Delaware, where Koens-Crispin points are typically made from argillite.

If Kinsey's (1972) chronology for broadspear components is correct, then a clear preference for chert and jasper is in evidence during the end of the Terminal Archaic Period in the Lower Schuylkill Valley. Perkiomen, Susquehanna, and Fishtail points are all predominately made from these two materials. Quartz appears to have been avoided. The widespread use of these raw materials throughout the Mid-Atlantic might signal a realignment or break-down of territorial boundaries. It is also possible that the riverine focus of these groups postulated for certain areas is related to a realignment of territories. That is, major rivers were no longer shared boundaries and/or transportation arteries between groups, but rather were incorporated into and within territories. These riverine loci therefore could have become the focus of more permanent residential settlement. Hence, there is a marked increase in site numbers and sizes along many major rivers in the region and a sudden, intensive exploitation of anadromous fish where they were available (e.g. Kinsey 1972:354). However, the suggestion that such shifts in settlement/subsistence orientation and/or territorial boundaries were omnipresent during this period explicates certain inconsistencies in Terminal Archaic settlement within the Schuylkill drainage. As discussed in detail later, there is no apparent tendency for sites to be located on floodplains. Sites are more dispersed and are generally located where their Late Archaic forbearers lived. Territorial boundaries may have shifted, and/or other people may have intruded upon the area at this time, but a riverine-oriented economy is not in evidence in the Lower Schuylkill Valley.

A sharp break between the Terminal Archaic and Early Woodland Periods is lacking. A significant Meadowood component is lacking and Orient Fishtail and Fishtail-like points may persist into the Early Woodland Period. The association of Early Woodland ceramics with indistinct, possibly Rossville- and/or Bare Island-like projectile point forms, as at the Indian Point Site, is problematic and is discussed in detail later. An apparent reliance on argillite is realized during the Early and Middle Woodland Periods in the Lower Schuylkill Valley. Nine of 13 Rossville and Fox Creek points are made from this raw material type. A dominant presence in the Lower Schuylkill Valley by a particular group is not indicated by the lithic data, though combined ceramic, lithic, and other data suggest otherwise (see Section 9.0 and below). Argillite-using occupations during this time are rather more visible in the Lower Delaware Valley at sites in the Abbott Farm area (Cross 1941, 1956; Cavallo 1984), and at the Lower Black's Eddy (Schuldenrein et al. 1991), Byram (Kinsey 1975), and Lambertville (Struthers and Roberts 1982). Sites in the Middle Delaware Valley. The latter two sites are intimately associated with the manufacture of chipped stone tools from local argillite sources, and suggest ties of some sort with manifestations in the Lower Schuylkill Valley.

Other projectile points assigned to the Middle Woodland Period are also comparatively rare. Jack's Reef (n=2) and corner-notched points (n=16) together only comprise 4.7% of all projectile points. Similarly, corner-notched points of all types make up only 3.4 percent (n=5) of all points from the Blue Marsh Lake study area. Snethkamp et al. (1982: 4.07, Table 4.04) also state that both Jack's Reef and Fox Creek points are rare. Raw materials represented among Jack's Reef and corner-notched points include chert, jasper, and quartz, with no clear preference for any one of these materials. The greater reliance on cryptocrystalline materials may indicate a cultural or technological preference, regular exploitation of resources to the north and/or south of the study area, or maintenance of social relations.

By early Late Woodland times, utilization of the study area may have been minimal, since the period is represented by only four Levanna (Ritchie 1971) points. Again, raw material preferences seem to be chert, jasper, and quartz. Untyped triangular points are numerous, though, which introduces a certain ambiguity in these inferences. However, all 30 chert/jasper untyped triangular points derive from a single site (36 MG 124), suggesting a special function for this site or that the points may have been cached. Regardless, uncontrolled bias is evident and additional data must be sought to investigate the nature of raw material use during this period.

Subsequent Late Woodland utilization of the Lower Schuylkill is considerably greater and indicative of a reliance upon local raw materials. Twenty of 22 Madison (Ritchie 1971) points were made from quartz. This dramatic increase in projectile point frequency should not be misconstrued as representing intensive, residential settlement of the Lower Schuylkill Valley. Survey data from the Limerick Transmission Lines as well as the PASS files demonstrate that Late Woodland pottery is very rare, even at major sites located along the Schuylkill River. Evidence to be presented later indicates that sizable Late Woodland settlements or agricultural villages are rare to absent in the Lower Schuylkill; such sites may have been located outside of the present study area. This fact suggests that the Lower Schuylkill Valley was utilized for specialized resource procurement, and most sites are probably temporary hunting camps, hunting stations, or other specialized site types. The use of local raw materials, especially quartz, is interpreted as evidence of the replacement of projectile points and other extractive tools as necessary during the exploitation of this peripheral area. A lower level of utilization of upstream and headwater environments such as the Blue Marsh region appears to have continued from Middle Woodland times. Only five triangular points of all types were reported by Snethkamp et al. (1983:4.07, Tables 4.04, 8.01), and pottery occurred at only three sites.

In order to test this hypothesis, future Late Woodland lithic research might focus on the diversity of tool types manufactured from quartz and the relative frequency of quartz debitage at Late Woodland sites. Investigations should also focus on when this shift occurred (Middle Woodland, late Middle Woodland, early Late Woodland) and why this manner of exploitation of the Lower Schuylkill Valley is apparently most intense during the latter portion of the Late Woodland Period.

The focus of the remainder of this analysis is on the sample of sites discovered or otherwise investigated during the transmission line surveys conducted for PECO by JMA. Data from these sites were considered primary in order to maintain consistency in artifact classification, and because debitage counts/percentages and tool type lists were so rare from the other sites included in the study area. Sample sizes for the transmission line sites were also taken into consideration. Two categories of data, frequencies of debitage by raw material type and frequencies of tools by raw material type, were examined. In the first category, only sites yielding at least 25 pieces of debitage were considered to be sufficiently large to be included in the analysis. A total of 26 sites had at least 25 pieces of debitage, which represents 99.0 percent of all debitage recovered during the Limerick Transmission Line Surveys. Likewise, only sites producing at least 10 formally retouched tools (not including utilized flakes) were included in the analysis of tool raw materials. Sixteen sites possessed 10 or more tools; tools from these 16 sites account for 97.3 percent of all tools recovered.

Pooled data from the 26 sites utilized in the debitage analysis (Table 18) suggest that lithic reduction within the Lower Schuylkill Valley involved three primary lithic raw material types.

Quartz, quartzite, and jasper occurred at all 26 sites in the sample. As seen in Table 18, the mean percentages of quartz, quartzite, and jasper debitage at these sites are 55.4 percent, 19.6 percent, and 18.5 percent, respectively. Variation in the percentages from site to site for each type of raw material is considerable. Quartz varies from 6.3 percent to 94.4 percent, quartzite varies from 0.2 percent to 77.1 percent, and jasper varies from 1.0 percent to 54.6 percent.

Considering that quartz and quartzite are both locally available raw materials throughout most of the study area, a clear preference for them is unremarkable. Together, these two raw materials typically comprise the majority of debitage on any given site. Only at 36 MG 1, 36 MG 151, 36 MG 173, and 36 CH 103 did the combined proportions of quartz and quartzite fall below 50 percent. Jasper, perhaps most easily obtained from quarries located north of the Schuylkill drainage basin, but also available from outcrops south of the study area, is the most common "exotic" raw material. Not unexpectedly, the highest percentages of jasper, ranging from 32.3 percent to 54.6 percent, occur at the four sites listed previously, as well as at 36 CH 56.

Mean percentages for chert, argillite, and rhyolite are consistently low with values of 4.2 percent, 1.4 percent, and 2.9 percent, respectively. Expectedly, variation in percentages within these raw material types is of a lower magnitude than the primary raw material types. The percentage of chert for the 26 sites varies between 0.4 percent and 12.9 percent, argillite varies between 0.0 percent and 7.2 percent, and rhyolite varies from 0.0 percent to 2.9 percent.

Reduction of any sort within the Lower Schuylkill Valley involving the above raw material types was rare. Argillite and rhyolite debitage were the least common types. Argillite was found at 13 sites and rhyolite was found at six sites. Chert, however, was present at all 26 sites. Although chert may have been available from localities within the study area, and was readily available at outcrops just north and south of the study area, its low mean frequency is surprising. Due to the low frequencies of chert, this raw material was not further separated into specific types. Sites with chert percentages exceeding eight percent include 36 MG 1, 36 MG 151, 36 MG 173, and 36 CH 103; again, these are the four sites with the highest proportions of jasper in the sample. This association suggests that the intensive use of jasper may be correlated with chert in certain instances.

The pooled data for tools disclose a slightly different pattern (Table 18). The mean percentages of quartz and jasper tools are only slightly lower than their respective mean percentages for debitage, indicating a roughly equivalent rate of discard and/or utilization for both debitage and tools. The primary difference in utilization between these two raw materials is the higher absolute frequency of quartz; in other words, quartz procurement, utilization, and discard occurred at a higher rate or intensity than did jasper. Therefore, despite the fact that jasper was probably procured from sources located outside of the Lower Schuylkill Valley, jasper was treated in the same manner as a locally available lithic material.

This pattern of procurement and use of jasper appears to be an extension of jasper procurement behavior within the Hardyston District proper. According to Anthony and Roberts (1988), a localized procurement pattern obtained within the Hardyston District in that there appeared to be little extra effort made to procure jasper. Other materials were used as encountered, and even quartz was used if convenient. Proximity and ease of access to the jasper quarries from the study area by means of Manatawny and Perkiomen Creeks may have fostered this pattern in the study area, possible territorial boundaries notwithstanding. The treatment of jasper as a "local" lithic source material in terms of discard also argues strongly for a system of regularly scheduled procurement in which cost was evidently not a primary limiting factor. The most likely scenario is a combination of an embedded procurement strategy (Binford 1979), in which jasper would have been obtained incidentally to the execution of basic subsistence tasks, though occasional forays made expressly for the purpose of obtaining jasper may have occurred as well.

Quartzite differs from the quartz and jasper pattern in that the mean percentage of debitage exceeds that of tools to a greater degree. As a locally available raw material with unrestricted access, no difference was expected with the other local raw material, quartz. This suggests that the higher proportions of quartzite debitage and lower proportions of quartzite tools may reflect different flaking technology(ies) employed to effectively reduce quartzite or the nature of tools made from quartzite.

In contrast, the mean proportions of tools made from chert, argillite, and rhyolite all exceed their respective mean proportions of debitage. This is not a surprising situation for non-local materials such as argillite and rhyolite, since finished tools rather than unmodified or partially modified raw materials would likely have been transported into the study area. The low frequencies of argillite and rhyolite debitage support this contention. Further, the extremely low frequencies of both tools and debitage made of argillite and rhyolite also underscore the infrequent procurement of these materials. In the case of rhyolite, the distance to the source, which is a minimum of 70 linear miles, would have discouraged both special trip and embedded procurement. Argillite, though much closer in proximity, shows clear temporal restrictions in its use that affect its overall representation.

On the other hand, the relatively high mean percentage of chert tools and low mean percentage of chert debitage, when taken together, suggest that local chert sources were not utilized to any great degree, and finished or partially finished tools were being transported into the study area. Further, the intensity of chert utilization for projectile points is nearly equal that of quartzite and jasper. This is rather curious, given the general co-occurrence of chert and jasper outcrops in many locales. For whatever reasons (which may have varied through time), chert may have been more completely reduced prior to transport, and it may have been preferable to transport jasper in raw form for later reduction. It is also possible that jasper was preferred over chert for the manufacture of non-projectile point tool classes.

Cluster analysis was employed to further investigate differential lithic raw material utilization and to address spatial patterning within the data set. Cluster analysis is a multivariate method useful for detecting natural groupings within data sets. The goal of such an analysis is to classify a set of objects into meaningful subgroups, although neither the number of subgroups nor their members are known *a priori*. Two clustering methods, K-Means (Hartigan 1975) and Ward's Minimum Variance method (Ward 1963), were employed. Given the extreme variation in the raw frequency data, absolute counts were converted to percentages.

The K-means clustering method splits a set of items into a specified number of groups by maximizing between, relative to within, cluster variation as calculated from the input data. In this case, the data are the percentages of raw materials for tools and debitage at each site included in each analysis. Put another way, the largest F-ratio (calculated as the Between Sum of Squares/degrees of freedom divided by the Within Sum of Squares/degrees of freedom) is sought by repeatedly reassigning members to groups until an optimal solution is found. The method therefore groups items that are most like each other and, when compared as groups, differ from other groups as much as statistically possible. Although the number of potential clusters is unknown, the method requires that this quantity be specified for the clustering procedure to function. Several attempts were made in analyzing the debitage data by utilizing different numbers of clusters; a solution of seven clusters emerged as optimal. Extreme values among the tool percentages resulted in several uninterpretable clusters, regardless of the number of clusters specified.

Ward's method differs from the K-means method by being a hierarchical clustering algorithm. It seeks to link items which are most similar to each other and/or to existing clusters until all items are partitioned into nested sets. The output can be depicted as a tree or dendrogram which shows the linkage of each item or group of items as a joining of branches in a tree. The dendrogram of the hierarchical relationships between items (sites) includes a scale of relative similarity (or dissimilarity) which can be used to specify at which point(s) an item or cluster of items joins the tree.

Like the K-means method, Ward's method seeks to minimize within-group variance. However, Ward's method, like other hierarchical clustering methods, employs a matrix of similarity or distance coefficients instead of using the original data matrix. This is constructed by computing the mathematical relationship or correlation between all pairs of items (sites) to be clustered as calculated from the variables measured for each site. These values are then used in computing a statistic in order to evaluate whether or not an item should join a cluster or whether a new pairing should be established. In the present analysis, Euclidean Distance (D) was utilized as the clustering metric.

The clustering of raw material types of tools by site was not successful using the K-means method due to the high variation in raw material type percentages among the tools, and the small sample size of the sites (n=16). Ward's method partitioned the sites into two interpretable groups when a cut-off value of 25.2 was utilized (Figure 34). Group 1 sites include those with tools manufactured almost exclusively from quartz, and Group 2 sites include those sites with lower proportions of quartz and relatively higher proportions of chert and/or jasper tools. The difference between these sites in terms of quartz utilization is marked. The lowest percentage of quartz tools for any site in Tool Group 1 is 64.3 percent and the mean value for Tool Group 1 is 76.5 percent, while the highest percentage of quartz tools among Tool Group 2 sites is 46.2 with a mean value for Tool Group 2 of 30.6 percent. Additional interpretations of these sites based on these distinctions will be made within the context of the debitage analysis discussed below, as well as on the basis of proportions for individual sites as shown in Table 20.

Both methods of cluster analysis performed on the 26 sites having 25 or more pieces of debitage partitioned the sites into similar groupings. Ward's method, using a cut-off value of 13.34, produced five site clusters. The K-means method, utilizing a 7-cluster solution most closely replicated the clusters produced by Ward's method and proved to be somewhat more discriminatory. Figure 35 depicts the hierarchical tree generated by Ward's method; K-means cluster numbers are superimposed next to each site. K-means distances between sites as well as means, ranges, and standard deviations for each raw material type are given for each K-means cluster in Table 20.

K-means Clusters 1 and 7 are both characterized by high percentages of quartz debitage. Quartz varies from 73.7 to 94.4 percent in Debitage Cluster 1, and the proportions of all other raw material types are negligible. Significantly, all five of the sites from Cluster 1 that had 10 or more tools (36 MG 44, 36 MG 104, 36 MG 140, 36 MG 155, 36 CH 383) were included among the Tool Group 1 sites in the tool cluster analysis; the latter were characterized by high proportions of quartz tools (Table 19).

The sites of Debitage Cluster 1 may be a productive source of data for future research by virtue of their almost "pure" quartz composition. Therefore, additional surface collections and/or excavations could be conducted at the sites comprising Debitage Cluster 1 to gather additional information pertaining to temporal affiliation and site function. Ideally, these sites might produce a dominant temporal occupation and/or function that could be directly related to the high proportion of locally available quartz. Present data hints at a dominant temporal affiliation: six of the seven sites contain Woodland Period diagnostics. Based on the projectile point data discussed above, a Late Woodland affiliation can be justifiably hypothesized. Future survey data might also provide an additional sample of sites with high percentages of quartz tools and debitage for comparison.

In Debitage Cluster 7, quartz varies from 59.0 to 71.7 percent, with jasper accounting for the majority of the remaining debitage. Jasper varies from 13.6 to 25.7 percent and has a mean percentage of 20.2. Three of the sites in Cluster 7 were included in the tool analysis. One of these, 36 MG 8, is similar to the sites in Debitage Cluster 1 and is characterized by an equally high percentage of quartz tools and debitage. However, Sites 36 CH 53 and 36 MG 162 belong to Tool Group 2, and have significant proportions of chert, jasper, and/or argillite tools (Table 19). This is not due to sample size since these sites have the first and fourth highest tool counts of all sites in the sample. Apparently, quartz tools were being manufactured at a higher rate at these sites, perhaps to replace worn-out or broken specimens made from other materials. Alternatively, or in combination with a higher rate of quartz tool manufacture, the greater range of raw materials may indicate a high degree of reoccupation. A high frequency of tools and wide variety of raw materials can be expected at multi-component sites.

Sites in Cluster 6 also have relatively high percentages of quartz, varying from 46.5 to 55.9 percent. However, Cluster 6 sites differ from both Clusters 1 and 7 by having a significant quartzite component. The percentage of quartzite varies between 22.6 and 30.8 percent. Together, the mean percentage of quartz and quartzite is 75.1 percent, indicating an overwhelming dominance of local raw materials. Like Debitage Cluster 7, jasper is the other relatively common raw material and has a mean percentage of 18.1. Only two sites from Debitage Cluster 6 could be included in the tool analysis. Site 36 CH 382, a member of Tool Group 1, had quartz and quartzite tools almost exclusively. Site 36 MG 172 is unusual in that 33.3 percent of all tools were made of chert, suggesting that chert tools were being replaced with quartz and quartzite tools. However, the sample of tools at this site is small (n=15) and may not be representative.

Sites where quartzite occurs in highest proportions are included in Clusters 2 and 4. Quartzite varies from 43.6 to 77.1 percent in these two clusters. Cluster 4 is comprised of a single site with an extremely high proportion of quartzite (77.1%) and insignificant quantities of other raw materials. As suggested by the solution produced by Ward's method, this site is best affiliated with the sites of Cluster 2. At both of the sites included in the tool analysis (36 MG 134, 36 MG 139), quartzite debitage was evidently discarded at a much greater rate than quartzite tools (Table 18). Although both samples are small, it is likely that quartzite tools were manufactured to replace those brought to the site that were made out of other materials. In addition, the three sites comprising Cluster 2 exhibit an appreciable proportion of quartz debitage, varying from 27.6 to 47.4 percent. Reliance on these local materials is further underscored by the fact that the combined percentages of quartz and quartzite average 86.6 for these four sites. Like the Debitage Cluster 1 sites, sites with combined high proportions of quartz and quartzite could be further investigated with regard to temporal, spatial, and functional variables.

Interestingly, Terminal Archaic diagnostics, specifically broadspears, are present at three of the four sites in Debitage Clusters 2 and 4. As discussed above, Koens-Crispin points are typically manufactured from quartzite and could represent a local, territorial group during this time period. Future research could attempt to identify sites with strong quartzite components to test this hypothesis.

The remaining two clusters exhibit the highest proportions of jasper debitage among the sample. The proportion of jasper debitage at both sites constituting Debitage Cluster 5 was 54.6 percent. The percentage of quartz at these two sites was atypically low and averaged 25.0. The last cluster of sites, Debitage Cluster 3, was characterized by debitage assemblages with nearly equal percentages of jasper, quartz, and quartzite. Mean percentages for these raw material types are 33.9, 32.4, and 21.8, respectively. Clusters 5 and 3 share an additional similarity by virtue of having the highest proportions of chert. The mean percentage of chert for Cluster 5 is 8.2, and 6.7 for Cluster 3.

All four sites included in the tool analysis from Debitage Clusters 3 and 5 were members of Tool Group 2. However, no other similarities hold between these sites in terms of raw material usage. Both sites belonging to Debitage Cluster 5 appear to be anomalous. At Site 36 MG 173, 50.0 percent of all tools were made from chert while 54.6 percent of all debitage was jasper. Conversely, only 16.7 percent of all tools were made from jasper and only 8.2 percent of the debitage was chert. An inverse relationship between jasper and chert is indicated for reasons not understood. Similarly, an inverse relationship between quartz and quartzite obtains at 36 MG 151. At 36 CH 103 all tools except jasper tools occur in higher proportions than their respective proportions for debitage. Finally, with the primary exception of argillite tools, the percentages of tools and debitage for each raw material at 36 MG 156 are roughly equal.

Additional investigations at sites comprising Clusters 3 and 5 or sites with similar lithic raw material compositions might demonstrate an association between high jasper utilization and the frequency and/or intensity of occupation. Extensive excavations at 36 CH 103 and 36 MG 156 revealed evidence for multiple occupations beginning with the Early Archaic and lasting through at least the Middle Woodland period. Alternatively, or in conjunction, these sites might consistently represent base camps where a high incidence of tool manufacture, repair, and discard took place.

The spatial distribution of these sites by K-means cluster is not indicative of obvious locational or temporal patterning. Sites of each cluster occur most anywhere along the Schuylkill River, and sites located in true upland locales away from high order streams are few in number. Assuming that the Schuylkill River served as the major transportation corridor within the study area, a heterogenous mix of sites and site types and a high incidence of reuse through time is to be expected. Consequently, a great deal of variation in raw material types occurs between sites. However, upon closer inspection, some preliminary observations and hypotheses about spatial relationships, in addition to those enumerated above, can be made.

First, sites with more than 25 pieces of debitage tend to be located where S-shaped meanders of the Schuylkill River occur. Although these features are interpreted as significant locational variables, sampling error, created by the culturally arbitrary location of the transmission line surveys and historic and modern development, may contribute somewhat to this tendency. Nevertheless, patterning exists within and between the three site groupings shown in Figure 36. The first, which will be referred to as the Southern Group, includes 36 MG 8, 36 MG 156, 36 MG 172, 36 MG 155, 36 MG 104, 36 CH 116, 36 CH 384 and 36 MG 173. The confluence of Perkiomen Creek also occurs at this meander. The second group of sites, the Central Group, is located near a meander immediately north of Phoenixville and includes 36 CH 53, 36 MG 44, 36 MG 162, 36 MG 134, 36 MG 141, 36 CH 383, 36 MG 136, 36 MG 140, and 36 MG 139. The last, or Northern Group, is associated with two meanders immediately south of Pottstown and is comprised of sites 36 MG 39, 36 MG 1, 36 CH 56, 36 MG 37, 36 CH 382, and 36 CH 103. Upland sites removed from the Schuylkill River include 36 MG 137, 36 MG 149, and 36 MG 151.

Central Group sites exhibit the strongest intra-site association of debitage raw material types. Only sites belonging to K-means Debitage Clusters 1, 2, 4 and 7 occur at this location. These four clusters represent sites with extremely high proportions of quartz or quartzite and very low proportions of jasper, chert, argillite, and rhyolite. The high proportion of raw materials indigenous to the study area and low frequency of debitage from materials thought to have been procured outside the study area may be partially explained by two interacting factors: the proximity to quartz and quartzite sources and the areas exploited from these sites.

Extensive quartz and quartzite deposits are locally available, forming the bulk of the North Valley Hills and Diamond Rock Hill in Chester County. These deposits lie roughly four to six miles south and southeast of the Central Group of sites. These materials were used for tools to replace worn-out or broken tools of both local quartz and other materials when present at these sites. Comparison of tool and debitage proportions corroborate this interpretation.

Of the seven Central Group sites with more than ten tools (Table 19), three have tool and debitage assemblages dominated by quartz to the near exclusion of other materials (36 MG 44, 36 MG 140, 36 CH 383), demonstrating an almost exclusive reliance on this raw material. Two others (36 MG 162, 36 CH 53) have unbalanced lithic assemblages with a greater proportion of quartz debitage than tools, and, conversely, a greater proportion of non-quartz tools than non-quartz debitage. This, plus the greater frequency of quartz materials at these sites, suggests that quartz tools were manufactured to replace the tools, especially non-quartz tools, that were discarded on these sites. The last two sites (36 MG 134, 36 MG 139) have high proportions of quartzite debitage but low proportions of quartzite tools. In comparison, the percentage of tools made from materials other than quartzite tends to be higher than the corresponding percentage of debitage. It is possible that quartzite tools were manufactured to replace the tools discarded on these two sites. At 36 MG 134, quartz tool manufacture was evidently just as important as quartzite; this fact underscores the importance of both quartz and quartzite at this site.

The proximity to quartz and quartzite sources does not fully explain these raw material preferences, since other concentrated deposits of quartz and quartzite at Mount Misery and Mount Joy are equally near Valley Forge, where Southern Group sites are located. However, if access to supplementary exploitation territories from the vicinity of Central Group sites is considered, then the potential utilization of quartz and quartzite is far more understandable.

Four watercourses intersect the valley between the Southern and Northern Groups. Mingo Run and Stony Run are short, second order streams. Resources in these watersheds could have been easily procured directly from Central Group sites. The other two streams, French Creek and Pickering Creek, are fourth order streams and can be considered major tributaries; only two other tributaries relevant to the study area, Manatawny and Perkiomen Creeks, are larger. It should also be pointed out that French Creek and Pickering Creek provide the primary access to the southern portions of the Schuylkill Basin below Reading, while Perkiomen Creek and Manatawny Creek provide the primary access to the northern portions of the Schuylkill Basin lying below Reading. Because of their close proximity, the French and Pickering Creek drainage basins could have been regularly exploited from base camps located in the vicinity of Central Group sites. Being more accessible than the Perkiomen and Manatawny Creek drainage basins, the former two areas may have been the principal territories exploited from the Central Group locality. Exploitation of the Perkiomen Creek or Manatawny Creek watersheds instead may have been undertaken from locations closer to their respective confluences with the Schuylkill River.

Given the demonstrated isomorphism between traffic flow characteristics and stream order (e.g. Haggett 1967; Robinson 1976; Robertson 1987), and the historic pattern of utilizing streams (by boat or by adjacent foot paths) as avenues for group movements, the intensity of prehistoric movements can be modeled. Specifically, the amount of movement within each drainage basin can be correlated with the number and order of its component streams; that is, higher order streams will witness a greater intensity of population movement than lower order streams. Further, each drainage basin can be viewed as representing a package of component resources with access controlled by the structure of the stream network comprising the drainage basin. Ironically, the only traces of movements within the basin are the locations where people stopped. By extension, then, the intensity of land use can also be correlated with the structure of the drainage network.

Both the Pickering and French Creek watersheds as a whole would have seen a higher frequency of human traffic than either Mingo or Stony Run, since they are higher order streams and have a greater number of tributaries. Further, exploitation of their tributary watersheds would likely have required the establishment of satellite camps, especially in the headwaters regions. This increased frequency of movements and establishment of satellite camps within these watersheds would therefore have increased the opportunity or need to utilize and procure lithic raw materials from within these watersheds. The raw materials available within these areas are largely restricted to quartz and quartzite along Pickering Creek and the headwaters of French Creek.

This tendency toward the exploitation of local lithic resources encountered within the regular foraging range of a group is also supported by the nature of the lithic assemblages at sites elsewhere in this vicinity. Located immediately south of the study area, sixteen sites investigated by JMA in conjunction with the Exton Bypass project (Roberts et al. 1983) are located near the southern border of the Pickering Creek watershed. Thirteen of the sites produced lithic assemblages almost exclusively comprised of quartz and three others were predominately quartz and quartzite. Another site (36 CH 211), which is located on the northern flanks of the North Valley Hills, has a lithic assemblage which is almost exclusively comprised of quartzite. Likewise, all but one site surveyed by JMA in conjunction with the nearby Church Farm School development produced lithic assemblages comprised either exclusively or predominately of quartz (Zatz et al. 1987). However, exceptions to this trend toward the use of quartz and quartzite do occur. For example, jasper outnumbers quartz at site 36 CH 508, which is located near the Exton Bypass sites.

Northern Group sites, located below Pottstown, include only one site, 36 CH 111, from Debitage Cluster 1 (almost exclusively quartz); the remaining five sites belong to Debitage Clusters 2 (36 MG 37), 3 (36 MG 1, 36 CH 103), and 6 (36 CH 382) which exhibit high proportions of jasper and/or quartzite. Looking at potential areas of resource procurement that could easily be accessed from this locale, only low order streams with their concomitant small drainage basins occur between Pottstown and Phoenixville. The first watercourse upstream from Pottstown is Manatawny Creek, a sixth order stream that flows south from the western end of the Hardyston Jasper quarries. In effect, Northern Group sites have slightly greater accessibility to jasper than Central Group sites. Further, regardless of whether or not jasper procurement was embedded into subsistence-settlement movements within the Manatawny Creek drainage basin, movement into the main stem of the Schuylkill would have been funneled into the area around Pottstown. Further comparisons based on tool proportions are unfortunately not feasible since only two sites from the Northern Group met the sample size requirements.

A more complex situation may hold for Southern Group sites that effectively surround the confluence of Perkiomen Creek and the Schuylkill River. A heterogenous mix of sites occurs here, including two each from K-means Debitage Clusters 1, 6, and 7; and one each from K-means Clusters 3 and 5. Tool proportions for those sites meeting the sample size requirements are evenly split between Tool Groups 1 and 2. This degree of variety in raw material composition is to be expected at the confluence of the two major branches of the Schuylkill Valley, especially given the fact that Perkiomen Creek may have been a major transportation route to and from the chert and jasper sources located north of the study area. Trends in raw material distributions based on assemblages from sites in the Perkiomen drainage could be helpful in ascertaining the diversity of raw materials emanating from the north. Unfortunately, survey data and information from avocational archeologists along Perkiomen Creek from the Schuylkill River to Schwenksville is extremely limited, hence the gap in the distribution of sites in Figure 30. The location of sites at this major confluence might also have fostered a high rate of reoccupation, since the traffic flow around this area would have been intense.

Finally, with regard to transportation networks in general, movements into and out of the southern portions of the Schuylkill drainage basin below Reading were potentially less frequent and of a lower volume than movements to and from the north. As discussed above, the two largest tributaries that flow south from the Schuylkill River are fourth order streams and extend westward as much as they do south; all other tributaries are short, low order streams. In comparison, there is one sixth order stream and two fourth order streams that flow directly into the Schuylkill below Reading. All three lie north of the Schuylkill, with tributaries fanning out to encompass an area several times as large as the area south of the Schuylkill. The implication, then, is that the intensity of resource utilization, and even the potential for social and/or economic interaction, may have been greater in the Triassic Lowlands to the north of the Schuylkill River. From the perspective of lithic raw materials, then, the occupants of the Lower Schuylkill Valley appear to have been oriented more toward the north and east, and not toward the south or west. Therefore, it can be hypothesized that future research regarding lithic raw materials should demonstrate a near absence of raw materials procured from source locations south and east of the study area, in Delaware and Maryland. Conversely, the origin of non-local raw materials should be predominately from loci north or east of the study area.

10.2.3 Determinants of Settlement 3: Subsistence-Related Factors

10.2.3.1 Summary of Sites and Component Occupations

This section presents a discussion of the nature and distribution of component occupations at sites in the study area. The locations of all 184 sites in the study area are depicted in Figure 30. As is clear from the preceding sections, individual component occupations at sites vastly outnumber the site locations themselves. This fact has important implications for understanding settlement dynamics through time in the Lower Schuylkill Valley, and the analysis of settlement patterning will thus begin with an exploration of component occupations.

The term "component" or "component occupation" is used herein to denote a recognizable temporal/cultural occupation at a site. For example, if a site is recorded as having a Late Archaic component, this means that at least one artifact diagnostic of the Late Archaic Period was recovered from that site. No inferences have been made (or generally can be made) regarding the number of actual occupations of the site that may have occurred during the Late Archaic Period. Similarly, extant data from the vast majority of sites do not permit the explication of occupational intensity or function of an occupation. Thus, a Late Archaic component may have been utilized only once, or intensively reutilized over several thousand years; the limitations of most available intra-site data and the realities of sampling bias render finer partitioning impossible for most of the sites in the present sample. Further, in the tables and quantitative analyses that follow, components are not isolated with regard to cultural affiliation within major temporal periods. For example, sites yielding Laurentian Tradition artifacts are lumped with sites yielding Piedmont Tradition artifacts into the general Late Archaic category; sites producing different types of broadspear and/or fishtail projectile points are summarily considered Terminal Archaic, despite potential cultural distinctions between the users of these artifacts. Since cultural affiliations of this nature remain problematic in many cases and are not mutually agreed upon by all researchers, these distinctions have not been introduced into this phase of the settlement analysis. However, the recognition of such cultural variability in the study area is of obvious importance to the understanding of the nature of occupation and use of the valley, and this topic is discussed in detail in a later section.

Cultural/temporal components were assigned on the basis of diagnostic artifacts wherever possible. Many assignations gleaned from the PASS files, where supporting documentation was often not present, were simply assumed to be correct. Key diagnostic artifacts and other criteria may be briefly summarized at this point. Paleo-Indian assignations were made based on the presence of fluted projectile points and/or on PASS information. All but one Early Archaic identification were based on the presence of bifurcate-base projectile points; the exception is an unsubstantiated PASS file entry. The Middle Archaic Period is probably the most problematical. Most sites are assigned on the basis of PASS file information, which was usually unsubstantiated, though some assignations appear to have been based on the presence of Vosburg points; these may not date as early as the Middle Archaic. One other site is assigned to the period based on the presence of an Otter Creek projectile point. The numerous sites in the Late Archaic category are so assigned based primarily on the presence of Laurentian and/or Piedmont Tradition diagnostics. Since some of the latter types (or similar types) have been demonstrated to persist into the Woodland Period, some degree of misclassification is likely here. Terminal Archaic sites are rather securely placed on the basis of distinctive broadspear and/or fishtail projectile points. A residual category of "Archaic" sites remains, and is comprised of PASS file sites purported to date to the Archaic Period, but for which no further temporal discrimination or artifactual data was provided. The vast majority of these sites are older PASS file entries.

Woodland Period assignations are no less ambiguous in many cases. Early and Middle Woodland assignations are based on the presence of diagnostic points and ceramics, as well as radiocarbon dates and/or PASS file entries. The combined Early/Middle Woodland category was formed on the basis of information from certain sites, notably Indian Point, indicating that discriminating between the two periods may be unwarranted. Also, some PASS file entries recorded sites as Early/Middle Woodland. Thus, the combined taxon is included for analytical purposes in order to evaluate whether settlement or other distinctions between these sites and others can be observed. Late Woodland sites can be considered fairly secure, and are based on ceramic and, predominantly, lithic typology; the majority of Late Woodland sites in the sample are so assigned on the basis of small triangular projectile points. Residual "Woodland" sites are for the most part PASS file entries or sites yielding ambiguous or otherwise non-diagnostic pottery. A single Historic/Contact Period site occurs in the sample. This Susquehannock village is a PASS file site. Finally, the ever-present category "Unknown Prehistoric" consists of both PASS file sites lacking supporting docmentation as well as other sites for which even gross assignations such as "Archaic" or "Woodland" are not possible. The latter are typically small lithic scatters lacking diagnostic artifacts.

Table 20 shows that 313 individual components have been discriminated from the sample of 184 Lower Schuylkill Valley sites, including 63 "Unknown Prehistoric" sites; disregarding the latter, 250 identified components are present. Late Archaic components predominate at sites in the study area, comprising 20 percent of all components; this figure matches the 20 percent figure for "Unknown Prehistoric". "Archaic" components follow at 13 percent, Late Woodland at 11 percent, and Terminal Archaic at 10 percent. Note that the rather low percentages for the Early and Middle Woodland Periods, (4% and 3% respectively) are somewhat artificially deflated due to the inclusion of the Early/Middle Woodland category (3%). To the extent that the component identifications are largely correct, it can be observed that the study area was occupied by just about everybody to some extent throughout the prehistoric period. However, Archaic Period occupants appear to have substantially outnumbered their Woodland counterparts by a ratio of 2.18:1, as shown by the calculations for all Woodland versus all Archaic components, where the latter comprise nearly 70 percent of the total. The predominance of Archaic occupation in the Lower Schuylkill Valley is not surprising, and has been anticipated by several previous studies in the Schuylkill Valley (e.g. Kent 1970; Snethkamp et al. 1982). The relative distributions of Archaic and Woodland components is graphically depicted in Figure 31.

Table 22 provides additional insight into the distribution of components, and Woodland and Archaic components are summarized independently. Note the predominance of Late Woodland components in both the segregated and aggregated Woodland tables. Note also the close concordance of Early, Early/Middle, and Middle Woodland components; it is important that no single period drastically outnumbers another, which in turn lends provisional support for the combining of the Early and Middle Woodland into a single period. Late Archaic components dominate the Archaic table, followed by "Archaic" and Terminal Archaic. As noted, Middle Archaic sites may actually be fewer than indicated here. Early Archaic sites are more securely dated and, at 11 percent, constitute a respectable presence in the study area. This finding mirrors similar observations made upstream in the Blue Marsh study area (Snethkamp et al. 1982). In all tables, it is gratifying that the undifferentiated "Archaic" and "Woodland" sites do not outnumber the sites assignable to more specific periods.

Spatial distributions of most Archaic and Woodland components are illustrated in Figures 31-33. Figure 31 shows single component Archaic Period sites, single component Woodland Period sites, and multicomponent Archaic/Woodland sites. The Figure 32 map focuses on the predominant isolatable Archaic Period occupations, and shows sites possessing Terminal Archaic components, Late Archaic components, and both. Figure 33 depicts Late Woodland and aggregated Early, Early/Middle, and Middle Woodland components, and multicomponent combinations. These maps and the preceding tables conclusively demonstrate that multicomponency is a dominating factor in the present data set. Frequencies and percentages for single versus multiple component occupations at sites are provided in Table 23. In examining these figures, small sample sizes and thus artifically inflated percentages for some periods, should be borne in mind. Particularly noteworthy is the low proportion of single Woodland components; the vast majority (92%) of all Woodland component occupations occur in conjunction with something else (e.g. Figure 31). Archaic components also display this tendency, though not to the same extreme. Of the latter, only "Archaic" components tend to occur as single component sites more than 50 percent of the time; Late Archaic components are the next most likely to occur singly, but at 31 percent they nonetheless display a clear tendency toward multicomponency (e.g. Figure 31). Finally, the figure at the bottom of Table 23 reports the frequencies and percentages of single and multicomponent sites, not individual components, in the sample, with the exclusion of the *de facto* single component "Unknown Prehistoric" sites.

Fully 56 percent of the 122 sites assignable to periods are multicomponent, while 44 percent are single component.

Building upon the foregoing, the nature of the pronounced multicomponency in the site sample can be examined by determining whether certain kinds of components tend to co-occur with certain others. Numerous cross tabulations were calculated between various component combinations, resulting in Table 24, which provides a comparison of Woodland-with-Woodland components, Woodland-with-Archaic components, and Archaic-with-Archaic components. For reference, the table may be compared to the Archaic and Woodland component distributions shown in Figure 31. The table is straightforward and graphically displays the co-occurrences. It can be observed that the overwhelming majority (77%) of multicomponent sites tends to be some combination of Woodland-with-Archaic components. Multicomponent sites with only Woodland Period occupations are very rare, while sites with multiple Archaic Period occupations constitute 20 percent of the sample.

These figures, in concert with those in Table 23 and the distributions illustrated in Figures 31-33, reveal important patterning. Tremendous redundancy in site reoccupation over time is demonstrated. It would appear that Woodland Period occupants of the Lower Schuylkill Valley occupied the same sites as their Archaic predecessors in the majority of cases; it might be observed that Woodland people evidently chose to live at locations previously occupied during the Archaic. Relatively little variability in Woodland versus Archaic settlement patterning therefore may be postulated, with the exception that Archaic sites outnumber Woodland sites by a margin greater than 2 to 1. Even given the longer duration of the Archaic Period, a discrepancy of this magnitude is not expected. This fact, in turn, indicates that the Archaic Period occupations of the lower Schuylkill Valley were evidently denser, more numerous, or more frequent than the later Woodland occupations, and may have occupied a wider range of environments. The greater number of single component Archaic occupations, and the multiple Archaic-only occupations, indicates that while Woodland peoples reoccupied some of these same locales, they did not reoccupy all of them. It remains to be determined whether the variability in site densities and reoccupation reflects differential land use patterns between the Archaic and Woodland Periods, i.e. whether Archaic societies utilized a wider range of environments than Woodland societies, and/or whether Woodland societies selected sites on the basis of a specific set of environmental configurations to the exclusion of others. Within-period settlement variability, which also appears to be minimal, remains to be explicated as well.

10.2.3.2 Settlement Pattern Analysis

This part of the settlement analysis focuses on the sites and components and their relationships with site-specific environmental variables. The intent is to build upon and further explore patterning elucidated previously, and to associate sites/components with shared or otherwise similar environmental associations. The analysis is predicated on the assumption that subsistence exigencies are among the primary determinants of settlement patterning, and that proximity to critical subsistence resources was a principal factor in site location choices made by prehistoric societies. The examination of site-specific environmental associations allows one to evaluate changes or continuities in subsistence systems by monitoring the way in which the environment was utilized by different societies over time.

The initial task in this endeavor is to identify discrete environmental features, or variables, that may have been considered by prehistoric populations when selecting locations for settlement. A variety of maps and other documentary sources was scrutinized for this information. As noted previously, environmental data for the greater Schuylkill River Valley is far from ideal, even on a general level. This fact created numerous problems and ambiguities in the recordation of site-specific variability. Ultimately, however, all relevant or otherwise availible environmental associations for each site were recorded, coded, and utilized in the subsequent computer-assisted analysis. The variables examined in this analysis are:

1) Distance of site to nearest water source. Several water-related characteristics were examined, beginning with distance to the nearest water source. It was found that fully 175 sites (95%) were located within .25 miles of a water source. Of these, the vast majority were actually adjacent or otherwise in very close proximity to the water. Eight sites (4%) occurred between one-quarter and one-half mile from water, and only a single site (1%) lay more than one-half mile from water. Greater distances did not occur.

2) Type of associated water source. As discussed in Section 2.0, the bulk of the study area lies in the Triassic Lowlands, which is a well-drained area with numerous large and small streams. This region generally lacks large or even small lakes or ponds, and riverine or upland swamplands or marshes appear to be relatively rare. However, the fact that all 184 sites would be associated with streams was not anticipated. This distribution may be somewhat skewed toward streams and away from swamps or marshy areas, since the former are readily apparent on USGS topographical maps but the latter are not always evident. Small upland marshes, for example, may exist seasonally when water tables are high, but these features typically are not recorded on USGS or soil survey maps. Yet, even if such detailed information was availible, swamps or marshes would neither exceed nor even come close to matching the numerical predominance of active streams in this region. Further, only five percent of the sites in the sample were found to lie more than .25 miles from a mapped, readily identifiable flowing water course. This fact suggests that the predominance of streams and the lack of other types of water sources is a real phenomenon.

3) Stream order. Active water courses in the study area were ranked according to criteria established by Strahler (1952). Stream orders, or ranks, range from zero to seven, with zero representing intermittent streams, one representing small but permanently-flowing headwater streams, and so on. The confluence of two stream channels of the same order form a channel of the next highest order. The highest order stream segment, seven, is the Schuylkill River below its confluence with Perkiomen Creek; the river is a sixth order stream from the Perkiomen upstream to Pottstown at the study area boundary. Perkiomen Creek is itself a sixth order stream from its confluence with the Schuylkill to where the main branches split in the northern part of the study area. No other sixth order streams occur, and fifth and fourth order drainages are fewer compared with first and second order streams. Regarding site associations, 72 sites (39%) lie along zero, first, and second order streams; 38 (21%) occur in association with third, fourth, and fifth order streams; and 74 (40%) lie near sixth and seventh order streams. These figures suggest that sites most often occur in association with the largest and smallest streams to the relative exclusion of medium-sized drainages. This distribution tends to reflect the structure of the drainage basin, which is dominated by large main-stream watercourses and relatively small tributaries.

4) Presence of a second water source within one-half mile of site. This variable was included in an attempt to measure variability with respect to the nature of secondary water sources. It was also included because sites lying in close proximity to two water sources, particularly different types of water sources, might be considered to occupy more diverse, perhaps resource-rich locations relative to single-source sites. Such settings would have been optimal locations for resource exploitation. Interestingly, it

was found that 146 sites (79%) are located within one-half mile of a second water source, while only 38 (31%) are not. This distribution reflects, if nothing else, the omnipresence of water in the Piedmont, and the apparent ease with which site locations proximal to multiple water sources could be found. The type of secondary water source was also examined but, like the primary sources, only active streams occurred. Of the 146 sites lying near a second source, 24 were located near low order streams, with a sixth or seventh order stream as the second source, i.e. the secondary source was in fact the Schuylkill River (n=23) or lower Perkiomen Creek (n=1). Upon closer examination, it became apparent that a site's relatively close proximity to the larger streams was "masked" by its closer proximity to a smaller stream. Since these sites demonstrate a presumed orientation toward the larger streams as well as to their smaller primary associations, the presence of the larger streams was thus recorded.

5) Landform Type. Four principal types of landform associations were discriminated, and include terraces, bluffs, uplands, and upland slopes. Terraces are defined as relatively level land adjacent to watercourses; terrace formations can thus include active floodplains, islands, Holocene alluvial terraces, or Pleistocene outwash or erosional formations. The key criterion in identifying terraces is elevation of the landform relative to the nearest principal water: landforms lying very near the elevation of the water are considered terraces, while landforms considerably higher in elevation are considered bluffs or uplands. This variable displays some autocorrelational tendencies with larger order streams, since smaller, low-order streams tend to lack well-developed terrace formations. Bluffs are the best example of landforms lying at considerably higher elevations above a watercourse. Formed as a consequence of severe downcutting by streams, bluffs understandably have a tendency to occur with larger order streams. Uplands, by contrast, occur with all stream ranks. Uplands are defined as relatively level (approximately <5% slope) tracts of land occurring anywhere except adjacent to, and at a similar elevation as, an associated watercourse. The latter would be considered a terrace. Upland slopes are identical landforms with the obvious exception that the land is sloped, minimally more than five percent. No sites were noted on severe slopes. It might be added that the landform "lowland slope" was observed near major stream valleys, but was infrequent and no sites were found associated with it. This finding is not unexpected, given the deeply incised nature of the river valley and typically abrupt transition from river valley to upland.

6) Soils, presettlement vegetation, and vegetation interfaces in close proximity to sites. Variables defined by soil and vegetation characteristics were sought but not found, at least none that could be utilized with any degree of confidence. Unlike many other areas of the United States, reconstructions of presettlement, pre-logging era forests are lacking for most of the Middle Atlantic region, due principally to the early European settlement of the area and the rapid conversion of much of the landscape to agriculture. Extant data on soils in Chester and Montgomery Counties cannot rectify this shortcoming. Soil type distributions from USDA Soil Service surveys have been used by other researchers to estimate resource productivity (e.g. Morenon et al. 1986), but in the present case soil classifications tend to be too precise at the site-specific level to be useful; perusal of the soil associations recorded for the site inventory in Section 6.0 reveals no fewer than 40 individual soil types, most of which could not be meaningfully associated with differences in resource productivity. Conversely, the county-wide maps of general soil associations are too generalized to be useful. Various criteria were explored, such as the use of woodland suitability measures for particular soil types or groups, in an attempt to ascertain whether presettlement forest conditions or ecotones could be reconstructed or estimated with a degree of confidence. It was found however,

that appropriate data are simply lacking and attempts to incorporate soil/vegetation data into the analysis were unsuccessful. As a result, this variable was reluctantly dropped from the analysis.

Thus, four variable classes and 18 variable states were ultimately examined. These include 1) distance to water (<.25 miles, .25-.50 miles. >.50 miles); 2) stream order (8 orders); 3) secondary water source within .50 miles (fifth order stream or lower, sixth order or greater, none); and 4) landform type associated with each site (terrace, bluff, upland, upland slope). These variables constitute the dependent variables utilized in the analysis. Independent variables held constant in the analysis include the temporal/cultural affiliation(s) of the sites and the nature of the material evidence (i.e. surface versus excavated artifacts, lithic raw material types, artifact classes) recovered from the sites.

The principal method used to investigate settlement patterning is polythetic agglomerative cluster analysis of the sites. The analysis is based on relationships and degrees of similarity/dissimilarity between site locations as measured by the sharing or non-sharing of the environmental variables enumerated above. Numerical taxonomic analyses of this variety have been successfully employed in a number of previous settlement studies (e.g. Lovis 1978; Kingsley 1979; Roper 1979). The application of such procedures to archeological settlement data is particularly appropriate, since the measures incorporate few restrictions on statistical reliability of samples, sample sizes, numbers of variables employed, and on interpretation of the resulting site taxonomy.

Degrees of similarity between any two sites or sets of sites are measured by a similarity coefficient. Following previous applications of similarity measures, the coefficient of Jaccard (S_J) is employed here. This measure is well-suited to studies utilizing nominal scale data, or nominally-coded interval scale data, since only positive variable associations and variable mismatches are utilized, and negative matches inherent in the data are excluded from consideration. That is, the d cell indicating conjoint absences (0,0) is not incorporated in the calculation of the similarity matrix. Exclusion of negative matches avoids potential situations where high coefficients of "similarity" may be obtained for sites which in fact share the *absence* of similar environmental variables (e.g. Sneath and Sokal 1973:131-132).

A clustering algorithm is employed in order to convert the Jaccard similarity matrix into a Q-mode, hierarchically-arranged dendrogram reflecting similarities/differences in site locations and environmental associations. Three different clustering algorithms were initially employed to evaluate which might yield the most satisfactory clustering solution. Single linkage, also referred to as nearest neighbor clustering, has been known to occasionally produce dubious results with nominal scale data, since it tends to form long, drawn-out chains (rather than hierarchical clusters) of observations that are largely uninterpretable (Sneath and Sokal 1973:216-222). Such was indeed the case with the present data set. Complete linkage, or farthest neighbor clustering, was also employed. This routine can be useful since it tends to form tight, discrete clusters that display considerable within-cluster similarity and between-cluster differences (Sneath and Sokal 1973:222-223). Roper (1979:82-84) successfully employed complete linkage with a Euclidean distance matrix in an analysis of Woodland Period settlement patterns in Illinois. With the present data set, however, results were unsatisfying since the algorithm tended to tightly cluster only identical sites and excluded or "forced-out" closely similar sites, due in part to the mechanics of the routine, but also because of the redundancy in some of the variables utilized.

The average linkage method, also referred to as the "unweighted pair-group method using arithmetic averages" (Sneath and Sokal 1973:228-234), ultimately produced the most interpretable clustering solution. This approach examines average similarities between sites and/or clusters of sites, and thus avoids extremes of chaining and intense clustering inherent in the previous two routines; this algorithm produces meaningful results with a minimum of mechanical distortion in the resulting dendrogram (Sneath and Sokal 1973:228-234).

Since the ability to interpret the results of these routines in a culturally meaningful manner is wholly dependent upon the ability to assign sites to temporal/cultural components, the 63 "Unknown Prehistoric" sites were dropped from consideration. Also, the one single component Paleo-Indian site and three other sites for which locational data were overly ambiguous were omitted. The overall site sample subject to analysis thus numbers 117, and the number of individual components numbers 240. One hundred sixty-five Archaic Period components are represented at 110 sites; 75 Woodland Period components occur at 56 sites. The dendrogram for the 117 site sample is shown in Figure 37.

One of the limitations of numerical taxonomy is that there are no fixed rules for interpreting the resulting dendrograms. The procedure does not provide confidence intervals or levels of statistical significance to aid in the interpretation of the results. The algorithm hierarchically organizes observations, but it is the investigator's task to select the level of similarity which produces the most reasonable set of site groupings. Generally, one looks for levels in the dendrogram in which the degree of "distance" between clusters is maximized, thereby indicating a fairly high degree of within-cluster similarity and between-cluster dissimilarity. The Jaccard coefficient of similarity ranges in value from 0.0 to 1.0 and a scale measuring relative similarity between sites and site clusters appears along the margin of the dendrogram in Figure 37. The similarity level at which the clusters best elucidate settlement variability is approximately .42, at which point seven major clusters of sites have been created, as well as a residuum of small clusters or individual sites that do not join clusters at this level. Note that at the .42 level of similarity all but a few sites are members of a few all-encompassing clusters; higher-level solutions (e.g. .50 or above) would form many more clusters and leave far more individual sites unclustered, thus compromising the interpretation of settlement variability.

The seven clusters have been labeled A through G in Figure 37. The figure also includes the within-cluster breakdown of components, and single versus multiple component Archaic and Woodland sites. The reader is also referred to Table 25, which provides relevant percentages for components within clusters as well as for the overall 240-component sample. One useful manner in which the compositions of the clusters may be evaluated is by comparing temporal/cultural components occurring within clusters with expectations based on their occurrences in the overall sample. That is, if the distribution of temporal/cultural components in the study area is more-or-less uniform with regard to environmental associations, then no drastic within-cluster deviations from the overall sample percentages would be expected.

Beginning with Cluster A, 18 sites and 24 components share several environmental attributes. The single omnipresent environmental characteristic is upland slope, while all but two sites lie within .25 miles of water, and the remainder lie within .50 miles. Fifteen sites lie within .50 miles of a second water source (fifth order or lower), and three sites lack a second water association. No fewer than five stream orders are represented: 1 seventh, 10 sixth, 3 fourth, 3 third, and 1 zero. The dominant, apparently defining attributes for this cluster of sites are therefore upland slope setting and close proximity to primary and secondary water sources, which are predominantly larger order streams. Turning to Table 25, it can be seen that only the percentage for the "Archaic" category greatly exceeds that for the sample as a whole; most of these sites associate with sixth order streams. More Middle Woodland components occur than might be expected, as well as fewer Early Archaic components, though these figures are probably affected by the relatively small number of components (n=24) in the cluster. All in all, then, no temporal period except "Archaic" drastically deviates from its overall representation in the larger sample, and no overwhelming patterns or apparent preferences can be discerned. Regarding numbers of components at sites, 13 sites have Archaic-only components, two have Woodland-only, and three have both Archaic and Woodland components represented.

All eight sites in Cluster B share bluff location and close (<.25 mi) proximity to a primary water source; seven sites occur on sixth order streams, one on a seventh. Five sites lie within .50 miles of a second water source (fifth order or lower), while three do not. Clearly, bluff settings in close proximity to the Schuylkill River define this cluster of eight sites and 22 components. Table 25 shows that considerably greater numbers of Early Archaic and Terminal Archaic occupations occur here than would be expected based on the overall sample distribution; similarly, fewer Late Archaic components are noted. Small sample size (n=22) does not appear to be a factor in these rather pronounced tendencies. Four sites possess Archaic components only and four possess both Archaic and Woodland occupations; no Woodland-only sites occur.

Cluster C is the largest in the dendrogram. All sites are located on terraces and in close (<.25 mi) proximity to a water source. Twenty-one of 25 sites lie within .50 miles of a second water source (fifth order or lower), one lies near a sixth or seventh order stream, and three do not lie near a second water source. Stream ranks are skewed toward higher order streams: 5 seventh, 9 sixth, 3 fifth, 7 fourth, and 1 third. Sixty component occupations are represented at the 25 sites. However, perusal of Table 25 reveals that no components are drastically over- or underrepresented, as compared to the sample as a whole. Slightly fewer than expected Middle Woodland and Late Archaic sites may be observed, but these deviations are not nearly as pronounced as others noted elsewhere. Fully 14 sites have Archaic and Woodland occupations; eight sites have Archaic-only components, while only three have Woodland-only components.

Cluster D differs from the previous three in that the omnipresent environmental variable is not landform type, but rather stream order, specifically an association with first order streams, along with close (<.25 mi) proximity to water. Three landforms are represented: 12 upland, six upland slope, and two terrace. Eighteen sites lie within .50 miles of a second stream (fifth order or lower), while two do not. These 20 sites and 39 components thus lie near small first order streams in a variety of settings, most of which are upland in nature. Table 25 reveals that considerably more Late Archaic components occur within this cluster than expected; somewhat more Late Woodland components are also found here. A lower than expected number of Early Archaic components is in evidence. Eleven sites represent Archaic-only occupations, nine have Archaic and Woodland occupations, and Woodland-only components are absent.

Moving to Cluster E, upland landform associations and close (<.25 mi) proximity to water are shared by all 22 sites. An unusual mix of small, medium, and large-sized streams also define this cluster: 5 sixth, 4 fifth, 4 fourth, and 9 zero. Regarding sites lying within .50 miles of a second water source, 18 occur with a fifth order stream or lower, one with a sixth order stream or higher, and three are not associated with a second water source. The diverse combination of stream ranks in this cluster is interesting, and the data were examined to determine whether within-cluster patterning was evident at higher levels of similarity. The only potentially noteworthy occurrence is a predominance of Archaic components at sites associated with the sixth order streams (Sites MG 104 - MG 69 in Figure 37). Archaic components occur at all five sites, while a Woodland component occurs at only one. However, the impact of this finding is diminished by the fact that Archaic components tend to occur with every other stream order as well. Other than this apparent Woodland avoidance of sixth order streams on upland landforms, the various components are more-or-less evenly distributed among the other stream orders, as has been the case generally. Table 25 further underscores the unremarkable composition of Cluster E, with only "Archaic" sites displaying a less-than-expected frequency. Eleven sites in the cluster are Archaic-only occupations, none are Woodland-only occupations, and 11 have both Archaic and Woodland components.

Clusters F and G in Figure 37 are discussed jointly because both contain only a few sites and together contain all sites in the sample that occur in association with second order streams. One additional site in Cluster F occurs on a seventh order stream. The clusters have partitioned at the .42 level primarily on the basis of landform type: all five Cluster F sites occur on uplands, while in Cluster G, six sites lie on terraces and three occur on upland slopes. All sites are located within .25 miles of the streams. Nine sites lie within .50 miles of a second water source (6 sixth order or greater, 3 fifth order or lower), while five sites do not. Like Cluster E, these clusters also evidence considerable within-cluster variability. There is a tendency for Woodland components to not occur on uplands, and not at sites lacking a second water source. This "tendency" is only noticeable against the backdrop of omnipresent Archaic components, which occur at all 14 sites in the two clusters. Table 25 shows that considerably more than expected "Archaic" components are included here compared to the sample as a whole; somewhat more Middle Woodland occupations can be observed, as well as somewhat fewer Late Archaic components. Inferences based on the latter two observations must be tempered by the rather small sample size (n=24) of the two clusters. No sites with solely Woodland occupations are present. Archaic-only components number six, and sites with both Archaic and Woodland components total eight.

Finally, a brief consideration of the ten residual sites that do not join the previous clusters at the .42 level is in order. A variety of environmental attributes is in evidence, and heterogeneity is the rule. Six sites lying between .25 and .50 miles from water are included here, as well as the single site located greater than .50 miles from water. The relatively rare water source characteristics of these sites largely account for their exclusion from the other clusters. Six of the ten sites are associated with first order streams. The heterogeneous nature of these sites and environmental associations, in concert with the small number of components (n=12) present, precludes meaningful interpretation of this group of sites. Their status as unclustered residuals reflects their unusual or atypical environmental configurations.

Based on the foregoing, it is clear that certain environmental variables are more discriminatory than others with regard to partitioning sites into clusters. Specifically, stream order and landform type exhibit a stronger influence on the definition of individual clusters than either distance to water or presence/absence of a second water source. This is not altogether surprising; the distributions of the latter variables are heavily skewed and are considerably more redundant. This situation is reflected by the nature of the lower level linkages between the clusters in Figure 37, which indicate between-cluster joins based primarily on the sharing of stream order and landform variables. To explain, note that Cluster A (defined primarily by upland slope/predominantly higher order streams) links most closely with Cluster B (bluff/high order streams), both of which in turn join Cluster C (terrace/high to medium order streams). Clusters D (various landforms/first order streams) and E (upland/high and low order streams) are linked at a similar level, and join the A/B/C group at a lower level. Clusters F and G (various landforms/second order streams), in turn, join Clusters A through E at a still lower level. This pattern indicates that the clustering algorithm has appropriately defined the larger clusters at the lower similarity levels based on the sharing of similar variables as the individual sites at the highest levels. By contrast, the more highly skewed variables do not tend to be discriminatory but are omnipresent across many clusters or are relegated to the residuals category.

In evaluating the dendrogram, one dominant fact stands out: there are no strong associations between components/sites of particular temporal/cultural periods and particular environmental contexts. That is, the proportions of components/sites of particular temporal/cultural periods within each cluster mirror their respective proportions for the sample as a whole. Associational tendencies were discussed above, and may be briefly summarized:

1) Late Woodland components tend to occur with somewhat greater frequency than expected near first order streams;

2) Middle Woodland occupations occur with somewhat greater frequency on upland slopes and higher order streams, and along second order streams on uplands/terraces/upland slopes;

3) "Archaic" components are more frequent on uplands/terraces/upland slopes, and higher order and second order streams;

4) Greater than expected frequencies of Terminal Archaic components are found on bluffs along higher order streams;

5) Late Archaic occupations tend to occur more frequently along first order streams on uplands/terraces/upland slopes;

6) Early Archaic components are found more frequently than expected on bluffs near higher order streams, and somewhat more frequently on upland slopes.

Despite these certain tendencies, it would appear that spatial and temporal omnipresence of components/sites is the rule in the study area, and overall trends observed for the sample as a whole are not contradicted by this more refined analysis. The analysis strongly corroborates the generalizations made in the preceding section, which were based on the site distribution maps and tabular data.

As a further test of this phenomenon, chi-square (x^2) tests were calculated to examine the relationship between aggregated Archaic Period and Woodland Period components, stream order and landform type. Tests comparing non-aggregated, individual temporal periods were not possible due to small sample sizes in most of the categories, which would have resulted in artificially inflated, generally unreliable statistics (e.g. Blalock 1972; Thomas 1976). Chi-square was used as a test of independence of variables, i.e. to determine whether statistically significant non-random associations of components and environmental variables exist in the data set. Based on the site distribution maps and the results of the cluster analysis, this possibility was presumed to be remote. Thus, the chi-square analysis serves to test the results of the cluster analysis.

The results of these tests are displayed in Tables 26 and 27. Table 26 shows the result of the comparison between temporal periods and stream orders; note that the eight stream orders have been grouped into four classes due to small frequencies of occurrence with many individual orders. The very low chi-square value of .252 is not statistically significant at any meaningful level. Of great interest in Table 26 is the column "O-E", which represents the difference between actual frequencies observed ("O") in the data and frequencies expected ("E") if the variables were distributed in a random fashion. As shown, the degree of difference is almost nil and it can be concluded that relationships between Archaic/Woodland components and stream orders in the study area approximate that which might be expected to occur by chance alone. There are no significant differences in stream order associations between Archaic and Woodland Period components.

The results of the Archaic/Woodland versus landform calculation are shown in Table 27. Again, the chi-square value of 3.159 is not statistically significant. The O-E column displays a pattern similar to that of the preceding test, though it is not as dramatic. There is a very slight tendency for Archaic occupations to avoid terraces, and a concomittant tendency for more Woodland occupations to occur on terraces. Nonetheless, it can be observed that there are no pronounced differences in landform associations between Archaic and Woodland Period sites.

These chi-square calculations are elementary and need not be dwelt upon further. However, they have been presented in detail in order to emphasize the remarkable degree of homogeneity in environmental associations through time and across space in the study area. The chi-square tests clearly support the results of the cluster analysis which indicate that there are no demonstrably strong tendencies for differential usage of the landscape of the study area through time, at least as measured according to the environmental variables defined herein.

Despite the conviction of the results of the previous analyses, the data set was further scrutinized in an attempt to discover patterning. It was speculated that component/variable associations and attendant settlement patterning might possibly be discerned within smaller subsets of the data base, and that more subtle patterning in the data potentially might have been masked by the use of the entire 117-site data set in the cluster analysis. Accordingly, cluster analyses were performed on two temporal/cultural subsets: Late Archaic and Terminal Archaic components, and aggregated Early, Early/Middle, Middle Woodland components and Late Woodland components. As before, the express purpose of these operations was pattern recognition, and the isolation of environmental associations exclusive to or otherwise strongly associated with particular temporal/cultural components. However, neither analysis displayed characteristics very different from the larger analysis. Thus, these examinations need not be discussed at length. In the following discussion, the reader is referred to Figures 32 and 33, which graphically illustrate the spatial distributions of these components.

The average linkage dendrogram for the Late and Terminal Archaic components is presented in Figure 38. Sixty-four Late Archaic components and 30 Terminal Archaic components are distributed among the 69 sites in the dendrogram. Perusal of the dendrogram and the similarity measures along the margin reveal that it is difficult to partition the sites in a meaningful manner at a high level of similarity. At the .34 level, as shown, all but one site are grouped into four rather large clusters, most of which in turn contain numerous smaller clusters demonstrating considerable variability. However, closer inspection of these smaller, higher-level clusters does not reveal temporal/cultural patterning among sites that is worthy of special note. The four clusters display the same general characteristics as the larger dendrogram with regard to variables upon which sites partition (i.e. landform and stream order), and the relative uselessness of the more redundant variables; no unusual or atypical component/variable associations are evident, and the results closely mirror those of the larger analysis. It is clear that important patterning in fact has not been masked by the use of the larger sample.

To generally summarize Figure 38, Terminal Archaic components do not demonstrably associate with environmental variables or variable combinations that differ appreciably from Late Archaic associations (cf. Figure 32). In the overall sample, the ratio of Late Archaic (n=64) to Terminal Archaic (n=30) components is slightly over 2 to 1. Only Cluster A in Figure 38 shows an appreciably different distribution which, if possible error due to the small sample (n=5) is ruled out, tends to show that Terminal Archaic sites occur more often than expected in bluff settings proximal to high order streams (i.e. the Schuylkill River). This pattern also emerged in the larger cluster analysis. Other than this, however, Late and Terminal Archaic occupations do not seem to demonstrate differential partitioning with regard to the use of space. Multicomponency is the rule for Terminal Archaic occupations, as only five of 30 sites are single component. These single component sites do not demonstrate patterning different from the multicomponent sites.

The above conclusions are supported by the calculation of chi-square statistics for the different components versus stream rank and landform. Neither test was significant. For Late/Terminal Archaic components versus stream order, the eight stream orders were collapsed into three classes (0,1,2; 3,4,5; 6,7) due to overly small frequencies of occurrence with most individual orders. A chi-square value of 2.750 was obtained, which is well below significance at any meaningful level. No observed frequencies deviated appreciably from expected frequencies for any cell, effectively mirroring the results of the larger sample calculation. Regarding landform, the very low chi-square value of 1.871 is also not significant. Extremely low deviations from expected frequencies occurred here, indicating environmental associations very similar to a random distribution. Even the single strong tendency indicated by the cluster analysis, an association between Terminal Archaic sites on Schuylkill River bluffs, was not borne out: the chi-square calculation indicates a lower-than-expected occurrence of Terminal Archaic sites in these settings.

Figure 39 illustrates the average linkage dendrogram for Woodland Period sites. Forty-four sites are present, including 35 Late Woodland, nine Middle Woodland, seven Early/Middle Woodland, and 11 Early Woodland components. In the tabulation of single versus multiple components, note that the Early, Early/Middle, and Middle Woodland components have been combined into an "other" (i.e. "not Late Woodland") category. The sites form five clusters and one residual site at the .42 level of similarity. The overall trends observed in the larger 117-site cluster analysis are generally mirrored in Figure 39: occupations of any particular period do not exclusively cluster with any particular configuration of environmental variables. Rather, components are more-or-less evenly spread among the clusters (cf. Figure 33). The apparent dominance of Late Woodland components in many clusters is unremarkable, since Late Woodland occupations are more numerous in general. The ratio of Late Woodland to aggregated earlier Woodland components is 1.25 to 1 in the overall sample; only in Cluster C is this ratio greater, and in Cluster A it is slightly inverted. Examination of smaller, higher-level clusters reveals little in the way of noteworthy patterning. Late Woodland occupations may display a slight tendency to occur in uplands and on upland slopes in association with smaller streams. Concomitantly, earlier Woodland sites show a weak trend toward occupying locations on terraces proximal to higher-order streams.

These potential patterns were again tested with the chi-square statistic. For the components versus stream order test, the earlier Woodland components were aggregated into a single "not Late Woodland" category, since low frequencies in some individual categories would have rendered the chi-square value invalid. For the same reason, the stream ranks were grouped into three categories (0,1,2; 3,4,5; 6,7). The abysmally low chi-square value of .387 is well below any meaningful level of significance. Indeed, inspection of the deviation between observed and expected frequencies showed that two cells did not deviate from the expected at all, and the remaining four only deviated by one. Thus, the relationship between Late Woodland/"not Late Woodland" components and stream orders approximates a random distribution. The test involving landforms was also not significant, with a resulting chi-square value of 1.752. No observed frequency deviated from its expected value by more than two. In short, the weak patterns and tendencies observed in the cluster analysis are not supported by the statistical analysis.

To briefly summarize the salient points demonstrated by the foregoing analyses, the general picture that emerges is one of an overall *lack of change* in settlement locations and presumably use of the environment of the Lower Schuylkill Valley throughout most of prehistory. Differential tendencies were noted and will be further explicated later, but in general all indicators point to strong spatial/temporal redundancy in settlement locations through time. These indicators include the pronounced multicomponency of site occupations, the similarities of site environmental characteristics through time, and the lack of exclusive/predominant environmental variation that can be associated with sites of any particular temporal/cultural period. Also indicated is a heavier utilization or occupation of the study area during the Late and Terminal Archaic (and "Archaic") Periods as compared to the Woodland Period. However, it is clear that the higher frequency of Archaic sites does not reflect the use of a significantly wider or different range of environments than those used by Woodland peoples. Stated differently, Woodland peoples utilized the same environments as their Archaic predecessors, but evidently not with the same intensity, or as often.

Regarding the settlement trends noted, Figures 31-33 show the distributions of components of most temporal periods. Figure 33 illustrates the Late Woodland components' greater-than-expected occurrence on first order streams. The weak tendency for earlier Woodland components to occur with upland settings, terraces, and high and low order streams is also apparent in the widespread distribution of these sites. "Archaic" components are not depicted separately in the graphics, but their tendency toward upland settings and high and low order streams is apparent in Figure 31, which shows all Archaic Period components. In Figure 32, the greater-than-expected tendency for Terminal Archaic components to occur on bluffs along higher order streams can be seen, though their spatial omnipresence is also very evident. Like the Late Woodland sites, Late Archaic occupations display a tendency to occur throughout upland localities near low order streams. Figure 31 demonstrates the typical multicomponent nature of Archaic and Woodland sites in such upland settings. Finally, Early Archaic and Middle Archaic sites have not been mapped separately due to their relative scarcity. However, the tendency for Early Archaic components to occur on bluffs near higher order streams is borne out by the fact that 12 of 19 components lie directly on the Schuylkill River, and six of the remaining seven occur on major tributaries. Middle Archaic components, which did not display any notable tendency in the cluster analysis, by contrast are widespread and occur with any number of environmental associations. It should be added that Paleo-Indian components tend toward the same pattern as Early Archaic occupations, as four of five lie directly adjacent to the Schuylkill.

It is clear that environments very near the Schuylkill and other large streams were a continued focus of settlement over time, but upland localities and lower order streams were also heavily utilized. Given the hydrology and physiography of the Schuylkill drainage and the Triassic Lowlands in general, such a conclusion is expectable. The linear, narrow, deeply incised nature of the main stem would have promoted linearly arranged riverine site locations. The lack of extensive floodplains and the resultant close proximity of upland landscapes suggests that the main stem of the river would have been a favorable location for many and varied resource procurement activities, which probably explains why so many multicomponent sites occur on or near the main river. Further, given this scenario, the incised, reverse horseshoe meanders in the river may have been optimal settlement locations due to potentially greater environmental diversity at these localities within the relatively uniform environment of the Triassic Lowlands. The pronounced density of settlement at these meanders has been discussed previously. In this regard, it is interesting to note the large horseshoe meander upstream from the project area at the Poplar Neck locality immediately below Reading (Figures 2-4); here too is a deeply incised meander, with high bluffs and steep cliffs. According to PASS file data, numerous sites are known to exist in this locality, including open sites as well as a rockshelter, which date from nearly all temporal periods in the Schuylkill Valley. This phenomenon would seem to support the inference that these meanders were optimal environments for settlement through time. It also suggests that the heavy occupation of the meanders in the present study area is not simply a sampling (or cultural) anomaly.

Another factor that may have prompted the repeated use of site locations on the main stem of the Schuylkill River is the nature of many tributary drainages. Since most of the minor first and second order stream drainages encompass less than 30 to 50 square miles in area, they constitute rather small resource procurement areas; by themselves, they probably could not sustain lengthy or densely populated settlements. Therefore, it would have been advantageous to remain located on or near the main stem of the Schuylkill River, Perkiomen Creek, or another major tributary, which would have allowed access to multiple procurement localities. It is also likely that the omnipresent sites occurring on uplands and upland slopes near small, lower order streams were accessed and utilized by people from sites located on the larger streams. These upland locales may have been occupied and used on a seasonal basis, or a highly scheduled basis. They may also have been exploited for the local availability of usable lithic raw materials such as quartz, as discussed previously.

Parenthetically, it might be noted that, given the above reconstruction, the Perkiomen Creek drainage assumes added interest. This watershed, in contrast to the main stem of the Schuylkill, is highly dendritic with numerous large and small tributaries fanning out in all directions, except to the south where the creek joins the Schuylkill (Figures 2-4). These watercourses provide relatively easy access to nearly all parts of the Triassic Lowlands; the Perkiomen Valley thus may have constituted one of the best environments for settlement in the study area. It is also worth remembering that Perkiomen Creek is one principal route to the Hardyston jasper quarries near Macungie and Vera Cruz. The Northeast Branch of Perkiomen Creek is also a direct route to the Durham jasper quarries and the Delaware Valley in upper Bucks County.

At this point in the analysis, functional data from individual sites might be introduced in order to elaborate upon and further elucidate settlement patterning suggested by the spatial analysis of site distributions. Up to now, the sites have been studied in effect as though they are all identical with regard to size, density, function, etc. It is certain that important functional variability exists among sites in the study area, and the explication of such variability is appropriate for the accurate reconstruction of settlement systems and adaptations in the region. Thus, it is highly unfortunate that intra-site data meeting the necessary requirements are weak to non-existent for most temporal/cultural periods in the Lower Schuylkill Valley Study Area. As discussed previously, this phenomenon is characteristic of most large-scale, regional settlement studies, though knowledge of this fact provides little comfort. Only the barest glimpses of differential intra-site function, seasonality, occupational densities, and other factors can be gleaned from the present data.

One potentially significant pattern regarding settlement systems is the distribution of site sizes across the study area. As a general rule, sites located on or very near the Schuylkill tend to be larger in areal extent than sites located at greater distances; the latter tend to be smaller loci. This fact is not reflected on the site distribution maps (Figures 30-33). This observation is based on field data collected by JMA as well as on site boundaries depicted on PASS file maps.

The pattern *might* be interpreted as indicating that large sites closer to the river were more densely or intensively occupied as compared to the smaller, predominantly non-riverine sites. The problem with this interpretation is that in this case, the correlation between site size and occupational intensity remains largely untested through intra-site data analysis.

Many archeological studies in the Mid-Atlantic region have ascribed a typological/functional significance to the ordinal scaling of sites based largely on size, or occasionally on a simpler "big-site/small-site" distinction. Site functions and occasionally the nature of societal group composition are inferred not only by site size, but on the basis of the size and diversity of artifact assemblages, the number and nature of features, and other structural elements found at sites (e.g. Custer and Wallace 1982:149). Larger sites, which typically yield larger quantities and a greater diversity of artifacts, are often assumed to represent "base camps" or otherwise substantial habitations, usually occupied by larger societal segments such as "macro-bands" or, at less complex sites, "micro-bands"; smaller sites with few artifacts are usually regarded as "procurement sites" or other specialized locales (e.g. Gardner 1983; Custer and Wallace 1982; Custer 1984a, 1984b, 1988a; Stewart 1987). In one study, site size and nature of surface material distribution (i.e. discrete versus scattered) was used to infer the nature of resource procurement at sites: "focused resource procurement" was indicated by "discrete archeological sites", while "more generalized forays" produced "more scattered, less discrete" sites (Hodny et al. 1989:84-86).

The preceding paragraph is not intended to be a comprehensive critique of functional site taxonomies in the Mid-Alantic region. However, perusal of the literature indicates that, in the frequent absence of intra-site functional data, an inordinate amount of interpretive weight is placed on site size as the *ipso facto* defining criterion of site type, site function, societal group composition, and hence the role of a site in a settlement system (see Dunham 1987 for a recent critique of the "site type" approach in settlement analysis). While such assumptions may be correct in many cases, the present data set argues for greater caution; in the Lower Schuylkill Valley, indications are that such assumptions are likely to be incorrect, and would not adequately take into account interpretational problems resulting from site multicomponency and the typically shallow, mixed nature of artifact assemblages at the sites. Many natural and cultural factors have contributed to site sizes and artifact compositions/ configurations in the Lower Schuylkill Valley.

The Frick's Lock Site is a case in point (see Section 7.0). The 22 acre area encompassed by the defined site boundaries is very large. The JMA investigations at the Frick's Lock Site produced evidence of Early, Late, and Terminal Archaic occupations as well as Early through Late Woodland occupation. The Late Archaic and Late Woodland components appear to have been the most substantial, and fire hearths and probable post molds dating to these periods were discovered, though associated artifacts or subsistence remains were lacking. Most features could not be reliably assigned to any occupation and indeed, features were not particularly abundant overall; storage pits were conspicuously absent. Projectile points and bifaces predominated in the lithic assemblage, suggesting that hunting and hunting-related activities were important at the site. However, the use of locally available raw materials was not intensive, and actual tool manufacture appears to have been infrequent. Various processing tools, such as scrapers, drills, perforators, and gravers, were also present, which suggests that other kinds of domestic activities were also conducted. Unfortunately, as pointed out in Section 7.0, it is not possible to accurately attribute non-diagnostic tools - and functional inferences based upon them - to specific occupations, however tempting it may be to do so, particularly given the riverine/upland exploitation scenario outlined above. Therefore, it is not possible to assign a specific function(s) to any occupation(s), or label the site as a particular "site type", e.g. a "Late Archaic base camp". Ironically, it is entirely likely that the bulk of the features and artifactual remains on this large site do indeed date to the Late Archaic and possibly Late Woodland Periods, but this cannot be unequivocally established on the basis of the extant data.

Further, even if it could, functional questions remain, since all indicators clearly do not point to a large and intensive base camp-type occupation(s), at least not comparable to other presumed Late Archaic base camps in the region (see below). Is Frick's Lock truly a large, habitational "base camp" from which procurement forays were dispatched, or is it simply a riverine-oriented procurement locality with many "base camp characteristics" (large size, presence of features, many and diverse artifacts) due to its continued reuse over many thousands of years? Binford's (1982:15) comments on the nature and function of residential camps or "base camps" are germane here. Binford points out that residential camp locations "...can be expected to yield a most complex mix of archaeological remains since they were also commonly utilized logistically when the residential camps were elsewhere." Stated differently, a location utilized for a time as a base camp, perhaps by a sizable societal group, may also have been reused as a special function locus by a small group at a time when the base camp(s) was located somewhere else. Multi-functional use of a site location by a single society, coupled with reuse of the site by many societies over time, can be expected to produce large sites with dense, highly varied artifact assemblages. Given these factors, the assumption that large site sizes and varied artifact assemblages are invariable indicators of base camp-type site functions does not necessarily hold. A solution to this interpretational dilemma is not immediately forthcoming, and underscores the pressing need for more site testing and excavation in the Lower Schuylkill Valley area.

In any case, the present study will offer suggestions regarding site functions and settlement systems in the following section, but it is emphasized that these inferences are provisional and await empirical testing; unfortunately, site functions cannot be conclusively inferred based on size distinctions or even artifact variability, despite the fact that these are some of the few functional variables available for analysis. It should be added that the authors have chosen to dwell upon this phenomenon at some length because the shortcomings in intra-site data appear to be somewhat more limiting herein than in many large-scale settlement analyses.

11.0 SETTLEMENT SYSTEMS AND CULTURAL DYNAMICS IN THE LOWER SCHUYLKILL VALLEY

With the foregoing analyses concluded, it remains to synthesize these results into an understanding of the prehistory of the study area, and to place the Lower Schuylkill Valley within the broader context of Middle Atlantic regional archeology. In many respects, the present study can be regarded as an independent test of several models and hypotheses of subsistence-settlement systems in the Middle Atlantic Region and, in particular, in the Piedmont Physiographic Province. However, the analysis has not been explicitly construed as such a test because such was not the express intent of the study from the outset. Nevertheless, the present data set and analysis allows the evaluation of many previous settlement constructs, and provides additional insights as well.

As a point of departure for the remainder of this discussion, it should be mentioned that Custer and Wallaces' (1982) study of settlement patterns in the Piedmont Uplands constitutes the only temporally comprehensive study of settlement in a region immediately adjacent to the present study area. Thus, their study is particularly germane to the present analysis, since all but the southern margin of the Lower Schuylkill Valley Study Area lies within the Triassic or Piedmont Lowlands (Figure 3), which invites comparisons between the regions. In this connection, it is important to point out that Custer and Wallace (1982:141-142, Fig. 1) incorrectly include the entire Triassic Lowlands (and the entire present study area) in their definition of the Piedmont Uplands. This error was not detrimental to their study, since their analysis concentrated on a defined study area lying south and west of Brandywine Creek, which is well within the Uplands. However, their inclusion of the Triassic Lowlands area does incorrectly imply that settlement patterns discerned for the Piedmont Uplands obtain here too, since the study was intended to be a general model of settlement throughout the Piedmont Uplands based on their specific study area. It will be shown that settlement patterns in the Triassic Lowlands do not in fact closely parallel those in the Piedmont Uplands region to the south. The following discussion is presented by culture-chronological period.

11.1 Paleo-Indian and Early/Middle Archaic Periods

Paleo-Indian and Early and Middle Archaic materials are rare in the study area in comparison to later periods. Regarding the former, Paleo-Indian diagnostics were recovered from only five sites in the study area. This general lack of early sites is not surprising and parallels the relative sparseness of Paleo-Indian sites in adjacent areas such as the Delaware Valley (Mason 1959), the Blue Marsh area (Kinsey 1976; Snethkamp et al. 1982), and the northern Piedmont Uplands (Custer and Wallace 1982:151). All of the present data derive from the PASS files and information on lithic technology, typology, and raw materials is lacking.

To the extent that these five sites are representative of Paleo-Indian settlement patterning in the area, it may be observed that four of the five sites are located directly adjacent to the Schuylkill River, while the fifth lies near the headwaters of Pickering Creek, on an upland slope adjacent to a first order stream. This pattern tends to indicate a high-order riverine orientation of settlement, though the function of these occupations or the nature of subsistence pursuits is unknown. Minimally, it may be noted that this pattern contrasts with Paleo-Indian patterns noted in the Piedmont Uplands to the south (Custer and Wallace 1982:151-153). Here, three of four sites were located near sinkholes or upland bogs, and the fourth occurred on a poorly drained floodplain. An upland, hunting-oriented settlement pattern is implied by these locations (Custer and Wallace 1982:151). Potentially, some systemic relationship might exist between the Schuylkill River sites and those in the Piedmont Uplands, i.e. they may be part of the same settlement system. This possibility warrants further study.

Early Archaic sites in the Lower Schuylkill Valley have been identified primarily on the basis of bifurcate-base projectile points; it is recognized that some of these artifacts may linger into the Middle Archaic Period, but for analytical purposes all have been grouped into the Early Archaic. Other defined Early Archaic types were not identified during the Limerick Transmission Line Surveys or in the PASS files. As previously discussed, most of these other types are distinctive and easily identified (e.g. Dalton, Palmer, Kirk variants), and their absence from the study area is perceived as a real phenomenon. These and other Early Archaic types are also rare-to-absent further upstream (Kinsey 1976). The relatively large numbers of bifurcate-base points in both the Lower and Upper Schuylkill Valley (Kinsey 1976; Snethkamp et al. 1982) clearly indicate an occupation by Bifurcate Tradition societies that can be regarded as substantial, at least by Early Archaic standards. The strong presence of bifurcate-base points and relative rarity of other Early Archaic point types also provisionally suggests differential occupation/usage of the Schuylkill Valley during the Early Archaic Period.

Eighteen bifurcate-base points were examined in the course of this study. All but two were made of jasper or chert, and the remainder were fashioned of rhyolite. Clearly a preference for high quality cryptocrystalline materials is in evidence. This fact may in turn suggest a rather wide societal or resource procurement territory for this group(s), and/or a non-intensive or otherwise transient use of the area by a highly mobile society. More permanent occupations may be in evidence in the Blue Marsh area, where a number of bifurcate-base points made of local quartz and quartzite were recovered (Kinsey 1976), though this conclusion may be attributable to sample error.

Nineteen Early Archaic components have been isolated. The cluster analysis demonstrated a weak tendency for sites to occur more frequently than expected on bluffs near higher order drainages (i.e. the Schuylkill River) and on upland slopes. Twelve of the 19 sites lie on the Schuylkill; of the remaining seven, six occur near a major tributary (Perkiomen, Skippack, and French Creeks), and one lies on a low order headwater tributary of Pickering Creek. This latter site is the only site located in the Piedmont Uplands. Again, to the extent that this small sample of sites is reflective of overall Early Archaic Bifurcate Tradition settlement systems in the region, a riverine orientation seems to be in evidence, which, interestingly, parallels the Paleo-Indian situation. However, occupation or use of upland locales also occurred with some degree of regularity, though it is noteworthy that relatively major streams, rather than low order headwaters or marshes, appear to have been favored. The precise meaning of this distribution is not known at this point, though the riverine orientation of these sites is noteworthy and suggests a consistent, redundant use of a particular habitat type, which in turn suggests the redundant use of the Lower Schuylkill Valley for largely the same purposes or resources by these people. This observation is consistent with the lithic raw material data that indicate a predominantly transient or otherwise non-resident population that presumably utilized the natural resources and transportation corridors of the lower Schuylkill as needed, and then moved on.

This reconstruction stands in contrast to Bifurcate Tradition settlement patterns in the Piedmont Uplands to the south. Though Custer and Wallace (1982) ascribe bifurcate-base points to the Middle Archaic, distribution patterns may be compared nonetheless. Sites are small and tend to be located on upland slopes near ephemeral streams and springs, or near swampy floodplain areas such as near White Clay Creek and Brandywine Creek (Custer and Wallace 1982:154). They propose that these sites are probably extractive sites associated with base camps located outside of the Piedmont, perhaps various sites in the Fall Line Zone near

Churchmans Marsh in northern Delaware (Custer and Wallace 1982:164). Populations based in the latter area may have made forays to the Piedmont Uplands but did not locate substantial residential sites there. Since site functions in the Lower Schuylkill Valley Study Area are difficult to identify, it is not possible to examine the extent to which the two patterns may be integral; the Lower Schuylkill sites may be part of this larger settlement system. However, the site locations along the main stem of the Schuylkill may suggest a different system, or a different element(s) of the larger system that as yet remains poorly understood.

It is difficult to comment on settlement patterning during the Middle Archaic Period. As discussed, this period is poorly defined in the study area, and cultural/temporal assignments are based only on PASS file data. These data are either unsubstantiated or the identifications are based on Laurentian point types such as Vosburg and Otter Creek, which may not date exclusively to the Middle Archaic. Also as discussed, bifurcate-base points may date to the Middle Archaic as well, but are not so included in the present analysis. Minimally, no unequivocal Middle Archaic types have been observed. For the record, the site distribution pattern shows no real tendencies, and sites tend to be located variously across the study area, and with a variety of environmental associations. This pattern *may* be a reflection of unreliable data. In any case, this problem cannot be resolved here, and the identification of unequivocal Middle Archaic artifacts and sites and the explication of settlement systems must await further field work and analysis.

11.2 Late Archaic Period Laurentian and Piedmont Traditions

All data collected to date point to the Late Archaic Period occupation of the Lower Schuylkill Valley as the most intensive and sustained of any. Identified Late Archaic and unidentified "Archaic" components far and away dominate the sites in the sample. Synthesis of the Late Archaic presence in the study area is a multi-faceted endeavor, and requires the use of several analytical approaches and the consideration of a wealth of comparative data. Despite numerous gaps in the present data base, a reasonably accurate reconstruction of Late Archaic settlement and cultural dynamics is possible.

Late Archaic presence in the study area includes both the Piedmont and Laurentian Traditions. Components of the latter have been identified primarily on the basis of diagnostic Brewerton Corner-, Side-, and Eared-notched projectile points, as well as sporadic Normanskill and other types. To this list might be added certain side-notched points isolated by Kent (1970:Fig. 8), such as those labeled Brandywine and Monocacy, though the precise temporal position of these artifacts is arguable and notched points are known to occur during the Woodland Period. Laurentian occupation of the Lower Schuylkill was sparse and remains equivocal and poorly known; it is assumed that Laurentian probably pre-dates the Piedmont Tradition, though some temporal overlap is possible. This presence may be related to the more substantial Laurentian presence in the main stem and West Branch of the Susquehanna River Valley (e.g. Turnbaugh 1977), and/or to Laurentian-related systems throughout the Delaware Valley (e.g. Kinsey 1972).

In the study area, approximately 15 components have been identified, six of which are multicomponent with Piedmont Tradition occupations. Cryptocrystalline materials were evidently preferred for projectile points and other tools, though the first extensive use of local quartz occurs during this occupation. Only one Laurentian site yielded an (apparently) unequivocally associated ground stone tool. This fact serves to highlight the sparse, ephemeral nature of Laurentian occupation in the area. Site distributions include locations on the Schuylkill in the vicinity of Valley Forge and the Indian Point Site, in the Upper Perkiomen Valley near the northern edge of the study area, and a few sites on or near French and

Pickering Creeks. Sites are associated with high and low order streams, and are situated on terraces as well as in the uplands. The site distribution generally parallels the Piedmont pattern described below, though sites are far fewer. Although only six of 15 components are multicomponent with Piedmont occupations, most of the rest of the components generally occur near Piedmont sites in similar environmental settings; minimally, there is no obvious, dramatic difference in settlement locations. Despite this overall similarity, it would be premature to posit similar settlement systems, and the subsistence practices of Laurentian populations remain unknown.

The Piedmont Tradition is clearly the predominant Late Archaic manifestation in the area. Approximately 47 components are present. Diagnostic projectile points include Lackawaxen, Poplar Island, and probably some points identified as Bare Island; Lackawaxen Points are probably underrepresented in the artifact counts. Quartzite and argillite are far and away the preferred raw materials for these points, followed by lesser amounts of quartz. Kent's (1970:Fig. 4) previous research in the Pennsylvania Piedmont identified lanceolate, stemmed bifaces found predominantly in the Schuylkill Valley that he termed "Schuylkill Points." Kent's point typology tends toward "splitting" and many of his types morphologically overlap with others. It is suggested here that "Schuylkill Points" approximate the Poplar Island/Lackawaxen and/or Bare Island categories, or in any case certainly represent the same occupation as that identified herein as the Lackawaxen Phase (see below). Kent (1970) also observed that most lanceolate stemmed points in the Upper and Lower Schuylkill were manufactured from local quartzite, which parallels the present findings. Most stemmed points made of quartz were regarded as Bare Island. Kent's (1970:31; also Fig. 9, 160ff) study implied a "river valley territoriality" in the Schuylkill and other drainages, which was based primarily on projectile point distributions and considerations of band territorialism as reported in the ethnographic and theoretical literature.

The onset of the Piedmont Tradition shows a dramatic population increase in the Lower Schuylkill Valley, and in the Upper Schuylkill as well (Snethkamp et al. 1982). Few cultural ties to systems to the west in the Susquehanna Valley are evident. The strongest and most obvious ties are to the Lower Delaware Valley Lackawaxen Phase (Kinsey 1972; Stewart 1987; Schuldenrein et al. 1991), but perhaps also to the Clyde Farm Complex in the Delmarva Peninsula (Custer 1984a:93ff). The latter strongly resembles the Delaware Valley manifestations and is probably culturally related in some manner. The extensive use of Lockatong Formation argillite indicates clear connections with the Delaware Valley. According to PASS file data, at least one argillite cache of unknown size has been found in the Lower Schuylkill Valley (36 CH 47) which may date to the Late Archaic, though a Terminal Archaic provenience is probably more likely. While argillite was heavily used for the production of lanceolate projectile points, most of these points are actually made of locally available quartzite. This fact may point to a permanent or semi-permanent presence in the Lower Schuylkill Valley by Piedmont people. On the other hand, it was suggested previously that at many sites in the study area local quartz and quartzite appear to have been used to replace expended tools made from other materials, and most of these sites have Late Archaic occupations. This fact may suggest a somewhat less-permanent, more transient use of the area. It is possible that the Lower (and probably Upper) Schuylkill was variously utilized by people centered on the Delaware, with little or no permanent habitation taking place. Also, the evident lack of fishing in the Schuylkill Valley suggests an "incomplete" settlement system (see below). Kent's (1970) postulation that the Lower Schuylkill is a band territory unto itself is therefore not altogether corroborated; however, it is not negated either and may in fact obtain. The Lower Schuylkill Valley lies farther afield than contemporary Delaware Valley-based Late Archaic settlement models allow (e.g. Stewart 1987; Cavallo 1987), and the sheer quantity of artifacts and sites in the study area argues for at least semi-permanent, continued use or residence in the valley.

As discussed at length previously, settlement patterns include widespread site locations on all stream orders and landforms. Upland and riverine environs were occupied and/or utilized. Cluster analysis demonstrated a weak tendency for a greater-than-expected occurrence of sites on uplands near low-order streams. It might be added that while unidentified "Archaic" components have not been scrutinized with the same intensity as Late and Terminal Archaic occupations, both the cluster analysis and visual examination of site locations indicate no significant differences from the Late Archaic site distributions. Good data on Piedmont Tradition subsistence practices is virtually absent. However, negative data indicate that subsistence pursuits at riverine-oriented (or other) sites did not include fishing, based on the almost total lack of netsinkers in the entire study area. Only one site (36 CH 453) out of 184 yielded netsinkers, which represents a single component Piedmont Tradition occupation. Perplexingly, this site is located not on the Schuylkill but some distance up French Creek, nearly at the western edge of the study area. This does not appear to be an optimal location for fishing. Since there is no reason to suspect that fish were absent from the river basin during this time, the apparent lack of fishing is peculiar and difficult to explain. This phenomenon may suggest that this is not a complete subsistence/settlement system. Fishing was certainly conducted on the Delaware (e.g. Kinsey 1972; Cavallo 1987; Stewart 1987; Schuldenrein et al. 1991), and if the postulated cultural connections with this area do obtain, then perhaps the Schuylkill was used for other purposes, most likely hunting. However, even if this scenario is correct, the apparent total lack of fishing activities remains enigmatic.

It is a safe assumption that plant foods were procured by Late Archaic people as well, despite a lack of hard data from habitation sites. Due to the dearth of reliable data on presettlement vegetation configurations in the region, relevant environmental variables could not be included in the cluster analyses, and the extent to which plant species distributions may have affected settlement locations is unknown. An interesting possibility is that the nature of plant resources in the Triassic Lowlands may have differed from that in the Piedmont Uplands, perhaps particularly during the warm and dry climatic conditions of the mid-postglacial xerothermic (see below). It may be speculated that vegetal foodstuffs could have been a more abundant or more dependable commodity in the Lowlands at this time, thus contributing to the intensive occupation and use of the area. At present, there seems to be no way to adequately test this proposition.

Few excavations have taken place at Late Archaic sites in the study area, and intra-site structural or functional data are characteristically sparse. However, the investigations at the Frick's Lock Site suggest something other than a large base camp-type site, as discussed above. Indeed, no large (or small) sites that may qualify as *bona fide* Late Archaic base camps are suggested by the present data. Sites comparable to Clyde Farm (Custer 1984a) or Delaware Park (Thomas 1981) in the northern Delmarva, the Webb Site (Custer 1985) and certain other sites in southern Chester County, Lower Black's Eddy (Schuldenrein et al. 1991) on the Delaware, or Savich Farm (Regensburg 1971) and Koens-Crispin (Cross 1941) in New Jersey have not been heretofore discovered in the Lower Schuylkill. One class of data that is usually interpreted as evidence for sustained, intensive habitation at a site is the frequency of occurrence of ground stone tools. Ground stone is present but not overabundant in the study area: 15 of 16 sites yielding probable Late Archaic ground stone tools occur with Piedmont Tradition diagnostics. Ground stone artifact classes include "axe", grooved axe, celt, bannerstone, gorget, pestle, and netsinker. Spatial distributions of these various classes disclose no noteworthy patterning, and it is not possible to calculate a tools-per-site statistic. Some of these tools may actually date to the Woodland Period. The relative sparseness of ground stone artifacts may be a further indication of less permanant, long-term settlement in the area, though it is certain that additional artifacts exist in private collections. Finally, PASS files indicate that only one burial site (36 CH 115) has been recorded within the bounds of study area, and it is of unknown temporal provenience. Six burials are reported to have been found at this site. Like the apparent dearth of substantial residential settlements, the apparent lack of Late Archaic mortuary sites may also suggest a less permanent presence in the area.

It is curious and perhaps telling that no sites in the Lower Schuylkill Valley apparently have *ever* been identified as large "base camps", like Clyde Farm, Delaware Park, Savich Farm, and so on. This fact bears emphasis. The lack of large village-type sites was implied by Witthoft and Mason (1949) on the basis of their early archeological work in the valley. Also, Gilkyson (1945) concluded as a result of her seminal survey work that "permanent settlements" were not present here. This phenomenon contrasts with the adjacent Delaware Valley, where large villages or otherwise substantial habitation sites were documented by earlier researchers (e.g. Abbott 1881; Mercer 1897; Spier 1918; Cross 1941, 1956). Early accounts of local archeology in the Schuylkill conversely suggest that Indian artifacts are plentiful, but that there are no "big village sites". More recent work, including JMA's transmission line surveys and the present volume, has been unable to contradict these previous conclusions, and thus tend to corroborate them.

All of the above factors make interpretations of the Piedmont Tradition settlement system very difficult, because the density of sites and materials in the Lower Schuylkill suggests at least a semi-permanent presence, and *some kind* of "base camp" or centralized group residential site(s) is expectable; it seems highly improbable that *all* Piedmont Tradition Late Archaic sites are special function extractive sites such as hunting camps. Site functions remain poorly known, but the seasonal and/or scheduled exploitation of small, low order tributary stream valleys from sites on the main stem and other larger streams was implied previously as a general working construct. The Late Archaic site distribution conforms well to this interpretation. The Schuylkill Valley may have been used as a logistic resource base; the relationship between main stem versus upland sites may approximate Binford's (1980:8-10) "tethered nomadism" pattern (see also Custer and Wallace 1982:163; Custer 1984a:105), where subsistence-oriented forays were conducted from more permanently occupied residential sites. Further, the exploitation of local quartz and quartzite sources was perhaps embedded in subsistence-oriented movements in and out of the low order stream valleys. However, the large sites on the main stem of the Schuylkill do not approximate documented Late Archaic base camp-type sites elsewhere. As discussed, these large sites can be expected to have had multiple functions, including specialized procurement loci as well as residential bases; large site size also may be a function of the reoccupation of site locations, not the sizes of groups occupying the sites (e.g. Binford 1982:15), and large site sizes therefore will not be categorically assumed to indicate base camp functions.

Of interest in this regard is an observation on the nature of Clyde Farm Complex settlement patterns and site functions in the Piedmont Uplands and Delmarva area. As mentioned above, Custer and Wallaces' (1982) study of settlement in the Piedmont Uplands inadvertently implied that settlement systems described in this region occurred in the present study area as well, which does not appear to be the case. Custer's (1984a:93ff, Fig. 11; 1988a) reconstruction of the Clyde Farm settlement system involves two primary site types/functions: large macro-band base camps found on the floodplains of larger drainages, and small procurement sites that are usually located in upland settings. These site types represent the ends of a structural/functional continuum, and the site type theoretically occurring in-between (the micro-band base camp) has not been unambiguously identified in the field, though some potential candidates have been noted (e.g. Custer 1984a:103-104; 1988b:45; 1989a:200). Such sites are potentially difficult to identify; expectations for such sites include sizes smaller than macro-band base camps, fewer tool types and quantities of artifacts, and a lower probability of containing diagnostic artifacts (Custer 1984a:103). Regarding the expected locations for such sites, "micro-band base camps are most likely to be located close to resource settings that are somewhat unique and located far enough from macro-band base camps to make likely the development of a separate camp. These special resource settings would include rich hunting and gathering locales and lithic sources" (Custer 1984a:103).

Given these structural and locational parameters, it may be hypothesized that some of the larger sites in the present study area might approximate those which have been proposed as micro-band base camps. It was argued above that large sites approximating "macro-band base camps" do not exist in the Lower Schuylkill, but that the settlement system logically must include some kind of centralized residential site(s). Perhaps the data from the excavated part of the Frick's Lock Site might be interpreted as approximating the expectations for a micro-band base camp-type site. Further, it has been posited that populations in the Lower Schuylkill were probably part of the greater Lower Delaware Valley Lackawaxen Phase settlement system. The role of the Schuylkill in that system appears to have been specialized, apparently focusing on hunting and probably plant food exploitation. Thus, the lack of large base camps in the Schuylkill Valley may be the result of their presence elsewhere, and the Schuylkill Valley may have been utilized by smaller societal segments. The societal composition of these groups (e.g. "micro-band") in the Schuylkill will not be conjectured at this point. However, to the extent that settlement patterns and societal partitioning at all approximate that which has been previously proposed, then a pattern of larger residential settlements on the Delaware and/or in the Delmarva, coupled with the obviously intensive use of the Schuylkill Valley but lack of genuine base camp-type sites, argues for an "intermediate" site type/function comparable to that suggested by the Clyde Farm model. This postulation must be regarded as speculative and hypothetical, but it is consistent with currently held settlement models elsewhere in the region, site structural expectations, and settlement data (both positive and negative) from the Lower Schuylkill Valley. This reconstruction does *not* imply that the larger sites in the Lower Schuylkill Valley are necessarily the missing part of the Clyde Farm settlement system, only that site functions comparable to the postulated expectations may be in evidence. However, while a cultural relationship with societies on the Delaware River is the favored interpretation here, possible connections with the Clyde Farm Complex are certainly not inconceivable and deserve further consideration.

Further explication of Late Archaic settlement patterns in the Lower Schuylkill can best be accomplished through additional comparisons with Clyde Farm patterns in the adjacent Piedmont Uplands. Late Archaic sites in the Piedmont Uplands are associated with the larger Clyde Farm Complex settlement system in the Delmarva Peninsula, which encompasses several physiographic zones. In the Piedmont Uplands, two basic site types have been identified. Macro-band base camps such as the Webb Site (Custer 1985) and the Minguannan Site (Custer 1984a:105) lie proximal to low-lying sinkhole complexes or swampy floodplains of larger drainages such as White Clay Creek and Brandywine Creek; small procurement sites are predominantly located in the uplands (Custer and Wallace 1982:158-159; Custer 1984a:105-107).

As discussed, settlement patterns in the Piedmont Uplands are unlike those in the study area, principally due to the lack of comparable base camp-type sites in the latter. Another important difference is the apparently lower numbers of small upland procurement sites in the Triassic Lowlands than in the Piedmont Uplands. Custer (1988a) has described and illustrated site densities in the Piedmont Uplands, as well as in the Lancaster-Frederick Lowlands, the subdivision of the Piedmont Lowlands located to the west of the Piedmont Uplands in Lancaster County. The vast majority of these sites are believed to date to the Late Archaic through Middle Woodland Periods. In both areas, the densities of small upland lithic scatter sites is remarkable, approaching nearly 25 sites per square kilometer (Custer 1988a:33-35, Table 2); potentially hundreds of thousands of these sites may exist (Custer 1988a:33). In the present study area, two transmission line surveys traversed predominantly upland environs (see Figure 1) and, while archeological sites of most temporal periods were indeed discovered in such settings, the density of these sites does not appear to approach that reported for the region to the south and west. One important reason for this difference may be the presence of the Schuylkill River and other higher order streams in the study area. That is, small "upland" procurement sites could have been located on these larger streams as appropriate, which is a site location option unavailable to occupants of the Piedmont Uplands. The net effect of this practice would be the proliferation of large and small multicomponent sites on the larger streams, as well as a deflation of the number of sites situated in the uplands. This interpretation is consistent with the intra-site and site distribution data from the Lower Schuylkill Valley, and while small, presumably procurement-oriented Late Archaic sites in upland settings are numerous in the study area, the lower relative density of these sites as compared to the Piedmont Uplands appears to be a real phenomenon.

Late Archaic settlement patterns in the Piedmont Uplands and throughout the Mid-Atlantic generally are posited to reflect responses to the warming and drying effects of the mid-postglacial xerothermic episode, which is generally regarded to have peaked at about the Archaic-Woodland interface. Certain problems and incongruities in the interpretation and dating of the xerothermic will be discussed in detail below. For the present, it may be summarized that the xerothermic precipitated a region-wide moisture stress and a general drying-out of the environment, particularly in areas that that were not particularly well-watered anyway. The latter include the Piedmont Uplands, where moisture stress was particularly pronounced, though it was not necessarily evenly distributed. In higher-lying upland settings, moisture stress would have been serious and many springs and low order drainages would have dried up. Lower-lying areas within the Uplands, such as the Chester Valley and the Kennett/Hockessin Lowlands, would have tended to better retain moisture, and sinkhole complexes and swampy floodplains along minor drainages associated with these low areas would have become optimal locales for settlement within this region (Custer and Wallace 1982:141-142, 147-148; Custer 1984a:89-91, 105; 1984b). More generally, however, cultural responses to these adverse environmental conditions involved settlement shifts to areas of more predictable subsistence resources and reliable water sources: "...the overall tendency was toward an adaptation focusing...[on]...a more specific range of resources and locations with a high degree of predictability" (Custer 1984a:97). Settlement shifts are postulated to have involved movement to and/or the establishment of riverine-oriented base camps in major river and stream valleys (Custer and Wallace 1982:147-148, 158-159; Custer 1988b:43; 1988c:125), as well as a greater use of coastal estuarine environments (Custer 1984b:34ff; 1988b:42; 1988c:125). However, these shifts to better- watered, more favorable environments clearly did not involve the wholesale abondonment of the largely dried-out uplands, since an increase in use of favorable localities in the uplands occurs at this time (Custer and Wallace 1982:159; Custer 1984a:104-105; 1988c:127), and small lithic scatter sites are ubiquitous in the Piedmont Uplands (Custer 1988a), as discussed previously.

Despite Kent's (1970:91) observation that in the greater Piedmont Physiographic Province there is a noticable environmental homogeneity as compared to adjacent regions, the degree of environmental homogeneity is clearly overstated, and important, if sometimes subtle, differences in hydrology and physiography exist between the various subregions of the

Piedmont Province. It is herein suggested that observed differences in settlement patterns in the Piedmont Uplands and Schuylkill Valley/Triassic Lowlands may be partly attributable to these environmental differences, and to the differential effects of the xerothermic on these respective environments. As pointed out in Section 2.0, the Triassic Lowlands are a particularly well-watered region with plentiful groundwater and a highly dendritic drainage pattern. Apparently, the Piedmont Uplands are not. In comparison to most areas of the Piedmont Uplands, the Triassic Lowlands *as a region* may have remained better-watered during the xerothermic, thus rendering the area particularly favorable for Late Archaic settlement. It may be hypothesized that both plant and animal species were probably more diverse and/or plentiful, more concentrated or localized and less dispersed or "patchy", and constituted a more reliable and predictable resource base than in the adjacent Piedmont Uplands.

However, the Schuylkill River, then as now, certainly did not comprise a "major" river as compared to either the Delaware or Susquehanna in terms of productive floodplain environments and overall resource abundance, which evidently explains why no groups apparently chose to locate a major residential "base camp-type" settlement here. Rather, the river and its entire narrow, incised valley was utilized in the manner of an "upland" logistic resource base. Stated differently, the Schuylkill River Valley seems to have been used for specialized resource procurement as though it was in fact a low order drainage. This mode of use evidently went so far as to exclude fishing pursuits, which in turn indicates use of the area on a highly scheduled basis, i.e. when anadromous fish were not running and people were not occupied with fishing elsewhere. Exploitation of the resources of the Schuylkill were evidently scheduled so as to not conflict with fishing activities, which likely took place during spring and fall. As suggested previously, the most likely occupants of the Schuylkill Valley derived from residential bases on the Delaware but also possibly from the Delmarva as well. The structural/functional equivalent of what have been described as "micro-band base camps" may have been a societal focus of the system. A somewhat more structured or spatially redundant use of the environment is tentatively indicated for the study area as compared to the adjacent Piedmont Uplands, where the "sites-all-over" pattern may indicate constantly shifting resource procurement localities, and less reliable or predictable resource distributions. By contrast, the structured pattern of the Lower Schuylkill Valley tends to resemble that described for the Lower Delaware Valley (e.g. Stewart 1987; Cavallo 1987).

The Lancaster-Frederick Lowlands to the west apparently are also well-watered, but this appears to be a rather different environmental configuration than in the Triassic Lowlands. In this region, areas lying beyond the floodplains of high order drainages like the Susquehanna River are characterized by numerous sinkholes and indistinct drainage patterns resulting from erosion of limestone and dolomite bedrock. In many respects, this situation resembles that described for low-lying areas within the Piedmont Uplands, and it has been proposed that settlement patterns and site densities in the Lancaster-Frederick Lowlands closely resemble those seen in the Piedmont Uplands (Custer 1988a:32-33). To the extent that this proposition is correct, this phenomenon strengthens the observation that the Piedmont Uplands and Lancaster-Frederick Lowlands are more similar environmentally than either are to the Triassic Lowlands.

The utilization of waterways as transportation corridors also may have affected settlement patterning in the Piedmont Province. The north-south trending river/creek corridors in the Triassic Lowlands may have had an effect on settlement location decisions and ultimate societal territories and boundaries. Transportation factors in the study area have been discussed previously, but these streams constitute routes to lithic sources in the Hardyston and/or Lockatong Formations, routes to various locations on the Delaware River, and routes avoiding various locations on the Delaware River. Higher order drainages in the Lancaster-Frederick Lowlands and adjacent portions of the Piedmont Uplands, such as Conestoga Creek, Pequea Creek, and Octoraro Creek, flow southwestward to the Susquehanna. Most streams in the Piedmont Uplands, particularly Brandywine Creek and White Clay Creek, flow southeastward to the Lower Delaware below Philadelphia. These differences in navigable waterways may further emphasize the apparent differences in settlement and possibly cultural affiliation between these areas. That is, drainage and transportation patterns in the study area tend to be oriented to the northwest, north and east, while in the surrounding areas drainage and transportation patterns tend to be oriented to the southeast and southwest.

To summarize, it is hypothesized that environmental differences between these regions, and differential effects of the mid-postglacial xerothermic, are in large measure responsible for observed settlement differences during the Late Archaic. These settlement differences may in turn serve to underscore cultural affiliations within and between the areas, and may indicate societal boundaries and differing cultural relationships. The Clyde Farm Complex present in the Lancaster-Frederick Lowlands and Piedmont Uplands may extend no farther to the north, while the Lower Schuylkill Valley and Triassic Lowlands were affiliated with the Delaware Valley Lackawaxen Phase.

Regarding the Lower Delaware River Valley, Stewart (1987:VIII-15-23) and Cavallo (1987:VIII-16ff) have proposed similar models of Late Archaic settlement based on extensive research into Late Archaic systems in the greater Delaware Valley. Seasonal movement between the Piedmont and Inner and Outer Coastal Plain during the Late Archaic - Early Woodland Period is indicated. The societal focus of settlement is posited to be on large, residential base camp sites occupied by "macro-social groups". These sites tend to be located in the environmentally-rich cuestas at the interface of the Inner and Outer Coastal Plains in New Jersey, and include the Cream Ridge and Red Valley (Cross 1941) Sites in the Abbott Farm vicinity near Trenton, as well as the Savich Farm (Regensburg 1971) and Koens-Crispin (Cross 1941) Sites located further south in New Jersey. Cavallo (1987:VIII-22) states that the latter two sites were probably occupied by aggregated social groups during early fall through late winter. Stewart (1987:VIII-20-22) proposes that the Piedmont Uplands along the Delaware River were used for argillite procurement, principally through special function camps. Data from the Lower Black's Eddy Site in the Middle Delaware Valley suggests that general habitation also took place in the Piedmont (Schuldenrein et al. 1991). Numerous small procurement-oriented sites comparable to those noted in the Piedmont Uplands and in the present study area occur throughout the Coastal Plains.

Neither Stewart (1987) nor Cavallo (1987) directly address the extent to which Late Archaic social groups from the Abbott Farm/Savich Farm/Koens-Crispin system may have occupied and/or utilized the Lower Schuylkill Valley, since the latter area lies outside the stated geographic ranges of their models. Indeed, Cavallo (1987:VIII-26ff) has stressed the environmental uniqueness and high resource productivity of the New Jersey cuestas, and states that this phenomenon would promote a considerable degree of permanent or semi-permanent settlement and the establishment of societal territories surrounding the large base camps. While the relationships between the Lower Schuylkill population and other systems remain imprecisely known, the data presented above demonstrate rather conclusively that the Delaware Valley system is the closest logical relative of the Schuylkill Valley Piedmont Tradition population. The development of a detailed, integrated Late Archaic settlement model encompassing the Lower Schuylkill and Lower Delaware (or anywhere else) is beyond the present scope, but constitutes an important topic for future research. Such research might seek to evaluate the pronounced degree of territoriality proposed for the Delaware Valley/New Jersey manifestations, and the nature of the proposed relationship between this area and the present study area. Relationships with the Delmarva Clyde Farm Complex also require clarification. This kind of research focus could lead to further insights into the nature of societal territoriality and boundary maintenence, and the potential isolation of discrete territories occupied by related bands or tribal segments.

Turning briefly to the the Upper Schuylkill Valley, Kinsey's (1976) previous research in the Blue Marsh Lake area identified 23 Late Archaic sites, most of which were located in the Tulpehocken Creek Valley (see Figure 2). The environmental associations of these sites (Kinsey 1976:59-60) included hilltops and hillsides, swampy floodplains, dry floodplains, terraces along the Tulpehocken, and terraces along tributaries of the Tulpehocken. Thirteen sites were located on hilltops with associated springs. Artifacts from these sites were made predominantly of quartzite. Floodplain sites most often yielded artifacts of jasper and chalcedony. Kinsey (1976:65) suggested that the floodplain sites represented transient camps associated with the hunting and processing of game, and that the hilltop sites constituted more substantial occupations as seasonal base camps. While some of the functional interpretations posited for the floodplain sites may be similar to those of some sites in the Lower Schuylkill, it is unlikely upland sites in the study area are hilltop base camps.

Field work and research by Snethkamp et al. (1982) in the Blue Marsh discovered ubiquitous Piedmont Tradition Late Archaic projectile points, but almost no evidence of features, postmolds, or structures at sites in the area; also, there are apparently no (or few) stratified sites in the area. These findings obviously mirror those presented here and suggest that, like the Lower Schuylkill, there is a lack of large base camps in the Upper Schuylkill as well. Snethkamp et al. (1982) conducted a location analysis of Late Archaic sites in the Blue Marsh Lake study area, although the analysis is flawed because dependent and independent variables were not appropriately isolated. Despite this shortcoming, locational criteria for sites were isolated, and a site typology was generated. If the site types have empirical validity, then there is some demonstrable difference in the locations of different site types (actually, site sizes): all "sizeable" sites were located near Tulpehocken Creek or its tributaries, never more than 100 meters from water, and always on terraces or knolls near the water. Small sites, defined as sites having fewer than five artifacts, tend to occur on knolls, often 200 meters or more away from the water (Snethkamp et al. 1982:11.07ff). Sites located along first and second order streams are more likely to be single component than sites lying along larger watercourses. A general parallel with the Lower Schuylkill can be observed in this distribution, though many multicomponent Archaic and Woodland sites occur in association with low order streams.

The Blue Marsh conclusions suggest that there is variability of some kind operating in the Upper Schuylkill, and Piedmont Tradition sites demonstrate spatial patterning or at least exclusivity with regard to location in space. Accepted at face value, the site size variability appears roughly comparable to that observed in the Lower Schuylkill; however, unsubstantiated site functions suggested for both areas confounds more definitive comparisons. In any case, while the landscape and environmental resources may have been somewhat differentially exploited, it seems certain that the Upper Schuylkill was occupied and/or utilized by the same socio-cultural system as that in the Lower Schuylkill.

One final digression regarding Late Archaic adaptations in the Mid-Atlantic region will be presented. A discussion of the effects of the mid-postglacial xerothermic on environment and settlement systems was presented above. While that discussion did not enumerate various problems with the xerothermic concept, it should be pointed out that several incongruities exist between the archeological data and certain postulated effects on settlement, and there is not universal agreement among archeologists regarding the specifics of the nature and dating of the xerothermic. The previous summary and following discussion draw heavily from Custer's numerous papers on Late Archaic-Early Woodland adaptations, which offer several interpretations of the timing, duration, and effects of the xerothermic. As discussed, the basic concept involves a general drying-out of the environment, producing moisture stress and rendering certain environments relatively inhospitable for occupation or use; the presence of a reliable source(s) of fresh surface water would have been the primary determinant of settlement location. Thus, a settlement shift to well-watered areas such as major river floodplains and estuaries is postulated, with a concomitant decrease in the use of the dry areas, such as most of the Piedmont Uplands. In the latter, areas of residual water, such as sinkholes and swamps near small streams, would have been favored, though according to the data presented by Custer (e.g. 1988a), it would appear that virtually all parts of the Piedmont Uplands were occupied to some extent.

As perceived herein, there is a basic incongruity in Custer's interpretation of the effects of the xerothermic. Specifically, the suggested settlement "shift" from dried-out uplands to riverine base camps, estuarine areas, or otherwise well-watered areas of more predictable resources makes good sense, but it is inconsistent with the simultaneous increase in the use of upland environs. The drying effects of the xerothermic have been proposed as the causal variables prompting the systemic shift from poorly-watered uplands to well-watered lowlands, but populations stayed in the uplands anyway. Based on Custer's model, one might expect that large tracts of the Piedmont Uplands would have witnessed the effects of severe moisture stress and would have been unfavorable for settlement, but settlement and utilization of this region actually increased dramatically compared to earlier times. As detailed above, Custer posits that utilization of the Uplands focused on discrete areas of available water, but a potential site density of as much as 25 sites per square kilometer (Custer 1988a:Table 2) belies this statement. For this scenario to obtain, water must have been readily available throughout the Piedmont Uplands; there are simply too many sites in the Uplands for the model to realistically obtain.

Stewart (1987) has made similarly conflicting statements on the effects of the xerothermic on Late Archaic settlement and subsistence. In analyzing Late Archaic settlement systems, he states that "the possible detrimental effects of the xerothermic on interior upland habitats would increase the economic importance of wetland and high order stream environments" (Stewart 1987:VIII-30). Yet, later in the same discussion, "many of the specifics of Middle to Late Archaic settlement changes remain to be worked out. A change from sporadic to consistent use of interior and low-order stream environments differentiated the settlement patterns of the two periods" (Stewart 1987:VIII-30-31). Thus, it is suggested that the xerothermic had a deleterious effect on the attractiveness of interior/upland habitats and thus fostered a Late Archaic shift to wetlands/high-order stream environs. Yet simultaneously one sees a dramatic increase and consistency in the use of interior/upland settings compared to sporadic use during earlier times, when the moisture stress of the thermal maximum would not have been present.

Cavallo (1987:VIII-11-16) has presented a well-considered critique of climate-based settlement models, with a focus on the lack of agreement over the timing and duration of the xerothermic, and on the nature of the evidence for the existence of the xerothermic. Regarding the evidence, Cavallo notes that the only hard data on the xerothermic consists of various undated pollen cores and relatively rare geomorphological and pedological studies. These, he suggests, are dubious bases upon which to posit a region-wide climatic trend with dramatic effects on human populations. Regarding dating, a review of recent literature on the Late Archaic/Early Woodland Period led Cavallo to the realization that numerous authors have suggested beginning dates for the xerothermic ranging from ca. 4,950 to 2,200 BC, and closing dates ranging from ca. 1,950 to 150 BC. Custer (1984b:33) has also stated that in some local areas, the climatic conditions of the xerothermic may have lasted as late as AD 600. Custer and Wallace (1982:147-

148) date the end of the period to ca. 800 BC. Though most authors similarly tend to place the end of the xerothermic within the greater Late Archaic/Terminal Archaic/Early Woodland Period (that is, prior to AD 0), the highly variable date ranges remain a significant interpretational problem.

Regardless of the actual timing, and assuming that the xerothermic was a real phenomenon which did produce a warming and drying climatic effect, there is little doubt that it would have affected settlement, with responses similar to the proposed general shift in locational preference from dried-out uplands to well-watered lowlands. However, it remains unanswered how upland environs can be dry and poorly suited to occupation yet simultaneously experience heavy occupation and use. One possible solution may lie with site chronology: many or most of these small, ephemeral, hard-to-date upland sites can be hypothesized to date to the post-thermal maximum, that is, after the peak of the xerothermic when the warming and drying effects had begun to subside, perhaps ca. 800 BC. Other upland sites may pre-date the thermal maximum but may be situated in the best watered areas, as has been suggested. The problem turns on dating but is twofold, involving difficulties in accurately dating large-scale climatic events and difficulties in dating small-scale archeological sites. Seriously compounding the problem is the general perception of widespread cultural continuity during the Late Archaic through Middle Woodland Periods in the Mid-Atlantic (e.g. Custer 1984a:76ff), a perception that might tend to obfuscate smaller-scale settlement changes or other cultural variability.

Thus, it is suggested that the upland settlement pattern described above, wherein sites tend to be found literally all over the landscape with little documented change through time, may be an artifact of general inclinations and explicit classificatory schemes that tend to lump up to 4,000 years of prehistory. The combining of all these millenia may mask changes in settlement systems and cultural responses to the xerothermic, changes that are admittedly very difficult to discern due to ambiguities in artifact typologies. It is suggested that future studies into the effects of the mid-postglacial xerothermic consider this possibility.

11.3 Terminal Archaic Period

The Terminal Archaic Period is represented in the study area by approximately 30 components, which have been defined by the presence of broadspears and/or fishtail projectile points; some of the latter may overlap later into the Woodland Period. The authors decline at present to join the on-going debate over the nature and function of broadspear bifaces (e.g. Cook 1976; Custer 1984a:79-82; 1984b:40). For present purposes, it will suffice to accept that these artifacts do represent sound temporal markers and tend to occur late in the Archaic Period, though it is ackn owleged that there is some degree of temporal overlap with Piedmont Tradition artifacts.

Two cluster analyses showed remarkable continuity in settlement locations with Late Archaic components, and most Terminal Archaic occupations are multicomponent with Late Archaic occupations, a pattern previously noted by Witthoft (1953) for the Schuylkill Valley. A slightly greater than expected frequency of Terminal Archaic components is found on bluffs along higher order streams. However, this fact should not be taken as evidence of a riverine, fishing-oriented settlement system as variously posited by earlier studies (e.g. Witthoft 1953; Kinsey 1972; Turnbaugh 1975). The preference for locating sites almost exclusively on floodplains does not obtain, and the adaptation in the Schuylkill Valley may be different due to ecological factors (cf. Witthoft 1953). Specifically, broad river terraces are not typical landforms in the Schuylkill Valley and the uplands and the river tend to be juxtaposed. The lack of a riverine-oriented Terminal Archaic economy is punctuated by the near absence of netsinkers, as discussed above.

As with the preceeding period, intra-site data are almost nil for the Terminal Archaic, and the functions of site occupations remain unknown. Minimally, no sites that may have functioned as base camps or otherwise substantial habitation areas have been previously reported, and none were discovered during the Limerick Transmission Line Surveys. Further, no soapstone bowls or unequivocally related early pottery are known from Terminal Archaic sites. The apparent lack of soapstone bowls or pottery may be a further indication of the lack of substantial base camp-type sites. The subsistence practices of these societies remain unknown. However, subsistence certainly did not involve a heavy reliance on anadromous fish. If the site location similarities with the preceding Late Archaic are any indication, then a shift in subsistence strategies is not in evidence.

As detailed previously, raw material utilization patterns do not appear to change appreciably at the beginning of the Terminal Archaic. Components in the Lower Schuylkill Valley are represented by Koens-Crispin projectile points, and show continued use of quartzite (n=8) and argillite (n=3). Lehigh points and Snook Kill points are rare; of the former, one is made from jasper and another from quartzite. The single Snook Kill specimen is made from quartzite. The rarity of Lehigh and Snook Kill points in comparison to Koens-Crispin points can be provisionally taken as evidence of societal continuity with the preceeding Lackawaxen Phase Late Archaic system; the predominant use of argillite and quartzite for Koens-Crispin points also suggests continuity. In contrast, a definite preference for chert and jasper is in evidence for Perkiomen, Susquehanna, and Fishtail points. The occupations represented by these artifacts may post-date the Koens-Crispin-related occupation or may be partly contemporaneous; certainly the Lower Schuylkill was not the societal/territorial focus of any of these systems. Local quartz was apparently avoided, possibly suggesting a transient presence by these people. This shift in raw material preference may represent a change in occupation and/or societal boundaries at the Terminal Archaic/Early Woodland interface.

Spatial variation among individual Terminal Archaic point types does not appear to demonstrate any kind of exclusive spatial distributions. The slightly more numerous Koens-Crispin components (n=8), along with untyped broadspears (n=10), are the most widespread. They are found predominantly along the Schuylkill River and Perkiomen, Skippack, and French Creeks. Most sites lie near the main channels, but a few are found on tributaries. Interestingly, the less-numerous Perkiomen Broadspear components (n=7) also occur along the same watercourses, though only two co-occurrences were noted, at the Frick's Lock and Indian Point Sites. Elsewhere the distributions of Perkiomen and Koens-Crispin Points tend to be mutually exclusive. Susquehanna Broadspears are represented at only four sites, all of which lie on the Schuylkill. Co-occurrences with other broadspears are noted at the Frick's Lock, Indian Point, and Point Bar Sites. The fourth site is 36 PH 22, a rockshelter site on the Schuylkill in Philadelphia County. Finally, Orient Fishtail components (n=7) are also found on the Schuylkill, as well as in the Perkiomen watershed.

It should be added that at least two caches of large bifaces have been discovered in the Schuylkill. According to PASS file data, a cache of argillite bifaces of unknown typology and quantity was found at 36 CH 47, located on the main stem slightly upstream from Indian Point. It is conceivable that this cache may relate to the Koens-Crispin occupation, since caches of argillite broadspear preforms have been recovered from numerous sites elsewhere in the Mid-Atlantic. A cache of over 165 jasper bifaces resembling broadspear forms was also recovered from 36 CH 278, located on the Schuylkill upstream from Frick's Lock (Witthoft and Mason 1949). These artifacts bear a general resemblance to Koens-Crispin or Lehigh preforms, but their actual typological/cultural affiliation remains unknown. This large cache is particularly noteworthy given the relatively small quantity of Lehigh (or other) broadspears made of jasper in the study area. The significance of this cache is difficult to interpret, but might be taken as further evidence of transient Terminal Archaic presence in the area.

In any case, individual point type distributions do not demonstrate clear patterning or trends. The Koens-Crispin type is predominant, and possible relationships with other types are difficult to assess. The largely mutually exclusive distributions of the various types at individual sites might be interpreted as evidence that the different broadspear types were either not utilized by the same group(s) of people, or that they are temporally distinct. However, the fact that most individual Terminal Archaic types tend to occur in the same general areas indicates that the results of the cluster analyses were not biased by combining these types into a single category.

Upstream in the Blue Marsh area, Snethkamp et al. (1982:4.22ff, 11.06) lump broadspears with lanceolate points at the end of the Piedmont Tradition, and have found intra-site evidence suggesting the concurrent use of these tools. They document no change in settlement or site distribution between sites yielding Piedmont versus broadspear points. As with the preceding Piedmont Tradition, no features, dwellings, or semi-permanent villages or seasonal base camps are in evidence in the region. In addition, no steatite or soapstone artifacts were discovered in the Blue Marsh project area, though a small quantity of steatite was reported in previous investigations (Snethcamp et al. 1982:11.04, 11.08-11.09). All things considered, the parallels between the Terminal Archaic in the Lower Schuylkill Valley and the Upper Schuylkill in the Blue Marsh project area are considerable.

The predominant use of argillite and quartzite for Koens-Crispin points clearly indicates occupation of the Lower Schuylkill Valley by a society affiliated in some manner with systems on the Lower Delaware, where the argillite was no doubt procured, as in earlier times. Potentially related systems parallel those noted for the Piedmont Tradition Late Archaic, such as at the Abbott Farm (e.g. Cross 1941; Stewart 1987) and Lower Black's Eddy (Schuldenrein et al. 1991), where argillite is also the predominant raw material for Koens-Crispin points. Other sites in New Jersey, such as Savich Farm (Regensburg 1970) and the Koens-Crispin Site (Cross 1941), were certainly part of this system as well.

Regarding potential cultural relationships to the south, broadspears are placed with narrow stemmed points in the Clyde Farm Complex in the Delmarva/Piedmont Uplands area (Custer 1984a:79-82,99-107), and in the Barker's Landing Complex in central Delaware (Custer 1984a:107-113). Broadspears clearly date to the latter portions of these complexes. Broadspears have been variously interpreted as utilitarian special function tools associated with the exploitation of anadromous fish (Custer 1984a:79-82; 1984b:40), but simultaneously as artifactual status markers manufactured from non-local, imported exotic raw materials (Custer 1984a:110-113; 1984b:40ff). While the potential incongruity of these two interpretations will not be elaborated on here, the evidence for high-status socio-political systems in the Delmarva Peninsula at this period of time appears to be negligible. At any rate, it is important to note that much argillite and some rhyolite occurs in the Barker's Landing Complex, where broadspears outnumber lanceolate points by a margin of three to one (Custer 1984a:107-110). Caches of argillite bifaces resembling broadspear forms have been recovered from two Clyde Farm Complex sites in the coastal zone (Custer 1984a:99ff), and rhyolite and argillite broadspears were found at the Mitchell Site in the Piedmont Uplands (Custer 1984a:106-107). Basically, cultural continuity from the Late Archaic through Terminal Archaic is posited for the Clyde Farm and Barker's Landing Complexes. The presence of argillite Koens-Crispin-like broadspears indicates clear connections with the Lower Delaware Valley and probably similar systems in the Schuylkill Valley as well. Similar patterns of cultural continuity obtain in all three areas.

11.4 Early/Middle Woodland Period and the Black Rock Phase

The onset of the Woodland Period in the Lower Schuylkill Valley witnesses a distinct break with the preceding periods. A lower population density and/or less intense utilization of the study area during Early and Middle Woodland times is indicated by the lower frequencies of components (n=29) and artifactual materials as compared to the Late/Terminal Archaic. However, Early/Middle Woodland systems (or at least culturally diagnostic artifacts) were apparently as varied as previously, if not more so; several groups were evidently present, though as before the area appears to have been dominated by one particular system. The fact that numerous, distinct cultural systems and diagnostic artifacts are documented in the study area may have implications for the rather unproductive results of the cluster analyses with regard to isolating Early, Early/Middle, and Middle Woodland settlement patterns or environmental associations. That is, the results *may* be a reflection of several different groups in the area, which were combined for analysis into a single category. In any event, inspection of individual artifact/component distributions does not elucidate meaningful patterning either.

Evidence for the earliest Woodland Period presence in the area is represented by three steatite-tempered Marcey Creek Plain sherds recovered by JMA from 36 MG 172, located on the Schuylkill near the Point Bar Site. The sherds were found in a disturbed context. Occupation of the area by makers of early experimental ceramic wares thus appears to have been negligible. Meadowood points have been reported in the PASS files from two sites, both near the northern edge of the study area, on Perkiomen and Skippack Creeks. No associated ceramics are reported. The accuracy of these identifications may be problematic, but in any case a substantial presence of Meadowood systems is not in evidence.

Fox Creek projectile points are reasonably common in the adjacent Delaware Valley, but are rare in the Schuylkill. The two unequivocal specimens are made of argillite; one was recovered from Indian Point and one derives from a site on the Upper Perkiomen. Elsewhere, Fox Creek points are commonly associated with interior/exterior cordmarked Vinette I pottery and/or net-marked Brodhead pottery. The former occurs at Indian Point but appears to be associated with other point types (see below). Net-marked pottery of any type is conspicuously rare in the Lower Schuylkill Valley, and is absent from the sizable Indian Point assemblage. A few possible net-marked sherds were observed in a private collection from 36 CH 55, and a single net-marked sherd was recovered from the Point Bar Site. Both sites lie on the main stem of the Schuylkill. Fabric-impressed sherds reported in the PASS files from a rockshelter site on the Upper Perkiomen could possibly be net-marked. While these very rare artifacts probably (but not invariably) indicate Lower Delaware Valley cultural ties, it is obvious that net-marked pottery was not popular in the study area. The extent to which this phenomenon indicates cultural change in the form of a territorial realignment from the preceding period is uncertain, since in the Delaware Valley the use of cordmarked and net-marked wares is known to have overlapped to some degree (e.g. Stewart 1985, 1987; Schuldenrein et al. 1991), and the continued use of argillite and perhaps quartzite suggests continuity as well. However, it is herein suggested that, beginning with the earlier portion of the Early/Middle Woodland Period and continuing into later times, societies on the Lower Delaware progressively became less interested in the Schuylkill Valley as a place to live, and the near absence of Early Woodland net-marked pottery in the valley is interpreted as one indicator of this trend. These people probably continued to use the valley to some extent for resource procurement, but evidently not for sustained or even semi-permanent habitation. The apparent total lack of Woodland manifestations in the Blue Marsh area upstream (Snethkamp et al. 1982:4.07) provides support for this observation, or at least does not contradict it.

Clearly the best represented Early/Middle Woodland manifestation in the Lower Schuylkill Valley occurs at the Indian Point Site. This manifestation has been termed the Black Rock Phase, and is radiocarbon-dated to ca. 460 BC-AD 250. A 700 year phase is rather lengthy, even for the Middle Atlantic region; logically the phase may be narrowed somewhat to ca. 400 BC-AD 200. The Black Rock Phase designation is intended to be a provisional taxonomic construct requiring further refinement and elucidation. Thus far, it is only well-represented at the Indian Point Site, which has been interpreted as a series of occupations/phases occurring over a long time span, as indicated by the radiocarbon date range and the spatial/temporal feature clusters. As a taxonomic unit, the Black Rock Phase possesses sufficient temporal depth and evidence of cultural continuity to qualify as a cultural tradition. However, the authors are highly reluctant to posit such on the basis of data from a single site, and must defer such labeling until additional data indicate that it is warranted. The term "Black Rock Complex" might also be employed, but the phase concept is herein preferred over the term "complex" (cf. Custer 1984a:28).

Other Black Rock Phase sites in the Lower Schuylkill Valley are poorly documented, which is unfortunate, since it is therefore not possible to unambiguously outline a discrete territory or settlement pattern for the Black Rock Phase occupation. Several sites may be provisionally included based on lithic artifacts, though the isolation of unequivocally diagnostic projectile points remains problematic (see Section 9.0). Five sites in addition to Indian Point may be included based on the presence of Rossville or Rossville-like points. One lies near Valley Forge, slightly downstream from the Point Bar Site, while a second is the Frick's Lock Site, which is located near the large river bend near Pottstown. One site occurs near the headwaters of Pickering Creek, which lies south of French Creek. Two lie on Perkiomen Creek near the northern boundary of the study area. If Eshback points are considered diagnostic of this phase, an additional site on Perkiomen Creek may be included. If Bare Island-like points are included, then numerous additional sites may be related. As discussed in several previous contexts, ceramics are sparse from the study area and most are small and difficult to identify. However, the small assemblages from both the Frick's Lock and Point Bar Sites *may* include related sherds. Point Bar also yielded a Rossville-like projectile point. Even rarer ceramic specimens in private collections could ultimately prove to be associated. Finally, the unidentified "Woodland" sites in the sample are all candidates for inclusion. Settlement patterning is not readily apparent in this site distribution, except that a wide range of environmental settings is clearly represented, which actually may be an important finding; it may suggest that a distinct settlement system is present, but as yet remains poorly explicated. These sites also dispel the likelihood that the "unique" Indian Point Site is the only site in the system.

External relationships with the Black Rock Phase are not altogether certain. Numerous similarities can be observed with adjacent manifestations, particularly in terms of the ceramic assemblage, e.g. with the northern Delmarva Wolfe Neck Complex, the Lower Delaware Valley, and the Lower Susquehanna Valley. However, the lithic raw material data clearly do not support a Susquehanna Valley connection, and the full range of variability in Susquehanna Series pottery (e.g. net or fabric-impressing, sand temper) is not present at Indian Point. The apparent preference for argillite and quartzite for the manufacture of Rossville points may suggest a Lower Delaware Valley relationship. Considering the data in the aggregate, however, the phase seems to best relate to the Wolfe Neck Complex of the Delmarva area. The "Vinette-like" pottery clearly resembles Wolfe Neck and/or Susquehanna Cordmarked ceramics, which are characteristic of Wolfe Neck in the northern Delmarva (Custer 1984a:84). Further, the living floor depressions at Indian Point strongly resemble the house features at the Delaware Park Site. Two of four Delaware Park house pits returned radiocarbon dates of 1,850 BC and

790 BC (Thomas 1981), which places the features in the earlier Clyde Farm Complex. A similar house pit and associated storage pits and a hearth were discovered at the Clyde Farm Site; the house pit was radiocarbon-dated to 1,000 BC (Custer 1988b:44; Custer and Hodny 1989). Despite these temporal discrepancies, the morphological similarity between the Delaware Park/Clyde Farm and Indian Point features remains striking. This phenomenon may indicate temporal as well as spatial continuity between the two areas, despite the conviction that earlier Late Archaic ties in the study area were with the Lower Delaware Valley. Finally, some of the projectile point associations for the Black Rock Phase correspond to those of the Wolfe Neck Complex, i.e. Rossville-like and other "miscellaneous" stemmed specimens (Custer 1984a:89, 113).

Numerous watercourses throughout the Piedmont Uplands provide potential avenues of communication and transport between the areas, though none are direct and all involve portages. For example, groups traveling up the East Branch of Brandywine Creek could portage to Valley Creek and thence to the Schuylkill near Valley Forge. Or, Valley Creek may be taken to Pine Creek and then to Pickering Creek or French Creek, both of which empty into the Schuylkill below Phoenixville, which is also the location of the Indian Point Site. From the western Delmarva or extreme lower Susquehanna area, Octoraro Creek provides access to the Schuylkill watershed, though this is a rather more difficult route. In any case, it is certain that ample communication and transportation between these areas could have transpired with minimal effort.

The Indian Point Site is a very favorable and strategic site location, whether residence in the Schuylkill Valley is permanent or transient. The site occupies a bluff within a large horseshoe bend in the river. Such bends have been posited to be potentially favorable locations with regard to subsistence resources. The location is within the Triassic Lowlands but is very near the interface with the Piedmont Uplands. Again, this locality would have been favorable for subsistence reasons, as well as for purposes of movement within or out of the valley. For example, the site could have been occupied during the course of travel to jasper and/or chert sources up Perkiomen or Manatawney Creek. This route avoids the big bend in the Delaware River at Trenton, as well as the people that lived there. It avoids traversing the Lehigh River Valley too. Alternatively, or in addition to the procurement of lithic raw materials, Black Rock Phase/Wolfe Neck people may have located here to exploit the subsistence resources of the Triassic Lowlands on a seasonal basis, i.e. in warm weather. If moisture scarcity lingering from the end of the xerothermic was still a regional settlement concern at this time, the well-watered Triassic Lowlands might have been a particularly productive habitat to exploit. The area may have been used as a hunting territory; although this explanation is often overused by archeologists, this possibility cannot be underestimated in the present case. People had to be eating something here, and it appears not to have been fish or agricultural produce, and evidence for heavy exploitation of plant foods is presently equivocal.

If cultural relationships obtain with systems in the Delmarva Peninsula, two settlement system scenarios present themselves: 1) that the Black Rock Phase occupants were in fact transient and originated from the Delmarva area and used the Schuylkill on a seasonal basis; or 2) that these occupants of the Lower Schuylkill Valley were largely permanent residents of the valley, and were probably a societal segment of a larger Wolfe Neck Early/Middle Woodland system. Regarding the former, the Lower Schuylkill Valley, or this segment of it, could have been encompassed within the summer/early fall range of the Black Rock Phase/Wolfe Neck settlement system with the Indian Point Site functioning as a base camp located on the main stem. This strategic location may have been chosen for its access to tributaries, movement up or down the valley, or to the uplands. This locality also provides an opportunity to exploit local quartz and quartzite, and/or the Lockatong and Hardyston Formation lithic sources, if desired.

With the onset of winter weather, the population could have moved off the exposed bluff back to the Delmarva, or perhaps to sheltered locations elsewhere.

Alternatively, this occupation may have been part of a permanent, northerly societal territory associated with Wolfe Neck systems located predominantly to the south. The existence of a stable, local settlement system in this area tends to be supported by the distinctive ceramic assemblage, and perhaps by the apparently occasional use of local quartzite. Seasonal settlement moves need not have left the watershed but could have remained within the greater Schuylkill Valley. Cold weather sites may be represented by the sporadic sites located on tributaries or in other, presumably more favorable cold weather locations. However, if this group was indeed permanently located here, then the lack of obvious fishing pursuits suggests a different subsistence system than that seen in either the Delmarva or the Lower Delaware, a situation that previously occurred during the Late Archaic. At this point, the lithic and settlement pattern data can be used to support either hypothesis, and cold weather sites of the Black Rock Phase are sorely needed to adequately evaluate either.

Aligning the Black Rock Phase at the Indian Point Site with the Wolfe Neck Complex, as currently defined, generates several cultural implications. As noted, Wolfe Neck in the northern Delmarva is represented by Smith's (1978) Susquehanna Series pottery, not Wolfe Neck Ware *per se*. Wolfe Neck Ware is reported to be distributed predominantly in southern Delaware (Custer 1984a:113). Differences in subsistence/settlement practices have also been observed between the northern and southern Wolfe Neck elements, with a predominant estuarine settlement orientation and a heavy reliance on shellfish occurring in the south, but apparently not at sites in the north (Griffith and Artusy 1977; Custer 1984a:114-117). Further, it was noted previously that radiocarbon dates for the Wolfe Neck Complex indicate a different date range for the northern versus southern elements: the more southerly Wolfe Neck apparently persists later, to ca. AD 300, than Wolfe Neck in the northern Delmarva, which is posited to have been replaced by the Carey Complex ca. AD 0 (Custer 1984a:114-115, 135ff). Custer (1984a:113-130) also suggests that the two Wolfe Neck manifestations are spatially segregated by the presence of the culturally distinct Delmarva Adena Complex in central Delaware, which might be regarded as a somewhat unusual spatial configuration for a prehistoric hunter-gatherer society. Finally, in a recent synthesis of Delmarva archeology, Custer (1989a: Table 22) intimates that while Wolfe Neck presence in extreme northern Delaware and southeastern Pennsylvania has been generally assumed, there is in fact little pertinent data deriving from the period ca. 400 BC - AD 0. Taken together, these factors may suggest that the northern Delmarva Wolfe Neck Complex could represent something else, i.e. a related yet distinct socio-cultural entity, perhaps that which has been termed herein the Black Rock Phase.

Thus, the differences observable between the two Wolfe Neck manifestations, coupled with the data from the Indian Point Site, may indicate a discrete Early/Middle Woodland system and/or societal territory occurring in the Lower Schuylkill Valley as well as the northern Delmarva Penninsula. This potential system thus occupies portions of three physiographic sub-provinces, i.e. the Triassic Lowlands, the northern Piedmont Uplands, and a portion of the Coastal Plain in northern Delaware. Related sites in the latter area are several and include Clyde Farm and Delaware Park, which have been interpreted as large macro-band and base camps; Delaware Park has produced numerous hearths and large cylindrical storage pits (Thomas 1981; Custer 1984a:114). It may be speculated that these people regarded the northern Delmarva as their residential base, and the Schuylkill/Triassic Lowlands as a warm weather resource procurement territory. The Black Rock Phase system doubtless would have been socially and culturally related to Wolfe Neck manifestations in southern Delaware, and to contemporaneous systems in the Lower Delaware and perhaps Susquehanna Valleys. The scenario that emerges is one of semi-autonomous but culturally interrelated bands or tribal segments, each occupying its own discrete societal territory and/or resource procurement range. Apparent differences in subsistence pursuits may in part be a reflection of different environmental settings, though the evident paucity of fishing in the Schuylkill River remains a puzzle and is difficult to explain.

If this provisional reconstruction proves correct, then a shift in societal boundaries and/or resource procurement ranges may be in evidence near the close of the Black Rock Phase/Wolfe Neck episode. As noted, Wolfe Neck in southern Delaware persists into the AD 300 period. In northern Delaware, Wolfe Neck is superceded by the Carey Complex, which ranges from AD 0-600 and is found state-wide (Custer 1984a:130ff). Shell-tempered Mockley ceramics are predominant; Rossville points persist in northern Delaware while Fox Creek points occur in the south (Custer 1984a:89, 131). At the Delaware Park Site, strong continuities with Wolfe Neck are posited, and radiocarbon dates range from AD 65-455 (Custer 1984a:131); numerous hearths and storage features are also present. In general, overall continuities in settlement and site distribution appear to obtain between the Wolfe Neck and Carey Complexes (Custer 1984a 133).

Mockley ceramics are very rare in the Lower Schuylkill Valley and are represented by a single cordmarked sherd from Indian Point. Clearly the Carey Complex is not represented to any appreciable degree in the Schuylkill Valley. Thus, regardless of which form of cultural relationship may have obtained between the Lower Schuylkill and northern Delmarva, the relationship appears to break down ca. AD 0. The Black Rock Phase at the Indian Point Site continues for at least 200 years but, if the AD 0 date for Carey is correct, then cultural ties are no longer in evidence. Perhaps Black Rock represents a temporal/cultural lag of sorts, whereby a Wolfe Neck-like system persisted in the Schuylkill and was eclipsed by Middle Woodland systems identified by distinctive Mockley pottery. The latter are seen in the Lower Delaware Valley, the Delmarva, and the Lower Susquehanna, but not to any appreciable degree in the Schuylkill (cf. Custer 1989a: Table 22).

The Delaware Park Complex succeeds the Carey Complex in the northern Delmarva area, and dates to between ca. AD 500-1,000; storage pits at the Delaware Park Site have been dated to AD 605-640 (Custer 1984a:135-136). Lithic artifacts include Rossville, Jack's Reef Pentagonal, generalized side-notched, and large triangular points; grit-tempered, cordmarked and fabric-impressed Hell Island ceramics are characteristic (Custer 1984a:88, 136). Only a few Delaware Park Complex sites have been found in the Piedmont Uplands (Custer 1984a:136), and Hell Island pottery is rare north of this area. Unequivocal Hell Island ceramics have not been recognized in the Lower Schuylkill Valley, though rare Jack's Reef and/or untyped side- or corner-notched points have been observed. While the latter may be related, they comprise a weak basis for positing the presence of the Delaware Park Complex in the study area. Rather, it appears that the Delaware Park Complex, like the preceding Carey, is not present; minimally, substantial settlements comparable to the Delaware Park site are not present. The existence of possibly related projectile points may suggest some continued use of the area, but most indicators point to continued cultural divergence from the Delmarva area.

At this point, it is not possible to accurately determine the nature of occupation of the study area from the end of the (known) Black Rock Phase occupation, ca. AD 200-300, until the arrival of Late Woodland peoples, perhaps ca. AD 800-1,000, as indicated by triangular projectile points and occasional pottery. No recognized, unequivocal data are known in the study area, with the probable exception of Jack's Reef Corner-notched points and perhaps various untyped notched points, though the dates and cultural affiliations of these are not precisely known. Thus, it is suggested that an occupational hiatus may have taken place during this time in the study area. Certainly the area was not altogether devoid of people for over 500 years, but permanent or even semi-permanent habitation evidently did not occur. As explained below, this condition also seems to obtain during the earlier portion of the Late Woodland Period, which in turn suggests continuity between the late Middle through early Late Woodland. The Lower Schuylkill may have been sporadically used for various purposes during this time, such as for hunting or as a transportation corridor, but substantial settlements were situated in areas to the east, west, and south.

Finally, the data from the Black Rock Phase may further suggest that Custer's (1984a:76ff) lumping of the Late Archaic through Middle Woodland Periods into a combined "Woodland I Period" is not universally correct throughout the greater Mid-Atlantic region, or at least is not accurate for the Lower Schuylkill River Valley. This estimation is based on the probable cultural discontinuity between the Terminal Archaic and Early Woodland Black Rock Phase. While the Late/Terminal Archaic Clyde Farm Complex of the Delmarva may be represented in the Lower Schuylkill Valley, most data suggest principal ties with Lackawaxen Phase societies on the Lower Delaware. The postulated reorientation of territorial ranges and boundaries from eastward to southward at the Archaic/Woodland interface does not support the postulation of overall cultural continuity throughout these periods and indeed, to persist in lumping these periods obfuscates important cultural variability and dynamics. The key to this problem is whether continuity exists within the Lower Schuylkill Valley between the Late/Terminal Archaic and Black Rock occupations, which is not certain at this point. The data from the Black Rock Phase clearly *does* support the combining of the Early and Middle Woodland Periods, since demonstrable continuity exists at least from the late Early through early Middle Woodland Periods.

11.5 Late Woodland and Contact Periods

Late Woodland components slightly outnumber earlier Woodland Period components in the study area (n=36). As discussed, considerable redundancy in site location is in evidence between Early/Middle and Late Woodland occupations, as well as between Woodland and Late/Terminal Archaic occupations. While this redundancy in site location suggests some degree of similarity in settlement patterns and use of the valley through time, Late Woodland components are fewer than those of the Archaic, and the respective adaptations were not identical. The cluster analyses showed that Late Woodland components tend to occur with somewhat greater frequency than expected near first order streams, though they are also common on larger streams. The first order, upland settings strongly parallel Late Archaic upland site locations, which implies a similar use of these environments.

To the extent that Levanna points tend to date to the earlier portion of the period, the four recovered specimens do not indicate a substantial presence during this time. Chert, jasper, and quartz were used for these artifacts. A minimum of 22 Madison points indicate a more intensive use, which probably post-dates AD 1,000. Most of these points are made of quartz. Unusual is Site 36 MG 124, with 30 unidentified triangular points made of chert or jasper. The nature or function of this site is unknown, though the points may represent a cache. Late Woodland pottery was recovered or recorded from at least three of the 56 sites investigated during the Limerick Transmission Line Surveys, and potentially two others as well. The PASS files identified only two more sites. Of these sites, only one (36 MG 161) yielded more than 25 sherds. This site is unusual, as it consists of an isolated whole pottery vessel.

A Late Woodland component with associated features was revealed by the excavations at the Frick's Lock Site, but the evidence for this occupation was scant and the precise nature and function of the component is uncertain. However, the data tentatively suggest a small, special-function occupation, and clearly not a large-scale, village-type site. Indeed, the Late Woodland Period parallels the Late Archaic in this regard, in that absolutely no Late Woodland villages, base camps, or otherwise substantial habitation sites are known for the entire Schuylkill Valley; agriculture was evidently not practiced here, and farming villages and/or agriculture-related artifacts appear to be absent. It is thought that the onset of the Late Woodland in the Middle Atlantic generally precipitated a widespread settlement shift, whereby the majority of large habitation sites were situated on productive floodplain environs of major river systems, with smaller sites occurring in upland environs (e.g. Custer and Wallace 1982:159). It is suggested that the narrow, incised Schuylkill Valley, with its general lack of broad floodplain tracts, was not well-suited for large-scale agriculture and would not have sustained such large settlements. Instead, all Late Woodland sites in the area appear to have been relatively small and/or ephemeral.

Thus, the lack of structures, the lack of definite burials, few features, little pottery, and few definite ground stone tools argue against the existence of heretofore unrecognized or undiscovered Late Woodland villages comparable to contemporary manifestations on the Delaware or Susquehanna. The pattern of numerous sites, relatively abundant projectile points, and relative lack of other material evidence suggests instead that the Lower Schuylkill River Valley was utilized as a logistic resource base (Binford 1980), and that most known sites were probably temporary and used principally for hunting. It is possible that plant-oriented procurement activities were conducted to some extent as well and the people utilizing the area appear to have come from various different systems (see below).

The Late Woodland settlement system suggested above, with its emphasis on non-permanent settlement and primary use as a hunting territory, obviously parallels the Late/Terminal Archaic Period system posited earlier. However, the Late Woodland reconstruction differs from Late/Terminal Archaic in that during the latter, there appears to have been more substantial, prolonged actual settlement in the area. This estimation is based principally on the large quantities of related artifacts and numerous components, and on the presence of potential small base camp-type residential sites. The Late Woodland occupations of the Lower Schuylkill look pale by comparison. This fact suggests that however transient or non-permanent the Archaic occupation may have been, the Late Woodland was much more so, and the Lower Schuylkill played an even less important role in regional Late Woodland settlement systems. It might be added that this suggested diminished role is underscored by data from the Upper Schuylkill, which saw a substantial Archaic occupation but appears to have played almost no role in Late Woodland settlement: only five triangular points and three ceramic-bearing sites were discovered in the entire Blue Marsh study area (Snethkamp et al. 1982:4.07, Tables 4.04, 8.01).

Regarding possible cultural affiliations of these people, one PASS file site (36 CH 84) reportedly produced Minguannan ceramics, which would indicate connections to the south; interestingly, this site lies near the southern edge of the project area, on a small tributary of French Creek. The smooth-surfaced, grit-tempered whole pot from 36 MG 161 is of indeterminate typology, though it may approximate the type Minguannan Plain (e.g. Custer 1984a:152-153; 1987). This site lies on Skippack Creek. Three sites have produced incised pottery strongly resembling the Overpeck or Bowmans Brook Incised types similar to ceramics from the Delaware Valley. One site (36 MG 85) occurs near the Northeast Branch of Perkiomen Creek which is, incidently, a direct water route to Upper Bucks County, where the Overpeck type site is located (Forks of the Delaware Chapter 1980). Two sites (36 CH 55, 36 CH 105) lie near each other on the Schuylkill, slightly downstream from the Frick's Lock Site. Presumably some of the sparse Frick's Lock assemblage also dates to the Late Woodland, though most certainly does not. Similarly, some of the pottery from the larger Indian Point assemblage may actually date to the Late Woodland, but no obvious or even suspected sherds have been noted. Both sites produced triangular points. No Shenks Ferry ceramics have been unequivocally identified. Similarly, late Middle/early Late Woodland Hell Island ceramics appear to be absent. Hell Island ceramics are considered to be ancestral to later Late Woodland Minguannan pottery (Custer 1984a:88, 154-156); the sparseness of Minguannan in the study area parallels the absence of the preceding Hell Island, and supports the observation that Hell Island/Minguannan are more southerly phenomena.

Relatively few studies have directly addressed Late Woodland societies, cultural relationships, or cultural boundaries within the Schuylkill River Basin. However, numerous authors have commented *et passim* on the Schuylkill Valley; several papers arrive at similar conclusions regarding Late Woodland societal distributions in areas surrounding the Schuylkill, and thus by extension within the Schuylkill basin proper. Stewart (1985) has proposed Middle and Late Woodland social boundaries based principally on ceramics in the greater Lower/Middle Delaware basin and adjacent New Jersey, for the periods ca. AD 200-800, and post-AD 800. The hypothesized southern and western boundaries for both distributions transect the Lower Schuylkill Valley. Custer's (1986:120, Fig. 13) distributional studies of Owasco/Clemson's Island versus Hell Island ceramics shows the northern boundary of Hell Island just barely encompassing the Lower Schuylkill; no system is depicted in the Upper Schuylkill, and Owasco/Clemson's Island occupies the Susquehanna Valley. Subsequent Shenks Ferry, Overpeck, and Minguannan distributions are thought to converge just north of the present study area; the Piedmont Uplands and Lower Schuylkill River proper are theoretically Minguannan, the Upper Schuylkill is Shenks Ferry, and Overpeck occurs in the Triassic Lowlands (Custer 1986:122, Fig. 14). Stewart et al. (1986:60, Fig. 5) illustrate a similar proposed Minguannan distribution. Elsewhere, Custer (1987:Fig. 5; also 1989b) draws a similar northern boundary line between Minguannan versus Shenks Ferry through the Schuylkill Valley at about Phoenixville. Importantly, he observes that "...a tentative boundary between the two complexes is noted for the region between the Susquehanna and Schuylkill Rivers....closer to the Schuylkill the boundary becomes ill-defined due to the limited nature of the archaeological data" (Custer 1987:17, 20).

Most of the proposed societal boundaries summarized above are supported by the Schuylkill River data, though there appears to have been even less occupation of the valley by these various societies than previously implied. Shenks Ferry is clearly absent from the Lower Schuylkill, and only three sites in the Upper Schuylkill have yielded Shenks Ferry sherds (Snethkamp et al. 1982:4.07). Overpeck and other Delaware Valley ceramics are rare in the Lower Schuylkill. Minguannan presence is negligible at best, and it may be observed that several Minguannan sites documented in the Piedmont Uplands in southern Chester County and northern New Castle County (Custer 1984a:155-156; 1985; 1987:20; Custer and Wallace 1982) probably represent the effective northern limit of substantial Minguannan occupation.

Given these distributions, it is clear that no particular society was predominant in the study area throughout the Late Woodland Period. This observation supports the idea that the Schuylkill was an "open territory" used for hunting and transportation, but not for sustained settlement. It is interesting to speculate on the possibility that the Schuylkill River and/or Piedmont Uplands/Triassic Lowlands interface may have demarcated a social or political boundary(ies) during the Late Woodland, and perhaps earlier (i.e. during the Late Archaic) as well. Indeed, lack of evidence for substantial habitation in the Schuylkill Basin might further suggest that the basin was actually more than simply a boundary, but could have functioned as a societal/territorial "buffer zone" between systems. The area was variously intruded upon and utilized by many societies on a regular or as-needed basis, but was never actually occupied by any group for an extended period of time. An interesting combination of factors emerges from this circumstance: 1) the environmental/ecological marginality of the Lower Schuylkill Valley for agriculture as compared to the neighboring Susquehanna and Delaware Valleys; 2) the potential high productivity of the valley for hunting, due in part to a lack of permanent occupants which would deplete game animal populations; 3) the geographical situation of the Lower Schuylkill Valley at the interface of two physiographic zones and between two major river drainages; and 4) the probable "need" or desire by Late Woodland societies to maintain territorial integrity for political and/or economic reasons. These factors comprise an internally consistent set, and are proposed as supportive of the territorial buffer hypothesis.

Various papers dealing with the Contact Period occupation of southeastern Pennsylvania outline historically-documented territorial patterns that may be of relevance to the Late Woodland. Few authors have directly addressed Lenape or Susquehannock presence in the Schuylkill proper, though one group of Lenapes was referred to historically as the "Schuylkill Indians" (e.g. Becker 1980b; Hunter 1983). However, for the most part the Schuylkill appears to have never been a focus of intensive Lenape settlement, despite their substantial presence in the Lower Delaware; the Schuylkill was probably used as a transportation corridor for purposes of trade, and possibly on a seasonal (warm weather) basis by groups centered along the Delaware (Becker 1980b:21-26). It has been suggested that hostile incursions by Susquehannocks may have contributed to a general depopulation of eastern Pennsylvania during much of the ethnohistoric period (Goddard 1978:215). Hunter (1983) has discussed a Susquehannock Indian town on the Schuylkill near Pottstown. His descriptions of the use of the Schuylkill in historic times by Susquehannocks is similar to such use by the Lenape, i.e. that the basin was a "no man's/every man's land", with much travel between the major rivers on either side, and thus much transient presence in the valley but relatively little prolonged settlement (see also Jennings 1978:362-365). It should be interjected that in the study area, only one potential Susquehannock site was recorded in the PASS files, and no other definite Lenape or Susquehannock sites or materials were found, though Lenape presence at the mouth of the Schuylkill and elsewhere in the vicinity of the study area has been previously documented (e.g. Becker 1980a, 1980b, 1982, 1984; Goddard 1978). While the patterns described above may be attributable to some extent to factors of European cultural contact and disruption, this phenomenon provisionally may be projected into the more distant past, which reflects changes in social/political dynamics and territories through time. In any case, the demonstrably sparse Late Woodland presence in the Schuylkill may be a result of social boundary maintenence, and similar patterns of use as documented for the ethnohistoric period may have obtained; the data collected to date clearly indicate that the Schuylkill can be considered a "peripheral" area for sustained settlement during both the Late Woodland and Contact Periods.

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TABLES

Table 1.

Frick's Lock Site, Distribution of Diagnostic Projectile Points by Terrace and Raw Material

Type	Upper Terrace (Raw Materials)	Lower Terrace (Raw Materials)
Madison	4 (3 quartz, 1 jasper)	1 (1 quartz)
Tock's Island	1 (1 quartz)	0
Teardrop	2 (2 quartz)	1 (1 quartz)
Rossville	1 (1 quartzite)	0
Dry Brook	1 (1 chert)	1 (1 chert)
Susquehanna	0	1 (1 rhyolite)
Perkiomen	3 (3 jasper)	0
Koens-Crispin	1 (1 quartzite)	2 (2 quartzite)
Broadspear	1 (1 chert)	0
Bare Island	5 (5 quartzite)	3 (3 quartzite)
Poplar Island	1 (1 argillite)	2 (1 quartz, 1 quartzite)
Genesee-like	0	1 (1 jasper)
Bifurcate	1 (1 jasper)	0

Table 2a.

Frick's Lock Site, Tool Classes Occurring on the Upper Terrace

Tool Class	Raw Material C/C	JAS	QUA	QZT	ARG	RHY	MISC	Total
Projectile/Knife	2	10	9	11	2	1	0	35
Scraper	2	5	1	1	1	0	0	10
Drill	0	2	0	0	0	0	0	2
Biface	5	10	9	3	1	0	0	28
Blank/Preform	0	1	1	2	1	0	0	5
Miscellaneous	1	4	6	2	1	1	0	15
Totals	10	32	26	19	6	2	0	95

Table 2b.

Frick's Lock Site, Tool Classes Occurring on the Lower Terrace

Tool Class	Raw Material C/C	JAS	QUA	QZT	ARG	RHY	MISC	Total
Projectile/Knife	2	8	9	12	4	1	0	36
Scraper	0	4	2	3	0	0	0	9
Drill	0	0	0	0	0	0	0	0
Biface	5	4	6	3	2	0	0	20
Blank/Preform	0	0	0	2	1	0	0	3
Miscellaneous	0	5	3	5	0	0	1	14
Totals	7	21	20	25	7	1	1	82

Key: C/C = chert/chalcedony, JAS = jasper, QUA = quartz, QZT = quartzite, ARG = argillite, RHY = rhyolite

Table 3a.

Frick's Lock Site, Tools by Raw Materials on the Upper and Lower Terraces

	Raw Material							
	C/C	JAS	QUA	QZT	ARG	RHY	MISC	Total
Upper Terrace Tools								
Frequency	10	32	26	19	6	2	0	95
Percentage	10.5	33.7	27.4	20.0	6.3	2.1	0.0	99.9
Lower Terrace Tools								
Frequency	7	21	20	25	7	1	1	82
Percentage	8.5	25.6	24.4	30.5	8.5	1.2	1.2	99.9

Table 3b.

Frick's Lock Site, Debitage by Raw Materials on the Upper and Lower Terraces

	Raw Material							
	C/C	JAS	QUA	QZT	ARG	RHY	MISC	Total
Upper Terrace Debitage								
Frequency	77	410	253	206	18	6	3	973
Percentage	7.9	42.1	26.0	21.2	1.9	0.6	0.3	100
Lower Terrace Debitage								
Frequency	55	291	163	131	35	2	4	681
Percentage	8.1	42.7	23.9	19.2	5.1	0.2	0.6	100.1

Key: C/C = chert/chalcedony, JAS = jasper, QUA = quartz, QZT = quartzite, ARG = argillite, RHY = rhyolite

Table 4.

Frick's Lock Site, Tool Classes

Tool Class	Frequency	Percentage
Projectile/knife	74	40.1
Scraper	19	10.7
Drill	2	1.1
Blank/Preform	8	4.5
Biface	48	27.1
Miscellaneous	29	16.4
Total	177	100.0

Table 5.

Point Bar Site, Soil Stratigraphy

Layer	Textural Class	Type of Deposit
I	Sandy Loam	Overbank/Levee
II	Silt Loam	Overbank/Levee
III	Loam	Overbank/Levee
IV	Sandy Loam	Overbank/Levee
V	Loamy Sand	Channel/Point Bar
VI	Sand	Channel/Point Bar
VII	Sandy Gravel	Channel/Point Bar

Table 6.

Point Bar Site, Distribution of Soil Strata at Proposed Structure 6/5

Unit	Layer	Average Depth at Bottom (Below Surface in Inches)
N5/W25	II	16
	III	22
	IV	33
S0/W20	II	15.5
	III	20.5
	IV	29
S0/W5	I	15.5
	II	23.5
	IV	35
S5/E5	I	14
	II	30
	IV	40
S10/W5	I	18
	II	30
	IV	46
N5/E15	II	13
	III	19
	IV	29.5
S0/E20	II	14
	IV	32
N15/E5	II	15
	IV	32
N20/E10	II	15
	IV	30

Table 7.

Point Bar Site, Diagnostic Artifacts by Soil Strata and Depth Below Surface

Artifact Class	Cultural Period	Layer (Depth below surface)	Unit
Proposed Structure 6/5			
Otter Creek-like	Middle/Late Archaic	I/II (14-17)	S0/W5
Brewerton Side-notched	Late Archaic	II (14-17")	S5/E5
Snook Kill	Terminal Archaic	II (14-17")	S5/E5
Potsherds (3)	Woodland	II (11-14")	S5/E5
Lehigh Broadspear	Terminal Archaic	II (11-14")	N20/E10
Bifurcate-base	Early Archaic	II (11-14")	N20/E10
Contracting Stem Broadspear	Terminal Archaic	II (9-12")	S0/W20
Potsherd	Woodland	II/III (15-18")	S0/W20
Potsherd	Woodland	II/III (16-19")	N5/W25
Rossville-like	Middle Woodland	III (19-22")	N5/W25
Potsherd	Woodland	III (15-18")	N5/E15
Greene Point	Middle Woodland	IV (18-21")	N5/E15
Potsherd	Woodland	IV (18-21")	N5/E15
Potsherd	Woodland	IV (18-21")	N15/E5
Orient Fishtail	Terminal Archaic	IV (19-22")	S0/E20
Proposed Structure 6/6			
Bifurcate-base	Early Archaic	N/A (13-16")	S0/E10
Bifurcate-base	Early Archaic	N/A (14-17")	S10/W5
Potsherds (4)	Woodland	N/A (16-19")	S0/W5
Potsherd	Woodland	N/A (17-19.5")	S0/W35
Potsherd	Woodland	N/A (19-22")	S0/E10

Table 8.

Point Bar Site, Debitage by Raw Materials

	Raw Material							
	C/C	JAS	QUA	QZT	ARG	RHY	MISC	Total
Proposed Structure 6/6 (Phase II)								
Frequency	32	205	598	113	38	0	5	991
Percentage	3.2	20.7	60.3	11.4	3.8	0.0	0.5	100.1
Proposed Structure 6/5 (Phase II)								
Frequency	133	1676	1809	1969	248	20	42	5897
Percentage	2.3	28.4	30.7	33.4	4.2	0.3	0.7	100.1
Overall Site Totals for Phase I and Phase II								
Frequency	175	2007	2515	2221	291	20	50	7279
Percentage	2.4	27.6	34.6	30.5	4.0	0.3	0.7	100.1

Key: C/C = chert/chalcedony, JAS = jasper, QUA = quartz, QZT = quartzite, ARG = argillite, RHY = rhyolite

Table 9.

Point Bar Site, Tools by Raw Materials

	Raw Material							
	C/C	JAS	QUA	QZT	ARG	RHY	MISC	Total
Proposed Structure 6/6 (Phase II)								
Frequency	0	5	8	3	3	0	1	20
Percentage	0	25.0	40.0	15.0	15.0	0.0	5.0	100.0
Proposed Structure 6/5 (Phase II)								
Frequency	2	22	18	20	12	0	1	75
Percentage	2.7	29.3	24.0	26.7	16.0	0.0	1.3	100.0
Overall Site Totals for Phase I and Phase II								
Frequency	2	30	30	26	18	0	3	109
Percentage	1.8	27.5	27.5	23.9	16.5	0.0	2.8	100.0

Key: C/C = chert/chalcedony, JAS = jasper, QUA = quartz, QZT = quartzite, ARG = argillite, RHY = rhyolite

Table 10.

Point Bar Site, Tool Classes

Tool Class	Raw Material C/C	JAS	QUA	QZT	ARG	RHY	MISC	Total (%)
Projectile/Knife	0	11	6	7	13	0	0	37 (34.0)
Scraper	0	0	0	0	0	0	0	0 (0.0)
Drill	0	0	0	0	0	0	0	0 (0.0)
Graver	0	1	2	0	0	0	0	3 (2.8)
Biface	0	4	9	12	3	0	1	29 (26.6)
Blank/Preform	0	0	2	0	1	0	0	3 (2.8)
Uniface	0	0	7	2	0	0	0	9 (8.3)
Miscellaneous	2	14	4	5	1	0	2	28 (25.7)
Totals	2	30	30	26	18	0	3	109
Percentage	1.8	27.5	27.5	23.9	16.5	0.0	2.8	100.0

Key: C/C = chert/chalcedony, JAS = jasper, QUA = quartz, QZT = quartzite, ARG = argillite, RHY = rhyolite

Table 11.

Indian Point Site, Diagnostic Projectile Points

Type	Raw Material Type							
	Chert	Jasper	Quartz	Quartzite	Argillite	Rhyolite	Other	Total (%)
Bifurcate-base	4	1	1	0	0	1	0	7 (5.6)
Side-notched	7	3	8	0	1	0	1	20 (16.0)
Brewerton Side-notched	7	2	3	0	1	0	0	13 (10.4)
Brewerton Eared-notched	0	0	0	1	0	0	0	1 (0.8)
Vosburg	0	0	1	1	0	0	0	2 (1.6)
Lamoka	1	3	0	0	1	0	0	5 (4.0)
Normanskill	0	1	0	0	0	0	0	1 (0.8)
Bare Island/Straight Stemmed	3	2	0	6	5	0	0	16 (12.8)
Poplar Island/Contracting Stemmed	3	0	2	2	6	1	1	15 (12.0)
Broadspear	1	7	0	0	0	0	3	11 (8.8)
Susquehanna	1	1	0	0	0	0	0	2 (1.6)
Perkiomen	1	0	0	0	0	0	0	1 (0.8)
Orient Fishtail/Fishtail	2	5	0	0	2	0	0	9 (7.2)
Eshback	0	0	0	2	0	0	0	2 (1.6)
Rossville	0	0	0	2	3	0	1	6 (4.8)
Fox Creek	0	0	0	0	1	0	0	1 (0.8)
Jack's Reef/Corner-notched	0	2	2	0	0	0	0	4 (3.2)
Levanna	0	0	1	0	0	0	0	1 (0.8)
Madison	0	0	6	1	0	0	0	7 (5.6)
Triangular	0	0	1	0	0	0	0	1 (0.8)
Totals	30	27	25	15	20	2	6	125
Percentage	24.0%	21.6%	20.0%	12.0%	16.0%	1.6%	4.8%	100%

Table 12.

Indian Point Site, Debitage and Tools by Surface Collection Units and Feature Group

Collection Unit	Debitage Count	Tool Count
N550-N600	134	2
N500-N550/Group 1	684	12
N450-N500/Group 1	893	31
N400-N450	109	10
N350-N400/Group 2	439	18
N300-N350	186	14
N250-N300/Group 3 (Fea. 28)	253	17
N200-N250/Group 3	193	12
N150-N200/Group 3 (Fea. 2)	79	10
N100-N150	14	2
N50 -N100	12	1
NO-N50	9	0
Totals	3005	118

Table 13.

Indian Point Site, Frequencies and Proportions of Debitage Raw Material Types, by Feature Group

Raw Material	Group 1		Group 2		Group 3	
Quartz	407	46.2%	185	46.6%	23	27.7%
Jasper	221	25.1%	106	26.8%	25	30.1%
Quartzite	70	8.0%	47	11.8%	5	6.0%
Chert	43	4.9%	16	4.0%	18	21.7%
Argillite	112	12.7%	28	7.1%	6	7.2%
Rhyolite	17	1.9%	9	2.3%	0	0.0%
Other	11	1.2%	6	1.5%	6	7.2%
Totals	881	100.0%	397	100.1%	83	99.9%

Table 14.

Indian Point Site, Frequencies of Tool Raw Material Types, by Feature Group

Raw Material	Group 1	Group 2	Group 3
Quartz	10	5	3
Jasper	4	2	4
Quartzite	5	4	1
Chert	4	2	1
Argillite	2	1	0
Rhyolite	1	0	0
Siltstone	1	0	0
Shale	0	4	0
Slate	0	2	0
Totals	27	20	9

Table 15.

Indian Point Site, Proportions of Angular, Flat, and Bifacial Retouch Debitage, by Raw Material and Feature Group

Group 1

Raw Material	Angular	Flat	Bifacial
Quartz	63.9%	27.5%	8.6%
Jasper	33.9%	35.3%	30.8%
Quartzite	40.0%	47.1%	12.9%
Chert	25.6%	34.9%	39.5%
Argillite	20.5%	58.9%	20.5%
Rhyolite	23.5%	29.4%	47.1%
Other	54.5%	36.4%	9.1%

Group 2

Raw Material	Angular	Flat	Bifacial
Quartz	51.4%	29.2%	19.5%
Jasper	17.9%	39.6%	42.5%
Quartzite	27.7%	55.3%	17.0%
Chert	26.7%	40.0%	33.3%
Argillite	7.1%	71.4%	21.4%
Rhyolite	33.3%	33.3%	33.3%
Other	83.3%	16.6%	0.0%

Group 3

Raw Material	Angular	Flat	Bifacial
Quartz	43.5%	39.1%	17.4%
Jasper	19.2%	53.9%	26.9%
Quartzite	0.0%	100.0%	0.0%
Chert	22.2%	61.1%	16.6%
Argillite	50.0%	16.6%	33.3%
Rhyolite	--	--	--
Other	66.6%	33.3%	0.0%

Table 16.

Indian Point Site, Chipped Stone Tool Class Frequencies, by Feature Group

	Group 1	Group 2	Group 3
Projectile Point	8	7	0
Drill	0	0	1
Knife	0	1	1
Unfinished Biface	4	3	2
Bifacially Retouched Flake	1	2	0
Miscellaneous Biface Fragment	6	3	1
Graver	0	0	1
Endscraper	2	0	0
Denticulate	0	0	1
Unifacially Retouched Flake	4	3	1
Piece Esquillee	2	1	1
Totals	27	20	9

Table 17.

Diagnostic Projectile Points from Lower Schuylkill Valley Study Area

Type	Chert	Jasper	Quartz	Quartzite	Argillite	Rhyolite	Other	Total (%)
				Raw Material Type				
Bifurcate-base	7	7	1	0	0	2	1	18 (4.7)
Side-notched	10	8	11	0	1	0	1	31 (8.1)
Brewerton Side-notched	8	3	5	2	2	0	0	20 (5.2)
Brewerton Eared-notched	0	0	1	1	0	0	0	2 (0.5)
Vosburg	0	0	3	1	0	0	0	4 (1.0)
Lamoka	1	3	0	1	1	0	0	6 (1.6)
Normanskill	0	1	0	1	0	0	0	2 (0.5)
Bare Island/Straight Stemmed	3	3	8	30	11	0	0	55 (14.3)
Poplar Island/Contracting Stemmed	6	2	7	24	20	1	1	61 (15.8)
Expanding Stemmed	1	0	8	11	0	0	0	20 (5.2)
Broadspear	3	10	0	3	3	0	3	22 (5.7)
Snook Kill/Koens-Crispin	0	0	0	8	3	0	0	11 (2.9)
Lehigh	0	1	0	1	0	0	0	2 (0.5)
Susquehanna	1	2	0	0	0	1	0	4 (1.0)
Perkiomen	1	2	0	0	0	0	0	3 (0.8)
Meadowood	2	0	0	0	0	0	0	2 (0.5)
Orient Fishtail/Fishtail	6	8	0	1	3	1	0	19 (4.9)
Eshback	0	0	0	2	0	0	0	2 (0.5)
Rossville	0	0	1	2	4	0	1	8 (2.1)
Fox Creek	0	0	0	0	5	0	0	5 (1.3)
Jack's Reef	0	1	1	0	0	0	0	2 (0.5)
Corner-Notched	5	5	5	1	0	0	0	16 (4.2)
Levanna	1	2	1	0	0	0	0	4 (1.0)
Madison	0	0	20	1	1	0	0	22 (5.7)
Triangular	17	13	12	1	0	1	0	44 (11.4)
Totals	72	71	84	91	54	6	7	385
Percentage	18.7%	18.4%	21.8%	23.6%	14.0%	1.6%	1.8%	100%

Table 18.

Lithic Raw Materials - Pooled Site Data

Raw Material	Tools 16 Sites Mean %	Debitage 26 Sites Mean %	Tools 16 Sites Range %	Debitage 26 Sites Range %	Tools 16 Sites Std. Dev.	Debitage 26 Sites Std. Dev.
Quartz	50.7	55.4	7.7-87.2	6.3-94.4	26.4	24.8
Quartzite	12.9	19.6	0.0-24.9	0.2-77.1	7.5	18.4
Jasper	16.9	18.5	0.0-46.2	1.0-54.6	13.2	15.3
Chert	11.1	4.2	0.0-50.0	0.4-12.9	13.8	3.0
Argillite	4.8	1.4	0.0-16.5	0.0 -7.2	5.5	2.1
Rhyolite	1.2	0.2	0.0 -7.7	0.0 -2.9	2.5	0.6

Table 19.

Percentages of Raw Materials for Tools and Debitage by Site

Site Number Debitage (Cluster #) Tools (Group #)	Percent Raw Material Type Chert	Jasper	Quartz	Quartzite	Argillite	Rhyolite	Other
36 MG 44							
Debitage (1)	1.9	3.9	94.4	0.2	0.0	0.0	1.1
Tools (1)	0.0	20.0	80.0	0.0	0.0	0.0	0.0
36 MG 104							
Debitage (1)	1.9	3.9	90.4	0.2	0.0	0.0	1.1
Tools (1)	14.3	7.1	64.3	0.0	7.1	7.1	0.0
36 MG 140							
Debitage (1)	0.7	1.0	88.4	9.0	0.0	0.0	0.7
Tools (1)	3.2	3.2	71.0	12.9	6.5	0.0	3.2
36 MG 155							
Debitage (1)	3.5	1.7	89.0	5.2	0.6	0.0	0.0
Tools (1)	0.0	0.0	87.2	12.5	0.0	0.0	0.0
36 CH 383							
Debitage (1)	0.4	4.5	86.5	8.2	0.0	0.4	0.0
Tools (1)	4.6	0.0	86.4	4.6	0.0	0.0	4.6
36 MG 8							
Debitage (7)	3.5	14.8	71.2	8.4	0.0	0.2	0.7
Tools (1)	2.0	9.8	74.5	3.9	9.8	0.0	0.0
36 MG 162							
Debitage (7)	6.0	13.6	71.2	8.4	0.0	0.2	0.7
Tools (2)	15.0	23.8	41.3	13.8	0.3	1.3	0.3
36 CH 53							
Debitage (7)	4.0	25.0	54.0	5.0	4.3	0.7	2.0
Tools (2)	10.9	24.7	42.0	13.3	6.8	0.8	1.6
36 MG 172							
Debitage (6)	7.2	20.5	48.2	22.9	1.2	0.0	0.0
Tools (2)	33.3	20.0	33.3	13.3	0.0	0.0	0.0
36 CH 382							
Debitage (6)	7.5	10.8	55.9	22.6	2.2	0.0	1.1
Tools (1)	4.0	4.0	72.0	20.0	0.0	0.0	0.0

Table 19. (Cont.)

36 MG 134							
Debitage (2)	0.7	7.1	44.3	43.6	1.4	2.9	0.0
Tools (2)	21.4	7.1	42.9	14.3	14.3	0.0	0.0
36 MG 139							
Debitage (2)	2.4	13.0	27.6	56.1	0.0	0.0	0.8
Tools (2)	0.0	30.8	46.2	15.4	0.0	0.0	7.7
36 MG 156							
Debitage (3)	2.4	27.6	34.6	30.5	4.0	0.3	0.7
Tools (2)	1.8	27.5	27.5	23.9	16.5	0.0	2.8
36 CH 103							
Debitage (3)	8.0	42.4	25.2	20.4	3.2	0.5	0.4
Tools (2)	9.6	29.9	26.0	24.9	7.3	1.7	0.6
36 MG 151							
Debitage (5)	8.1	54.6	31.3	4.0	2.0	0.0	0.0
Tools (2)	7.7	46.2	7.7	15.4	7.7	7.7	7.7
36 MG 173							
Debitage (5)	8.2	54.6	18.6	11.3	7.2	0.0	0.0
Tools (2)	50.0	16.7	8.3	18.8	0.0	0.0	0.0

Table 20.

K-Means Clusters, Debitage by Raw Material

Summary Statistics for 7 Clusters

Variable	Between SS	DF	Within SS	DF	F-Ratio	Prob
Chert	120.384	6	103.422	19	3.686	0.013
Jasper	5397.799	6	449.181	19	38.054	0.000
Quartz	14330.130	6	1045.930	19	43.386	0.000
Quartzite	7931.972	6	492.609	19	50.990	0.000
Argillite	62.414	6	43.806	19	4.512	0.005
Rhyolite	2.187	6	6.292	19	1.101	0.398
Other	15.878	6	14.287	19	3.519	0.016

Cluster Number: 1

Members		Statistics				
Case	Distance	Variable	Minimum	Mean	Maximum	St. Dev.
MG140	1.73	Chert	0.40	1.73	3.50	1.15
CH111	5.70	Jasper	1.00	4.21	7.90	2.27
CH383	0.68	Quartz	73.70	85.71	94.40	6.83
MG136	3.44	Quartzite	0.20	7.54	15.80	4.66
MG104	4.34	Argillite	0.00	0.27	1.30	0.47
MG155	1.93	Rhyolite	0.00	0.06	0.40	0.14
MG44	2.26	Other	0.00	0.44	1.30	0.54

Cluster Number: 2

Members		Stastics				
Case	Distance	Variable	Minimum	Mean	Maximum	St. Dev.
MG37	3.79	Chert	0.70	2.80	5.30	1.90
MG134	2.63	Jasper	3.50	7.87	13.00	3.92
MG139	5.90	Quartz	27.60	39.77	47.40	8.70
		Quartzite	43.60	47.87	56.10	5.82
		Argillite	0.00	0.47	1.40	0.66
		Rhyolite	0.00	0.97	2.90	1.37
		Other	0.00	0.27	0.80	0.38

Table 20. (Cont.)

Cluster Number: 3

Members			Statistics			
Case	Distance	Variable	Minimum	Mean	Maximum	St. Dev.
MG1	3.63	Chert	2.40	6.72	12.90	4.13
CH56	5.58	Jasper	27.60	33.85	42.40	5.36
CH103	4.30	Quartz	25.20	32.38	43.90	7.62
MG156	4.45	Quartzite	13.70	21.80	30.50	6.00
		Argillite	2.20	3.98	6.50	1.59
		Rhyolite	0.00	0.20	0.50	0.21
		Other	0.00	1.17	3.60	1.42

Cluster Number: 4

Members			Statistics			
Case	Distance	Variable	Minimum	Mean	Maximum	St. Dev.
MG141	0.00	Chert	2.10	2.10	2.10	0.00
		Jasper	10.40	10.40	10.40	0.00
		Quartz	6.30	6.30	6.30	0.00
		Quartzite	77.10	77.10	77.10	0.00
		Argillite	0.00	0.00	0.00	0.00
		Rhyolite	0.00	0.00	0.00	0.00
		Other	4.20	4.20	4.20	0.00

Cluster Number: 5

Members			Statistics			
Case	Distance	Variable	Minimum	Mean	Maximum	St. Dev.
MG151	2.94	Chert	8.10	8.15	8.20	0.05
MG173	2.94	Jasper	56.60	54.60	54.60	0.00
		Quartz	18.60	24.95	31.30	6.35
		Quartzite	4.00	7.65	11.30	3.65
		Argillite	2.00	4.60	7.20	2.60
		Rhyolite	0.00	0.00	0.00	0.00
		Other	0.00	0.00	0.00	0.00

Table 20. (Cont.)

Cluster Number: 6

Members			Statistics			
Case	Distance	Variable	Minimum	Mean	Maximum	St. Dev.
CH382	3.71	Chert	3.90	5.82	7.50	1.55
MG137	3.26	Jasper	10.80	18.08	25.60	5.54
MG172	1.50	Quartz	46.50	50.15	55.90	3.54
CH116	2.58	Quartzite	22.60	24.90	30.80	3.42
		Argillite	0.00	0.85	2.20	0.92
		Rhyolite	0.00	0.00	0.00	0.00
		Other	0.00	0.28	1.10	0.48

Cluster Number: 7

Members			Statistics			
Case	Distance	Variable	Minimum	Mean	Maximum	St. Dev.
MG162	3.13	Chert	2.90	4.08	6.00	1.04
MG149	1.81	Jasper	13.60	20.22	25.70	5.08
MG8	2.84	Quartz	59.00	66.96	71.70	5.09
CH384	2.72	Quartzite	4.00	7.00	9.00	2.07
CH53	3.84	Argillite	0.00	1.02	4.30	1.67
		Rhyolite	0.00	0.18	0.70	0.27
		Other	0.00	0.58	2.00	0.75

Table 21.

Summary of Component Occupations Within the Study Area

Components	f	%
Historic/Contact	1	.3
"Woodland"	12	4.0
Late Woodland	36	11.0
Middle Woodland	10	3.0
Early/Middle Woodland	8	3.0
Early Woodland	11	4.0
"Archaic"	40	13.0
Terminal Archaic	30	10.0
Late Archaic	64	20.0
Middle Archaic	15	5.0
Early Archaic	19	6.0
Paleo-Indian	5	2.0
Unknown Prehistoric	63	20.0
Total	313	101.3
All Woodland	77	31
All Archaic	168	69
Total	245	100

Table 22.

Woodland and Archaic Period Components in the Study Area

Components	f	%
"Woodland"	12	16
Late Woodland	36	47
Middle Woodland	10	13
Early/Middle Woodland	8	10
Early Woodland	11	14
Total	77	100
"Woodland"	12	16
Late Woodland	36	47
Early, Early/Middle, Middle Woodland	29	38
Total	77	101
"Archaic"	40	24
Terminal Archaic	30	19
Late Archaic	64	38
Middle Archaic	15	9
Early Archaic	19	11
Total	168	101

Table 23.

Single and Multiple Component Occupations, by Period

Component/Period	Single f	Single %	Multiple f	Multiple %	n
Historic/Contact	0	-	1	100	1
"Woodland"	0	-	12	100	12
Late Woodland	5	14	31	86	36
Middle Woodland	1	10	9	90	10
Early/Middle Woodland	0	-	8	100	8
Early Woodland	0	-	11	100	11
"Archaic"	22	55	18	45	40
Terminal Archaic	2	7	28	93	30
Late Archaic	20	31	44	69	64
Middle Archaic	2	13	13	87	15
Early Archaic	1	5	18	95	19
Paleo-Indian	1	20	4	80	5
Unknown Prehistoric	63	100	0	-	63
All Woodland	6	8	71	92	77
All Archaic	47	28	121	72	168
All Sites, Excluding Unknown Prehistoric	54	44	68	56	122

Table 24.

Cross Tabulation of Woodland and Archaic Component Co-occurrences

		Component	
		Woodland	Archaic
Component	Woodland	2	50
	Archaic	50	13

Summary:

n=65
Woodland/Woodland: n = 2 (3%)
Woodland/Archaic: n = 50 (77%)
Archaic/Archaic: n = 13 (20%)

Table 25.

Comparison of Percentages, All Components vs. Clustered Components (Figure 37)

Component	All (N=240)	Clusters A	B	C	D	E	F&G	Residual Sites
"Woodland	5%	4%	5%	8%	3%	2%	8%	8%
Late Woodland	15	13	14	15	20	12	17	8
Middle Woodland	4	8	-	2	3	7	8	-
Early/Middle	3	-	4	5	3	2	4	-
Early Woodland	5	4	-	7	3	8	-	-
"Archaic"	15	25	14	12	12	7	34	33
Terminal Archaic	12	13	23	10	12	15	-	18
Late Archaic	27	25	18	23	36	29	21	33
Middle Archaic	6	4	4	8	5	10	-	-
Early Archaic	8	4	18	10	3	8	8	-
	100%	100%	100%	100%	100%	100%	100%	100%

Table 26.

Chi-Square Calculation, Archaic/Woodland Period Components vs. Stream Orders

	O	E	O-E	$(O-E)^2/E$
Archaic/0,1	36	35	1	.028
Archaic/2,3	16	17	-1	.058
Archaic/4,5	21	21	0	.000
Archaic/6,7	37	37	0	.000
Woodland/0,1	17	18	-1	.055
Woodland/2,3	10	9	1	.111
Woodland/4,5	10	10	0	.000
Woodland/6,7	19	19	0	.000
Totals	166	166	0	$.252 = x^2$

$x^2 = .252$
P.05 = 7.815
df = 3
Fail to Reject H_o

Table 27.

Chi-Square Calculation, Archaic/Woodland Period Components vs. Landforms

	O	E	O-E	$(O-E)^2/E$
Archaic/Terrace	32	37	-5	.675
Archaic/Bluff	9	9	0	.000
Archaic/Upland	41	38	3	.236
Archaic/U. Slope	28	26	2	.153
Woodland/Terrace	24	19	5	1.315
Woodland/Bluff	5	5	0	.000
Woodland/Upland	16	19	-3	.473
Woodland/U. Slope	11	13	-2	.307
Totals	166	166	0	$3.159 = x^2$

$x^2 = 3.159$
P.05 = 7.815
df = 3
Fail to Reject H_o

FIGURES

Locations of Limerick Transmission Line Surveys

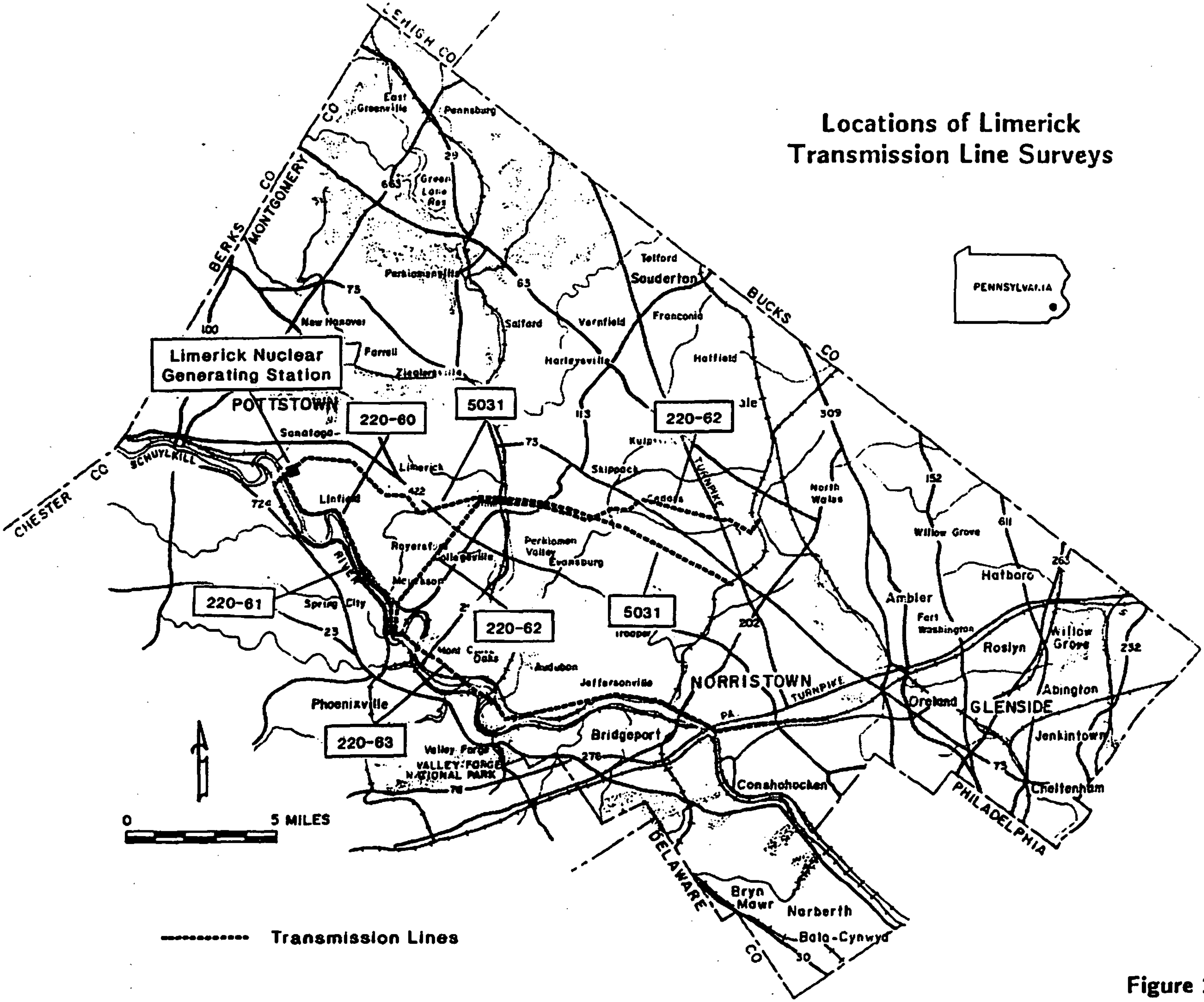
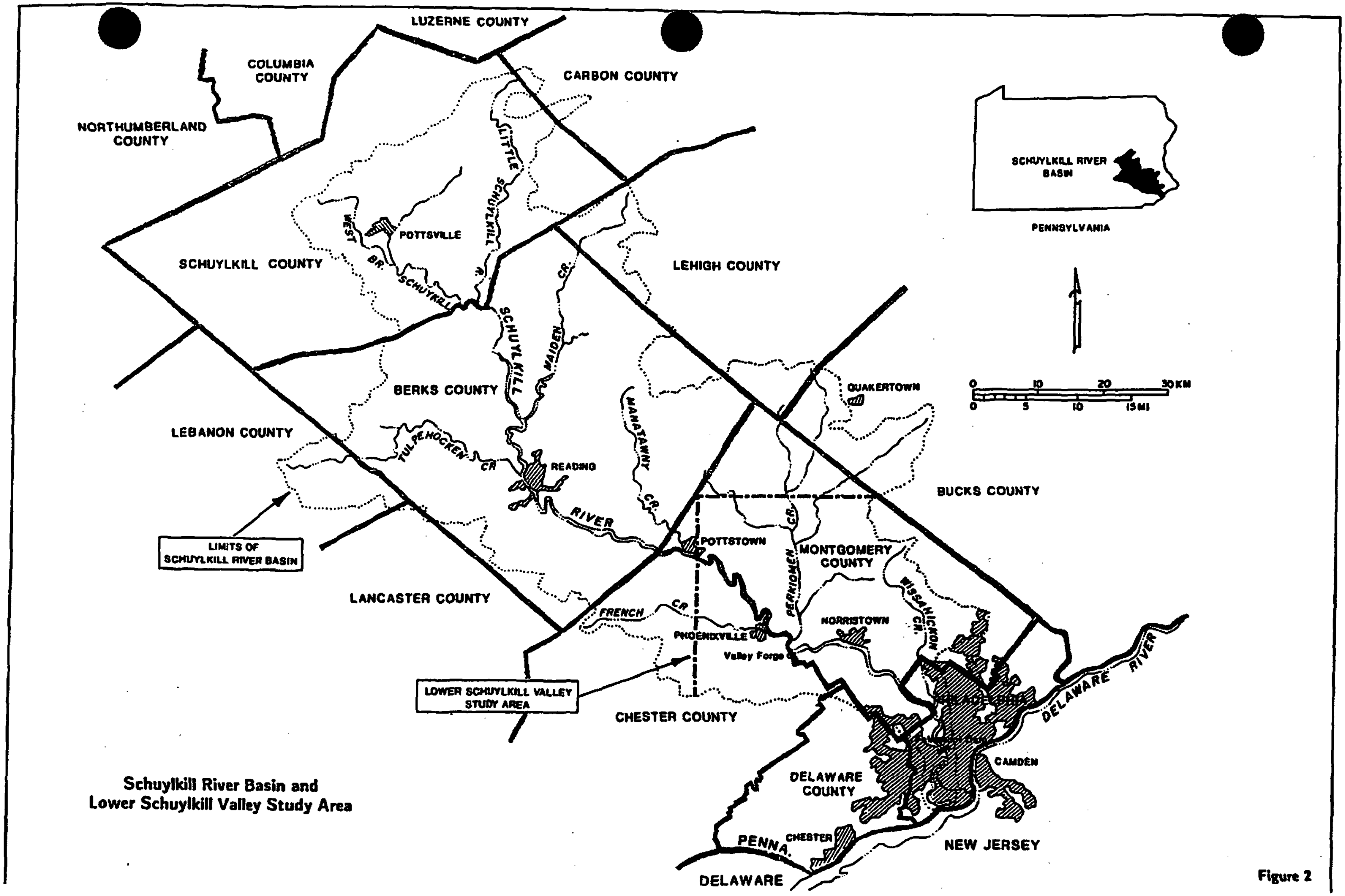
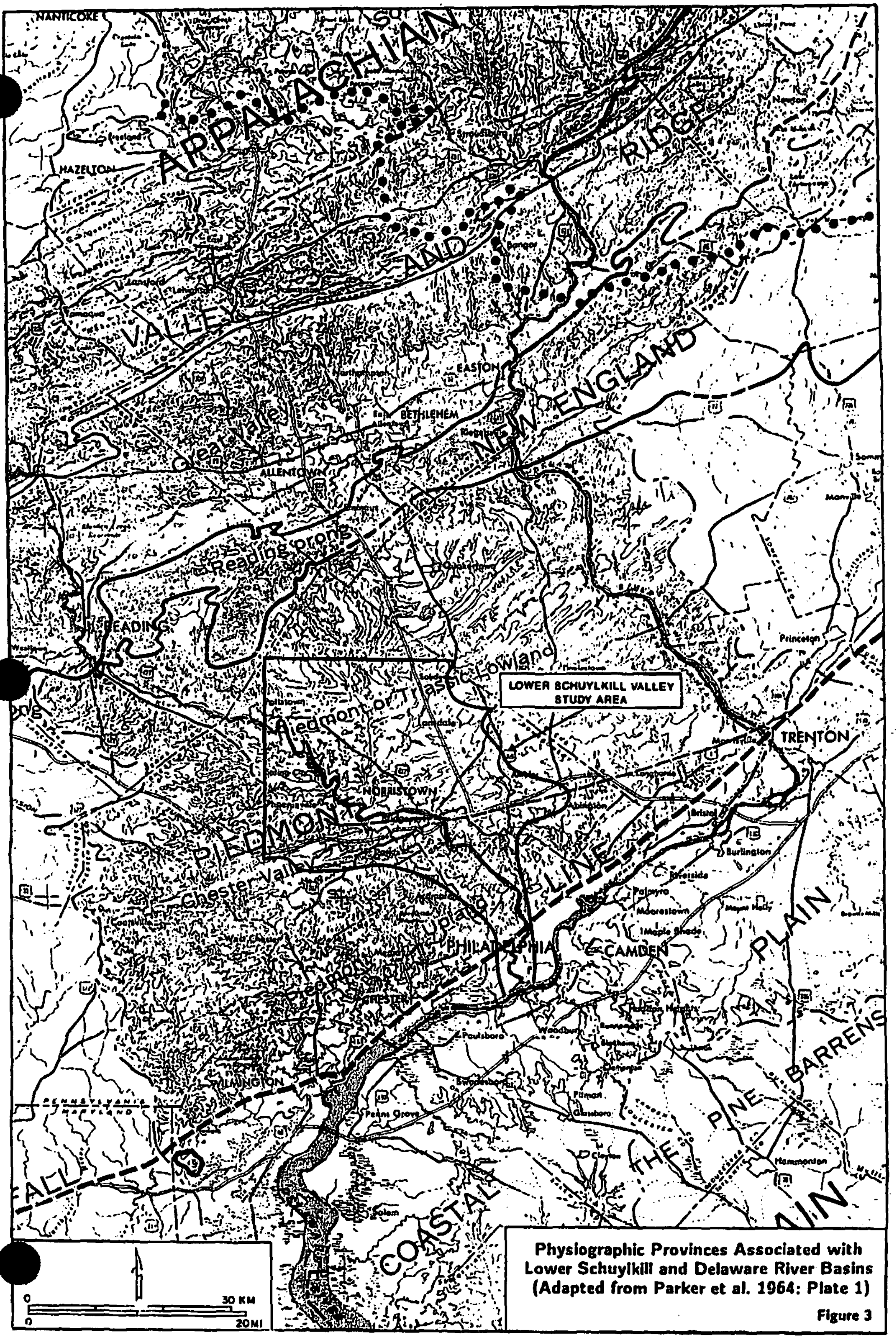


Figure 1



Schuylkill River Basin and Lower Schuylkill Valley Study Area

Figure 2



Physiographic Provinces Associated with Lower Schuylkill and Delaware River Basins (Adapted from Parker et al. 1964: Plate 1)

Figure 3

Subsurface Geology of Lower Schuylkill and Delaware River Basins (Adapted from Parker et al. 1964: Plate 5)

Figure 4

Representative Types of Lattice Towers

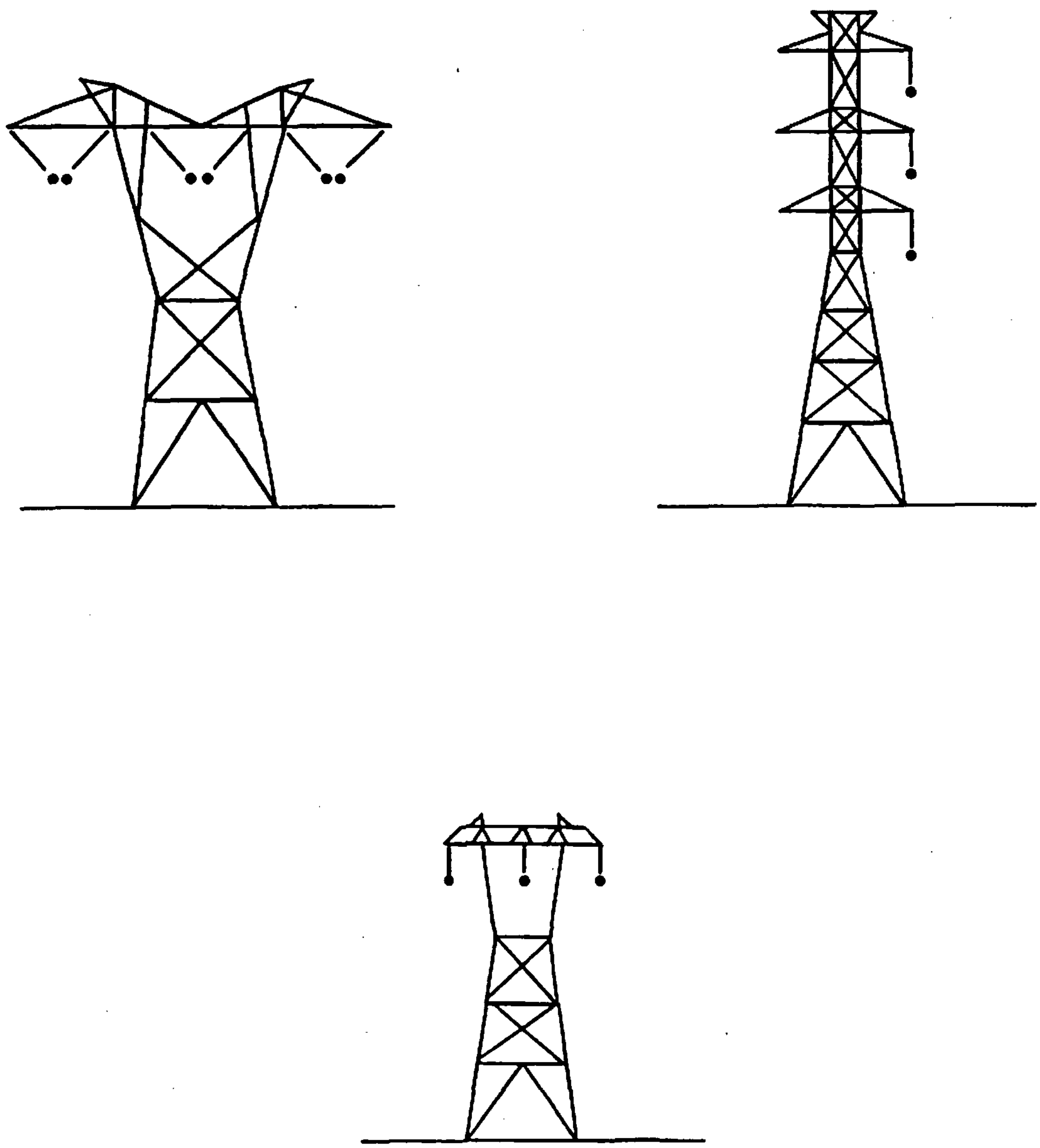


Figure 5

Typical Railroad Overbuild Structure

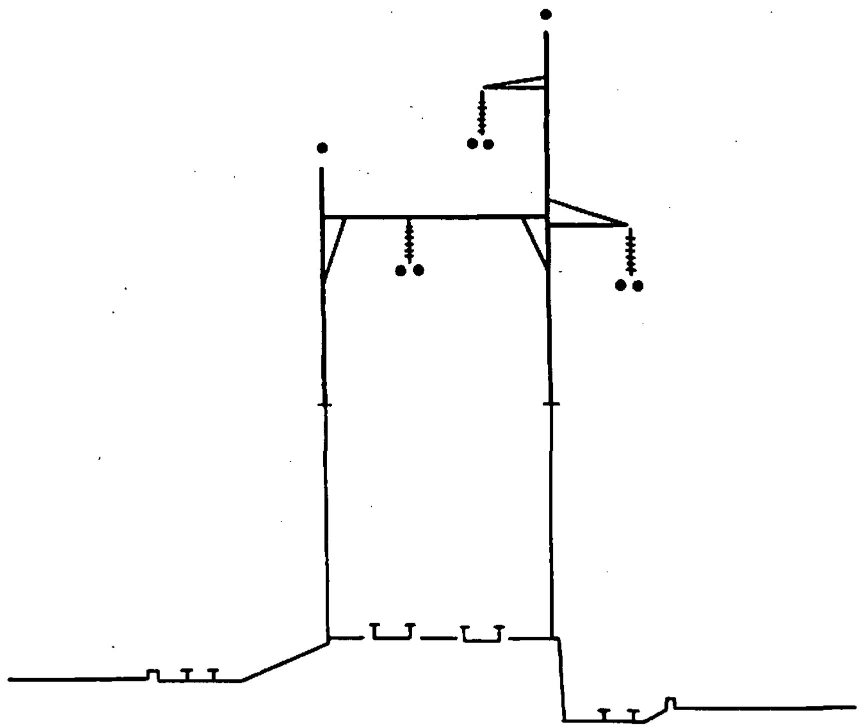


Figure 6

Representative Types of Tubular Steel Poles

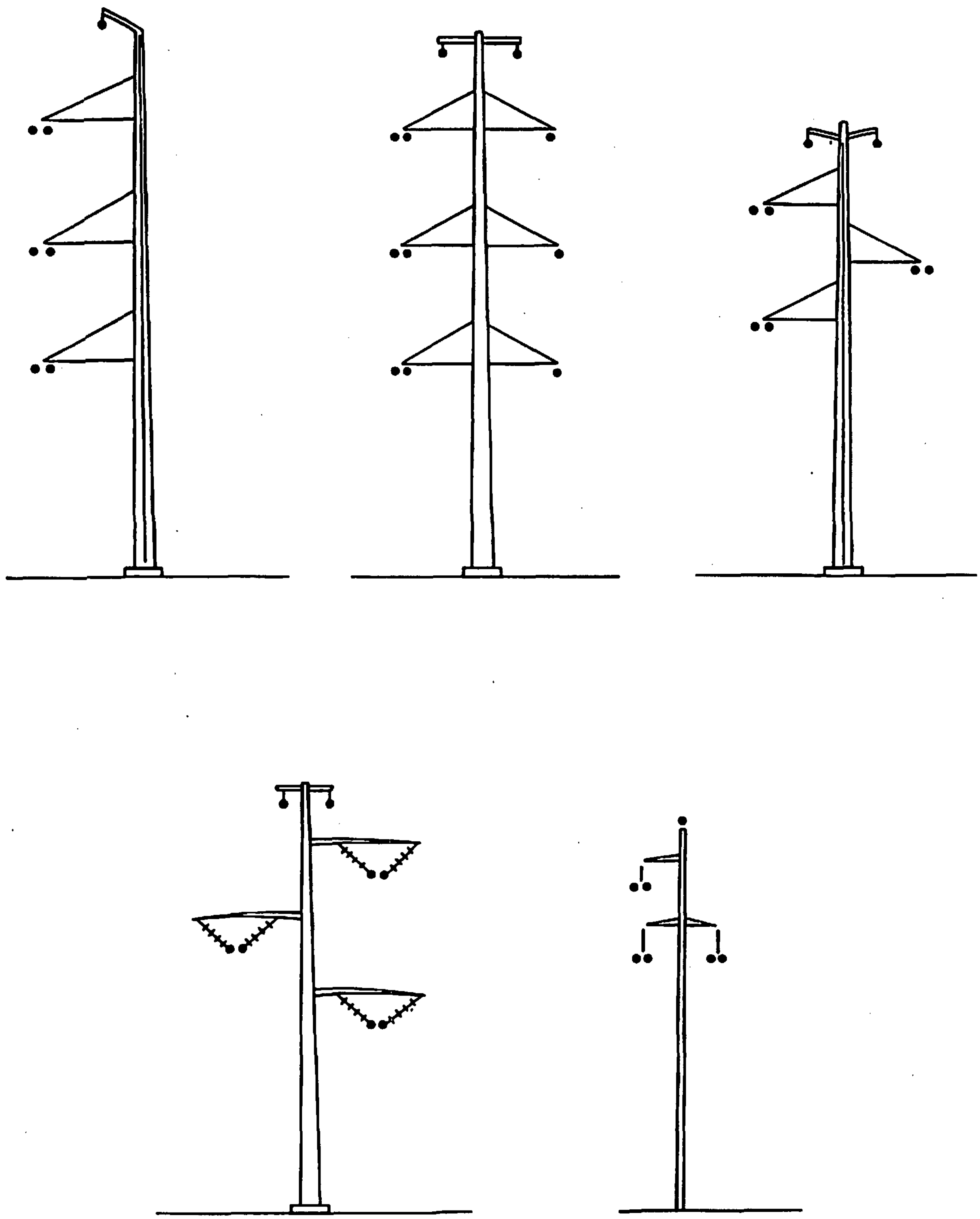


Figure 7

Typical Three Pole Deadend Structure

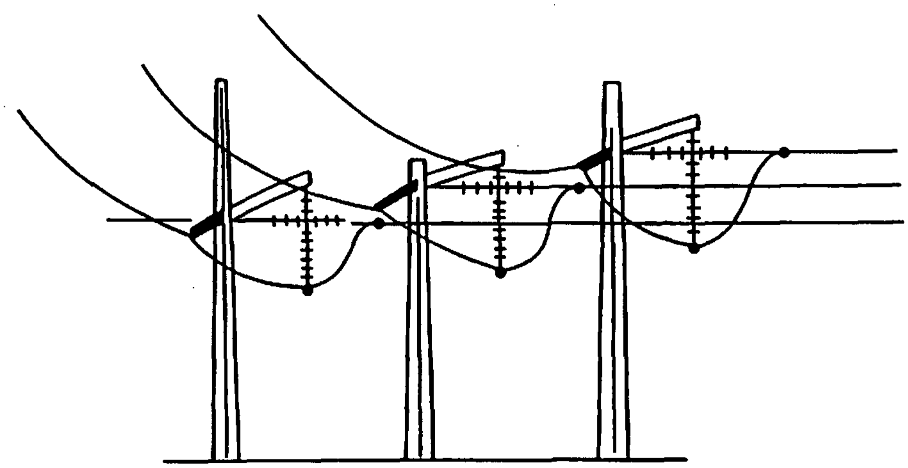


Figure 8

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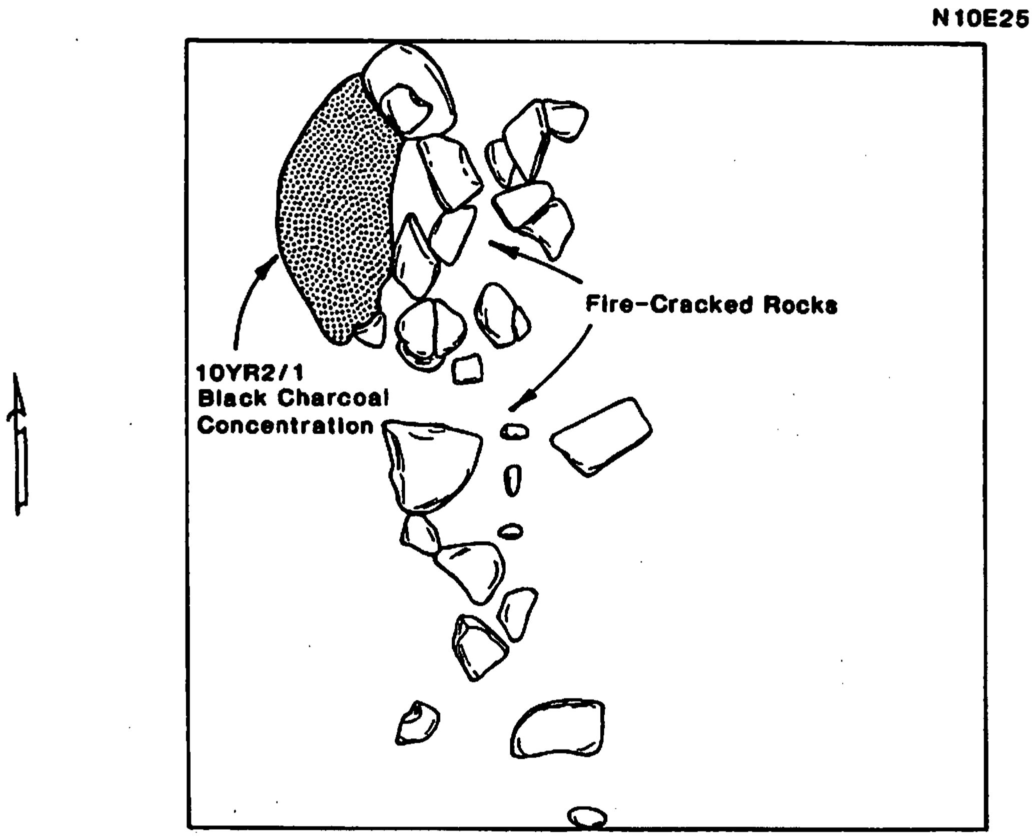
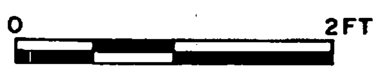
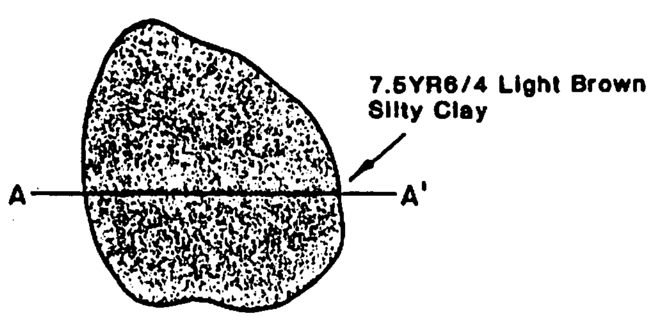
NRC GUIDELINES REGARDING SENSITIVE
CULTURAL RESOURCES LOCATION
INFORMATION

Frick's Lock Site, Features 35 and 9

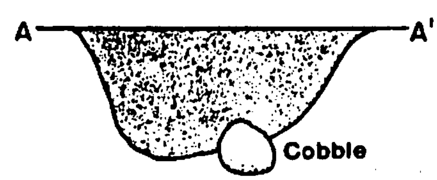
Feature 35, Hearth
Plan







Feature 9, Pit
Plan



Feature 9, Pit
Profile

Figure 11

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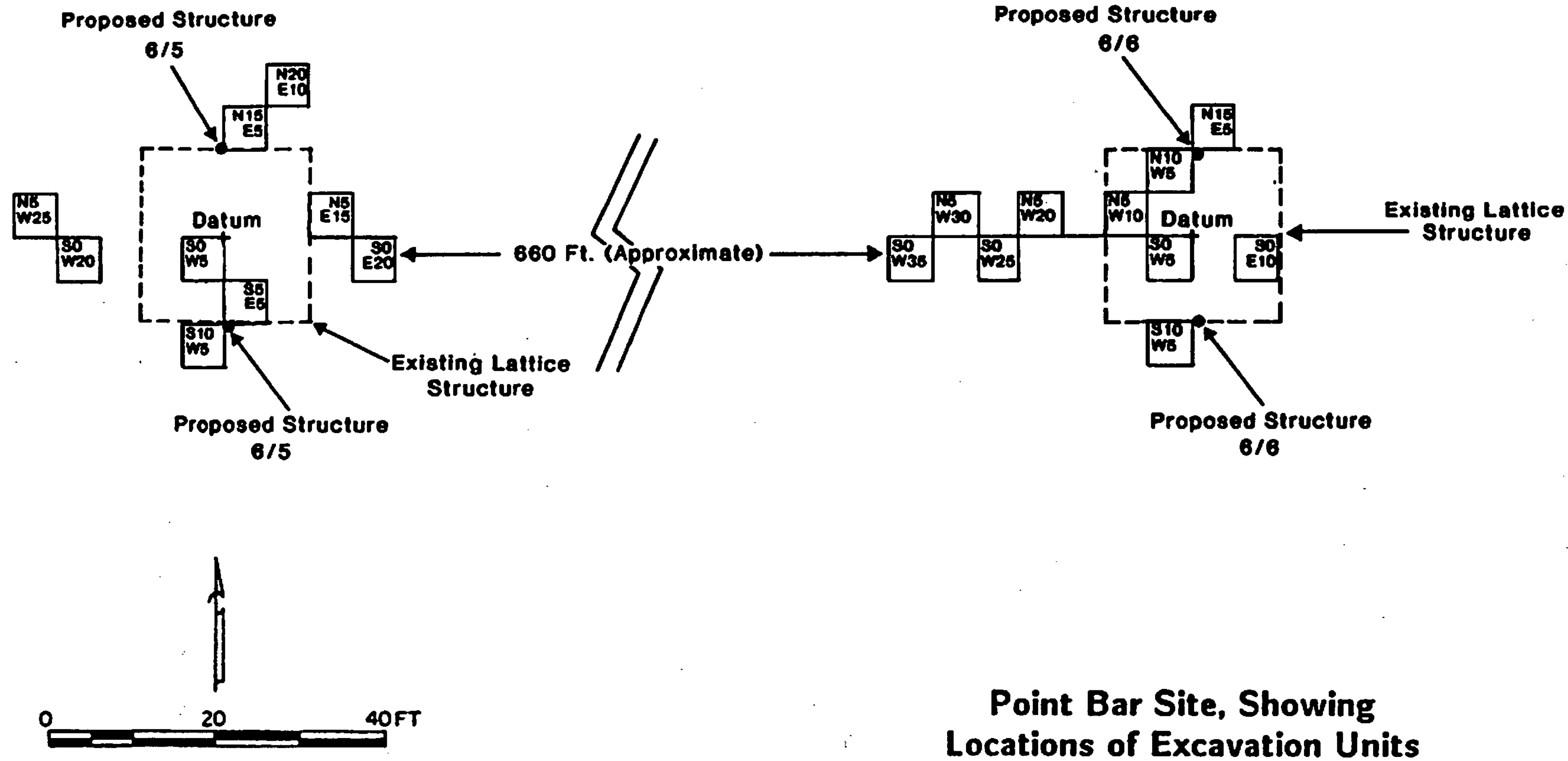
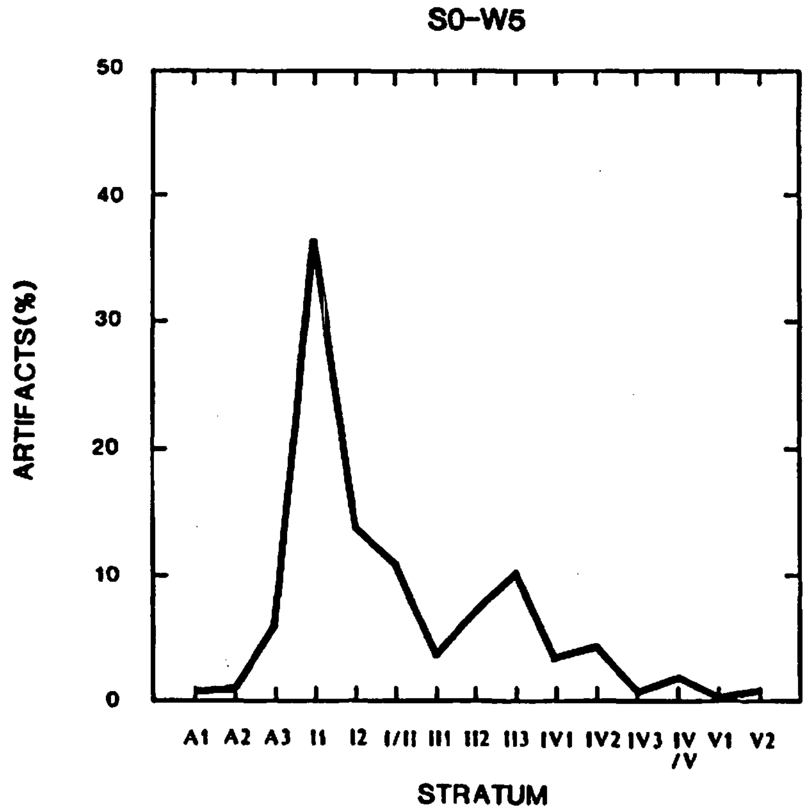
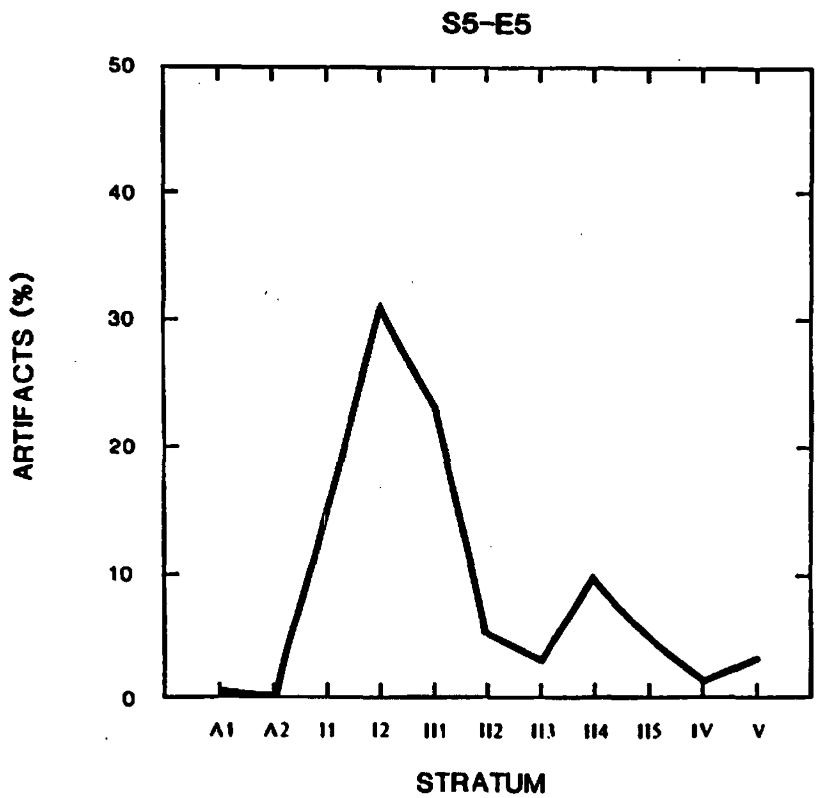


Point Bar Site, Showing
Locations of Excavation Units

Figure 13

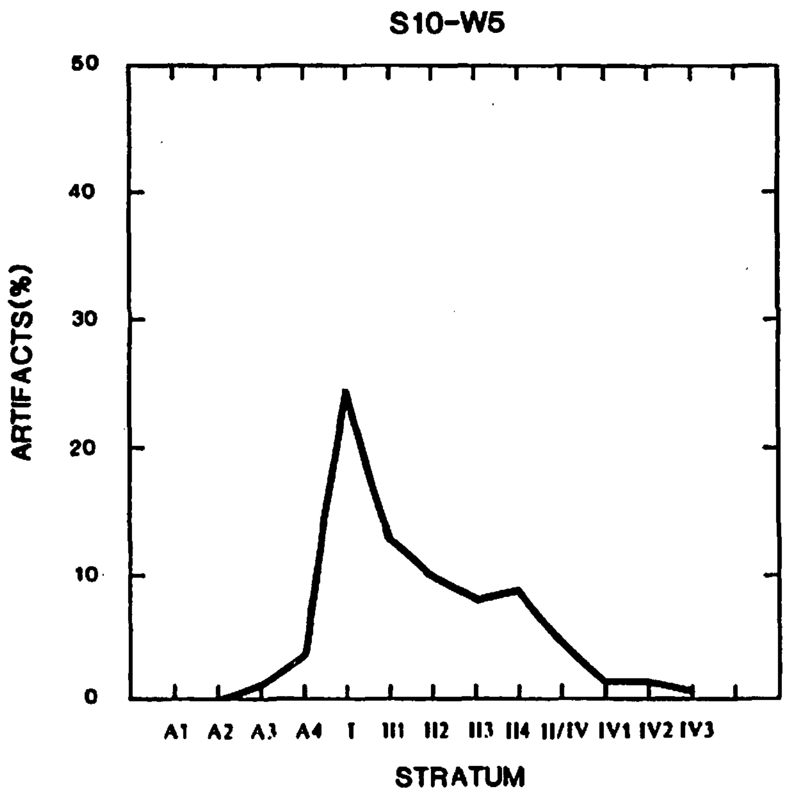


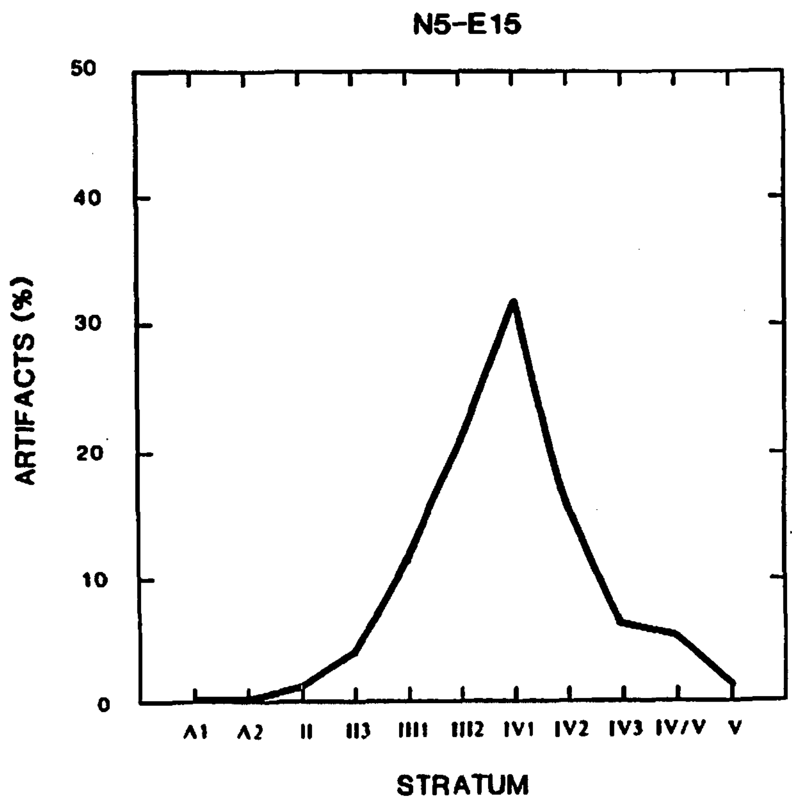


A = overburden
Roman Numeral = stratum
Arabic Numeral = arbitrary 3" level within stratum

Point Bar Site, Percentage of Artifacts by Level, Excavation Units S0-W5 and S5-E5

Figure 14

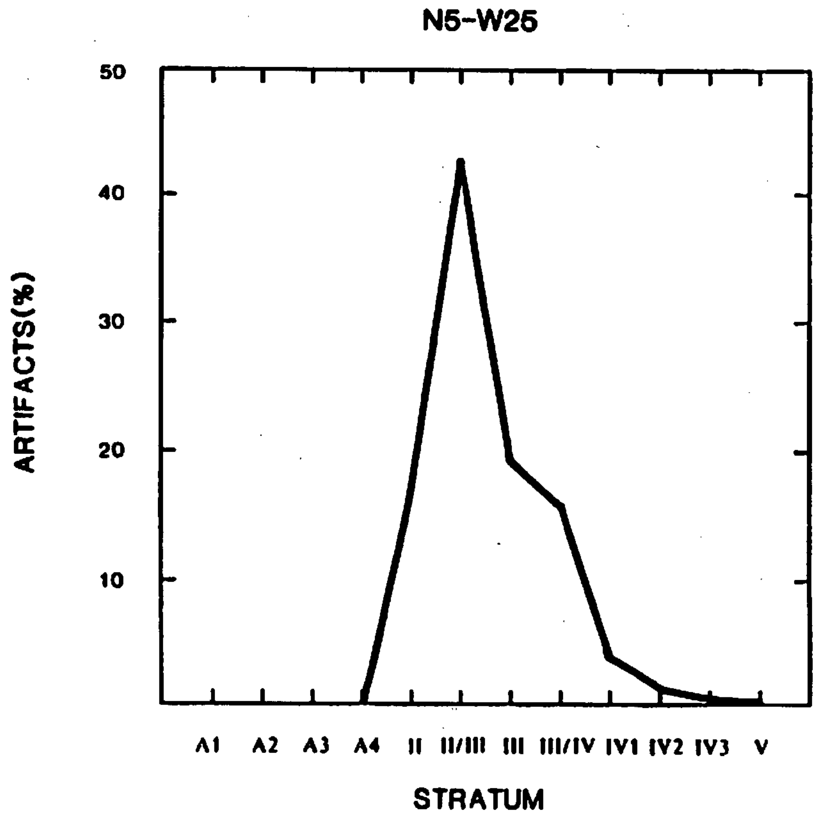


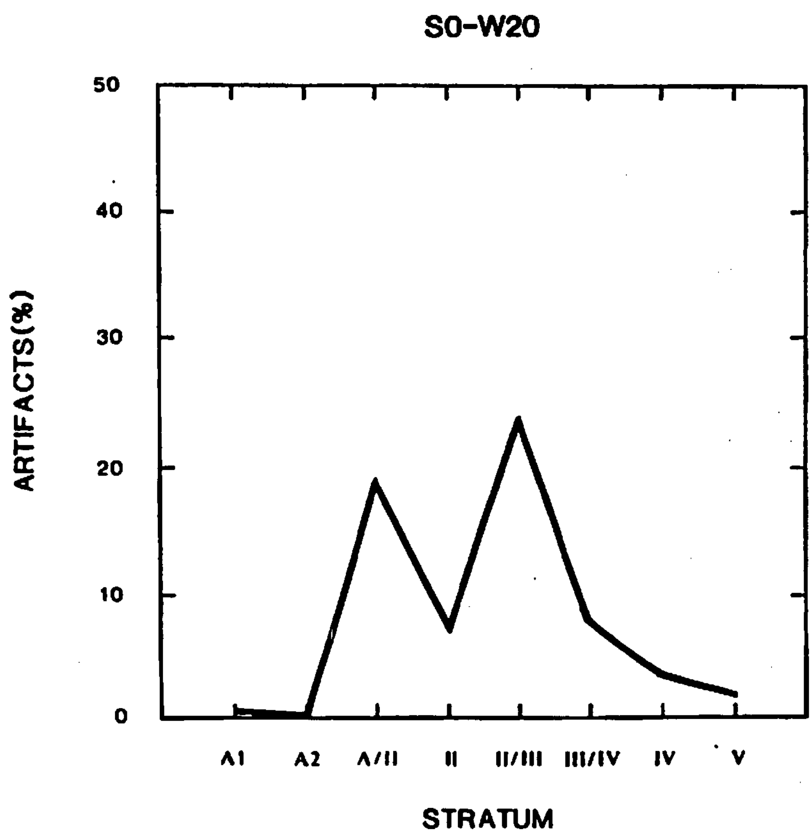


A = overburden
Roman Numeral = stratum
Arabic Numeral = arbitrary 3" level within stratum

Point Bar Site, Percentage of Artifacts by Level, Excavation Units S10-W5 and N5-E15

Figure 15

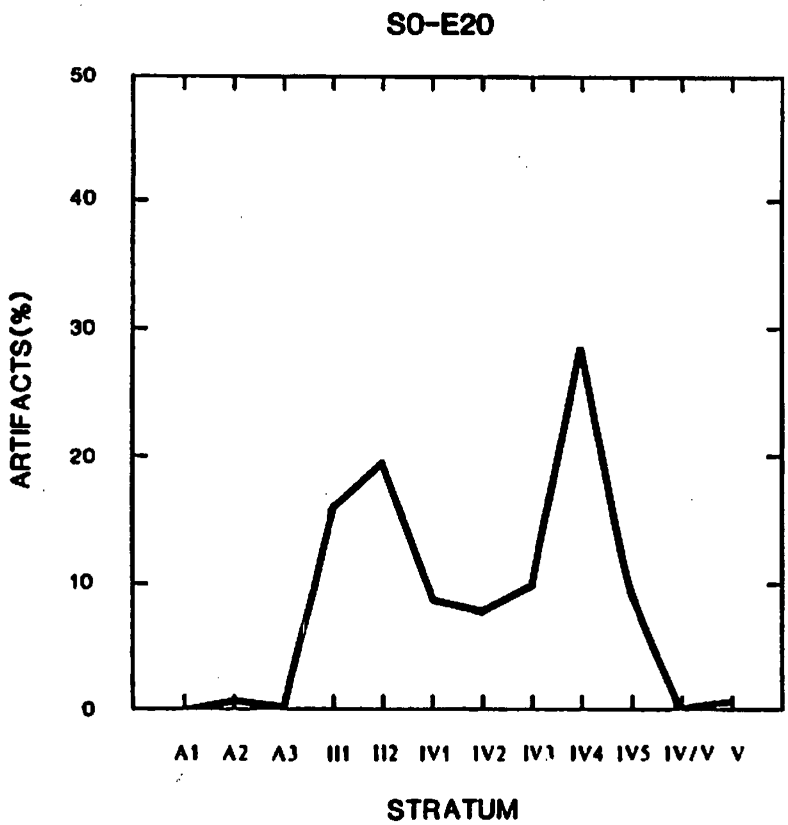


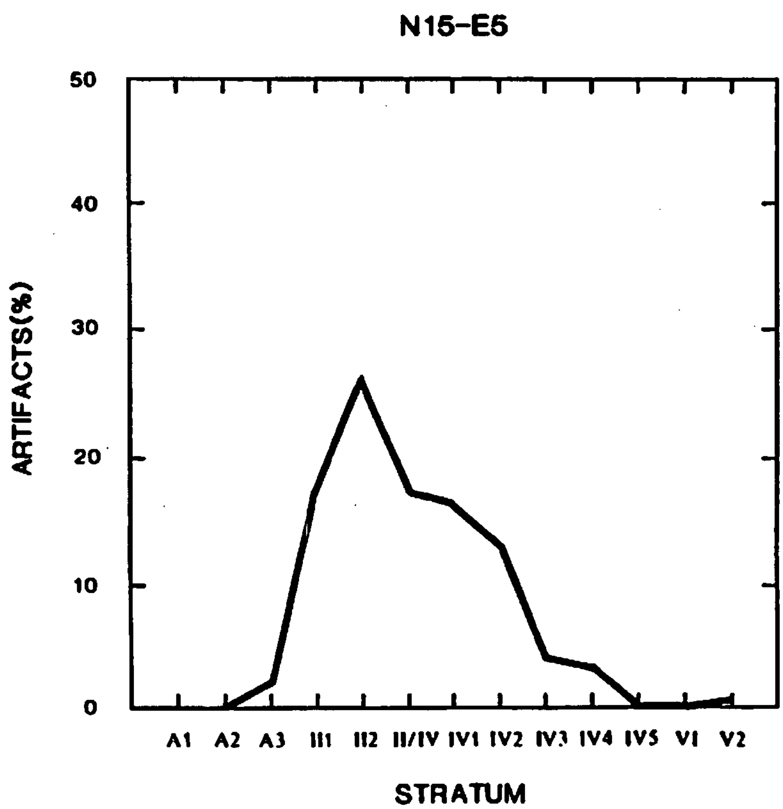


A = overburden
Roman Numeral = stratum
Arabic Numeral = arbitrary 3" level within stratum

Point Bar Site, Percentage of Artifacts by Level, Excavation Units N5-W25 and S0-W20

Figure 16

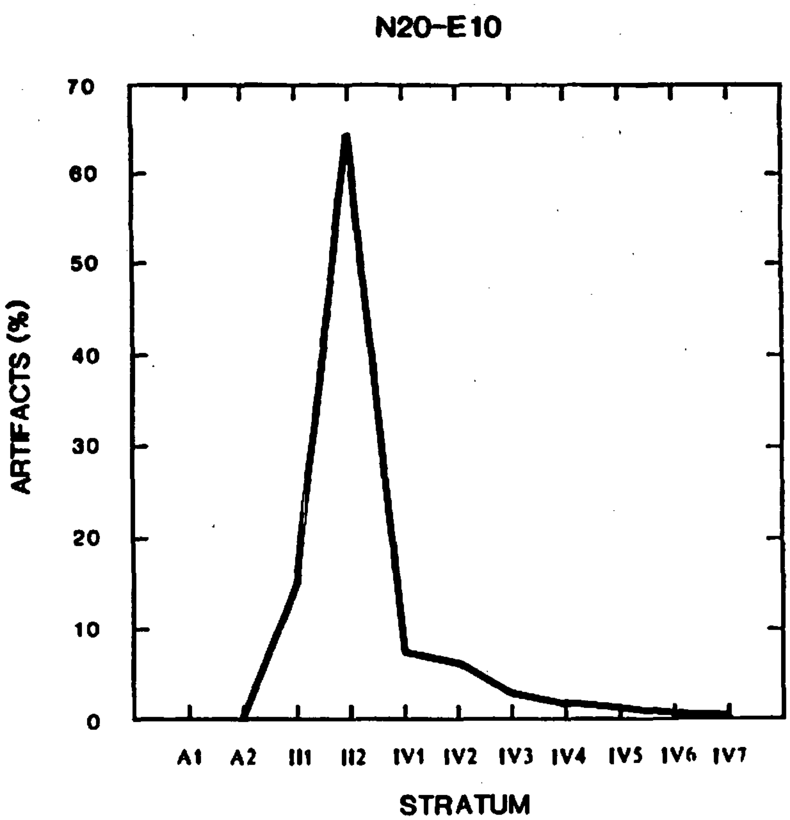





```
           A  =  overburden
Roman Numeral  =  stratum
Arabic Numeral =  arbitrary 3" level
                  within stratum
```

Point Bar Site, Percentage of Artifacts by Level, Excavation Units S0-E20 and N15-E5

Figure 17



A = overburden
Roman Numeral = stratum
Arabic Numeral = arbitrary 3" level within stratum

Point Bar Site, Percentage of Artifacts by Level, Excavation Unit N20-E10

Figure 18

Point Bar Site, Feature 1, Hearth

Plan

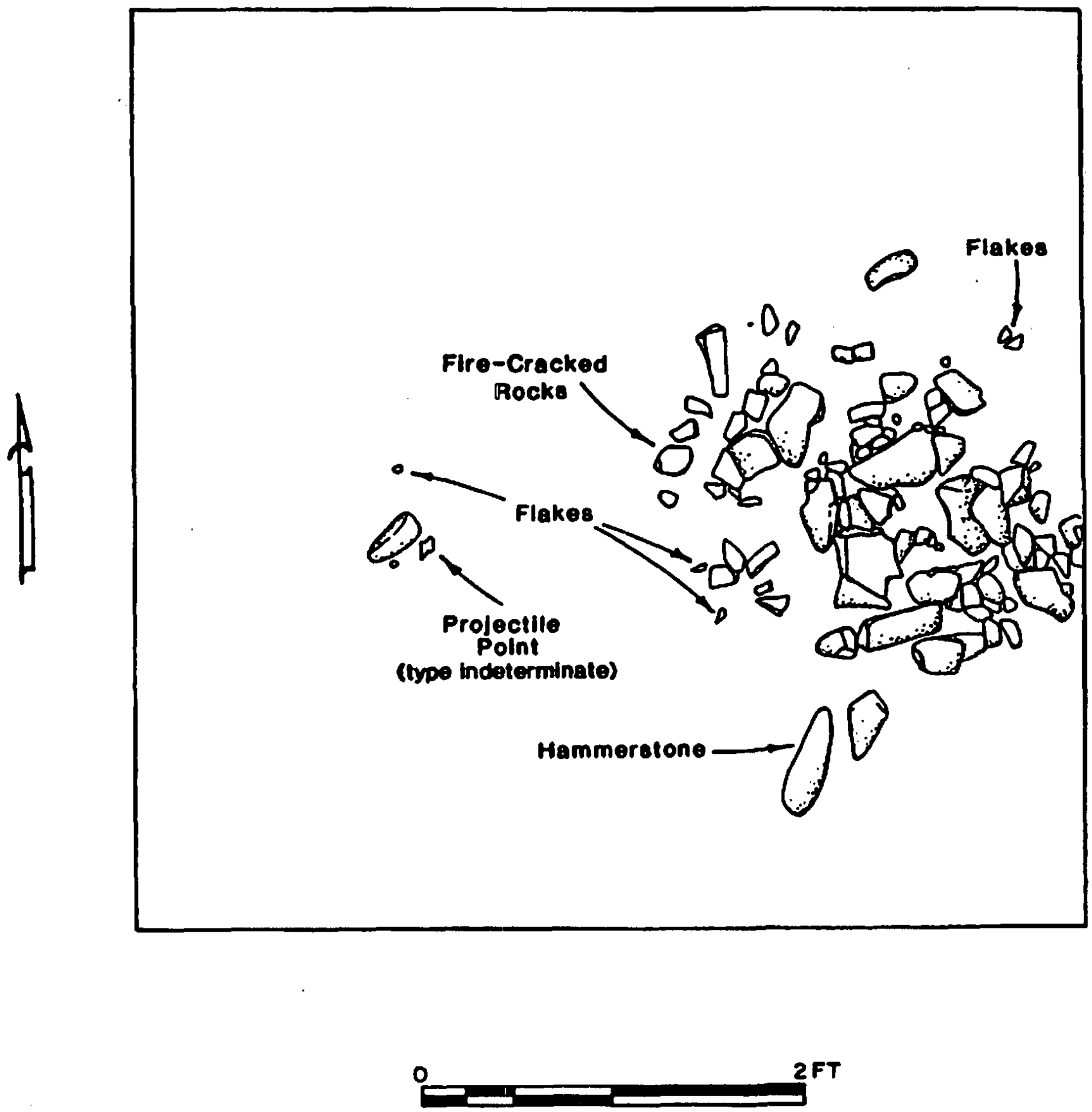


Figure 19

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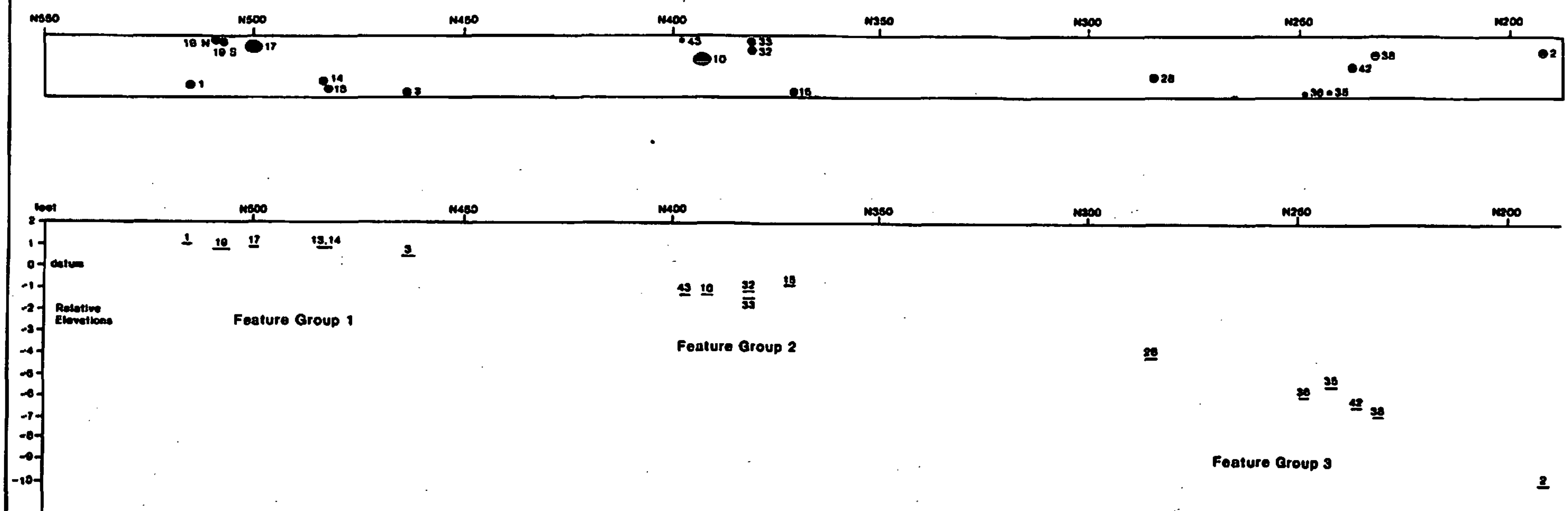


Feature 1	AD 200	±	80	Feature 17	AD 50	±	80
Feature 2	AD 250	±	80	Feature 17	230 BC	±	120
Feature 2	100 BC	±	90	Feature 19S	120 BC	±	70
Feature 10	390 BC	±	80	Feature 33	460 BC	±	70
Feature 13	AD 920	±	70				

*Erroneous

Indian Point Site, Showing Locations and Relative Elevations of Features and Feature Groups

Figure 22

Indian Point Site, Seriation of Radiocarbon Dates

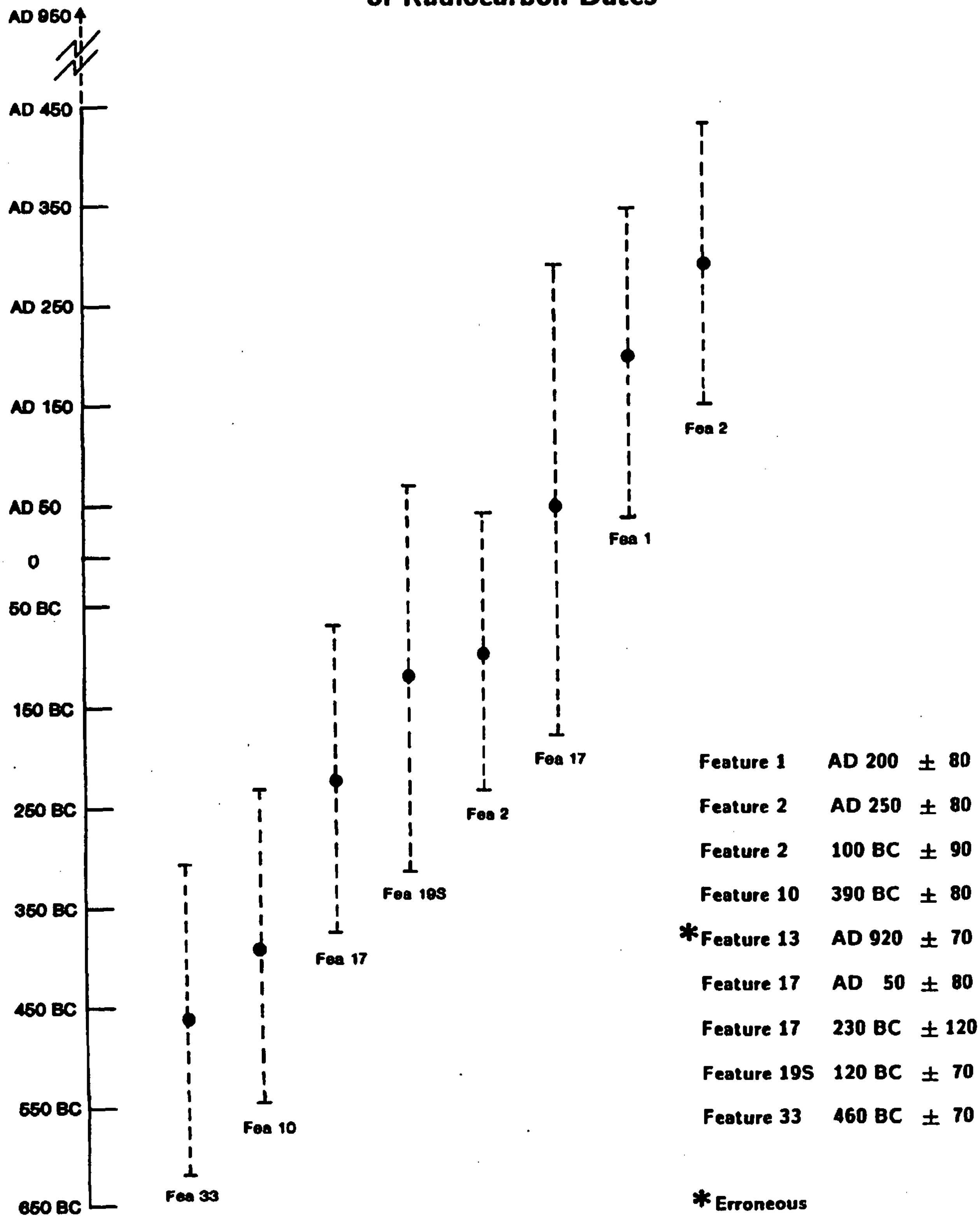
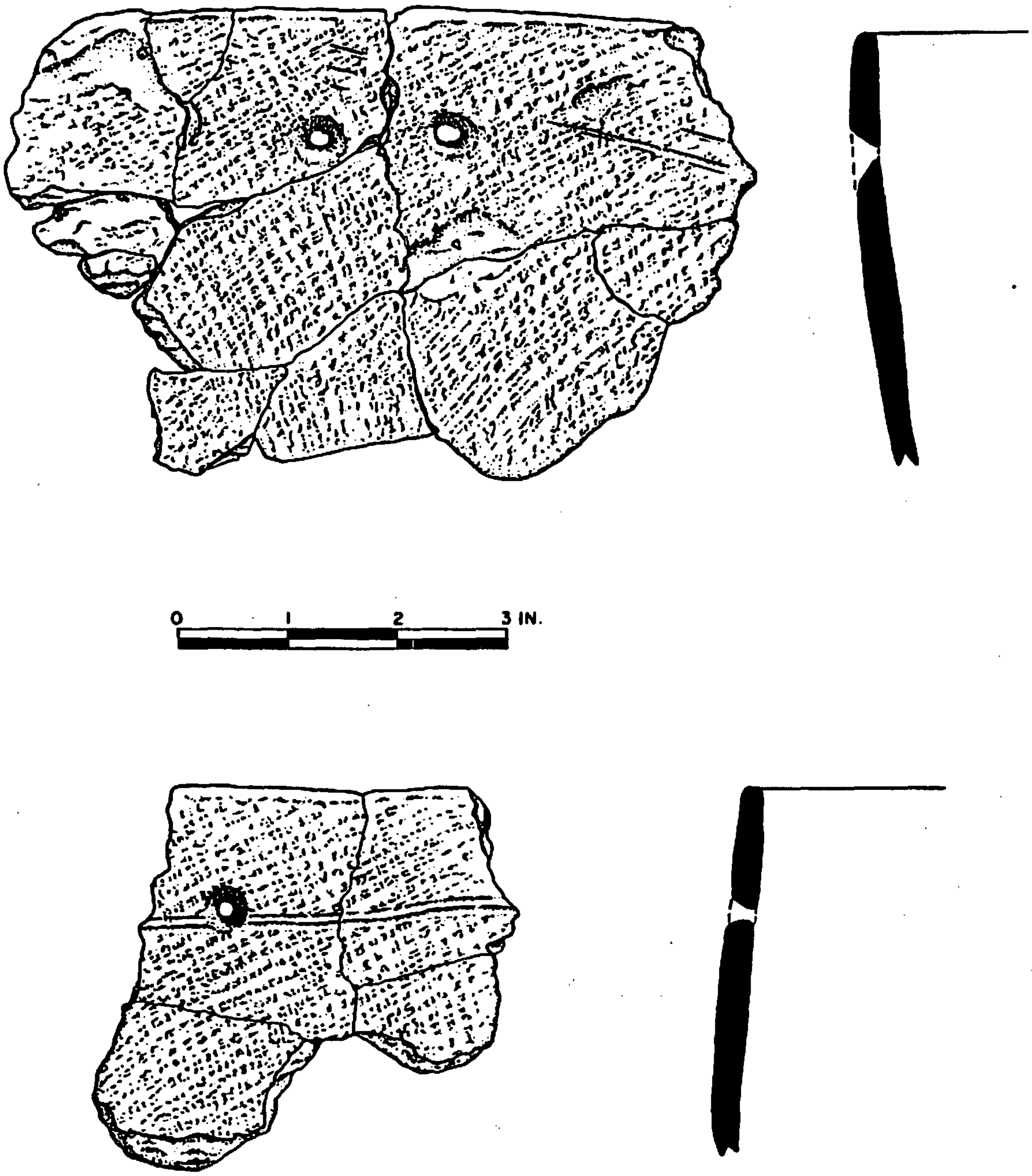


Figure 23



**Indian Point Site, Vinette I-like Ceramic Vessel;
Note Incising over Cordmarking**

Figure 24

Indian Point Site, Basin-Shaped Pit
Features 19 and 33

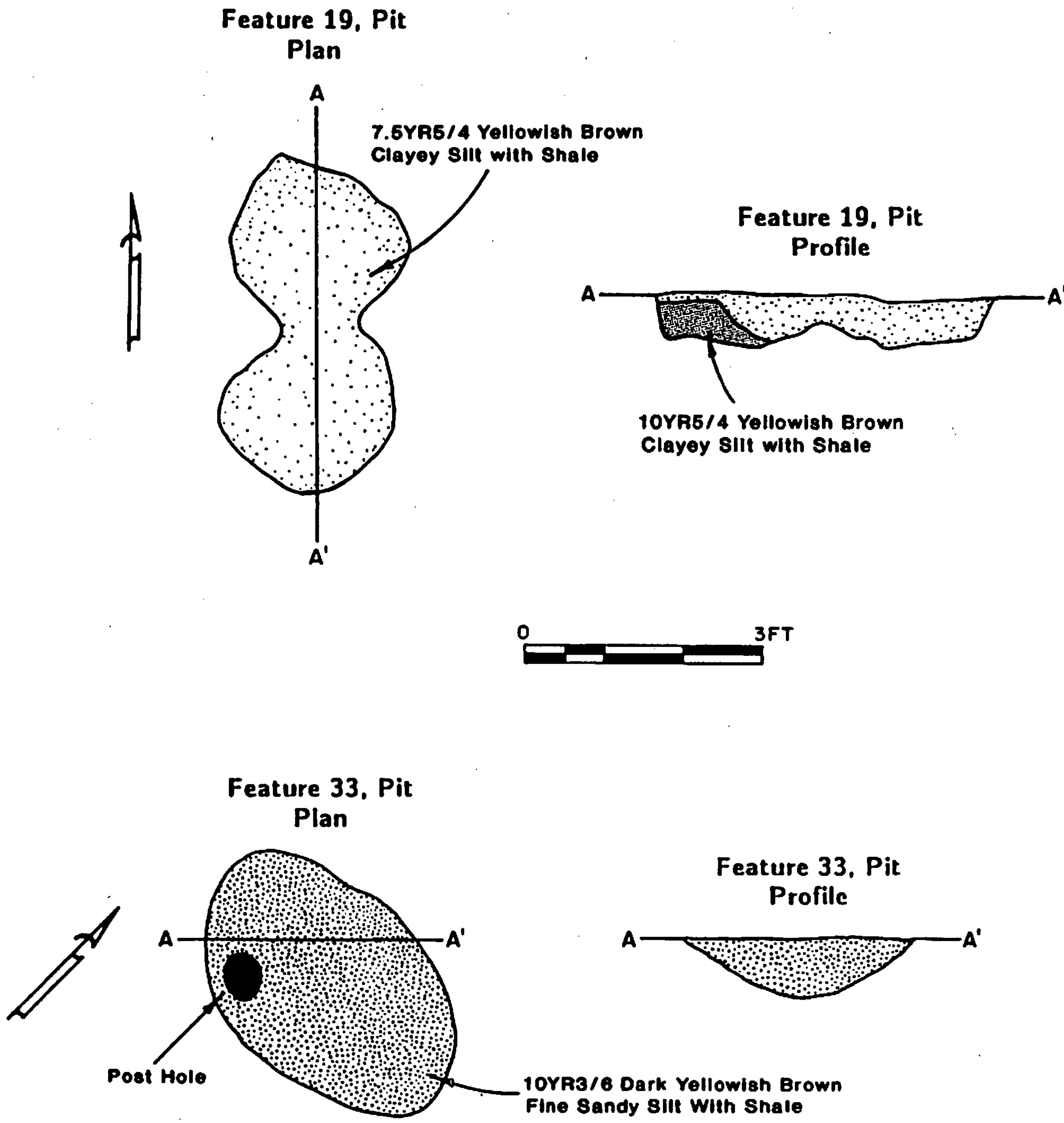


Figure 25

Indian Point Site,
Basin-Shaped Pit
Feature 2

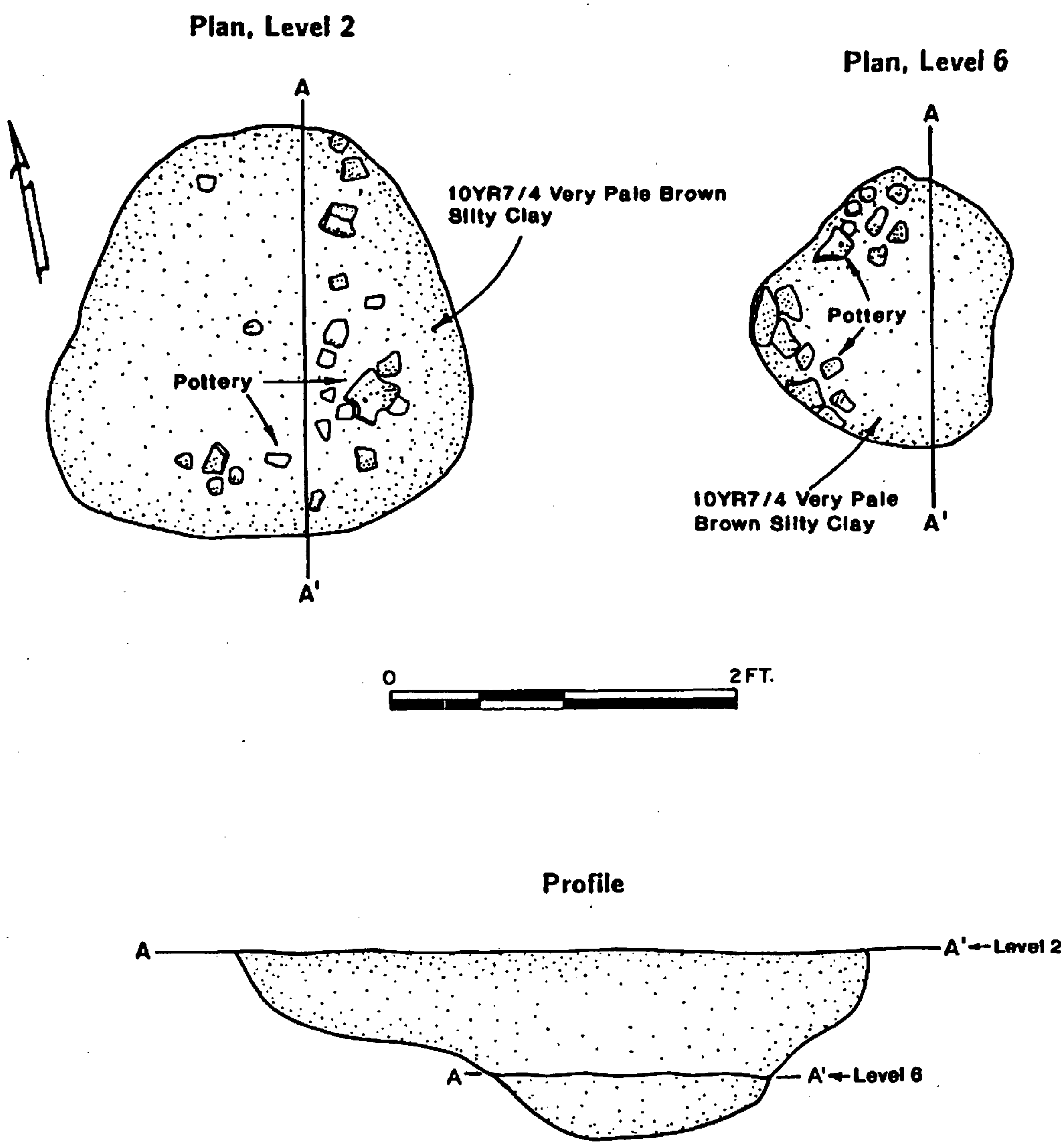
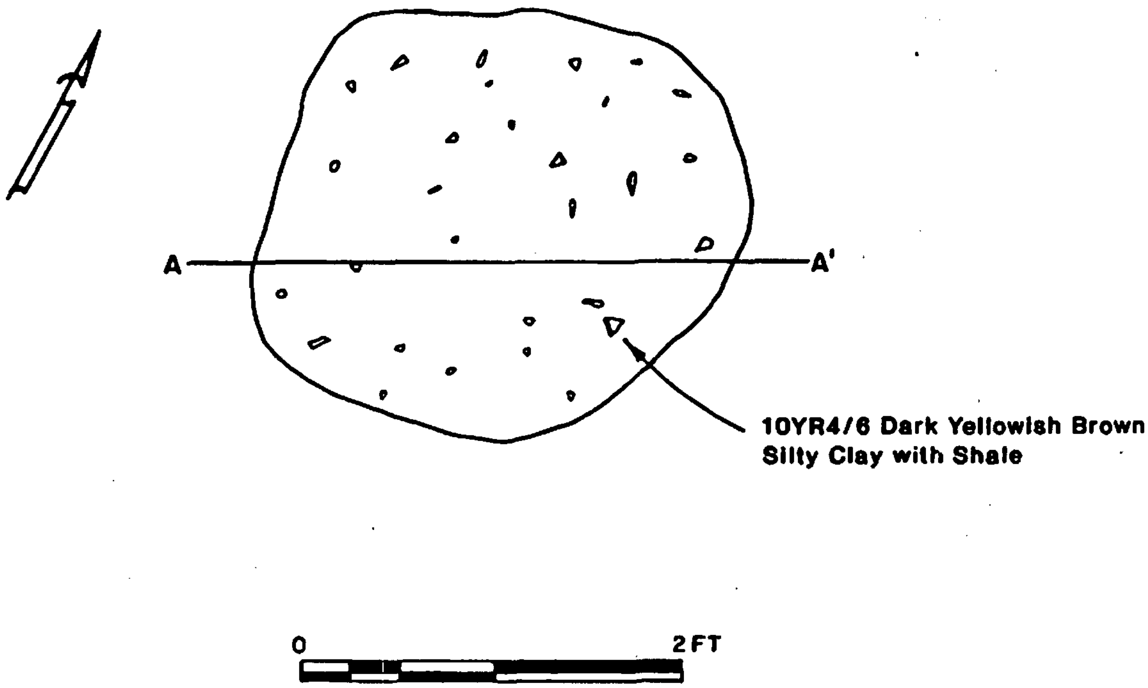


Figure 26

Indian Point Site, Basin-Shaped Pit, Feature 1

Plan



Profile

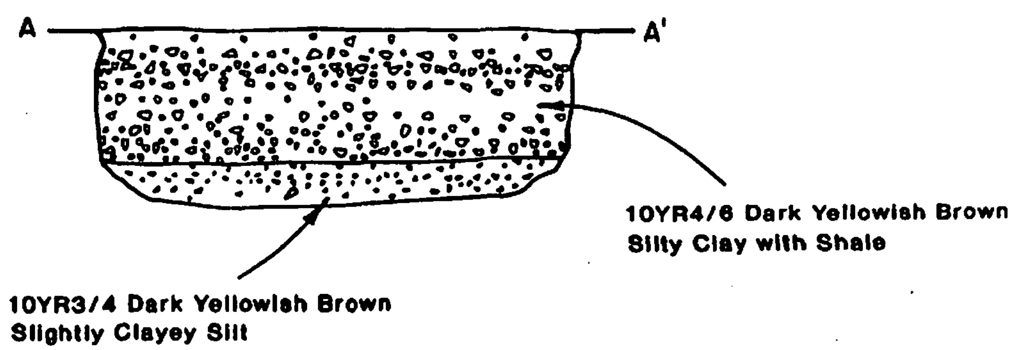


Figure 27

Indian Point Site,
Living Floor Depression
Feature 10

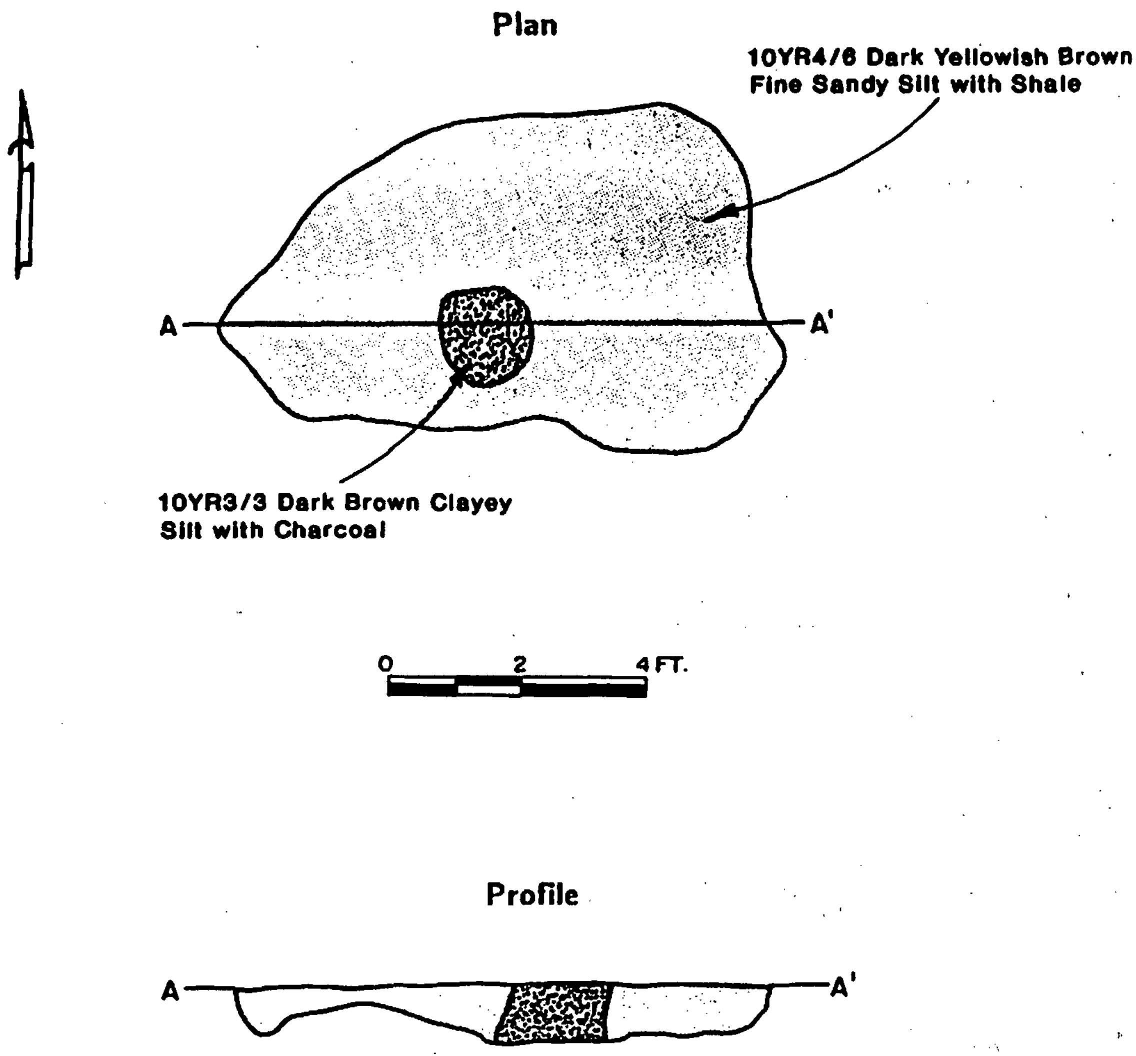
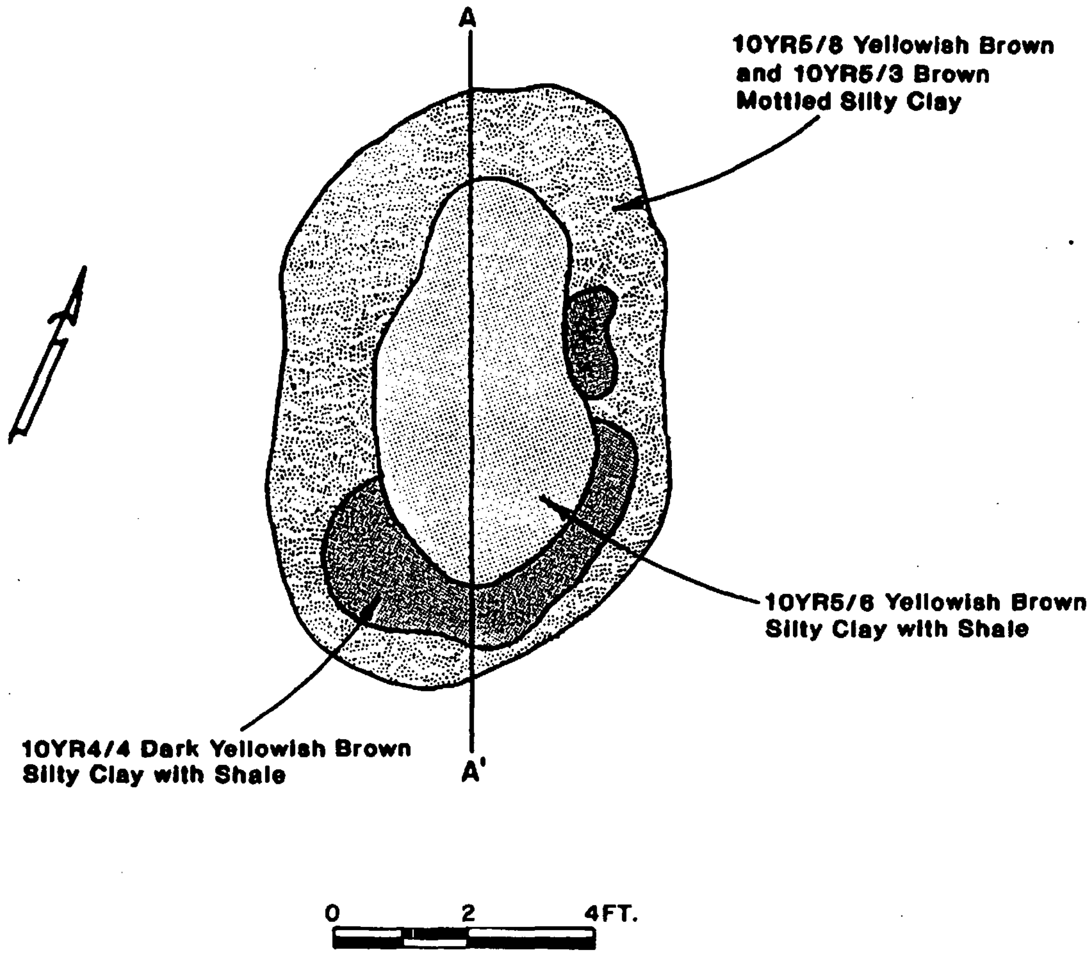
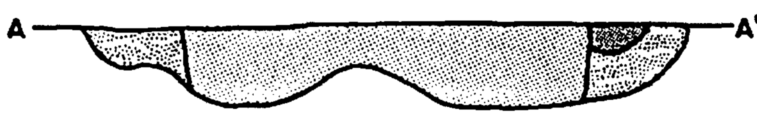


Figure 28

Indian Point Site, Living Floor Depression Feature 17

Plan





Profile

Figure 29

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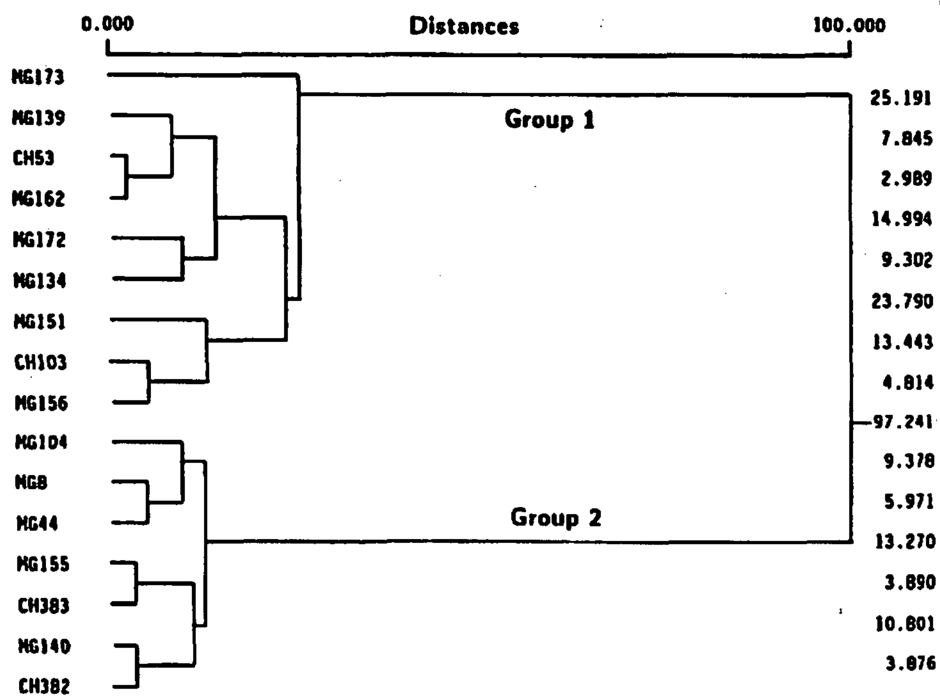
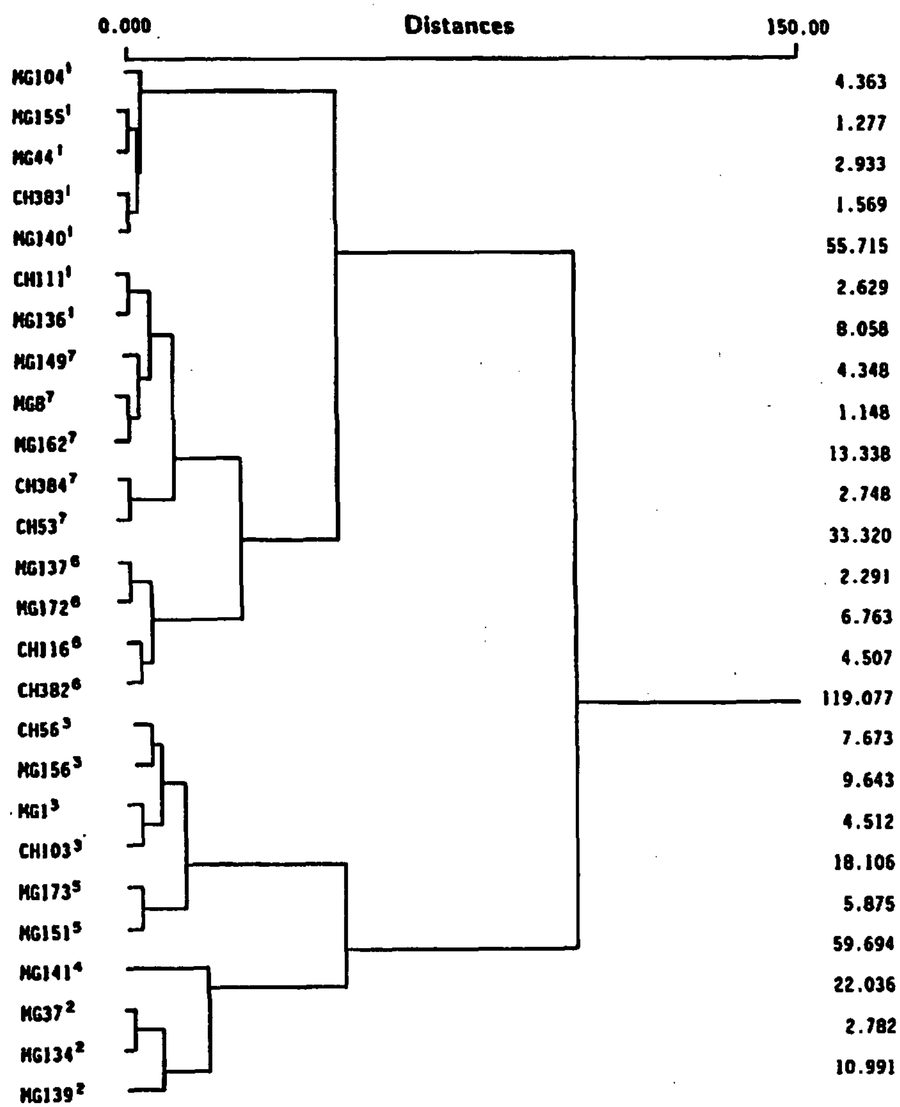


Dendrogram of Sites Clustered by Tool Raw Materials

Figure 34



*superscript = K-means Cluster Number

Dendrogram of Sites Clustered by Debitage Raw Materials

Figure 35

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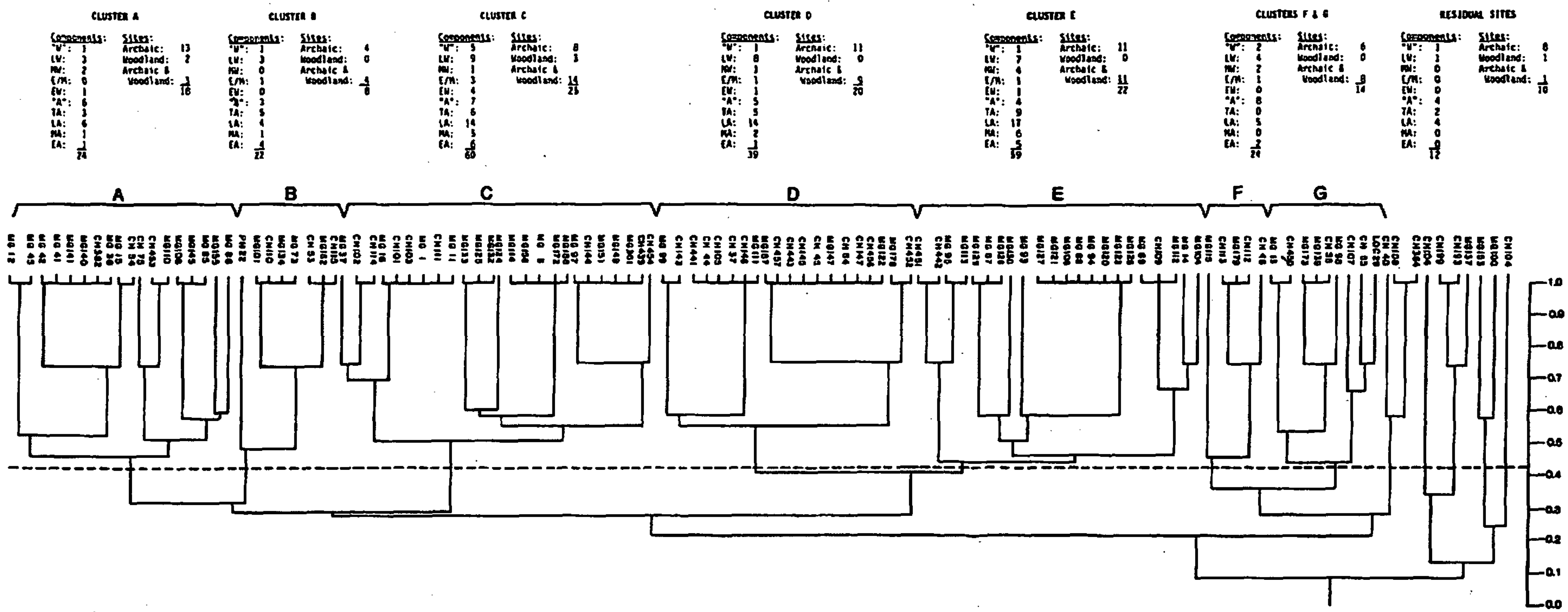


Dendrogram of Sites Clustered by Environmental Variable Associations

Figure 37

CLUSTER D

Components:		Sites:	
TA:	6	TA:	3
LA:	12	LA:	9
	18	TA & LA:	3
			15

CLUSTER C

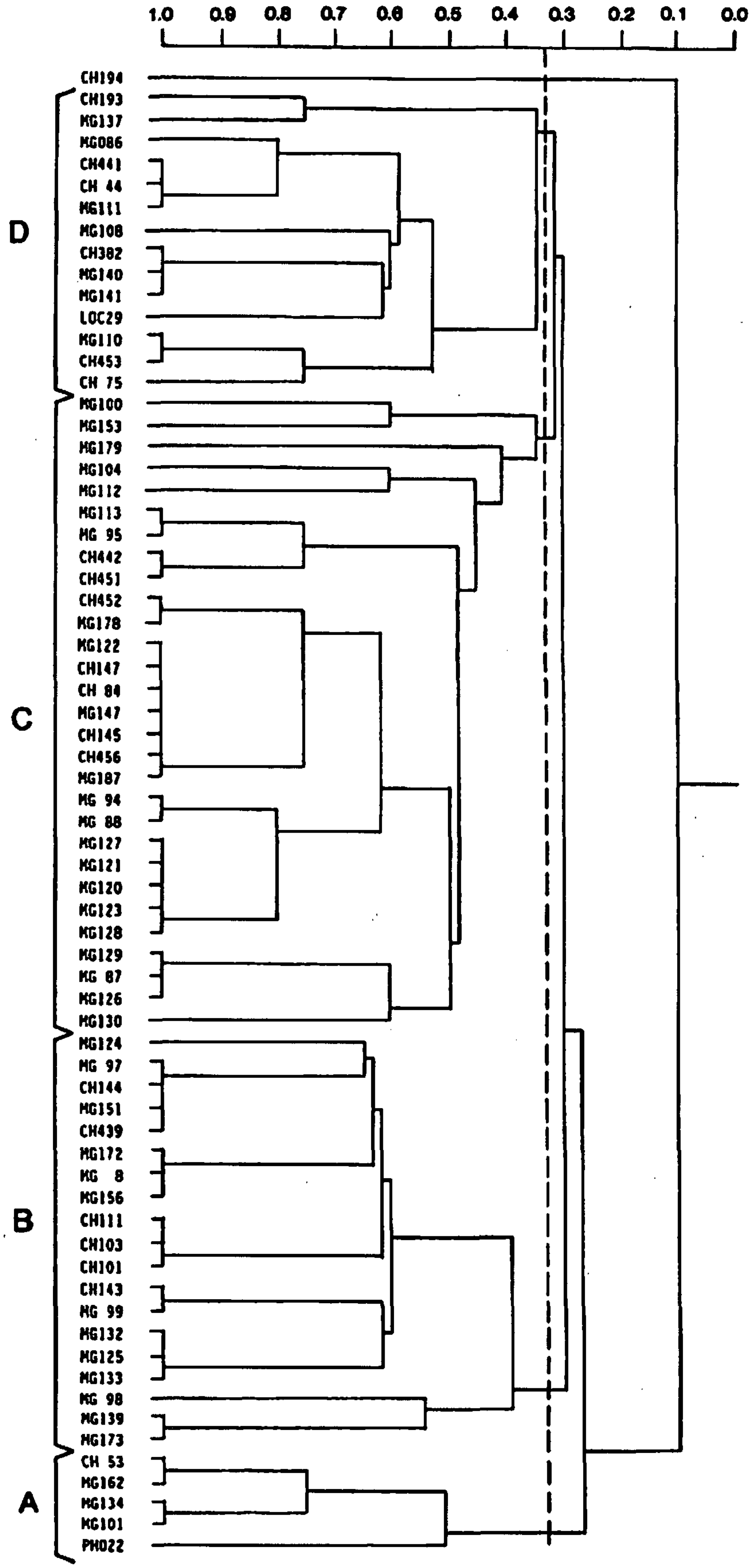
Components:		Sites:	
TA:	12	TA:	1
LA:	28	LA:	17
	40	TA & LA:	11
			29

CLUSTER B

Components:		Sites:	
TA:	7	TA:	0
LA:	19	LA:	12
	26	TA & LA:	7
			19

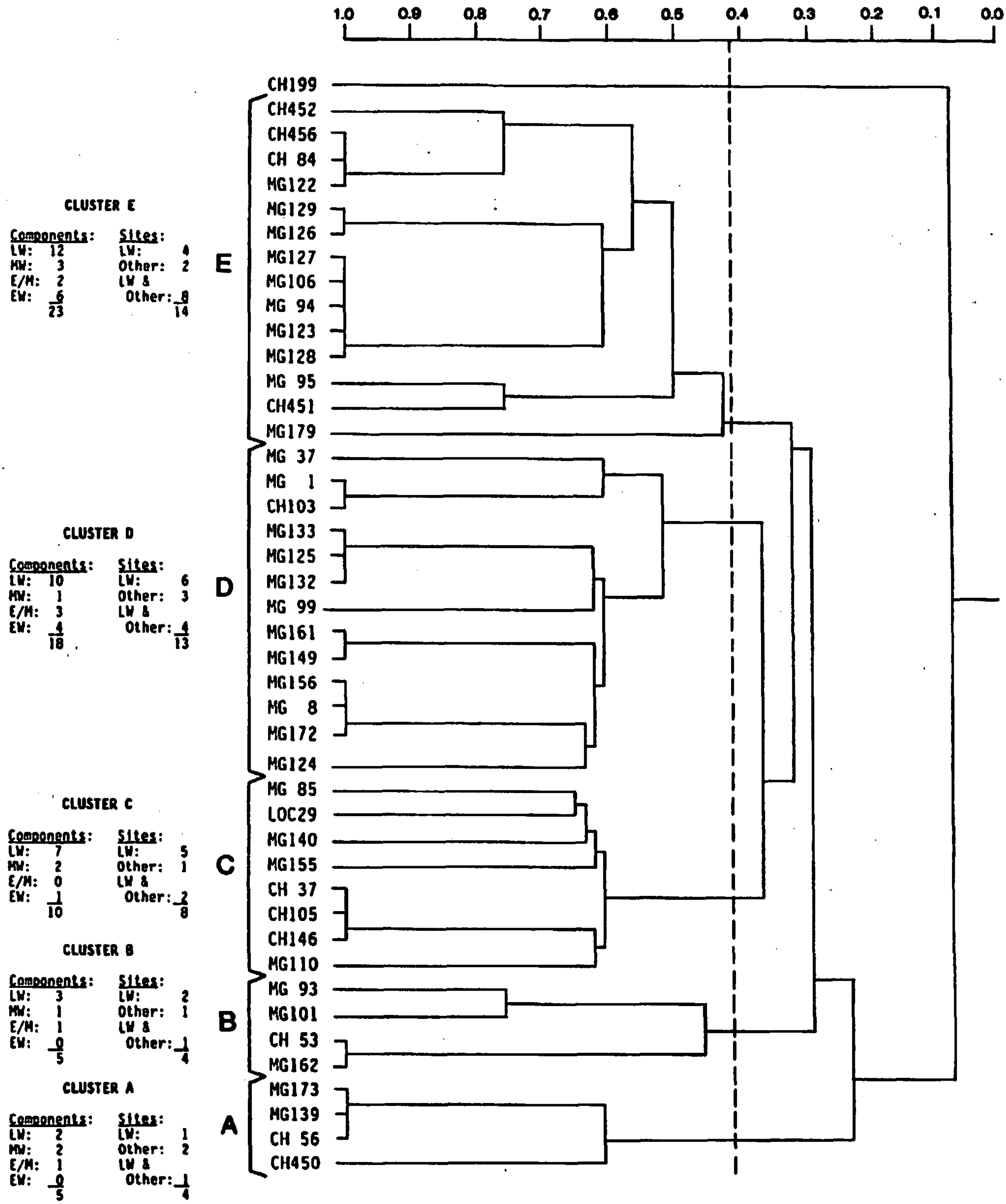
CLUSTER A

Components:		Sites:	
TA:	5	TA:	1
LA:	4	LA:	0
	9	TA & LA:	4
			5



Dendrogram of Late and Terminal Archaic Sites Clustered by Environmental Variable Associations

Figure 38



Dendrogram of Woodland Period Sites Clustered by Environmental Variable Associations

Figure 39

PLATES

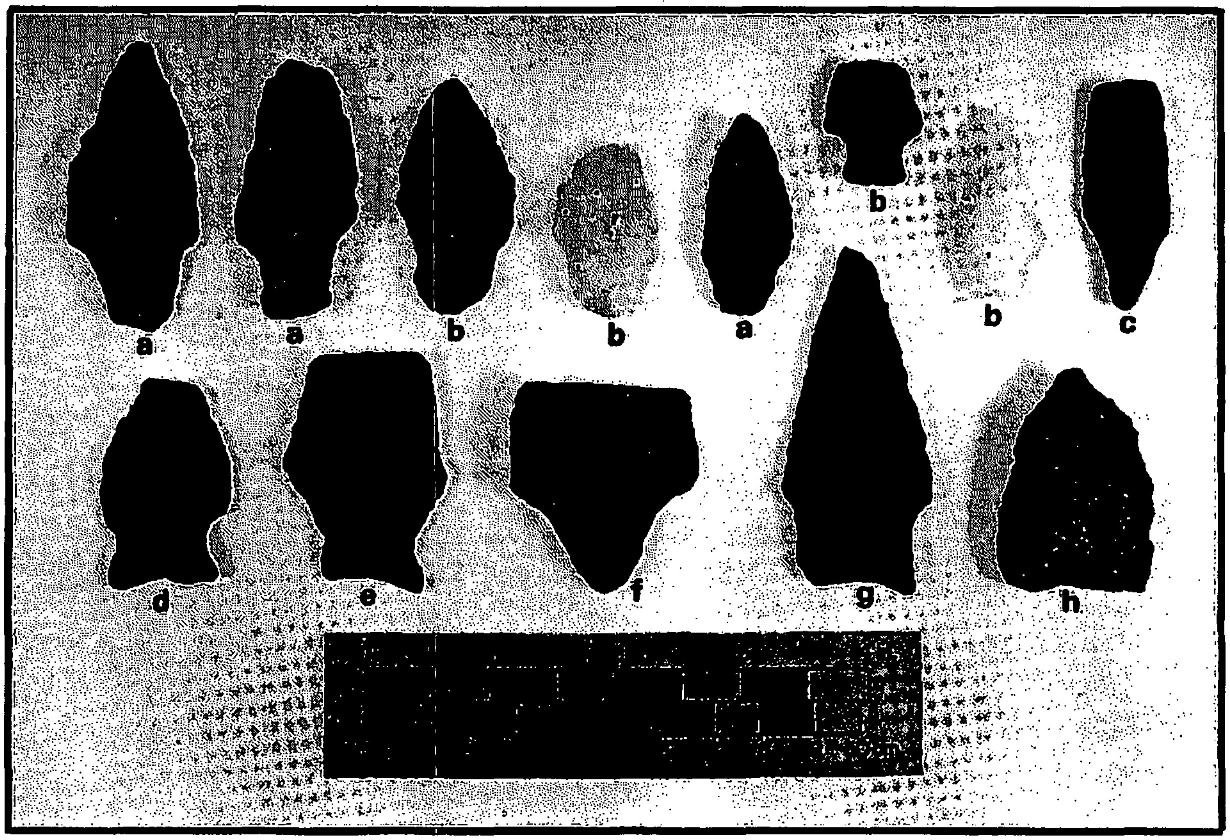


Plate 1. Representative Lithic Artifacts, Frick's Lock Site, Lower Terrace: *a*. Bare Island; *b*. Untyped Stemmed; *c*. Lackawaxen; *d*. Dry Brook; *e*. Susquehanna; *f*. Koens-Crispin; *g*. Genessee-like; *h*. Untyped.

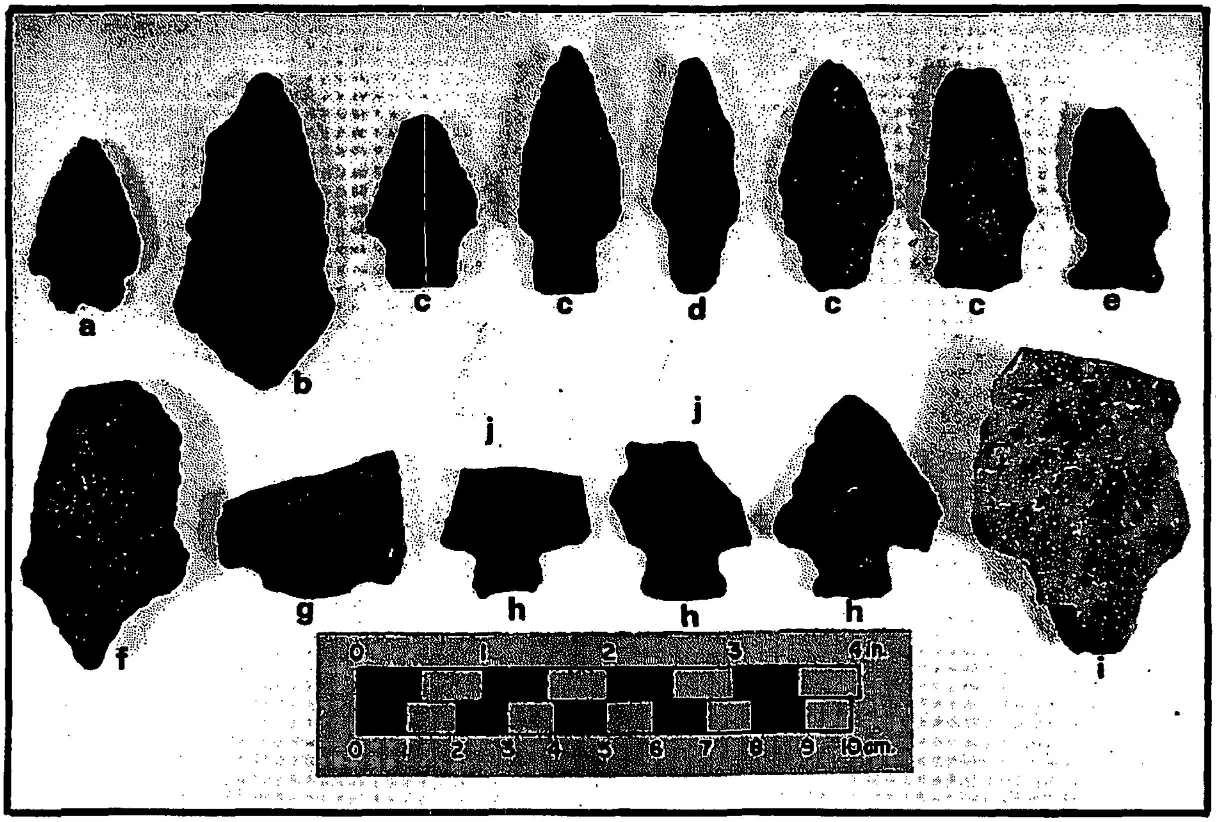


Plate 2. Representative Lithic Artifacts, Frick's Lock Site, Upper Terrace: *a*. Bifurcate-base; *b*. Rossville-like; *c*. Bare Island; *d*. Lackawaxen; *e*. Dry Brook; *f*. Untyped Stemmed; *g*. Broadspear Fragment; *h*. Perkiomen; *i*. Koens-Crispin (unfinished); *j*. Madison.

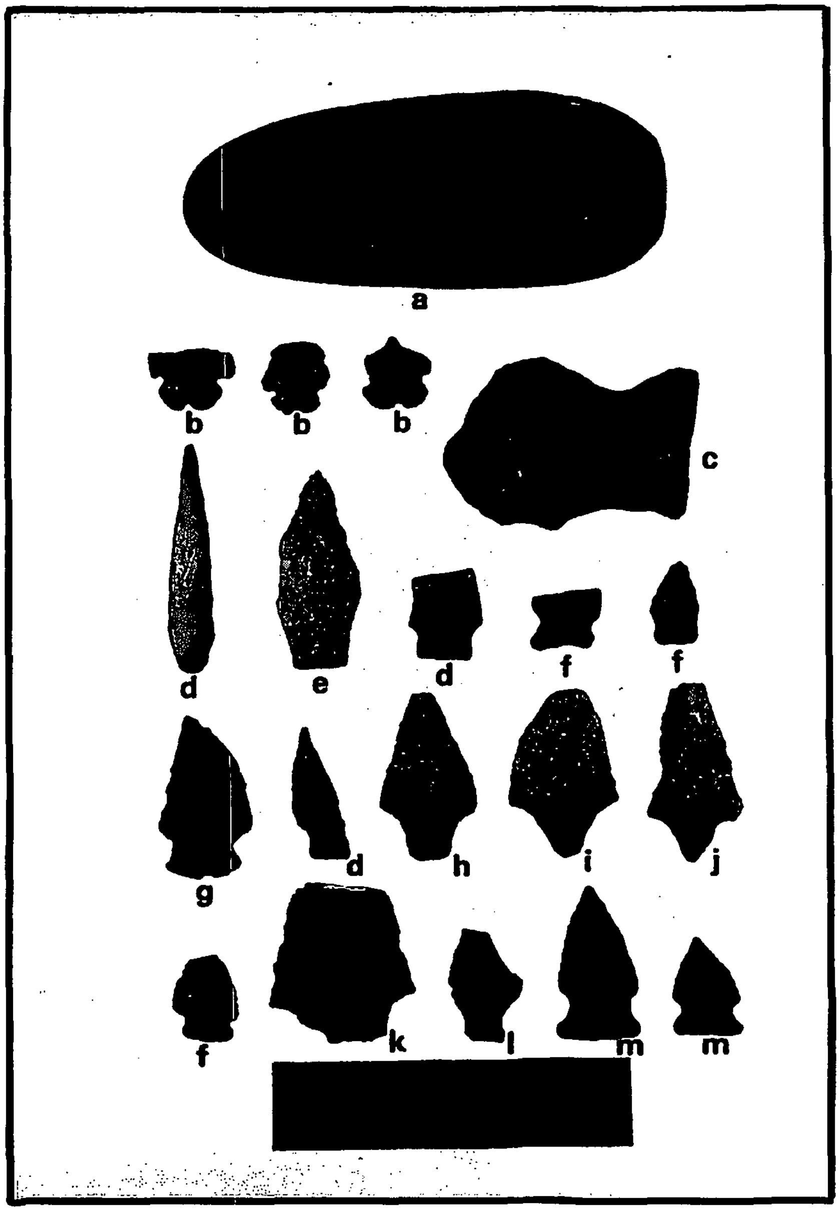


Plate 3. Point Bar Site, Representative Lithic Artifacts: *a*. Hammerstone; *b*. Bifurcates; *c*. Axe Fragment; *d*. Untyped Stemmed; *e*. Greene; *f*. Untyped Notched; *g*. Unfinished Notched; *h*. Snook Kill; *i*. Koens-Crispin; *j*. Rossville-like; *k*. Lehigh; *l*. Orient-like; *m*. Brewerton.

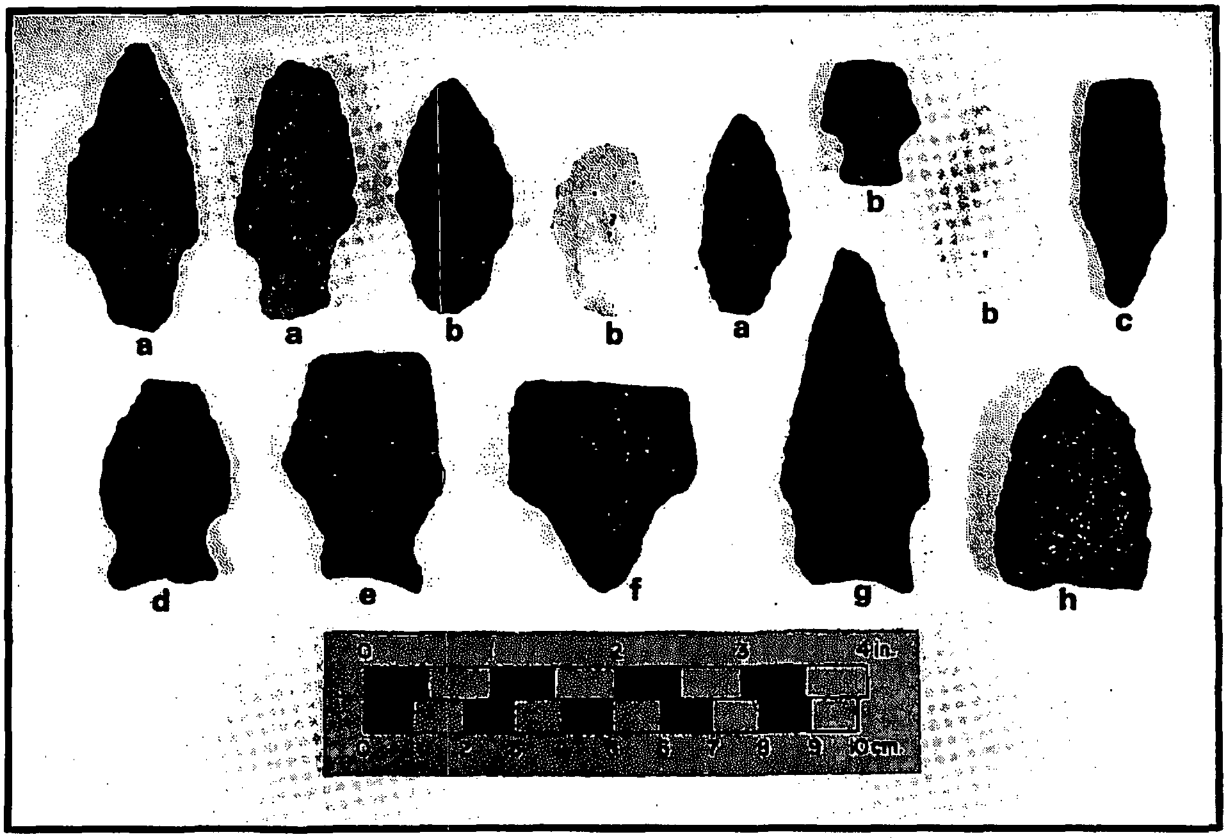


Plate 1. Representative Lithic Artifacts, Frick's Lock Site, Lower Terrace: *a*. Bare Island; *b*. Untyped Stemmed; *c*. Lackawaxen; *d*. Dry Brook; *e*. Susquehanna; *f*. Koens-Crispin; *g*. Genessee-like; *h*. Untyped.

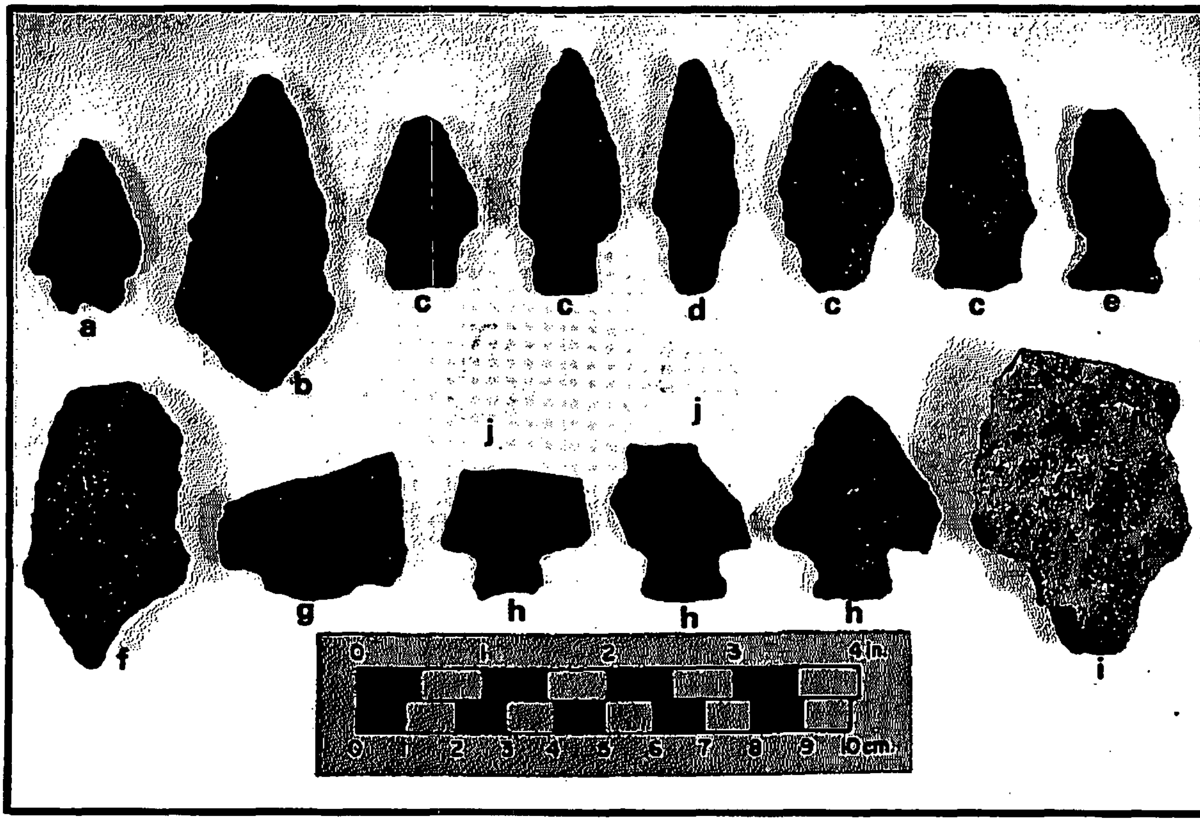


Plate 2. Representative Lithic Artifacts, Frick's Lock Site, Upper Terrace: *a*. Bifurcate-base; *b*. Rossville-like; *c*. Bare Island; *d*. Lackawaxen; e. Dry Brook; *f*. Untyped Stemmed; *g*. Broadspear Fragment; *h*. Perkiomen; *i*. Koens-Crispin (unfinished); *j*. Madison.

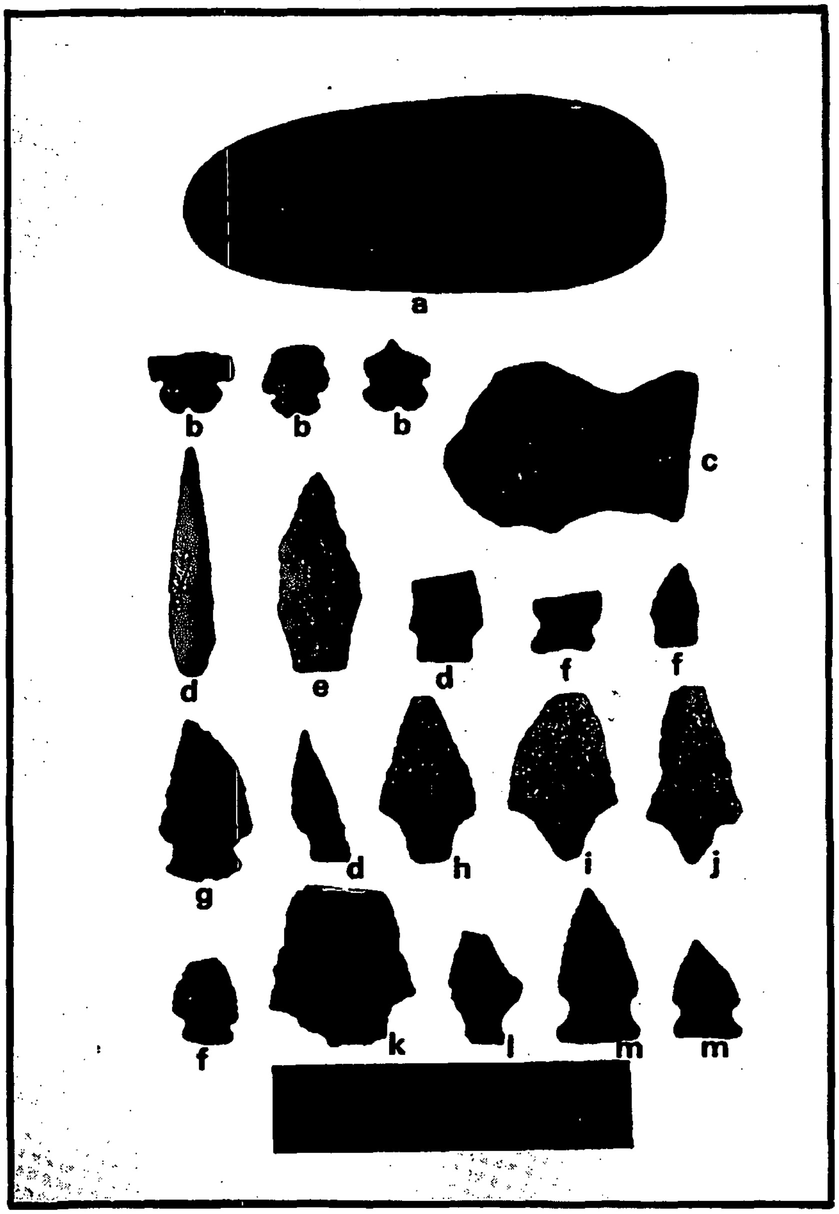


Plate 3. Point Bar Site, Representative Lithic Artifacts: *a*. Hammerstone; *b*. Bifurcates; *c*. Axe Fragment; *d*. Untyped Stemmed; *e*. Greene; *f*. Untyped Notched; *g*. Unfinished Notched; *h*. Snook Kill; *i*. Koens-Crispin; *j*. Rossville-like; *k*. Lehigh; *l*. Orient-like; *m*. Brewerton.

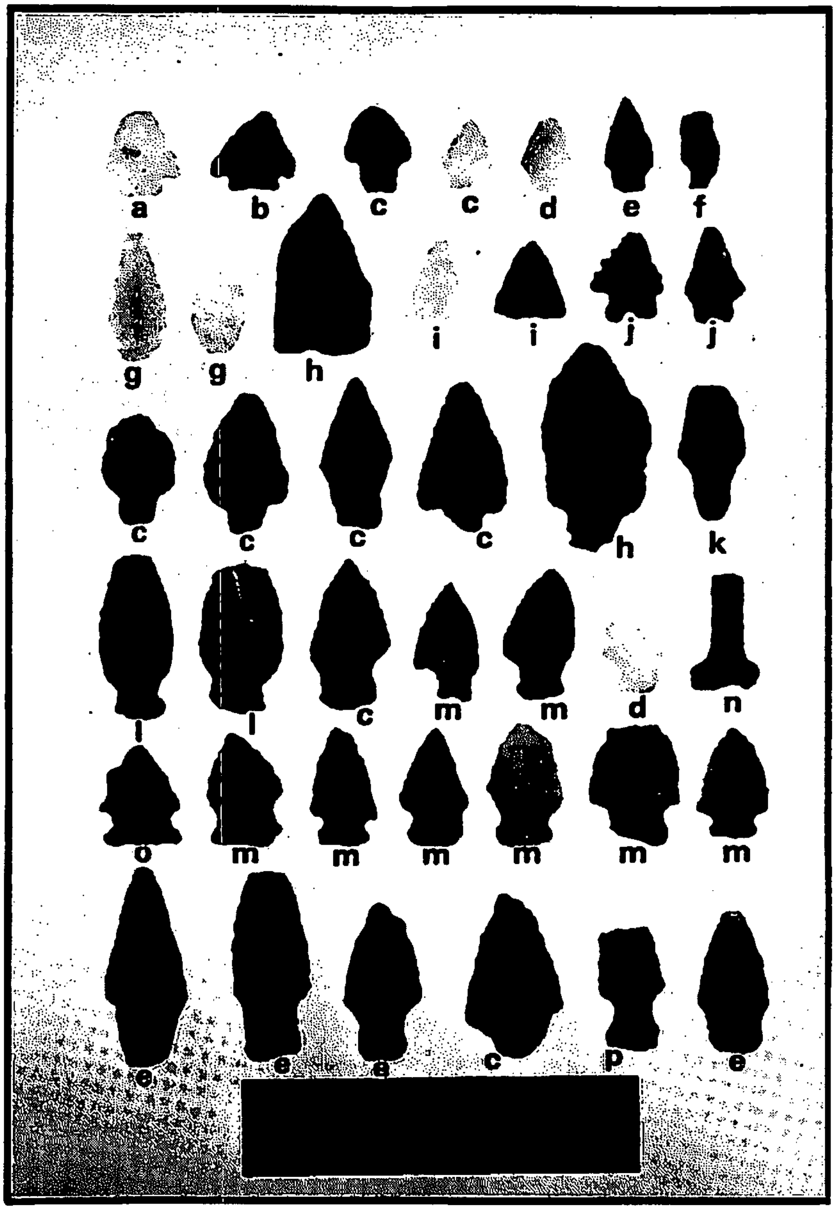


Plate 4. Indian Point Site, Representative Lithic Artifacts, Surface: *a*. Untyped Notched; *b*. Eshback; *c*. Untyped Stemmed; *d*. Brewerton-like; *e*. Bare Island; *f*. Untyped Point/Scraper; *g*. Teardrop; *h*. Biface; *i*. Madison; *j*. Bifurcates; *k*. Poplar Island; *l*. Dry Brook; *m*. Untyped Notched; *n*. Drill; *o*. Jack's Reef; *p*. Normanskill-like.

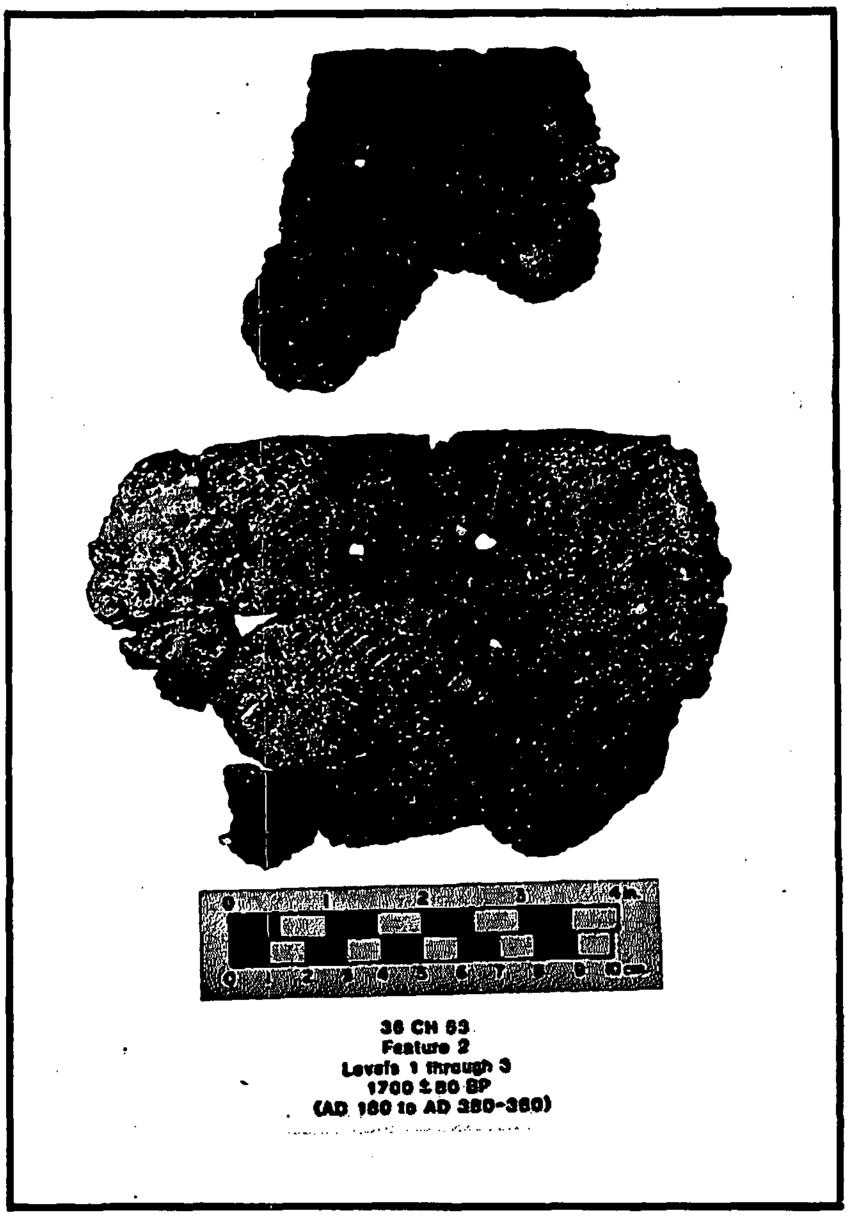


Plate 5. Indian Point Site, Vinette I-like Pottery Vessel.

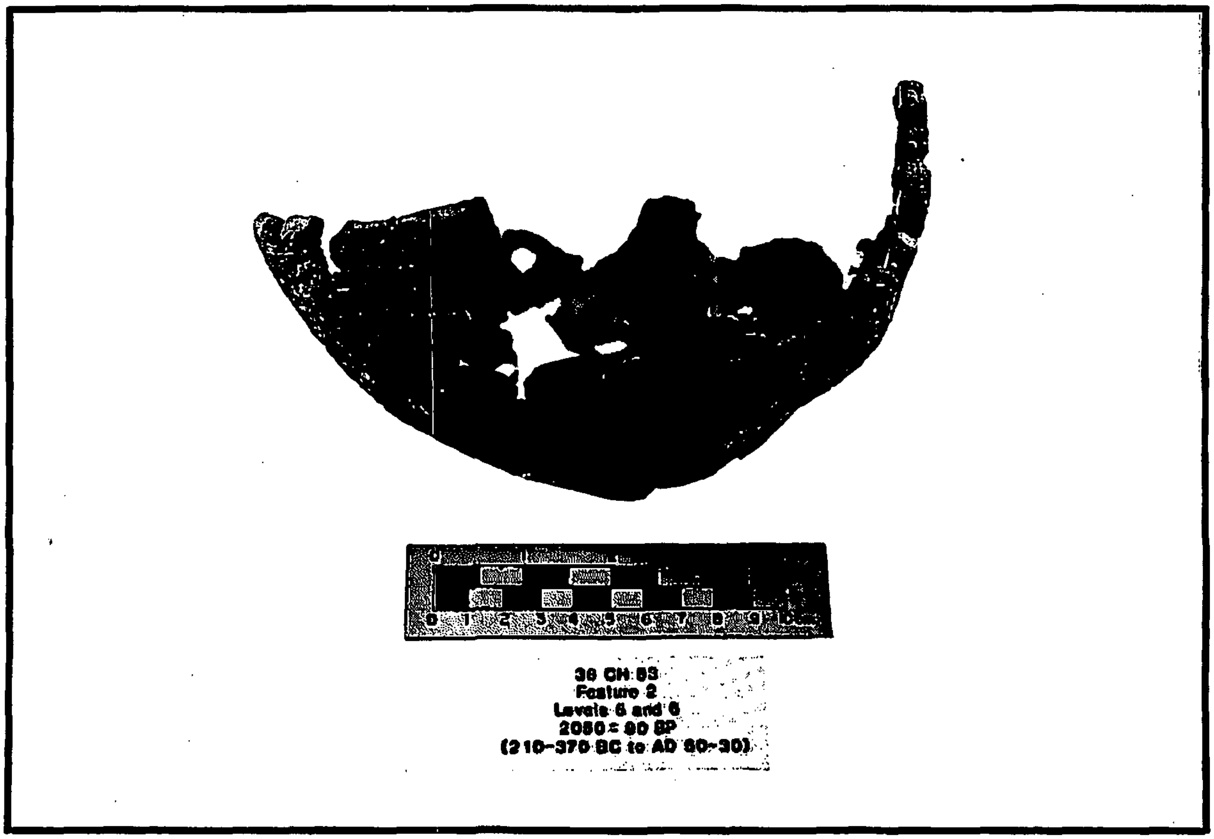


Plate 6. Indian Point Site, Bowl-shaped Vinette I-like Pottery Vessel (exterior).

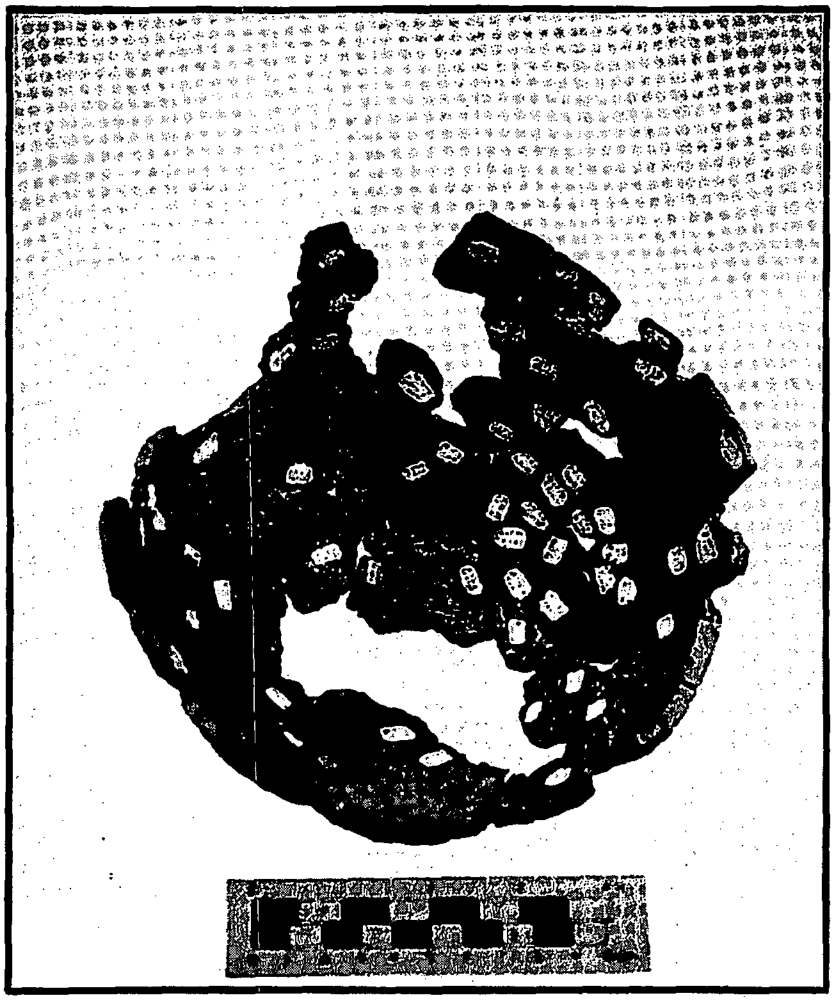


Plate 7. Indian Point Site, Bowl-shaped Vinette I-like Pottery Vessel (interior).

Plate 8. **Indian Point Site, Features 19 North and 19 South.**

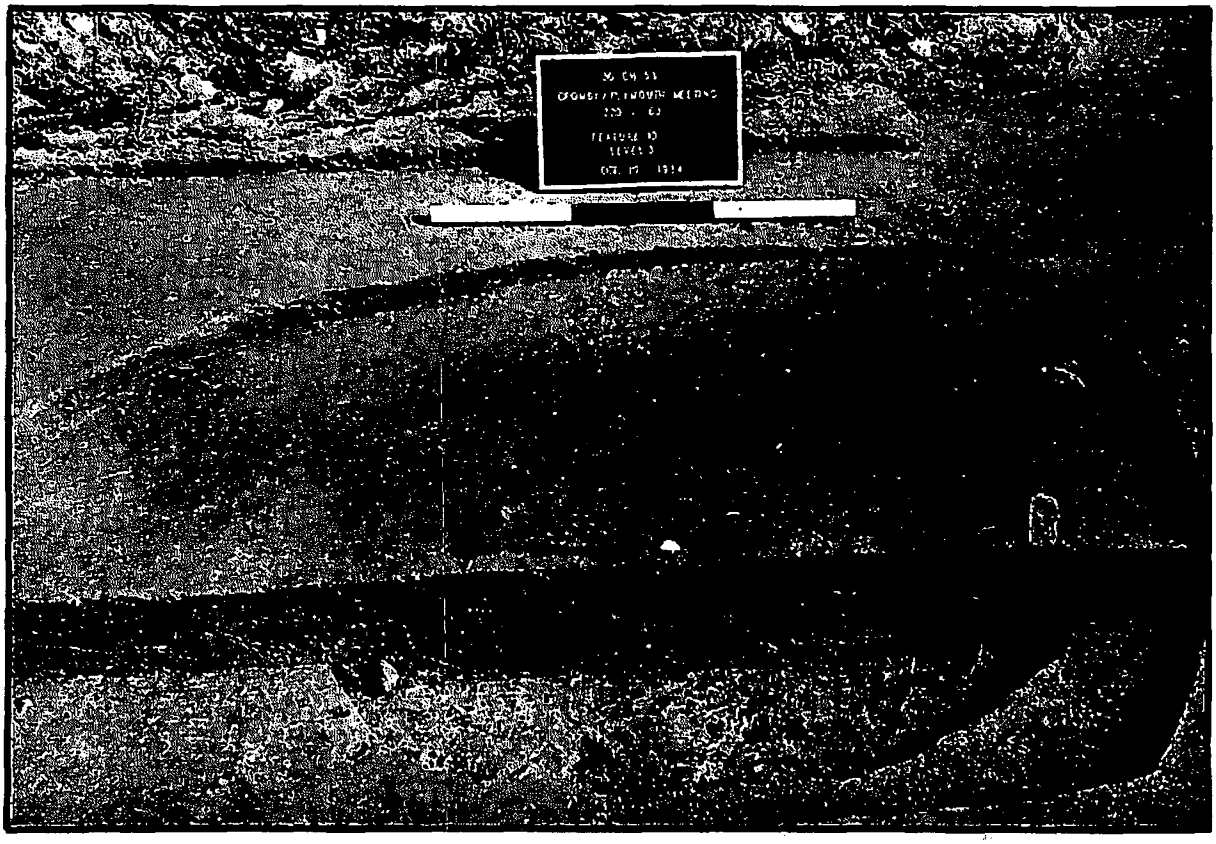


Plate 9. Indian Point Site, Feature 10, Level 3, West Half, View to East.

APPENDIX I:

Pedologic and Geologic Investigation of the Frick's Lock Site. (36 CH 103), Chester County, Pennsylvania

by:

Daniel P. Wagner, Ph.D.
Geo-Sci Consultants, Inc.
P.O. Box 1125
College Park, MD 20740-1125

Introduction

This report describes an investigation of the soils and geology of floodplain site 36 CH 103 in Chester County, Pennsylvania. The primary objective of the investigation was to determine major physical changes the area of the site has undergone through the Holocene and late Pleistocene periods. As a means of assessing the potential suitability of the site for utilization by prehistoric peoples, properties of the site's soils, geology and landscapes were evaluated as indicators of past environmental settings.

Preserved within stratigraphic columns may be records of depositional and erosional episodes as well as weathered soil profiles which serve to mark periods of relative land surface stability. Processes of landscape evolution are ever active, but both the type of process and the rate at which changes proceed can be highly variable. For instance, some interfluve land surfaces in the southeastern U.S. may approach Tertiary in age, whereas no existing landscapes in formerly glaciated portions of the continent exceed about 12,000 years in age. An area such as Chester County which was peripheral to the limit of glacial ice advance, has been subject to extreme shifts in climatic conditions throughout the Pleistocene, triggering an assortment of weathering, erosional and depositional events. The Holocene too is characterized by periods of instability, the evidence for which is often most readily apparent in the sediments and landscapes of river valley systems. Hence, the geologic history of the Schuylkill River floodplain site 36 CH 103 is potentially complex.

In the absence of preserved organic remains, soil profiles may provide the best indications of both former environmental conditions and relative land surface ages. This is possible since soil profiles are produced through the weathering of geologic materials principally as a function of climate and time. Some properties of soils such as clay enrichment to produce an argillic horizon are related to soil age. Other properties such as color can indicate present or past conditions of soil drainage. When an assortment of soil properties are viewed as a set, a record of the soil's history is available for interpretation. While this record could be important in widespread regional applications, it is necessary to consider as well that local variations in soil formation in response to local conditions can account for significant differences between age-equivalent soils occurring at separate locations. Without corroborating forms of evidence such as ^{14}C dates or associated age-diagnostic artifacts, age determinations estimated from soil morphology alone are less than absolute.

Methods

Site soils and stratigraphy were examined by means of backhoe excavations on August 30, 1983. Five excavations were situated along a transect within the power line and weather towers access road. The road and transect were oriented perpendicular to the Schuylkill River and site topographic contours, providing for soil observations in all major landscape positions. Additionally, an excavation was examined in the area of a second tower structure situated on a terrace position comparable to the highest landscape position in the main transect area. Figure 1 shows the locations of the backhoe pits, and descriptions of the soil profiles examined in the pits are given in Appendix A.

Of the six pits examined, four profiles were described in detail, and major soil horizons were sampled. Properties of soil horizons and substrata were described in accordance with standard pedological field techniques.

After completion of the field investigation, field data were reviewed, and soil samples were selected for particle size analyses. Particle size analyses were performed on the less than 2 mm fraction following air-drying, crushing and sieving of samples. Sand fractions were determined by sieving following dispersion of soil samples using sodium hexametaphosphate. Contents of clay and silt were determined by hydrometer analyses of dispersed soil suspensions.

In support of field investigations of the site, landscape features were interpreted with the aid of the USGS Phoenixville 7.5' topographic quadrangle map. Examination of 1:12,000 stereo aerial imagery of the site also assisted in the landscape analysis.

Site Geology

The site is located within what has been termed either the Newark-Gettysburg Basin by Glaeser (1966) or more simply the Newark Basin by Van Houten (1969). This basin is composed of late Triassic sedimentary rocks which trend in their extent NE-SW from New York to Maryland and are nearly contiguous with the Culpeper Basin in Virginia. In the vicinity of the site along the Schuylkill, the basin trends essentially E-W. Several formations, known together as the Newark Group, compose the bedrock stratigraphy of the area. These include the basal Stockton and New Oxford Formations and the overlying Gettysburg, Brunswick and Lockatong Formations (Glaeser, 1966). Owing to their mostly reddish colors, the shales, arkoses and conglomerates which comprise the Newark Group are considered to be red beds.

The much younger alluvial sediments of the Schuylkill River at the site rest on the Brunswick Formation. In this part of the basin, the Brunswick consists of conglomerates and coarse sandstones with minor shale components. The Brunswick is approximately 20,000 feet in thickness, and rests on the Stockton Formation. As indicated by petrologic features (grain size, sorting, orientation of conglomerate tongues) the source region for the Brunswick sediments was north of the basin (Glaeser, 1966). In contrast to underlying strata, reddish hematite present at grain boundaries and trapped under quartz overgrowths is thought to be detrital. Most of the alluvial deposits of the Schuylkill River are likely derived from erosion of the Brunswick Formation within the river's watershed.

As shown by Glaeser (1967), the course of the Schuylkill River in the area of the site closely corresponds to the N-S strike of a small fault in the regional bedrock. Hence, location of the river valley appears to be related to the identified fault. In that neither Glaeser nor Van Houten (1969) describe Quaternary movements by any of the faults within the Brunswick Formation or other Newark Group members, it seems likely that the present orientation of the Schuylkill near the site is little changed from ancestral flow patterns.

Site Pedology and Stratigraphy

The distribution of soil types on the site is related to the land forms present. The site can basically be divided into two river terraces oriented roughly parallel to the present river channel. These terraces are clearly distinguished from each other topographically, with the higher of the two terraces situated about 3 to 3.5 m above the lower terrace. A steep scarp of approximately 12 percent slope separates the two terraces, and an intervening trough-like land form runs along the edge of the lower terrace at the base of the upper terrace. The lower terrace lies approximately 4 m above the water level of the river. Figure 2 shows the distribution of major land form units as interpreted from aerial imagery.

Upper Terrace

Soil profiles examined in pits 1 and 6 were of the upper terrace soil. Of these two, only the profile of pit 1 was described in detail, since the surface portion of the soil in the area of pit 6 had been previously removed. The intact portion of profile 6 was found to be similar to the corresponding horizons of profile 1.

As typified by profile 1, the soil of the upper terrace is strongly developed and appears to be of considerable age. This is demonstrated by both field and laboratory evidence. Field observation revealed the thickness of the entire weathered solum (A and B horizons) was, at 175 cm, rather great. Additionally, the soil was found to contain a well developed argillic horizon (Btx) in the depth increment of 27 to 85 cm from the surface. It is generally considered that the minimum time required for argillic horizon formation is several thousand years of weathering (Bilgi and Ciolkosz, 1977; Fenton, et al. 1974; Foss, et al. 1977; Hall, et al. 1981). With increasing time argillic horizons become more strongly developed and have progressively greater clay content, more oriented clay coatings, and greater thickness.

The cumulative particle size distribution with depth for profile 1 is shown in Figure 3, and particle size data for all samples analyzed are contained in Appendix B. Particle size fractions plotted in Figure 3 include clay (<0.002 mm), silt (0.05-0.002 mm), very fine sand (0.1-0.05 mm), fine sand (0.25-0.1 mm), medium sand (0.5-0.25 mm), coarse sand (1-0.5 mm), and very coarse sand (2-1 mm). For the portion of the profile sampled, the particle size distribution indicates a relatively uniform lithology with no major discontinuities in the terrace deposit. The increase in clay content of the argillic horizon is readily apparent, and the amount of clay is twice as high in the argillic horizon as in overlying or underlying horizons.

As interpreted from soil morphological features and laboratory data, the land surface of the high terrace appears to have been essentially stable for the last 10,000 to 12,000 years. This amount of time would probably be required to achieve the degree of argillic horizon development in the soil. There is no evidence of any substantial addition of surface deposits throughout the period, which is consistent with the observed surface concentrations of artifacts in the upper terrace area. Floral, faunal or cultural disturbances of the land surface have generally not been active below the upper two horizons of the soil. Consequently, in the absence of historic or prehistoric subsoil excavations, soil horizons below the depth of about 25 to 30 cm should be archeologically sterile.

Lower Terrace

The soils and stratigraphy of the lower terrace are more complex than those of the upper terrace. Several sediment types differing in both composition and age serve as the parent materials in which soils of the lower terrace are developed. The dominant soil of the lower terrace is typified by profile 4. This soil is developed mostly in silty deposits which mantle the surface to a depth of slightly less than one meter. Below the silty mantle are stratified gravel and sand deposits. The discontinuity between the silt mantle and underlying deposits is clearly shown by the data presented in Figure 4. Soil formation has extended across the discontinuity (indicated by dashed line) into the gravel and sand deposits, producing a weathered solum slightly over 130 cm in thickness.

Like the soil of the upper terrace, the lower terrace soil typified by profile 4 also contains a well developed argillic horizon. This argillic horizon was recognized in the field and is indicated by the large increase in clay content shown in Figure 4 for the Btx horizons. A similar silty soil in northern Maryland having comparable development was found to have a ^{14}C date of 10,500 B.P. (Foss, et al. 1978). Hence, the strongly developed nature of the lower terrace argillic horizon also suggests an age of about 10,000 years. It thus follows that much of the lower terrace surface has been mostly stable throughout the Holocene, undergoing only infrequent flooding. Frequent flooding would have resulted in a continuously accreting and younger surface, gradually terminating soil formation at deeper depths and not allowing for the existing degree of soil development.

Dredge materials known to be deposited on the soil surface several decades ago appear to have been texturally similar to the natural soil, and subsequent mixing by plowing has made precise differentiation of the two materials impossible. The plow zone has been only slightly overthickened by the dark colored dredgings, indicating a relatively small volume of dredge materials was incorporated into the lower terrace soil.

About one fourth of the lower terrace area is within a trough-like landscape feature. This low-lying trough area was probably derived as a small, flood scour channel for the Schuylkill and may occassionally still serve as such during high flow conditions. The trough abuts the scarp of the high terrace and is more poorly drained than adjacent low terrace soils. Degree of drainage varies along the trough, and the soil of the trough was examined in an area slightly better drained than most other stretches of the trough.

Profile 2 was located in the middle of the trough and is assumed to be representative of the trough soils and stratigraphy. The stratigraphy of this profile is the most complex of all the profiles examined. Younger, more weakly developed soil horizons are present, and several major episodes of deposition are indicated. The profile consists of silty horizons overlying fine-sandy horizons which rest on stratified gravel and sand deposits similar to those observed in each of the lower terrace profiles examined. As indicated by dark brown colors (10YR 3/3, 4/3), the upper 70 cm of the silty mantle is composed of a succession of humus-rich, surface horizons. Much of this silty material has probably accumulated as a depositional product from historic agricultural erosion of the upper terrace. Although plowing appears to have obliterated some horizon differentiation, the original prehistoric surface is likely to have been somewhere within the 40 to 60 cm depth increment. Hence, the former soil profile would have consisted of a much thinner silt mantle over the underlying fine-sandy and stratified sand and gravel deposits.

The lithologic discontinuity between the silt mantle and underlying deposits is shown by the data presented in Figure 5. As the discontinuity is crossed at the depth of 91 cm, silt content declines, and concentrations of fine and very fine sand increase sharply in lower horizons. A weakly developed argillic horizon (2Btx) is present in the fine-sandy material immediately below the discontinuity. This argillic horizon is only slightly enriched with clay, and field observations revealed only thin, patchy clay coatings. These properties suggest a weathering duration of no more than about 4,000 years. It is possible the argillic horizon could be older if it is the remnant of a more strongly developed, truncated soil profile. Assuming the soil is not a truncated remnant, the argillic horizon indicates that major flow and fluvial depositional events ceased after about 4,000 years ago.

Genesis and Chronology of Landscapes

Based on stratigraphic relationships, soil properties, and stages of soil development, a general chronology in the evolution of the land forms at site 36 CH 103 can be postulated. As is apparent by the two principal terrace levels, the fluvial land forms present appear to represent two major periods of valley filling with intervening periods of stream rejuvenation and incision. Lesser, more local episodes of deposition as well as erosion of land surfaces have also contributed to landscape genesis. Figure 6 is an idealized cross-section showing the topography and major stratigraphic units of the site. The cross-section is based on field observations of this study together with descriptions of deep test borings (Appendix C) made by Site Engineering, Inc.

The first depositional unit is represented by the upper terrace deposits designated as I in Figure 6. Considering the estimated age of the soil formed in these deposits as well as the age of the major soil of the lower terrace, the upper terrace deposits appear to be the result of alluvial sedimentation dating to at least some time in the middle Pleistocene. Even though the estimated ages of both the upper terrace soil and main lower terrace soil are in the vicinity of 10,000 years, superposition requires that the upper terrace deposits (I) must be considerably older than the lower terrace deposits (II). Hence, the critical value is surface age rather than sediment age. It is apparent then that a significant erosional episode attacked the deposits of the upper terrace prior to and perhaps concurrently with deposition of the lower terrace deposits. This erosion probably involved both lateral undercutting of the older terrace and substantial denudation of any previously existing surface. Since the the minimum age of the lower terrace deposits must exceed the estimated 10,000 years of land surface stability needed to form the argillic horizon of the lower terrace soil, a time frame of late Pleistocene or very early Holocene is indicated for the erosion of the upper terrace and deposition of the lower terrace materials. A major period of deposition in early Holocene is compatible with an age of 9,000 years reported for alluvial fill in northern Pennsylvania and New York (Coates, 1976).

The bulk of the lower terrace deposits observed in the backhoe excavations consisted of stratified gravels and sands apparently derived mostly as channel and point bar deposits. Finer textured deposits identified below the gravels and sands in the deep test borings (Appendix C) indicate an earlier cycle of less flow velocity and overbank or backwater type deposits probably in late Pleistocene. Similarly, the surficial silt mantle in which most of the soil horizons are developed also suggests overbank or backwater type deposition as the final stage in the sedimentation cycle. Some eolian contribution is also likely, and infrequent flooding throughout the Holocene may have produced some minor additions.

The trough area appears to have served as a minor channel or flood scour route until about middle Holocene. By that time the trough was essentially plugged with fine sandy deposits (III), and a period of relative surface stability lasting several thousand years is indicated by the weak argillic horizon in the trough soil. Some silts carried by local runoff and occassional flooding have been deposited as a veneer above the fine sands. Historical clearing of the watershed and cultivation of the site have probably caused the accumulation of up to 50 cm of additional silty deposits in the trough area. These deposits may be thicker at some points, particularly in areas of alluvial fan-type deposits at the mouths of local drainageways dissecting the upper terrace scarp.

As estimated from soil morphological features, the overall suitability of the site for human habitation appears to have been favorable throughout the Holocene. The site soils would tend to have been excessively saturated during late winter and spring months due to water perching on the slowly permeable fragipan horizons (designated with subscript 'x') in both the upper and lower terrace soils. Beyond necessitating some delay in early spring crop planting, however, this seasonal condition can not be viewed as a particularly limiting feature of the site.

Environmentally, the most interesting aspect of the site is the low-lying trough area. In early Holocene, this trough is likely to have been the location of a small, shallow channel conducting water flow during floods or perhaps initially even on a continuous basis. The channel was probably bordered on the lower terrace side by a narrow belt of swampy terrain. After abandonment of the channel by middle Holocene, drainage in the area of the trough remained poor due to its low landscape position and the concentration of spring seepage from the upper terrace. Although no macro-organic remains were encountered in the soil profile examined, drainage conditions in other portions of the trough make the preservation of some organics likely.

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Appendix A: Soil Profile Descriptions

Profile 1

Horizon	Depth (cm)	Description
Ap	0-20	Dark brown (10YR 3/3) silt loam; weak coarse platy structure; friable; abrupt smooth boundary.
E	20-27	Brown (7.5YR 5/4) silt loam; common medium faint mottles of brown (7.5YR 5/2); weak coarse platy structure; friable; abrupt smooth boundary.
Btx	27-85	Brown (7.5YR 4/4) very gravelly heavy sandy loam; common medium distinct mottles of strong brown (7.5YR 5/6); moderate medium platy structure; thin continuous clay coatings; firm; gradual smooth boundary.
BC1	85-115	Variegated brown (7.5YR 4/4), (7.5YR 5/2), and strong brown (7.5YR 5/6) loam; weak medium platy structure; friable; clear smooth boundary.
BC2	115-175	Brown (7.5YR 4/4) loam; many prominent mottles of light brownish gray (10YR 6/2) and yellowish red (5YR 5/6); friable; clear smooth boundary.
2C	175-215	Brown (7.5YR 4/4) very fine sandy loam to silt loam; common coarse distinct mottles of pinkish gray (7.5YR 6/2) and strong brown (7.5YR 5/6); weak coarse prismatic breaking to weak coarse platy structure; friable.

Profile 2

Horizon	Depth (cm)	Description
Ap1	0-25	Very dark gray (10YR3/1) silt loam; weak medium subangular blocky structure; friable; abrupt smooth boundary.
Ap2	25-36	Dark brown (10YR3/3) silt loam; weak medium subangular blocky structure; friable; clear smooth boundary
Ap3	36-56	Dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; clear smooth boundary.

Profile 2 (Continued)

Ab	56-69	Dark brown (10YR 3/3) silt loam; weak medium prismatic structure; friable; clear smooth boundary.
E	69-91	Brown (10YR 4/3) silt loam; common fine distinct mottles of strong brown (7.5YR 5/6); weak coarse platy structure; friable; clear smooth boundary.
2Btx	91-119	Brown (7.5YR 4/4) sandy clay loam; weak coarse subangular blocky structure; thin patchy clay coatings; firm; clear smooth boundary.
2BC	119-147	Brown (7.5YR 4/4) fine sandy loam; many medium distinct mottles of dark yellowish brown (10YR 4/4) and brown (10YR 5/3); weak coarse platy structure; friable; clear smooth boundary
2C	147-203	Brown (7.5YR 4/4) fine sandy loam; mottling similar to above horizon; structureless to weak coarse platy structure; very friable; clear smooth boundary.
3C	203-234	Stratified sands and gravels; very friable.

Profile 3

Horizon	Depth (cm)	Description
Ap	0-19	Very dark gray (10YR 3/1) silt loam; weak coarse platy structure; friable; abrupt smooth boundary.
E	19-32	Brown (7.5YR 4/4) silt loam; weak medium platy structure; friable; clear smooth boundary.
Bx	32-50	Strong brown (7.5YR 4/6) and dark yellowish brown (10YR 4/4) silt loam; moderate coarse prismatic structure breaking to moderate medium subangular blocky; very firm; clear wavy boundary.
2Btx	50-88	Brown (7.5YR 4/4) fine sandy loam; manganese and organic stains; weak coarse prismatic breaking to weak medium platy and subangular blocky structure; firm; abrupt smooth boundary.
3BC	88-110	Strong brown (7.5YR 5/6) gravelly sandy loam; weak medium subangular blocky structure; friable; clear smooth boundary.

Appendix A: Soil Profile Descriptions

Profile 3 (Continued)

3CB	110-140	Brown (7.5YR 4/4) very gravelly loamy sand; structureless single grain; very friable to loose; clear smooth boundary.
3C	140-200	Dark yellowish brown (10YR 4/4) very gravelly sand; structureless single grain; loose.

Profile 4

Horizon	Depth (cm)	Description
Ap	0-25	Very dark gray (10YR 3/1) silt loam; weak medium subangular blocky structure; friable; abrupt smooth boundary.
E	25-38	Dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; firm; clear smooth boundary.
Btx1	38-64	Brown (7.5YR 4/4) heavy silt loam; moderate medium subangular blocky structure; thin clay coatings of reddish brown (5YR 4/4); firm; gradual smooth boundary.
Btx2	64-91	Brown (7.5YR 4/4) silty clay loam; strong moderate subangular blocky structure; thin clay coatings; firm; clear smooth boundary.
2Bt	91-132	Reddish brown (5YR 4/4) very gravelly sandy clay loam; patchy clay coatings; friable; gradual smooth boundary.
2C1	132-193	Dark yellowish brown (10YR 4/4) very gravelly loamy sand; very friable to loose; gradual smooth boundary.
2C2	193-211	Dark yellowish brown (10YR 4/4) very gravelly sand; loose.
2C3	211-249	Dark yellowish brown (10YR 4/4) very gravelly loamy sand; very friable to loose.

Profile 5: Very similar to profile 4; not described in detail.

Appendix A: Soil Profile Descriptions

Profile 6 (Partial description; profile similar to profile 1)

Horizon	Depth (cm)	Description
Bt	0-36	Brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; original surface horizons removed.
Btx	36-76	Yellowish brown (10YR 5/4) silty clay loam; moderate coarse platy structure.
C	76+	Stratified fine sands and silts; platy sediment structure with some deformation.

Appendix B: Particle size analyses

Profile	Horizon	Depth (cm)	Total Sand 2-0.5	Total Silt 0.5-0.002	Total Clay 0.002	Sand Very coarse 2-1	Sand Coarse 1-0.5	Sand Medium 0.5-0.25	Sand Fine 0.25-0.1	Sand Very fine 0.1-0.05
			%<2mm							
1	Ap	0-20	47.4	43.2	9.4	6.6	7.2	7.6	14.4	11.6
	Btx	27-85	33.4	48.2	18.4	2.2	5.0	6.2	10.8	9.2
	BC1	85-115	54.0	36.8	9.2	9.2	12.2	7.6	12.5	12.5
	BC2	115-175	59.6	29.8	10.6	8.2	10.2	9.4	16.2	15.6
2	Ap3	36-56	43.2	44.8	12.2	2.8	6.6	6.2	14.2	13.4
	E	69-91	33.0	52.6	14.4	1.0	4.2	4.2	10.8	12.8
	2Btx	91-119	48.0	35.0	17.0	0.2	0.6	4.2	24.8	18.2
	2BC	119-147	60.8	26.2	13.0	1.2	3.4	12.8	28.4	15.0
3	2Btx	50-88	59.8	25.6	14.6	0.6	4.8	13.0	28.8	12.6
4	Ap	0-25	25.8	57.0	17.2	0.6	2.2	2.4	9.4	11.2
	E	25-38	20.0	57.6	22.4	0.4	1.4	1.2	6.4	10.6
	Btx1	38-64	13.0	58.0	29.0	0.4	1.2	0.8	3.0	7.6
	Btx2	64-91	15.0	52.8	32.2	0.8	1.4	1.2	4.8	6.8
	2Bt	91-132	73.6	9.6	16.8	24.8	24.2	13.4	8.4	2.8
	2C1	132-193	94.8	1.6	3.6	28.2	34.2	18.8	12.6	1.0

SITE engineers, inc.

TEST BORING LOG

PROJECT Limerick Cromby Appendix C
LOCATION 220-61 Line

BORING B-1/4 Upper terrace
G.S. ELEV.
FILE SI-2020-18
SHEET 1 OF 1

GROUND WATER DATA			
FIRST ENCOUNTERED			
DEPTH	HOUR	DATE	ELAPSED TIME
12'9"	1100	8-12	½

METHOD OF ADVANCING BORE HOLE				
a	FROM 0'0"		TO	10'0"
b	FROM 10'0"		TO	21'0"
	FROM		TO	
	FROM		TO	
	FROM		TO	

DRILLER B. Radecke
HELPER S. Parisano
INSPECTOR A. Hall
DATE STARTED 8-12-83
DATE COMPLETED 8-12-83

DEPTH	A	B	C	DESCRIPTION	REMARKS
	S-1	4-8 10-14			S#1-P=3.0 TSF
	S-2	13-17 19-21			S#2-P=3.0 TSF
5	S-3	16-12 12-10		Brown Clayey Silt, Trace of Fine Sand and Gravel	S#3-P=2.5 TSF
	S-4	6-8 10-13			S#4-P=2.5 TSF
10	S-5	12-12 13-15			S#5-P=2.5 TSF
				13'	
15	S-6	12 16-24		Reddish Brown Silty Fine/Medium Sand, Some Shale Rock Fragments	
	NR	100/0		18'	
20				Reddish Brown Silty Dry Clay, Some Rock Fragments (Decomposed Shale)	
	NR	50/0		21'	
				Refusal on Cutter Head at 21'	
25					
30					
35					
40					
45					

FOR GENERAL NOTES SEE KEY SHEET AND LOCATION PLAN.

DRN. NG
CKD. JL

E905 7/82

TEST BORING LOG

SITE engineers, inc.

BORING	B-1/3 Lower terrace
G.S. ELEV.	
FILE	SI-2020-18
SHEET	1 OF 1

PROJECT Limerick Cromby Appendix C
LOCATION 220-61 Line

GROUND WATER DATA

FIRST ENCOUNTERED

DEPTH	HOUR	DATE	ELAPSED TIME
10'	1345	8-1	4

METHOD OF ADVANCING BORE HOLE

	FROM	TO
a	0'0"	10'0"
b	10'0"	33'0"

DRILLER B. Radecke
HELPER M. D'Ambrosio
INSPECTOR A. Hall
DATE STARTED 8-1-83
DATE COMPLETED 8-1-83

DEPTH	A	B	C	DESCRIPTION	REMARKS
	S-1	3-5 7-11		Brown Fine Sandy Silt, Trace of Roots	
	S-2	10-12 18-20		4'6	
5	S-3	25-50 70-75			
	S-4	60-74 86-95		Brown Silty Fine/Medium Sand and Gravel, Trace of Shale Rock Fragments	
10	S-5	90-65 79-89			
				12'	
15	S-6	11 16-29			
20	S-7	10 15-24		Brown Silty Medium/Fine Sand, Some Sandstone Rock Fragments	
25	S-8	12 16-20			
	NR	90/0		28'	Hard Drilling 28' to 33'
30				Green Gray Silty Dry Clay, Trace of Rock Fragments (Decomposed Shale)	
	NR	75/0		33'	
				Refusal on Cutter Head at 33'	
35					
40					
45					

FOR GENERAL NOTES SEE KEY SHEET AND LOCATION PLAN.

DRN. NG
CKD. JL

E905 7/82

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APPENDIX II:

The Geology of the Schuylkill River Floodplain Near Valley Forge, Pennsylvania in Relation to the Point Bar Site (36 MG 156)

by:

Elisabeth M. Ervin

II. BACKGROUND GEOLOGY

The study area is located in the Newark-Gettysburg Triassic basin. This basin, which runs in a belt from the Delaware River to Pennsylvania's southern border with Maryland, is one in a series of discontinuous sedimentary troughs extending from North Carolina to Nova Scotia (Glaeser 1966). These areas lie within faulted Precambrian to early Paleozoic metamorphic igneous rocks, parallel to the Appalachian fold belt.

Many of the rocks in the Newark-Gettysburg basin are sedimentary in origin. They often are red from the presence of hematite, a mineral; however, color varies from yellow to black. Common rock types found in the basin are shales, siltstones, sandstones, and conglomerates. Sedimentary particles making up these rock types were transported into the basin and are thus called clastic particles. The trough was tilted to the northwest, according to Bascom _et al_. (1931). Thick accumulations of sediments are recorded on the northwest margin. The southeast margin of the basin, where the present archeological site is located, was characterized by shallow water and a receding shoreline. Sediments in the early to mid-Triassic came from streams to the southeast of the margin (Glaeser 1966).

Cross-cutting the sedimentary deposits in the basin are tabular bodies called dikes. These are composed of Triassic age igneous rocks of diabase. The diabase was injected as hot magma through the sediments via internal faults. It is theorized that large-scale faulting resulted from the rifting of the continents in the Mesozoic. Shales and siltstones near the diabase dikes have been thermally altered by the intrusive magmas. The age of the diabase is approximately 195 million years old, late Triassic as determined by Uranium-thorium radiometric dating (Lapham and Root n.d.). Small extensive igneous deposits (lava flows) are also found in the basin. These have been found to be slightly earlier than the intrusive diabase.

The Point Bar site is underlain by the Triassic Stockton formation. This rock unit is the oldest formation (the earliest deposited) in the basin. The Stockton formation is between 1,000 to 6,000 feet in thickness. Conglomerates, which are common in the lower one third of the formation, are interbedded with finer deposits; arkosic fine to medium grain sandstone is present in the middle member and the upper member is characterized by shale and siltstone (Newport 1973). This formation weathers fairly rapidly and forms a topographic low.

Although the coarse to fine grain sequence has been noted, there is variation in sediment texture over distance. This indicates rapid depositional conditions with quickly shifting currents. Shallow water conditions are indicated by raindrop prints and desiccation cracks on shale bedding planes (Bascom _et al_. 1931). Many of these sediments were deposited as confluent deltas (Bascom _et al_. 1931) formed when streams entered the quieter lake conditions.

III. SAMPLING AND GRAIN SIZE ANALYSIS

Stratigraphy, Munsell soil color, texture, and horizon boundaries were described in the field for levels in each archeological test unit. Usually, geologic analysis includes large backhoe trenches to examine stratigraphy at depth. However, to prevent large-scale disruption in the vicinity of the site geologic samples were obtained from archeological test units measuring five feet on a side. The depth of the units did not exceed 77 inches. This information was supplemented by four test borings made at proposed Structure Locations 6/3, 6/4, 6/5, and 6/6 by Site Engineers, Inc. (1983) (Appendix I).

Four archeological test units at Structure Location 6/5 were selected for their stratigraphic control (Figure 2). Units N5W25 and S0E20 fall on an approximate east-west transect, parallel to the Schuylkill River. Units N15E5 and S10W5 form a north-south transect perpendicular to the river. Perpendicular control is generally more useful in the study of fluvial sediments.

Twenty-five samples were collected from stratigraphic divisions within the four units. Because of possible disturbance when the existing lattice structure was emplaced, sampling did not include the upper nine to 13 inches of the units.

Samples were analyzed for percent of clay, silt, sand, and gravel by particle size analysis. This test is fundamental to understanding depositional processes and obtaining an overall view of site geology. The procedure for this analysis is documented by the American Society for Testing and Materials (ASTM 1972) and is presented briefly below.

Throughout this discussion, the phi scale will be used. This is a negative log conversion of the millimeter scale. Table 1 (Lane et al. 1947) shows the relationship of phi sizes to the millimeter scale and textural classes.

Particle size analysis consisted of three phases: coarse sieving of material larger than -1.00 phi (pebbles and gravel); a hydrometer test on the silt and clay; and fine sieving of sand particles. Preparation of samples for analysis included oven drying at low temperatures to remove moisture. Clumps in the samples were crushed by hand to ensure accurate grain size measurement. The amount of sample tested was determined by the largest grain size diameter present. For analysis of samples containing gravel and pebbles, two kilograms was used. Five hundred grams was sufficient for the finer samples.

Coarse sieving was the next part of the procedure. The dry, disaggregated material was sieved in a mechanical shaker for 15 minutes. Material passing through the -1.00 phi sieve was set aside for the hydrometer test. Sieve sizes of -4.65 phi, -4.25 phi, -3.25 phi, and -2.25 phi were used to differentiate between coarse particle size retained on the -1.00 phi sieve. Particles larger than -4.65 phi were measured by hand. Weight retained on each sieve was weighed on a triple

IV. CALCULATION AND GRAPHS

Calculations to determine particle sizes from percent material remaining in solution for the hydrometer test are described by ASTM (1972).

Data from the hydrometer analysis and coarse and fine sieving was combined for each sample and plotted on a cumulative curve. These curves were constructed by graphing cumulative percent retained on each sieve for each sample on a logarithmic probability scale, versus grain size in phi units. The probability curve was expanded at the ends of the distribution, under 10 percent and over 90 percent, and condensed between 30 to 70 percent. Folk (1974) recommends use of the probability scale in cases where the sediments do not have a normal Gaussian distribution and are not clustered around one grain size. A non-normal distribution plots on a probability scale as a curved line. All 25 samples from the site have a non-normal distribution.

The percent of clay, silt, sand, and gravel for each sample was determined directly from the respective cumulative curve (Appendix II). This was necessary because sieve intervals did not correspond exactly to grain size divisions, as per Table 1.

In several cases at the end of the grain size analysis values of less than 100 percent were obtained. This can be attributed to the length of time the hydrometer was read. Readings were carried out to 1,440 minutes, as dictated by standard ASTM (1972) procedure. This last reading only measures particles down to 9.38 phi which is in the range of medium clay. Particles finer than 9.38 phi, often remain in suspension for longer periods of time. This is especially true of alluvial sediments and explains the difference between the two values. To normalize the samples the differences were added to the fine clay size group (Ladd 1984).

Cumulative grain size was plotted versus depth for each archeological unit to show changes in soil texture (Figures 3 through 6). Samples were classified by percent of sand, silt, and clay according to the USDA (1981) guide for textural classificatin. Stratigraphic grain size relationships over distance are shown in Figures 7 and 8.

The following statistical measures described by Folk (1974) were determined from cumulative curves for each sample: median, graphic mean, phi quartile deviation, graphic standard deviation, inclusive graphic skewness, and kurtosis. The median and graphic mean are measurements of average size. Phi quartile deviation and graphic standard deviation are measures of sediment uniformity. Inclusive graphic skewness and kurtosis measure asymmetry of the grain size distribution and peakedness of the curve, respectively. These parameters were determined from the cumulative curves by the formulae given in Table 2. Average values for geologic samples are given in Table 3. These measures are important in the understanding of sediment genesis and deposition. Variation in values represents differing depositional environments.

B. Site-specific Stratigraphy

Samples and stratigraphy from Structure Location 6/5 demonstrate changes in fluvial regime and depositional conditions. Grain size analyses of the floodplain samples at the Point Bar site indicate distinct stratigraphic trends between units. Seven levels were identified based on textural characteristics, color, and horizon boundaries (Table 4). Interrelationships between horizons are also demonstrated in these figures. Unit stratigraphy corresponds closely to the data from four test bore holes made by Site Engineers Inc. (1983) (Appendix I).

The most striking feature of the stratigraphy is the gradually fining upward sequence of sediments. Depth versus cumulative percent profiles (Figures 3 through 6) demonstrate this trend. Coarse sediments are present in the lower sections of the units. Lines of equal size slope upward as the sediments become finer toward the top.

The relationship of unit stratigraphy to levels determined by test bore holes is illustrated in Table 5. Correlation between the data is close but not exact. Error may be a result of stratigraphic measurement by different operators, location of the bore holes in relation to the units, and natural discontinuities in the strata. Unit levels are deeper than bore hole levels in Unit S10W5. This is particularly true for Levels I, II, III, and IV of Unit S10W5. Most of the discrepancy can be accounted for by the placement of Unit S10W5 in relation to the bore hole location. Of the four units, this one is closest to the Schuylkill River. Evidence indicates that the upper bore hole deposits, especially Layer 2 (brown silt with traces of fine sand), grade towards the river. Upper deposits in Unit S10W5 are, therefore, deeper than in other units.

Only two deposits in the bore hole sequence are common to all structure locations. These are Layers 1 and 2, identified by Site Engineers, Inc. (1983) (Appendix I) as topsoil and brown silt with traces of fine sand, respectively. The remaining bore hole layers at Structure Location 6/5, Layers 3, 13, and 6, representing sandy silts to sandy gravels, are found only at this location (Figure 9).

Based on deposit geometry and textural characteristics, Layers 1 and 2, which correspond to Levels I, II, III, and IV, are indicative of overbank deposits. A river bar or channel deposit appears to be represented by Layers 3, 13, and 6, which are analogous to Levels V, VI, and VII. A close look at size data and statistical parameters, determined from cumulative curves, supports this view.

Statistical measures used to describe the cumulative curves for each sample are shown in Table 5 for Levels I through VII. The spread of values and averages are recorded for each sample. Tables 6 and 7 represent statistical parameters for vertical and lateral accretion and channel/bar deposits as determined by other researchers.

The suggestion that these levels represent levee deposits has direct archeological implications. The majority of the cultural remains were found under 30 inches in depth in the natural levee deposits. Turnbaugh (1978) notes that because of high sedimentation rates, overbank, and in particular levee, deposits are often found in association with cultural remains.

Development of soil in the levee deposits at the Point Bar site was also investigated. Frequent flooding of an area inhibits formation of a well-developed soil profile as the result of burial and disturbance by vertical accretion. However, the presence of soils in alluvial sediments is not uncommon. Allen (1965) notes that levees often develop vegetative cover and soil horizons, especially if flooding occurs infrequently and the deposit is exposed to subaerial weathering.

Because the degree of pedogenesis is dependent on time, it is possible to examine soil development to determine its relative age. Among factors which indicate soil genesis with respect to time are increases in clay content, development of stronger soil structure, accumulation of carbonates, and increases in organics and degree of color, generally in the B horizon (Ryan and Paeth 1977).

Soil formation in the B horizon, the zone of illuviation, ranges in degree. Cambric horizons demonstrate slight soil development while argillic horizons indicate a greater degree of pedogenesis (Buckman and Braehy 1969). The time required to form both types of horizons has been measured in the field and checked with radiocarbon dates for different climatic conditions by numerous researchers.

Slight soil development has occurred in the levee deposits on the floodplain under study. Figures 4, 5, and 6 show an increase in clay content in loam and sandy loam levels of Units S0E20, N5W25, and N15E5. Unit S10W5 is closer to the footing of Structure Location 6/5, and the upper part of its profile seems to have been disturbed by tower emplacement. Comparison with clay content data of Bilzi and Ciolkosz (1977) for four alluvial soils in Pennsylvania indicates that a weakly developed Cambric horizon is present in the Levels III and IV depth of the above units. Although some pedogenesis has occurred, profiles indicate that alluvial sedimentation is the dominant process operating on this floodplain.

Before the floodplain developed, a very different fluvial environment existed at the location of the present site.

Levels V, VI, and VII could have been deposited either by river bar or point bar processes.

Folk and Ward (1957) analyzed similar sediments from a channel bar on a meandering river in Texas. The bar contained three major deposits, including a basal layer of sandy pebble gravel overlain by gravelly medium sand and topped with fine to silty fine sand. Cross-

Figure 7 shows a north-south stratigraphic profile at Structure Location 6/5 which is perpendicular to the Schuylkill River and lends additional evidence for bar development. Data for the boundary at the base of Level VII was determined from test borings. If Levels V through VII were laterally accreted deposits, as opposed to a channel bar environment, boundaries between levels would slope up and away from the river in profile. The geometry of meander bends causes point bar deposition to occur on the slip off slope and to thicken toward the river (Wolman and Leopold 1957).

Levels V, VI, and VII do not slope toward the Schuylkill River. Boundaries between Level V and Level VI are planar and the lower Level VII interface slopes away from the river. This indicates deposition by other than lateral accretion.

In addition to the geometric difficulties with a point bar deposit at this location, map position of the site in relation to the meander bend is not ideal for point bar development. Most lateral accretion occurs directly on the convex side of the bend (Blatt et al. 1980; Ritter 1978). Deposits at Structure Location 6/5 are located below the meander bend where the river begins to straighten. For this reason, and because the Schuylkill River does not have normal meanders, little lateral accretion probably occurred at the site.

A final argument for bar development in Levels V through VI is the presence of a channel remnant near the site. The channel scar has not been completely infilled and can be seen in air photos (Plate 1). The channel is on the north side of the site and is adjacent to the bedrock ridge.

In summation, although the fining upwards cyclothem at the site appears to be a continuous unit, it actually represents two distinct environments of deposition. Without the assistance of grain size analysis and data from test bore holes, it would be difficult to determine the end of the fining upwards sequence of the bar and the beginning of the levee deposit. Differentiation of the two environments is also supported by the artifact evidence. The majority of the cultural material was found in the levee deposit within a depth of 30 inches.

past when the river began to incise. This trend restricted large-scale channel migration and directly affected the development of the floodplain. Overbank deposits were less reworked and had the opportunity to develop. Ritter, Kinsey, and Kauffman (1973) reported similar findings on a part of the Delaware River which was also laterally restricted.

The river is no longer flowing on the bedrock it once eroded. Infilling, as a result of later change in river regime, has caused the build up of approximately 27 feet of unconsolidated sediment at the site.

A model for floodplain deposition is illustrated in Figure 11. Stage 1 shows the first phase of development. In the early Pleistocene or late Pliocene, it is probable that the main channel of the river was slightly to the north of the site. A channel remnant, as discussed previously, is still evident today (Plate 1).

The Schuylkill migrated south in the mid- to late Pleistocene and probably split its channel around the growing bar deposit, Levels V, VI, and VII (Figure 11, Stage 2). Although the bar may have been exposed subaerially at times, there is little doubt that, in the beginning of its growth, it was submerged.

Although it was not possible to obtain a bulk carbon sample for radiometric dating, a tentative date of pre-Holocene can be given to the bar deposits. Support for this date is based on Tuscarora and Shawangunk sandstone pebbles found in the sandy gravel deposits (Level VII). Sevon (1984) examined material from this level and was able, based on diagnostic characteristics, to distinguish several pebbles as possibly being Tuscarora sandstone. The Tuscarora and Shawangunk formations are the same deposit and have different names only because different locations were mapped by several geologists.

The Silurian Shawangunk formation is found only in the uppermost reaches of the Schuylkill River drainage basin, above Friedensburg and Harrisburg, Pennsylvania in the Appalachian mountain province (Pennsylvania Topographic and Geologic Survey 1980). MacLachlan (1979) notes that boulders of Tuscarora sandstone are found in terraces on the Schuylkill. He attributes their location there to high flow conditions and ice rafting in the Pleistocene. Since the Schuylkill River was an outlet for meltwater during glacial retreats, it is likely that the Tuscarora gravels and other exotic rocks in the bar deposits were transported by increased flow in the Pleistocene.

Bar development, similar to Stage 2, (Figure 11) is presently occurring downriver from the site west of the Betzwood Bridge (Plate 1). At this point, the river divides around a bar/ island. Although the gravel bar, represented by Levels V, VI, and VII, may not have been continuously exposed subaerially as the modern bar/island is, it appears that the same processes are operating. Already the north channel carries less water than the southern part of the channel. If the river migrates to

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TABLES

TABLE 1. GRAIN SIZE SCALES (Lane, et al. 1947)

GRADE LIMITS phi	mm	mm	inches	U. S. Standard Sieve Series	GRADE NAME		
-12	4096		161.3				
					very large		
-11	2048		80.6				
					large		
-10	1024		40.3			Boulders	
					medium		
-9	512		20.2				
					small		
-8	256		10.1				
					large		
-7	128		5.0			Cobbles	
					small		GRAVEL
-6	64		2.52	63mm			
					very coarse		
-5	32		1.26	31.5mm			
					coarse		
-4	16		0.63	16mm			
					medium	Pebbles	
-3	8		0.32	8 mm			
					fine		
-2	4		0.16	No. 5			
					very fine		
-1	2		0.08	No. 10			
					very coarse		
0	1		0.04	No. 18			
					coarse		
+1	1/2	0.500		No. 35			
					medium	Sand	SAND
+2	1/4	0.250		No. 60			
					fine		
+3	1/8	0.125		No. 120			
					very fine		
+4	1/16	0.062		No. 230			
					coarse		
+5	1/32	0.031					
					medium		
+6	1/64	0.016				Silt	
					fine		
+7	1/128	0.008					
					very fine		
+8	1/256	0.004					MUD
					coarse		
+9	1/512	0.002					
					medium		
+10	1/1024	0.001				Clay size	
					fine		
+11	1/2048	0.0005					
					very fine		
+12	1/4096	0.00025					

TABLE 3. STATISTICAL PARAMETERS
DETERMINED FROM CUMULATIVE CURVES FOR STRATIGRAPHIC LEVELS

*A = Average

Level	Median (M_d)	Graphic Mean (M_z)	Phi Quartile Deviation	Inclusive Graphic Standard Deviation	Trask (mm scale)	Inclusive Graphic Skewness	Kurtosis
I	3.80	4.21	2.41	3.04	5.31	+0.24	0.80
II	4.35 - 4.80 *A = 4.60	4.22 - 4.61 A = 4.42	1.74 - 2.15 A = 1.94	2.70 - 3.65 A = 2.99	3.34 - 4.43 A = 3.86	-0.16 to +0.06 A = -0.03	0.91 - 1.54 A = 1.09
III	5.07	4.79	2.44	2.70	5.44	-0.14	0.77
IV	2.32 - 4.05 A = 3.28	3.45 - 4.40 A = 4.10	2.00 - 2.36 A = 2.20	2.84 - 3.06 A = 2.96	3.75 - 5.11 A = 4.38	+0.22 to +0.66 A = +0.41	0.85 - 1.02 A = 0.92
V	1.50 - 2.40 A = 1.94	1.95 = 3.56 A = 3.05	0.78 - 1.81 A = 1.38	2.99 - 3.15 A = 3.05	1.75 - 3.49 A = 2.68	+0.24 to +0.75 A = +0.62	1.22 - 3.80 A = 1.95
VI	1.10 - 1.77 A = 1.50	1.67 - 2.61 A = 2.18	0.64 - 1.09 A = 0.85	1.98 - 3.02 A = 2.55	1.56 - 2.12 A = 1.81	+0.58 to +0.70 A = +0.66	2.47 - 2.76 A = 2.59
VII	-3.87 - 0.79 A = -1.75	-2.96 to -0.29 A = -1.53	1.26 - 2.61 A = 2.12	2.22 - 3.53 A = 2.96	2.37 - 6.10 A = 4.62	-0.19 to +0.56 A = +0.23	0.75 - 1.14 A = 1.00

TABLE 5. RELATIONSHIP OF UNIT LEVELS TO TEST BOREHOLE DATA
(Site Engineers, Inc. 1983)

Level from Unit	Textural Class	Depth (Inches)	Corresponding Test Borehole	Textural Class	Depth (Inches)
I	Sandy loam	A=19.3	1	Topsoil	15
II	Silt loam				
III	Loam	A=34.7	2	Brown silt, traces of fine sand	24-30
IV	Sandy loam				
V	Loamy sand	A=52	3	Red fine sandy silt, traces of rock fragments	48
VI	Sand	A=73.3	13	Red-brown fine-medium sand with grey rock fragments	72
VII	Sandy gravel	A=110	6	Brown fine-medium sand with gravel	108-144

A = Average Depth

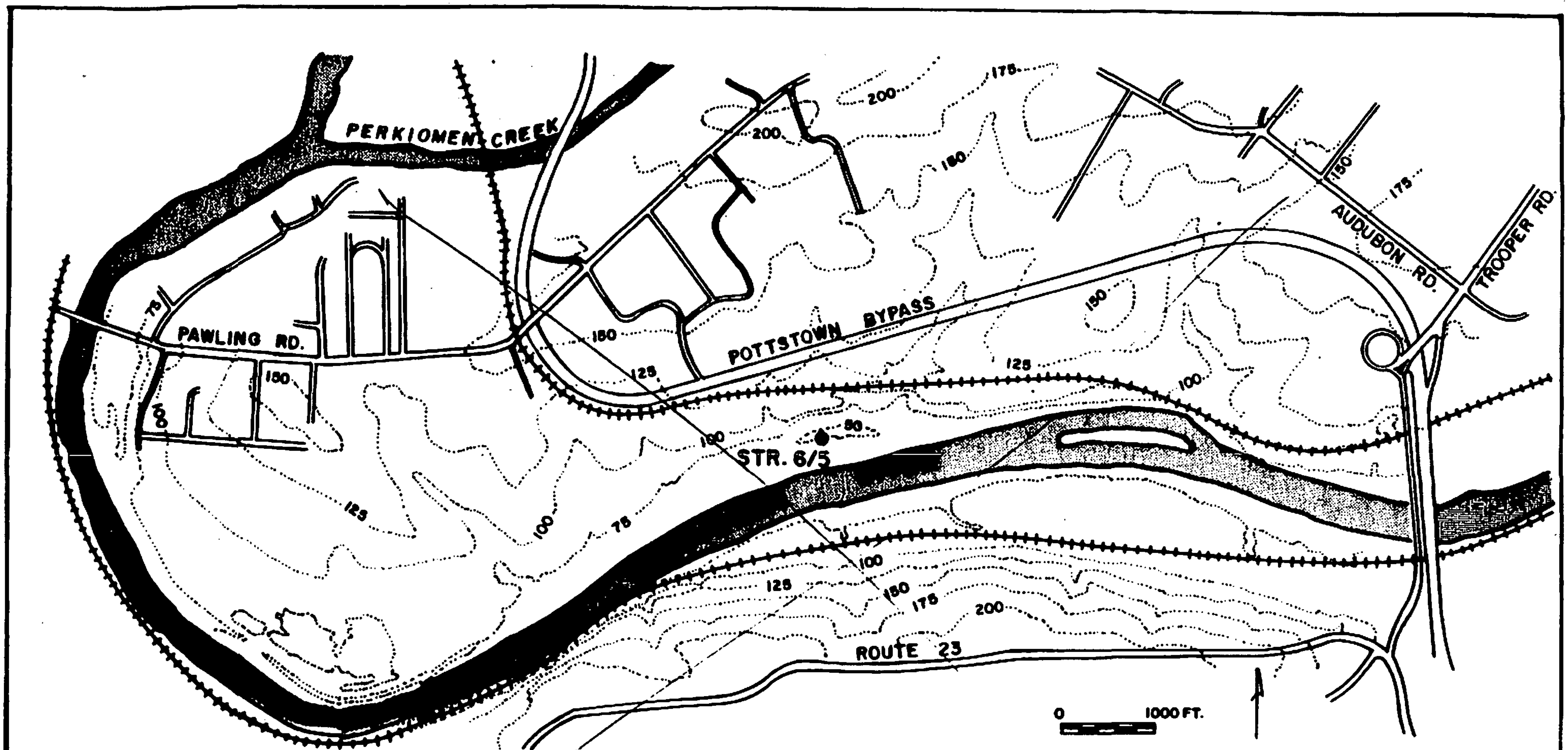
TABLE 7.
GRAIN SIZE PARAMETERS CHARACTERISTIC OF
LATERAL ACCRETION DEPOSITS AND BAR/CHANNEL DEPOSITS

Author	Lateral Accretion Deposits	Equivalent in Phi Units
Kukal (1971)	Md = 0.01 to 0.05	Md = 4.32ø to 6.64ø
Schumm (1961)	Md = 0.015 to 0.035	Md = 6.05ø to 4.83ø

Author	Bar/Channel Deposits	Equivalent in Phi Units
Wolman (1955)	Md = 0.7 - 4.1 mm Channel deposits--gravel	Md = 5.14ø to -2.04ø
Kukal (1971)	Md = 0.1 to 2.0 mm Channel deposits	Md = 3.25ø to -1.00ø
Polk and Ward (1957) (Bar)	Bimodal Mz of total bar samples = -1.7ø to to +3.2ø Max Conc.: -1.5 to -1.10	Mz of basal sandy gravels = -1.5ø to 0.0ø
	Very Bimodal Mz of sands = 1.1ø	Mz of upper sands = 1.8ø to 3.2ø
	OI for total bar = 0.40ø to 2.58ø	
	OI for channel samples = 1.8ø with 2 clusters: 2.0ø to 2.4ø and 0.40ø to 0.80ø	OI sandy gravels = 1.80ø to 2.30ø
	OI for sand samples - similar to channel samples	OI upper sands = 0.40ø to 0.50ø no values between 1.20 to 1.80ø
	Skewness for total bar = -0.68 to to +0.53	SKI sandy gravels = +0.20 to +0.40 fine tail in sand
	Skewness of sand samples - normal distribution	SKI gravelly sands = -0.30 to -0.55
	Skewness of channel samples - bimodal distribution	
	Kurtosis of sand samples = 0.96 = a normal distribution	
	Kurtosis of channel samples = non-normal - clustered mostly about 0.56 - 0.89 and a few 1.63 - 2.33	

Md = Median Diameter OI = Inclusive Graphic Standard Deviation
Mz = Graphic Mean SKI = Inclusive Skewness

FIGURES



PROJECT LOCATION MAP

Figure 1

PLACEMENT OF TEST UNITS

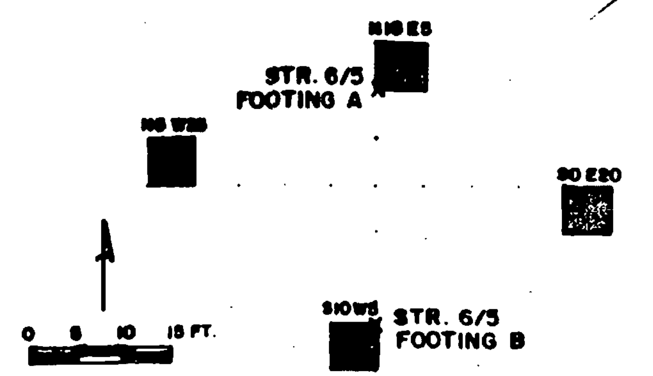
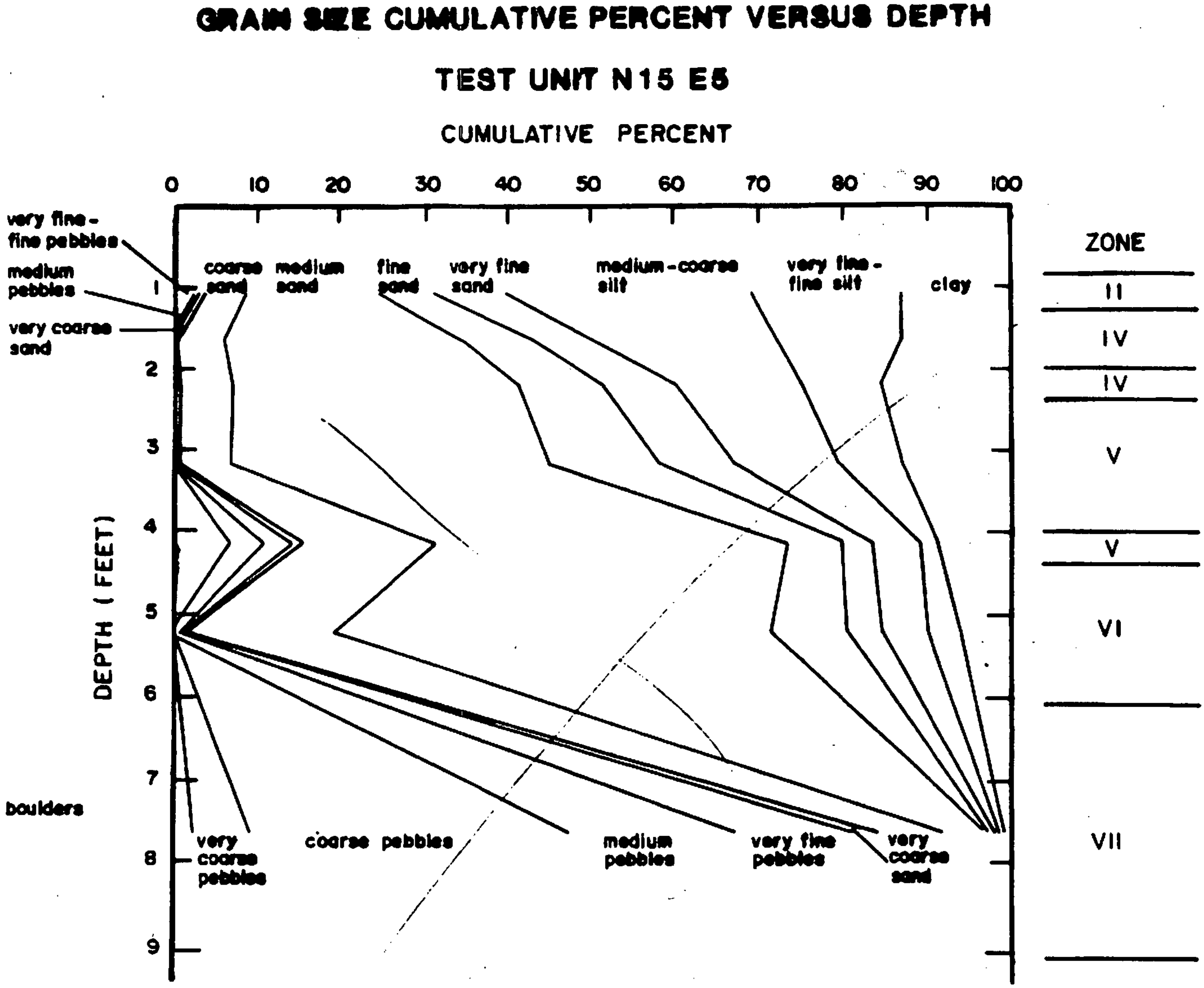


Figure 2

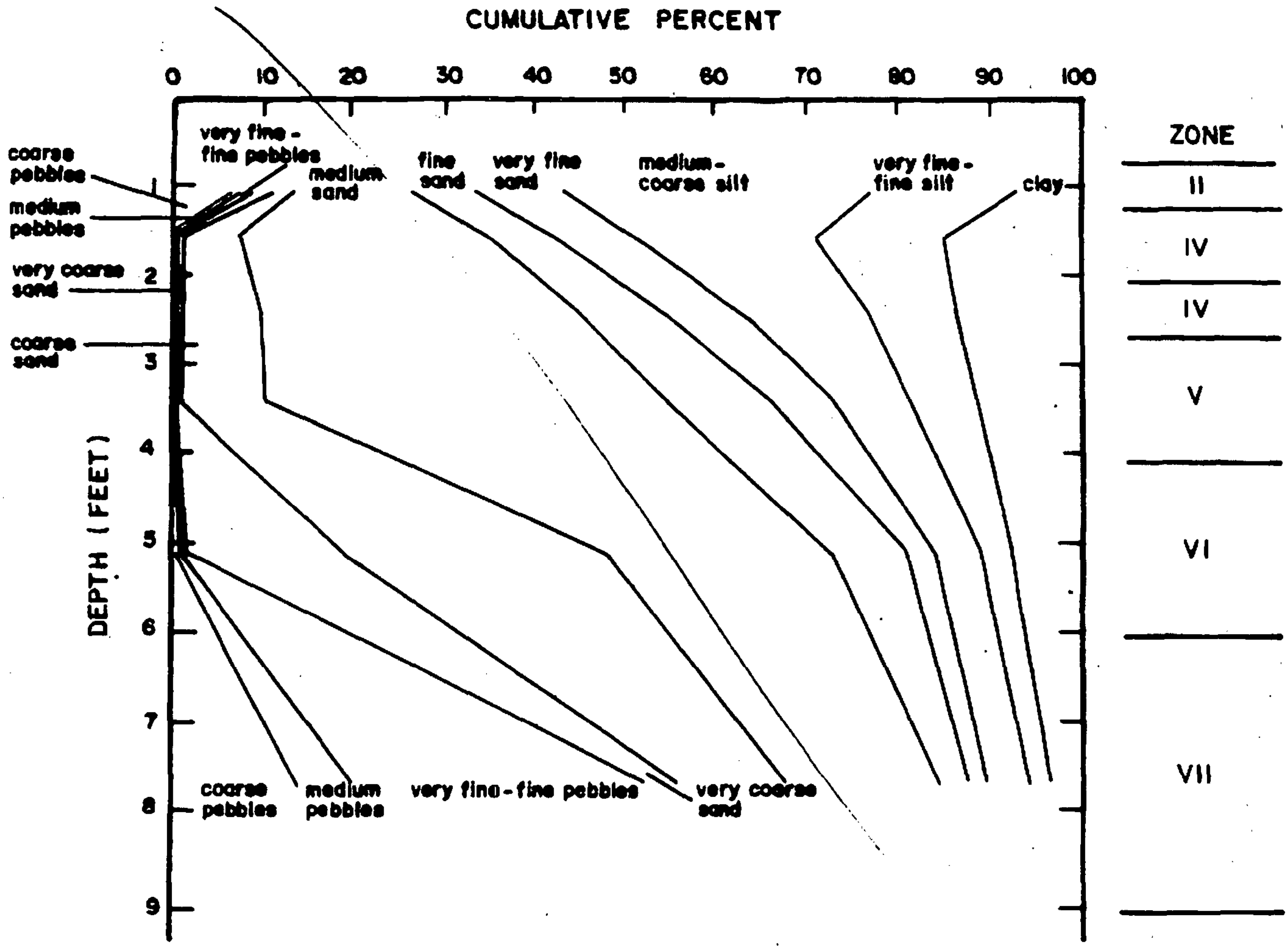


ZONE	LEVEL	DEPTH (inches)	DESCRIPTION
II	1	10-15	5YR 4/4 reddish brown silt loam; gradual wavy boundary
IV	2	15-24	5YR 4/6 yellowish red sandy loam; gradual wavy boundary
	3	24-28.2	5YR 4/6 yellowish red, very sandy loam; gradual, clear boundary
V	4	28.2-48	5YR yellowish red loam sand; clear, smooth boundary
	5	48-52	5YR 4/6 yellowish red loamy sand; clear, smooth boundary
VI	6	52-73	5YR 4/4 reddish brown sand; clear, smooth boundary
VII	7	73-110	5YR 4/4 reddish brown sandy gravel; boundary unknown

Figure 3

GRAIN SIZE CUMULATIVE PERCENT VERSUS DEPTH

TEST UNIT S0 E20

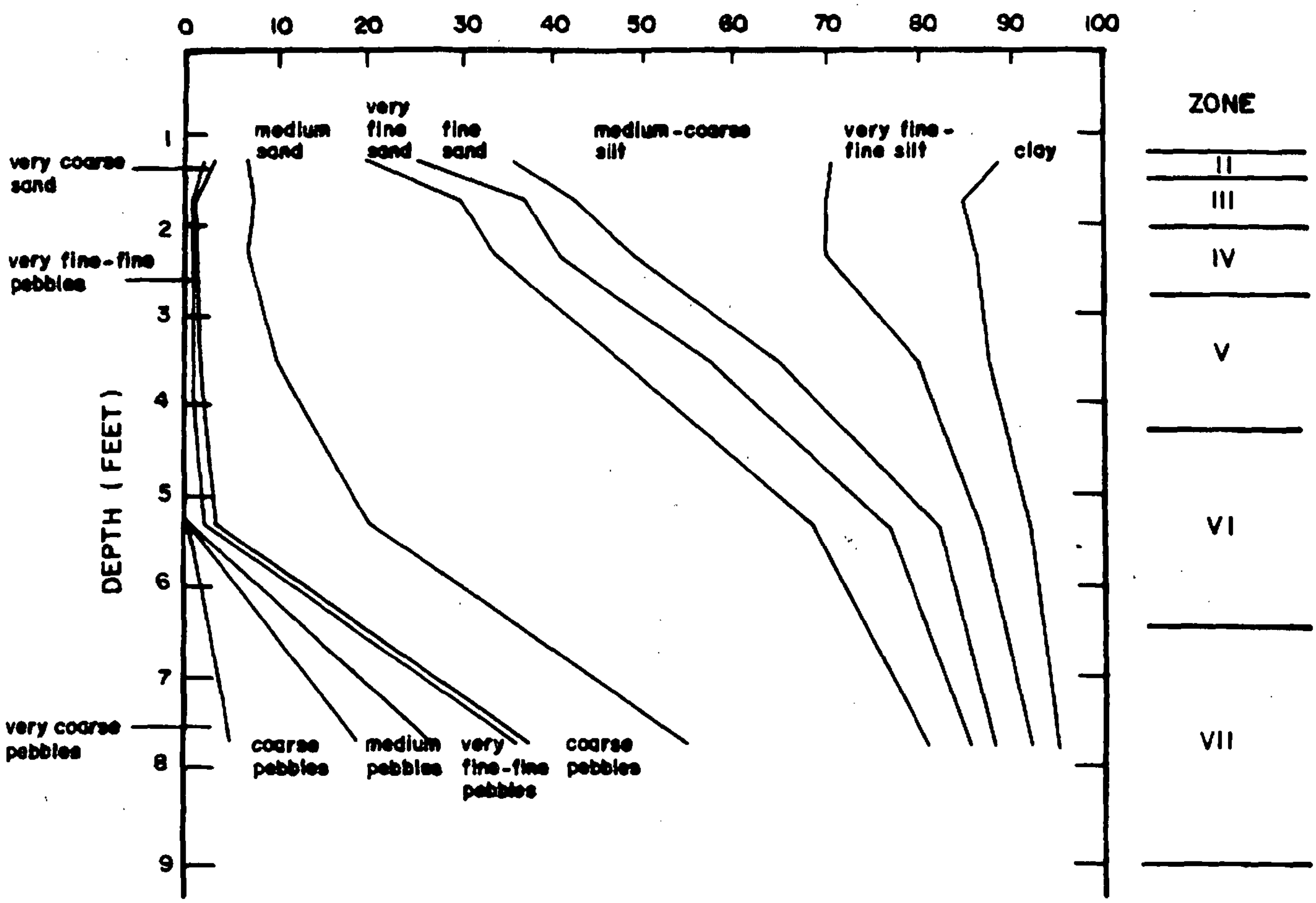


ZONE	LEVEL	DEPTH (inches)	DESCRIPTION
II	4	9-15	5YR 4/4 reddish brown silt loam; gradual, wavy boundary
IV	5	15-25	5YR 4/6 yellowish red sandy loam; gradual, wavy boundary
	6	25-32	5YR 5/4 reddish brown very sandy loam; gradual, clear boundary
V	7	32-49	5YR 4/6 yellowish red loamy sand; clear, wavy boundary
VI	8	49-73	5YR 4/4 reddish brown sand; clear, smooth boundary
VII	9	73-110	5YR 3/3 dark reddish brown sandy gravel; boundary unknown

Figure 4

GRAIN SIZE CUMULATIVE PERCENT VERSUS DEPTH

TEST UNIT N5 W25

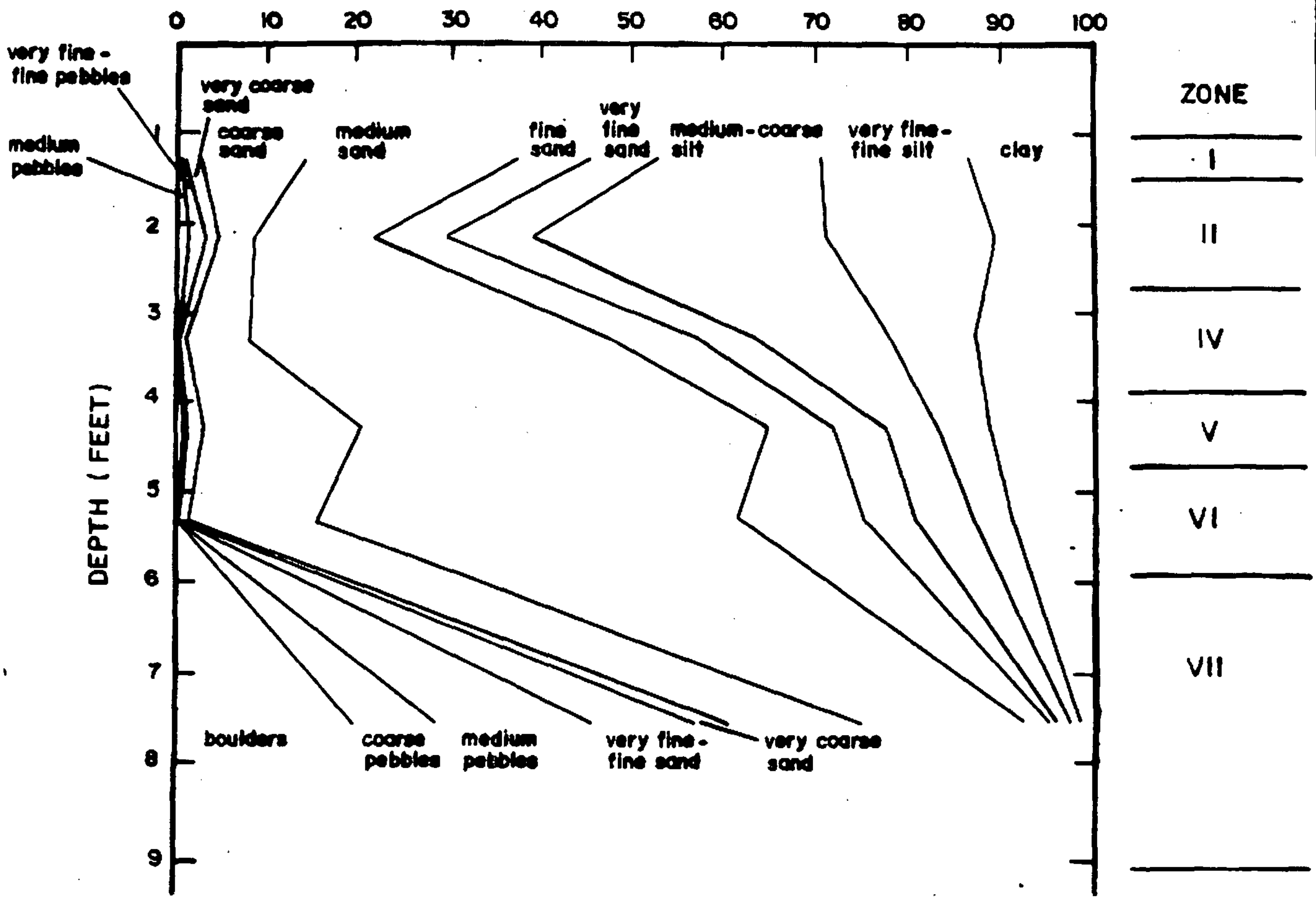


ZONE	LEVEL	DEPTH (inches)	DESCRIPTION
II	4	13-17	5YR 4/4 reddish brown silt loam; clear, smooth boundary
III	5	17-23	5YR 4/6 yellowish red loam; gradual, smooth boundary
IV	6	23-32.5	5YR 4/6 yellowish red sandy loam; gradual, wavy boundary
V	7	32.5-51	5YR 4/8 yellowish red sandy loam-loamy sand; clear, wavy boundary
VI	8	51-77	5YR 4/4 reddish brown sand; clear, smooth boundary
VII	9	77-109	5YR 4/4 reddish brown gravelly sand; boundary unknown

Figure 5

GRAIN SIZE CUMULATIVE PERCENT VERSUS DEPTH

TEST UNIT S10 W5



ZONE	LEVEL	DEPTH (inches)	DESCRIPTION
I	3	12-17.5	5YR 4/4 reddish brown sandy loam; gradual, wavy boundary
II	4	17.5-32	5YR 4/6 yellowish red silt loam; gradual, wavy boundary
IV	5	32-46	5YR 4/6 yellowish red sandy loam; gradual, irregular boundary
V	6	46-56	5YR 4/6 yellowish red loamy sand; clear, irregular boundary
VI	7	56-70	5YR 4/6 yellowish red loamy sand-sand; clear, smooth boundary
VII	8	70-110	5YR 4/4 reddish brown sandy gravel; boundary unknown

Figure 6

NORTH-SOUTH STRATIGRAPHIC RELATIONSHIP BETWEEN TEST UNITS N15 E5 AND S10 W5

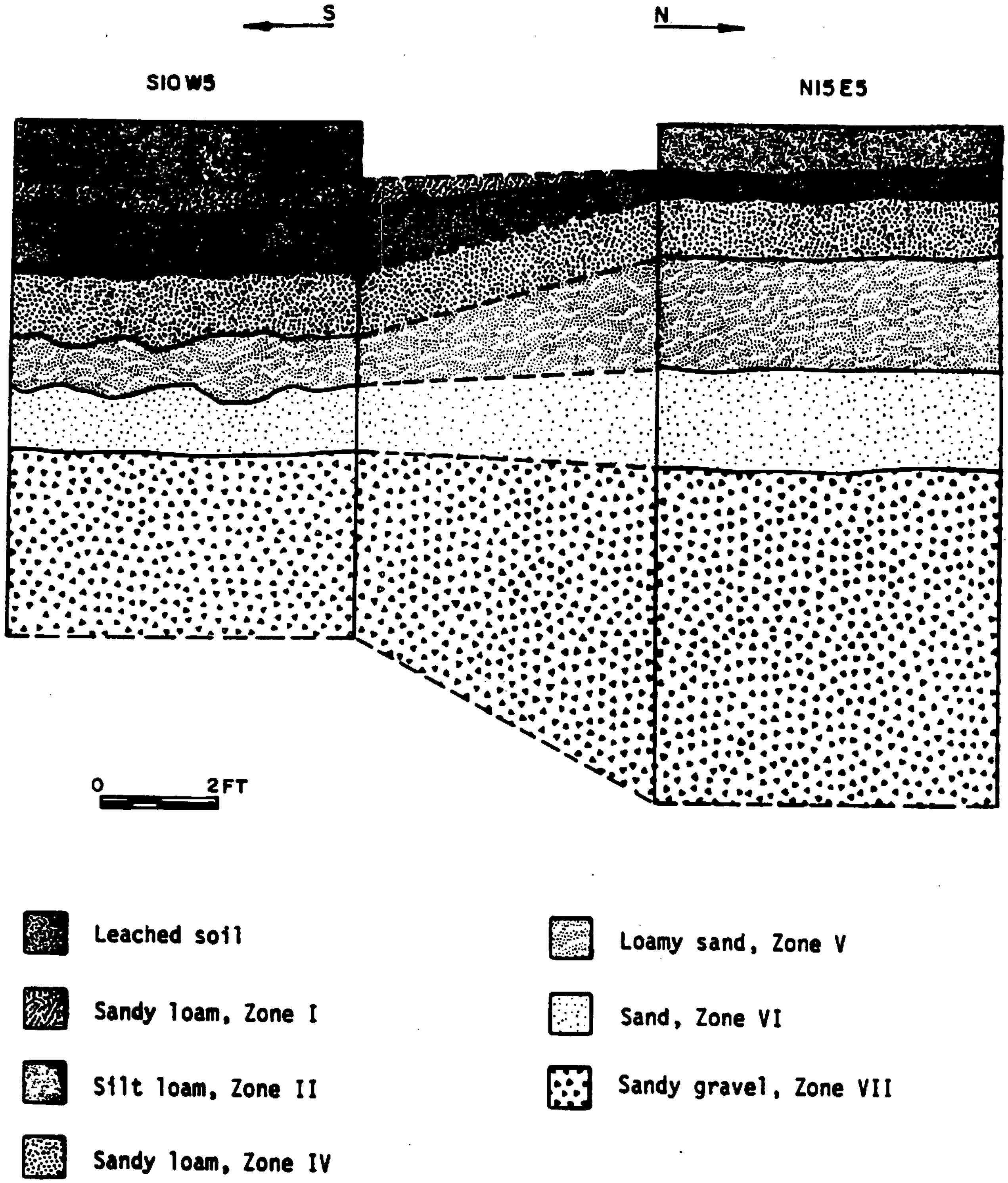
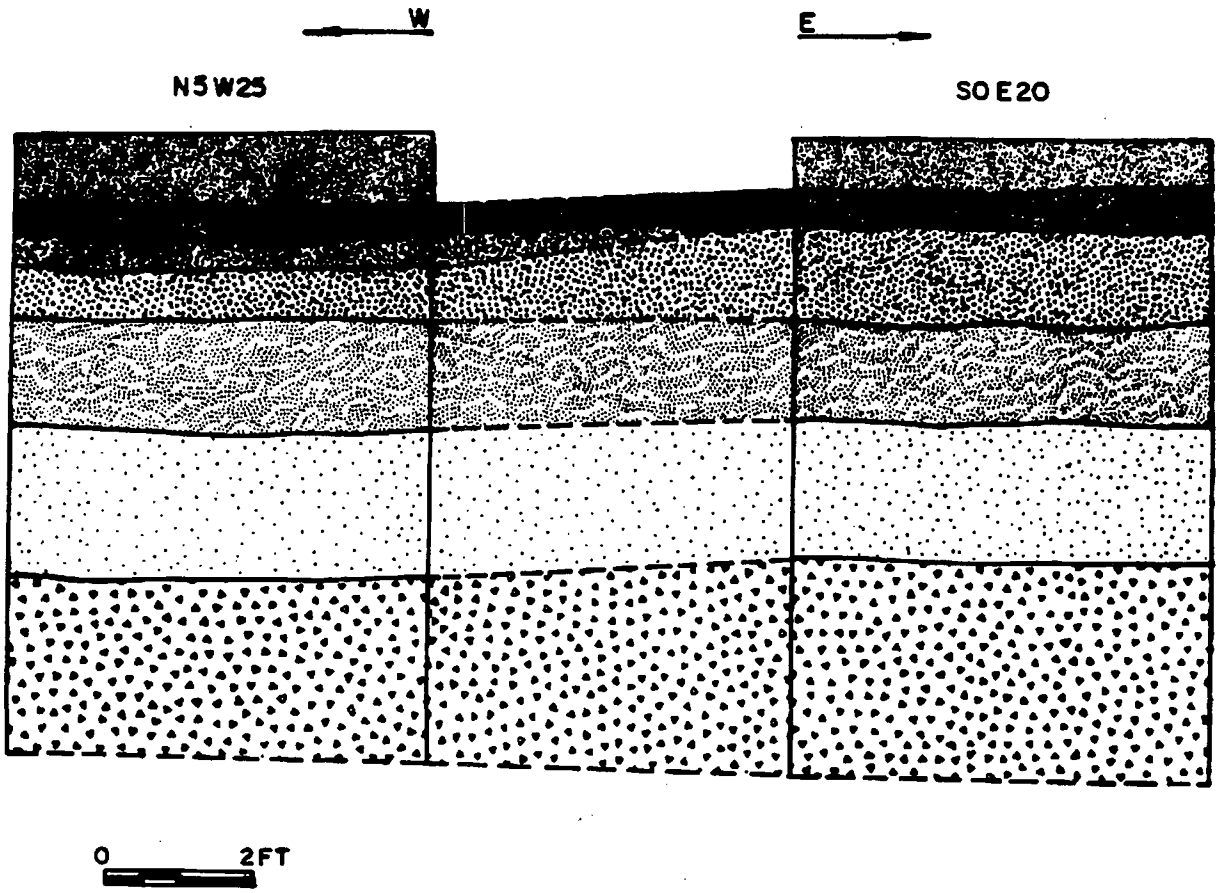


Figure 7

EAST-WEST STRATIGRAPHIC RELATIONSHIP BETWEEN TEST UNITS N5 W25 AND S0 E20



Leached soil, Zone I

Silt loam, Zone II

Loam, Zone III

Sandy loam, Zone IV

Loamy sand, Zone V

Sand, Zone VI

Gravelly sand, sandy gravel, Zone VII

Figure 8

SCHEMATIC PROFILE

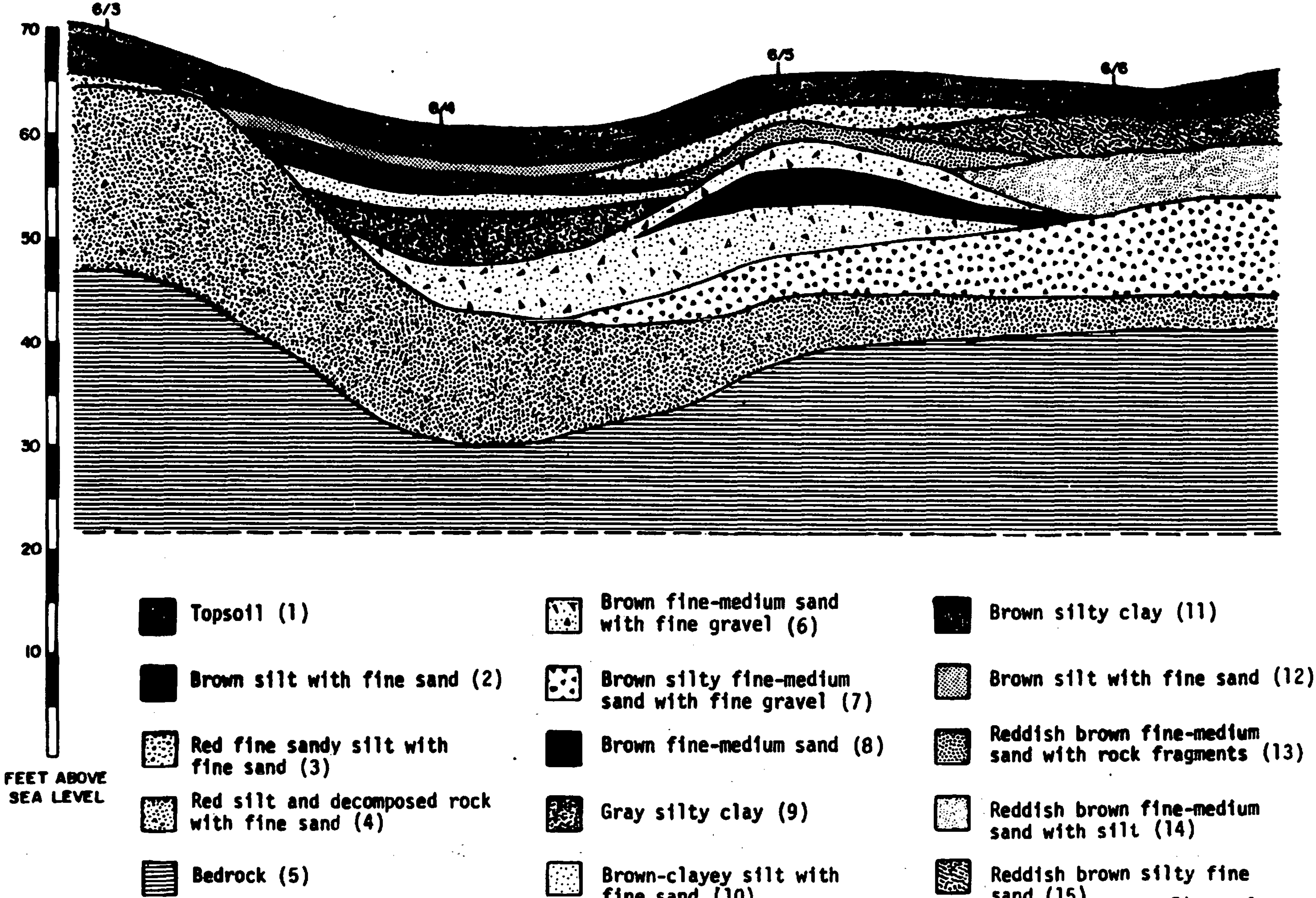


Figure 9

TREND OF BEDROCK PERPENDICULAR TO THE SCHUYLKILL AT STRUCTURE 6/5

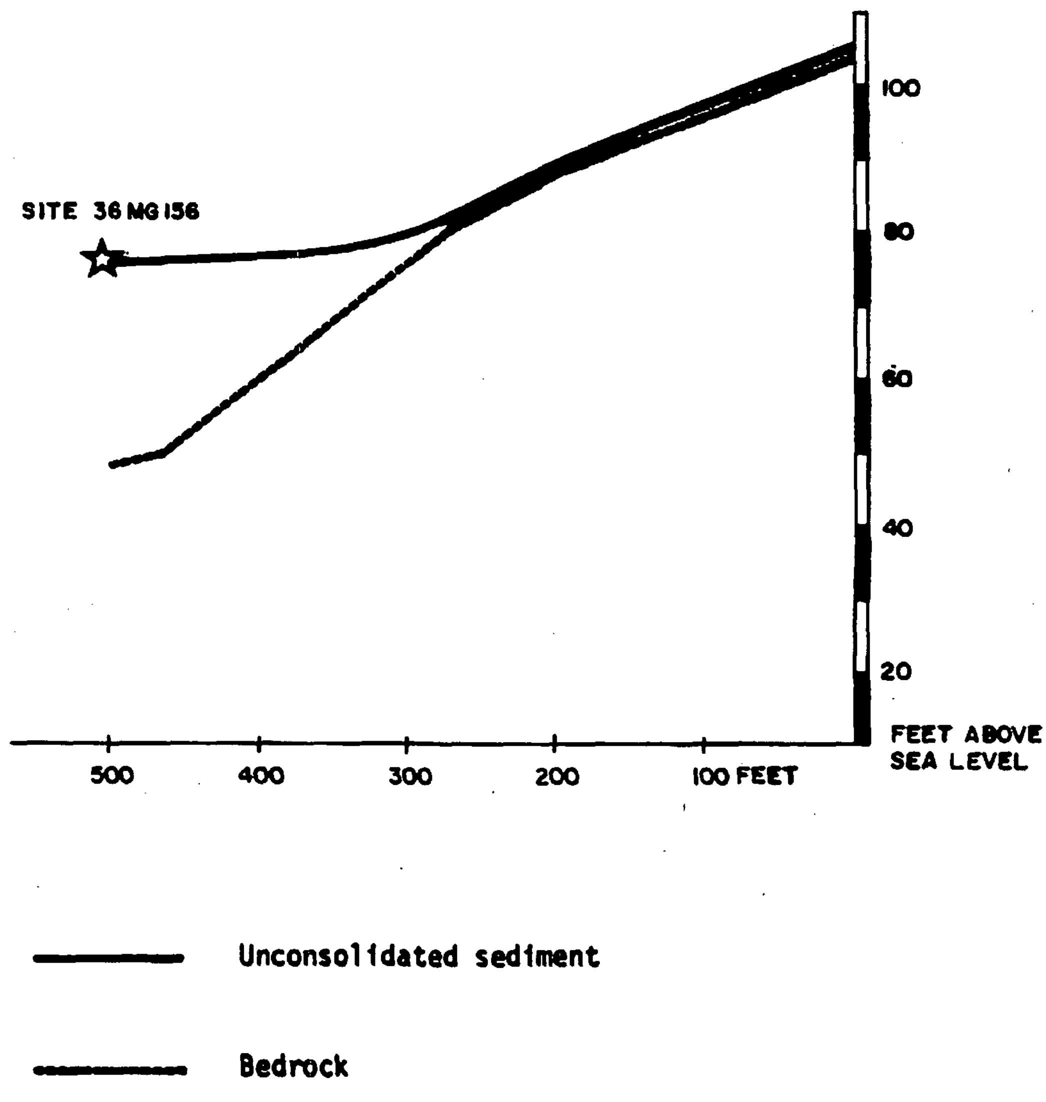
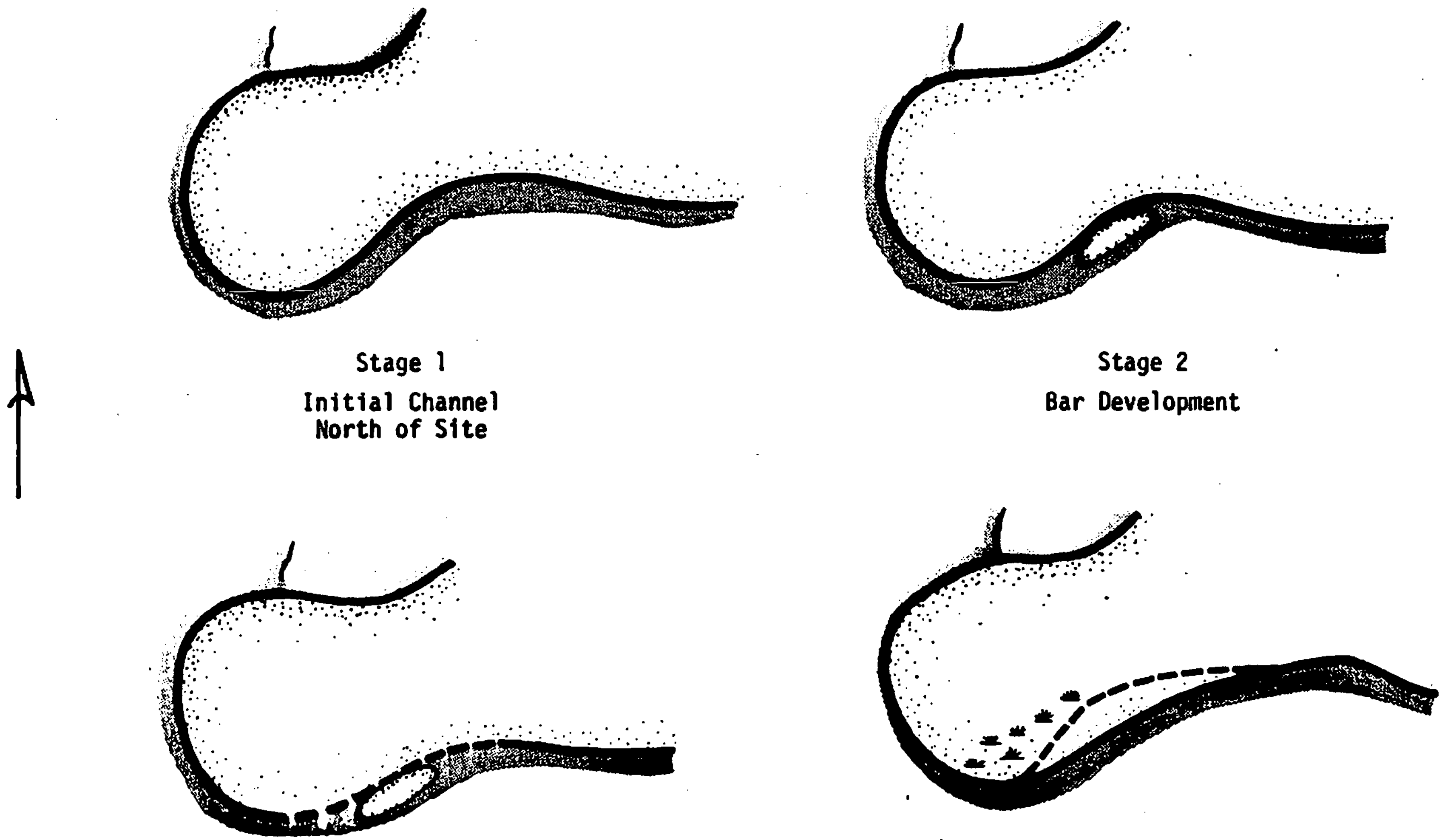


Figure 10

MODEL OF FLOODPLAIN DEVELOPMENT AT SITE 36 MG 156



Stage 1
Initial Channel
North of Site

Stage 2
Bar Development

Stage 3
Channel Abandonment
as River Shifts South,
Beginning of Floodplain Sedimentation

Stage 4
Present Channel,
Bar Buried by Floodplain

Figure 11

PLATE

Plate 1. Location of Abandoned Channel Scar Near Site 36 MG 156.

APPENDIX I

10/6/83

SITE engineers, inc.

TEST BORING LOG

PROJECT CROSBY PLYMOUTH MEETING
LOCATION 220-63-LINE

BORING 6/3A
G.S. ELEV.
FILE 2020-21
SHEET 1 OF 1

GROUND WATER DATA			
FIRST ENCOUNTERED:			
DEPTH	HOUR	DATE	ELAPSED TIME
[illegible]	[illegible]		15 MIN

METHOD OF ADVANCING BORE HOLE				
B	FROM	0	TO	8
B	FROM	8	TO	17'
	FROM		TO	
	FROM		TO	
	FROM		TO	

DRILLER D. D'AMBROSIO
HELPER B. [illegible]
INSPECTOR R. [illegible]
DATE STARTED 10-4
DATE COMPLETED 10-4-83

DEPTH	A	B	C	DESCRIPTION	REMARKS
0-2	S-1	4-6-11-13		5" TOP SOIL / BROWN SILT TR F/ SAND	6/3A
2-4	S-2	26-31-40-50		2' / BROWN SILT AND ROCK FRAGMENTS	0 N LEFT ~~TEST~~ FACING PLYMOUTH
4-6	S-3	37-40-41-49		4' / RED SILT TR F/ SAND DECOMPOSED SHALE	
6-8	S-4	42-42-63-100			
10					SOFT CASING 11-12.6
13 C		100/6			
15				17' / AUGER REFUSAL END	
20					
25					
30					
35					
40					
45					

FOR GENERAL NOTES SEE KEY SHEET AND LOCATION PLAN.

DRN.
CKD.

10/4/83

SITE engineers, inc.

TEST BORING LOG

BORING 6/4A
G.S. ELEV.
FILE 2020-21
SHEET 1 OF 1

PROJECT CROMBY PLYMOUTH METTING
LOCATION 220-63-LINE

GROUND WATER DATA			
FIRST ENCOUNTERED			
DEPTH	HOUR	DATE	ELAPSED TIME
10'	12:00		15 MIN

METHOD OF ADVANCING BORE HOLE				
A	FROM	0	TO	10
B	FROM	10	TO	28
	FROM		TO	
	FROM		TO	
	FROM		TO	

DRILLER M. D'AMBROSIO
HELPER B. DAILEY
INSPECTOR E. JARRETT
DATE STARTED 9-30
DATE COMPLETED 9-30-83

DEPTH	A	B	C	DESCRIPTION	REMARKS
0-2	S-1	4-5-6-8		DARK GREY SILT TR ROOTS FILL	10G
2-4	S-2	6-7-8-9		BROWN SILT TR F/SAND 4	
4-6	S-3	10-12-44-45		4' RED BROWN CLAYEY SILT TR F/ SAND & ROCK FRAGMENTS	BORING 6/4A 2D LOCATION
6-8	S-4	16-21-24-25		6' BROWN F/M SAND TR SILT SOME GREY ROCK FRAGMENTS 10	LEFT
8-10	S-5	17-19-22-26			
				13' BROWN F/M SAND & F/ GRAVEL	SIDE FACING PLYMOUTH
13-15	S-6	22-24-25			40G
				17' RED SILT TR F/ SAND DECOM SHALE	
18-20	S-7	31-62-97		20	
23		100/0			
				28' AUGER REFUSAL END	

FOR GENERAL NOTES SEE KEY SHEET AND LOCATION PLAN.

DRN.
CKD.

E906 7/82

12/12/83

SITE engineers, inc.

TEST BORING LOG

BORING 6/5A
G.S. ELEV.
FILE 2920.21
SHEET 1 OF 1

PROJECT CROMBY PLYMOUTH MATTING
LOCATION 220.G3OLINE

GROUND WATER DATA			
FIRST ENCOUNTERED			
DEPTH	HOUR	DATE	ELAPSED TIME
8'	9:30		15MIN

METHOD OF ADVANCING BORE HOLE				
A	FROM	0	TO	10
B	FROM	10	TO	26
	FROM		TO	
	FROM		TO	
	FROM		TO	

DRILLER M.D'AMBROGIO
HELPER [illegible]
INSPECTOR [illegible]
DATE STARTED --
DATE COMPLETED [illegible]

DEPTH	A	B	C	DESCRIPTION	REMARKS
0-2	S-1	1-2-2-3		BROWN SILT TR CLAY + F/SAND 2'	10G
2-4	S-2	5-6-6-7		BROWN F/SANDY SILT 4' 5'	
4-6	S-3	9-15-17-17		BROWN ROCK FRAGMENTS SOME F/SAND 6'	30G
6-8	S-4	20-21-29-36			
8-10	S-5	31-34-36-38		BROWN F/M SAND SOME F/GRAVEL + ROCK FRAGMENTS 13'	
13-15	S-6	17-24-26		BROWN F/M SAND + F/GRAVEL TR SILT	
18-20	S-7	20-36-48		20	
23		100/0		22' RED SILTY DECOMP SHALE	
				26' AUGER REFUSAL END	

FOR GENERAL NOTES SEE KEY SHEET AND LOCATION PLAN.

DRN.
CKD.

E906 7/82

11/18/83

SITE engineers, inc.

TEST BORING LOG

BORING 6/6A
G.S. ELEV.
FILE 2020-21
SHEET 1 OF 1

PROJECT GROMBY PLYMOUTH MEETING
LOCATION 220-63-LINE

GROUND WATER DATA			
FIRST ENCOUNTERED 7 6"			
DEPTH	HOUR	DATE	ELAPSED TIME
7'5"	2:00		15 MIN

METHOD OF ADVANCING BORE HOLE				
A	FROM	0	TO	10
B	FROM	10	TO	21
	FROM		TO	
	FROM		TO	
	FROM		TO	

DRILLER M. D'AMBROSIO
HELPER B. DAILEY
INSPECTOR E JARRETT
DATE STARTED 11-14
DATE COMPLETED 11-14-83

DEPTH	A	B	C	DESCRIPTION	REMARKS
0-2	S-1	1-2-3-3		GRAY BLACK SILT 12"	BORING 6/6A LEFT SIDE FACING GROMBY 20G
2-4	S-2	3-4-5-5		RED CLAYEY SILT TR F/SAND 2'6"	
4-6	S-3	6-7-8-8		RED SILT TR F/SAND 4'	
6-8	S-4	8-11-19-22		RED SILTY F/SAND 7'	
8-10	S-5	23-29-40-47		RED SILTY F/SAND TR F/GRAVEL 9'	
				RED SILTY F/SAND SOME GRAY ROCK FRAGMENTS 13'	30G
13⁶ 15	S-6	21-28-32		BROWN RED F/M SAND TR SILT SOME F/GRAVEL & ROCK FRAGMENTS 17'	
18⁶		100/0		RED SILTY SANDY DECOM SHALE 21	
				AUGER REFUSAL END	

4 10 15

FOR GENERAL NOTES SEE KEY SHEET AND LOCATION PLAN.

DRN.
CKD.

5906 7/82

APPENDIX II

APPENDIX II: PERCENT IN EACH SIZE CLASS

Unit	Level	Clay +12 to +8φ	Very Fine to Fine Silt +8 to +6φ	Medium to Coarse Silt +6 to +4φ	Very Fine Sand +4 to +3φ	Fine Sand +3 to +2φ	Medium Sand +2 to +1φ	Coarse Sand +1 to 0φ	Very Coarse Sand 0 to -1φ	Very Fine to Fine Pebbles -1 to -3φ	Medium Pebbles -3 to -4φ	Coarse Pebbles -4 to -5φ	Very Coarse Pebbles -5 to -6φ
N5W05	4	6.7	18.0	35.5	10.0	6.8	11.8	3.2	1.2	0.6	1.4		
	5	8.7	13.7	27.5	5.7	6.8	23.1	6.1	0.4	0.4			
	6	5.1	16.8	21.0	8.5	6.7	27.5	5.5	0.6	0.2			
	7	3.2	7.8	15.5	7.0	9.7	38.1	8.4	0.9	0.4			
	8	1.5	5.4	4.8	5.2	7.9	49.4	16.6	1.0	2.0			
	9	1.4	3.2	4.2	2.3	4.6	26.4	17.5	1.5	9.5	8.0	13.7	4.8
S0E20	4	2.2	16.3	33.5	10.0	7.1	12.7	4.8	0.8	0.4	1.2	6.5	
	5	5.6	14.3	19.4	9.3	7.6	27.3	6.4	0.5	0.2			
	6	3.3	9.1	14.5	8.5	9.4	35.1	8.3	0.9	0.3			
	7	2.7	6.6	9.2	6.7	11.5	44.5	9.3	0.5	0.2			
	8	0.5	3.6	4.9	3.0	8.6	24.4	29.0	17.9	0.3	0.8		
	9	1.2	2.9	4.0	2.1	3.6	16.7	12.0	2.7	33.4	5.9	13.5	

APPENDIX II (continued)

Unit	Level	Clay +12 to +8∅	Very Fine to Fine Silt +8 to +6∅	Medium to Coarse Silt +6 to +4∅	Very Fine Sand +4 to +3∅	Fine Sand +3 to +2∅	Medium Sand +2 to +1∅	Coarse Sand +1 to 0∅	Very Coarse Sand 0 to -1∅	Very Fine to Fine Pebbles -1 to -3∅	Medium Pebbles -3 to -4∅	Coarse Pebbles -4 to -5∅	Very Coarse Pebbles -5 to -6∅
N15E5	1	5.6	18.3	29.5	8.5	6.9	15.8	4.8	0.6	0.1	2.8		
	2	5.0	15.3	22.0	7.0	8.5	28.5	5.6	0.3	0.1			
	3	5.2	9.8	14.9	8.5	9.9	34.9	6.1	0.4	0.2			
	4	3.3	7.5	12.5	9.0	13.4	38.2	5.8	0.4	0.2			
	5	3.2	2.1	5.6	3.9	6.7	42.3	16.3	0.6	3.6	4.2	6.3	
	6	1.7	4.0	5.5	4.0	8.8	52.7	17.9	0.6	0.1	0.4		
	7	0.1	0.4	0.9	0.5	0.4	5.5	7.7	2.9	14.2	19.8	38.2	7.2
S10W5	3	7.1	16.0	18.0	7.5	7.7	23.3	11.6	1.5	0.3	0.6		
	4	7.4	18.9	31.8	9.8	7.5	12.4	5.0	1.1	0.8	2.4		
	5	4.9	9.8	15.0	6.0	9.7	39.3	7.1	0.6	0.3			
	6	2.9	5.3	5.5	5.7	6.9	44.9	16.6	1.8	1.1	0.5		
	7	1.7	4.5	6.0	5.7	13.5	45.8	14.0	0.8	0.2	0.5		

APPENDIX II (continued)

Unit	Level	Clay +12 to +8Ø	Very Fine to Fine Silt +8 to +6Ø	Medium to Coarse Silt +6 to +4Ø	Very Fine Sand +4 to +3Ø	Fine Sand +3 to +2Ø	Medium Sand +2 to +1Ø	Coarse Sand +1 to 0Ø	Very Coarse Sand 0 to -1Ø	Very Fine to Fine Pebbles -1 to -3Ø	Medium Pebbles -3 to -4Ø	Coarse Pebbles -4 to -5Ø	Very Coarse Pebbles -5 to -6Ø
S10W5	8	0.1	0.9	1.4	0.9	2.6	17.2	15.0	2.4	12.5	17.1	8.4	19.6

APPENDIX III:

Geology, Geomorphology and Soils of the Indian Point Site (36 CH 53), Chester County, Pennsylvania

by:

Elisabeth M. Ervin

INTRODUCTION

The objective of this report is to provide a geologic and geomorphic analysis of the Indian Point site (36CH53). Discussion will cover regional setting, geology, geomorphology, soils particular to the site, and the site in relation to human occupation.

REGIONAL SETTING

Physiographic Province and Geology

The Indian Point site is located in the Triassic Lowland Physiographic Province. This area is also known as the Newark-Gettysburg Basin of Early Jurassic to Late Triassic age (135-225 million years ago). This basin is one in a series of discontinuous Mesozoic basins which extend from North Carolina to Nova Scotia (Glaeser 1966). These basins lie within faulted Precambrian to Early Paleozoic metamorphic and igneous rocks which parallel the Appalachian mountains. They were formed by continental rifting during the Mesozoic Era (Figure 1).

The Newark-Gettysburg Basin is 32 miles wide at the Delaware River and 14 miles wide at the Maryland border in Pennsylvania. It is bound to the north by a large border fault. The southwest margin of the basin does not have a border fault because it was characterized by a shallow water environment with a receding shoreline. Rocks in the basin dip at a low to intermediate angle toward the north and thicken to at least 33,000 feet also toward the north (Lyttle and Epstein 1987). The majority of rocks in the Newark-Gettysburg Basin are sedimentary, and include conglomerates, igneous diabase dikes and sills which have thermally metamorphosed adjacent rocks. Sedimentary rocks are Lower Jurassic to Triassic in age, with the oldest rocks to the southeast and the youngest to the northwest. The intrusive igneous rocks in the basin are lower Jurassic in age (Lyttle and Epstein 1987). The stratigraphy of rocks in the Newark-Gettysburg Basin is illustrated below:

Newark Supergroup

Brunswick Group-Upper Triassic to Lower Jurassic
Lockatong Formation-Upper Triassic
Stockton Formation-Upper Triassic

Rocks in the Triassic basins recently have been reclassified based on work by Lyttle and Epstein (1987). The Newark Group is now known as the Newark Supergroup, and members of the Brunswick Formation are now widely accepted as the Brunswick Group. These sedimentary rocks were deposited under shallow freshwater continental conditions. They are clastics and vary in color from yellow to black; however, most are red from the presence of hematite. The Stockton and Lockatong Formations were deposited as delta or lacustrine sediments. Deposition of the Stockton Formation may have been more influenced by fluvial processes and the Lockatong by lacustrine processes. Source rocks of these two formations were to the south of the basin (Rima et al. 1962; Turner-Peterson and Smoot 1985). Sediments of the youngest member of the Newark Supergroup, the Brunswick group, probably originated from the north as a result of downfaulting on the northern edge of the basin from the weight of the older sediments (Rima *et al*. 1962).

Drainage and Major Rivers

The Schuylkill River is the main path for drainage in the vicinity of the Indian Point site, and the river has played a major role in shaping the landscape of the area. The headwaters of the Schuylkill River are located in Schuylkill County, Pennsylvania. The river drains an area of 1,915 square miles, and empties into the Delaware River at Philadelphia. From its headwaters to the Delaware River, a distance of 100 miles, the river drops 800 feet. The Schuylkill crosscuts a variety of geologic formations, and in some places is incised into the bedrock (Bascom and Stose 1938). Channel patterns vary from meandering, to straight, to impounded, or to braided in different sections of the river, in response to sediment load, flow velocity, channel composition, and dams. The Schuylkill River has a meandering pattern in the vicinity of the site. The channel in this section of the river bends at relatively equal intervals, and is generally wide and fairly shallow. Near the site, the river is incised and has cut into its bedrock possibly as a result of tectonic uplift or climatic change (Glen Thompson, personal communication). Incision of the Schuylkill River probably began between the Eocene and the Pleistocene, and may also have been a result of sea levels changes, decreases in sediment load, increase in runoff, increase in net volume of water through stream capture, or changes in drainage basin size. Incised meanders on the Schuylkill River are of the ingrown type. Lateral restriction of the river as it cut into its bedrock may have allowed for increased overbank deposition in some locations.

Sediment load in the Schuylkill River near the site is moderate, and the river drops approximately 1 2/3 feet per mile (Bascom and Stose 1938). Pool and riffle sequences alternate in the meandering portion of the river, with pools coinciding with the concave cut banks on the river (Pennsylvania Environmental Council 1979). During glacial times, the river probably carried glacial meltwater and had increased sediment load.

Soils

Soils that tend to form in the Newark-Gettysburg Basin are of the Alfisol order, Udalf suborder and Hapludalfs-Drystrochrepts great group. Soil temperatures in this region are mesic (Smith 1984). The term Alfisol connotes soils that have an argillic horizon with a high base status (Miller and Quandt 1984). Alfisols tend to form under humid conditions with deciduous, mixed deciduous, or coniferous vegetation. Some Alfisols in the northeastern United States result from weathering of glacial drift, and form from Late Pleistocene deposits. In the vicinity of the site, however, and to the south in Maryland and Virginia, these soils have formed from other parent material and are probably pre-Pleistocene (Kuhl et al. 1984). There is a fairly strong correlation between soil order and age of the soil. Birkeland (1984) estimates that at least 10,000 years are needed for Alfisol formation. This observation is primarily based on the length of the time it takes for development of the argillic horizon.

SITE SETTING

The Indian Point site is located on upland terrain north of Phoenixville on a meander bend of the Schuylkill River, at approximately 240 feet in elevation overlooking the river. Change in elevation from the site to the river is approximately 130 feet. To the south of the site, French Creek drains into the Schuylkill River. On the hilltop near the site is a small feeder stream that appears to be intermittent.

Site Geology and Geomorphology

The site is underlain by the Upper Triassic Lockatong Formation (Figure 2). This formation strikes generally east-west and is 1.2 miles wide at this location. West of the site 1.5 miles the Lockatong Formation is faulted and offset. The formation pinches out west of Phoenixville and is replaced by a conglomerate of the Brunswick Group.

The Lockatong Formation is more resistant to weathering and erosion than the Stockton Formation or the Brunswick Group, and tends to form a ridge where it outcrops (Hawkins 1914). Evidence of the ridge exists not only west of the site where the land surface is 350 feet in elevation, but also in the vicinity of the site where altitudes range from 200 to greater than 250 feet above sea level.

The Lockatong Formation is known among paleontologists for its Upper Triassic fossil remains. These fossils include fresh water fish, reptiles, crustaceans, ostracods, plant fossils and other species. Some of the best fossils from this formation were found in 1857 during construction of the Reading Railroad tunnel north of Phoenixville (Bascom and Stose 1938). This tunnel, which is approximately 3/8 of a mile in length, is also known as the Black Rock Tunnel and runs almost directly beneath the Indian Point site. Stratigraphy of the Lockatong Formation at the railroad tunnel was recorded by Hawkins (1914):

Rock Type	Thickness (feet)
Shale, dark red to black	380
Shale, brown	380
Argillite, brown	250
Shale, sandy, red and brown	(?)
Black shale with estheriae fossils	490
Shale, red and brown, transition beds	(?)
Total	1500

The Lockatong Formation has a lens-like character (Hawkins 1914). Rocks within the formation are composed of fine clastic fragments, and in much of the formation they are held together by a silica cement. Massive, dense argillites are generally found in the central portions of the Lockatong Formation, both vertically and horizontally. Microscopic analysis of the argillite by Hawkins (1914) revealed small angular quartz grains, bleached biotite and occasionally feldspar. Few other minerals are found in the argillite and this, in addition to the silica cement, causes this rock type to have a very low rate of weathering. Shales are more common on the margins of the formation.

Geomorphologically this site is in an upland setting. Principal factors affecting the upland area are hillslope weathering and erosion and, in the past, downcutting by the Schuylkill River. Both chemical and physical weathering have impacted and continue to impact formation of the topography in this location.

Site Soils

The Penn soils series underlies the Indian Point site (U.S. Department of Agriculture 1963). Penn soils are generally located in upland areas and vary in depth from shallow to moderately deep. Grain sizes in this soil series in the vicinity of the site range from shaley silt loam to silt loam. Depth of the soil tends to be shallow, particularly for the shaley silt loam. Depth to the parent material is on the order of 10-12 inches.

Grain size and soil color information were obtained from archeological test units at the site. Soil grain size varies from a silty loam, the plowzone, at the surface of the site, to a compact silty clay with occasional sand sized particles (the argillic horizon), to clay with weathered bedrock fragments, and finally to the bedrock Lockatong Formation. Table 1 illustrates characteristics of soils at the site.

Table 1. Characteristics of Soils at the Indian Point Site from Archeological Test Units

TYPE	AVERAGE THICKNESS	RANGE IN DEPTH (inches)	MOST COMMON COLOR	RANGE IN COLOR
Silt loam (plowzone)	10	0 - 6 to 0 - 12	10YR 3/4	10YR 3/2 to 10YR 5/4
Silty clay to Clayey silt (argillic horizon)	Variable, approx. 9	7 - 10 to 9 - 13	10YR 5/4	10YR 4/6 to 10YR 5/6
Clay with weathered bedrock fragments	5	9 - 11 to 28 - 35	10YR 5/4 and 10YR 5/6	10YR 4/6 to 10YR 7/6

Stratigraphy of soils at the site is illustrated in Figure 3 and was developed from archeological test unit data along the transmission line right-of way. These data were collected by a number of different investigators and are somewhat subjective. The silt loam horizon (the plowzone) (Figure 3) is the most continuous across the site and is found to a relatively uniform depth in all test units. The argillic horizon, consisting of silty-clay to clayey-silt, is discontinuous in the soil profile. This horizon is absent in Test Units 1, 2, and A, and is probably not present in Test Units 15 to 20. Thickness of the argillic horizon is quite variable, as shown in Figure 3; however, it is more pronounced as a result of the vertical exaggeration of the figure. The last horizon, consisting of silty clay with shale fragments, is continuous over most of the profile shown in Figure 3.

Bedrock varies in depth from approximately 10 to 12 inches in Test Units 15 to 20 to 30 inches in other parts of the site. Irregularity in the bedrock surface, possibly as a result of differential weathering rates, undoubtably contributed to the varied profile of the argillic horizon and the horizon containing silty clay with weathered shale fragments. The marked contrast in shape and distribution between these layers and silt loam is a result of plowing and farming activities in the plowzone. The argillic horizon may have been truncated by these activities.

Figures 4a and 4b illustrate typical profiles of the site from archeological test units. A profile where the argillic horizon is intact is shown in Figure 4a. Truncation of the argillic horizon is demonstrated in Figure 4b. This profile also shows bedrock approximately 14 inches from the land surface.

Soil Genesis

Soils at the site are residual in nature and have not been transported. They were formed mainly as a result of physical and chemical weathering processes, including freeze thaw effects along with rainfall and decomposition of minerals in the parent rock. Human activities such as modern cultivation of the fields may have resulted in an increased erosion rate on the top of the bluff. However, soils at the site tend to be shallow because of the resistant nature of the Lockatong Formation and also due to their hilltop position. It is probable that age of the argillic horizon is greater than 10,000 years based on studies by others (Birkeland 1984). The clay enrichment, demonstrated in data from the archeological test units, occurs extremely slowly over long periods of time.

Hawkins (1914) describes soils that form on the Lockatong Formation as clayey, with the dominant clay mineral kaolin. Kaolin is produced by the weathering of the feldspars present in the formation. The Lockatong Formation, particularly the argillite, is resistant to weathering and soil formation. Minimal weathering is a result of the silica cement that holds the Lockatong Formation together, and the absence of minerals for decomposition.

Shallow soil development at the site is a factor not only of the type of parent material but also topographic position. Chemical weathering of minerals tends to increase downslope, and is related to the amount of moisture held in the soil, clay or slope material. More water is present at the toe of a slope, and, therefore, more chemical weathering takes place (Brunsden 1979). Weathering of the Lockatong Formation may be slowed at the site as a result of the relatively gentle slope of the land.

RELATION OF THE INDIAN POINT SITE TO HUMAN OCCUPATION

With the exception of features that have been dug into the weathered bedrock zone and artifacts that have been moved by freeze-thaw processes or rodent disturbance, most artifacts have been found at fairly shallow depths in the soil profile at the site, in the silt loam horizon (plowzone, 0-10 inches). The shallow location of the artifacts is not unexpected, considering the probable age of the argillic horizon (greater than 10,000 years old) at this location, as demonstrated by clay enrichment from archeological test units and the truncated and weathered profile of this horizon. In addition, soil loss and increased erosion from cultivation may have brought artifacts closer to the present day land surface.

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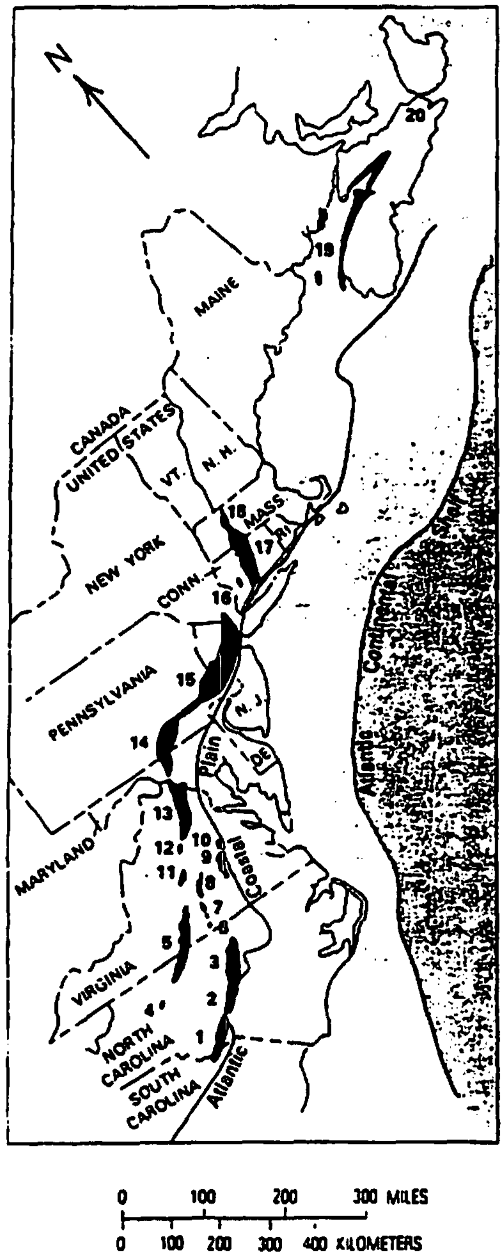

EXPLANATION

1. Wadesboro (N.C. – S.C.)
2. Sanford (N.C.)
3. Durham (N.C.)
4. Davie County (N.C.)
5. Dan River and Danville (N.C. – Va.)
6. Scottsburg (Va.)
7. Basins north of Scottsburg (Va.)
8. Farmville (Va.)
9. Richmond (Va.)
10. Taylorsville (Va.)
11. Scottsville (Va.)
12. Barboursville (Va.)
13. Culpeper (Va. – Md.)
14. Gettysburg (Md. – Pa.)
15. Newark (N.J. – Pa. – N.Y.)
16. Pomperaug (Conn.)
17. Hartford (Conn. – Mass.)
18. Deerfield (Mass.)
19. Fundy or Minas (Nova Scotia – Canada)
20. Chedabucto (Nova Scotia – Canada)

Figure 1.--Location of Mesozoic basins along the Atlantic coastline (From Froelich and Olsen, 1985)

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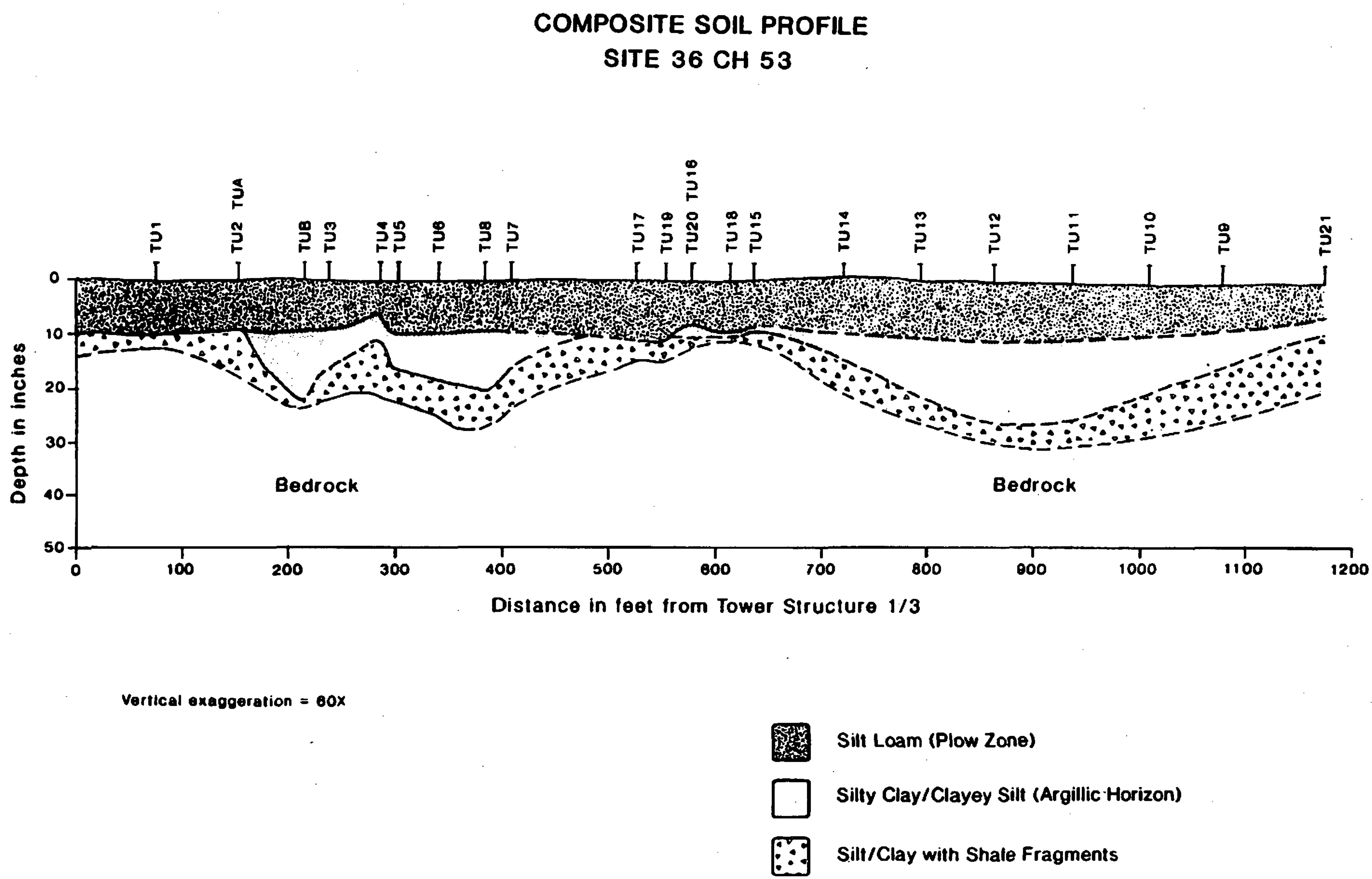

COMPOSITE SOIL PROFILE
SITE 36 CH 53
TU1
TU2
TUA
TUB
TU3
TU4
TU5
TU6
TU8
TU7
TU17
TU19
TU20
TU16
TU18
TU15
TU14
TU13
TU12
TU11
TU10
TU9
TU21
Depth in inches
0
10
20
30
40
50
Bedrock
Bedrock
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Distance in feet from Tower Structure 1/3
Vertical exaggeration = 60X
Silt Loam (Plow Zone)
Silty Clay/Clayey Silt (Argillic Horizon)
Silt/Clay with Shale Fragments

Figure 3

TWO TYPICAL PROFILES
FROM ARCHEOLOGICAL TEST UNITS, 36 CH 53

FIGURE 4a.
TEST UNIT 6

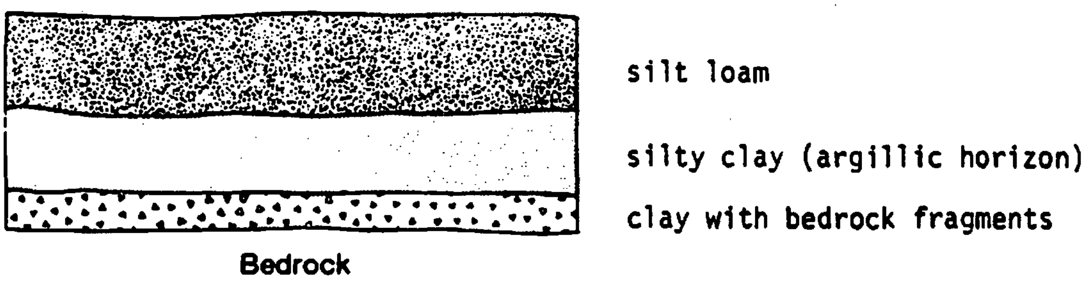
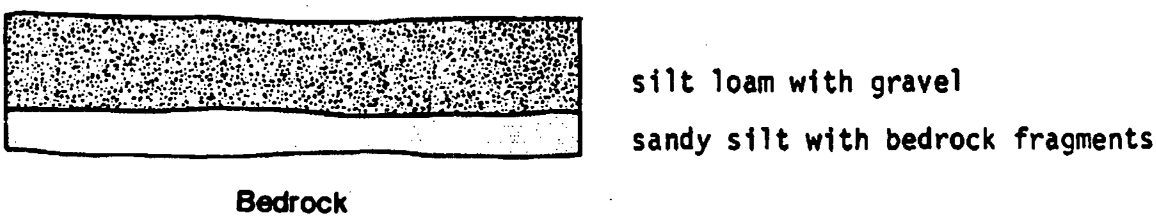


FIGURE 4b.
TEST UNIT 18



APPENDIX IV:

Preliminary Report on the Seeds from 36 CH 103

by:

Pam Crabtree, Ph.D.

Analysis and interpretation

This assemblage does not seem to represent the results of prehistoric or early historic plant collecting or agricultural activities. None of the most commonly collected prehistoric plant foods (e.g., hickory, acorn, wild grape) is present, and there is no evidence for cultigens such as maize, beans, squash, and tobacco. The only possibilities for medicinal are a small number of probably bayberry fragments. However, the very fragmentary nature of these remains make this identification tentative. The clearly idebtifiable seeds (goosefoot, purslane, carpetweed, and copperleaf) are all uncharred common weed plants. Seed type 9 (possibly a member of the dogwood family) may have entered the assemblage as a result of wood burning activities. Wood burning would also account for the large quantity of unidentifiable charred organic material.

Seed type	Sample	Comments
1	1	These seeds are not charred and are therefore modern. The seeds include a brownish outer coating. Is it worthwhile trying to identify these?
2	2	These are not seeds. These small round balls show no obvious surface morphology. They seem to be dark brown on the inside indicating that they are not charred. I think that they may be droppings.
3	3	<u>Portulaca oleracea</u> (common purslane). These seeds are naturally black in color. The shiny surface indicates that the seeds are not charred and therefore modern. Purslane is a common weed of cultivated lands and waste places (USDA 1971: 152).
4	4	<u>Mollugo verticillata</u> (carpetweed). These seeds are reddishbrown rather than black indicating that they are not charred. Carpetweed is a common weed of gardens, crops, lawns wasteplaces, and sandy riverbanks (USDA 1971: 150).
4	5	This sample is not the same as seed type 4 sample 4 above. It is a reddish brown seed coat or pod (similar to seed type 1 sample 1 above). It is not charred and therefore modern.
5	6	These are not seeds. They may be droppings or small abraded pieces of charcoal.
6	7	This is probably not a seed. (If it is, it is so abraded that it unidentifiable). It is more likely to be a small charcoal fragment.
7	8	This is a broken fragment of <u>Chenopodium</u> (probably <u>Chenopodium album</u>, white goosefoot or lambsquarters). <u>C. album</u> is a common weed of cultivated crops, gardens, grainfields, and wastegrounds (USDA 1971: 132). The plant is not native to the eastern United States; it was naturalized from Eurasia. Although this seed is naturally black, the shiny outer surface indicates that it is not charred.
8	9	The surface of this sample is completely eroded. There is not enough morphology visible to identify it.

Seed type	Sample	Comments
9	10-12	The overall morphology of these seeds suggest that they are members of the dogwood family (Cornaceae). Comparisons with herbarium specimens from the Morris Arboretum indicate that these seeds are not _Cornus florida_ (flowering dogwood). These seeds may represent the blackgum or sour gum (_Nyssa sylvatica_). However, I have not yet seen voucher specimens for this species. The seeds do seem to be arboreal. They may have entered the site as a result of wood burning rather than plant collecting activities.
10	13-14	These samples of probable charred organic material (possibly something like bark) are not seeds. No distinctive morphology is apparent, and I do not think that they can be identified.
11	15	This carbonized fragment is probably not a seed. It is certainly not well enough preserved to identify.
12	16	These seem to be charred fragments of _Myrica pensylvanica_ (bayberry). The tree has a number of documented medicinal uses. The bark has been used as a blood purifier and for kidney trouble (Tantaquidgeon 1942: 29). The leaves and stems are boiled for tea and used as a fever remedy by the Choctaw (Weiner 1972: 57). Bayberry was also used as a kidney remedy by the Connecticut Mohegan (Tantaquidgeon 1972: 130-131). The leaves and berries can be used for flavoring soups. The berries are available from late summer to spring. Although bayberry is a well known medicinal plant, it is quite possible that the seeds were burnt as a result of the use of this species for firewood.
13	17	Same as sample 9 seed types 10-12 above.
14	18	This may well have been a seed, but it was so badly distorted during burning that no clear morphological points remain.
15	19	_Acalypha_ sp., cf _Acalypha gracilens_ for size. (copperleaf or three-seeded mercury). The seed is brownish in color and therefore not charred. Charred examples of copperleaf are occasionally recovered from archaeological deposits, but there are no documented food or ethnomedical uses for this plant.
16	20	These carbonized fragments are not seeds.
17	21	These are not seeds. They might possibly be droppings.

Seed type	Sample	Comment
18	22	This carbonized fragment is badly broken. It is broadly globular in outline, but no morphological points are preserved. There is not enough left to attempt an identification; it cannot even be taken to family.

APPENDIX V:

Floral Analysis of Site 36 CH 53

by:

Cheryl A. Holt
Analytical Services for Archeologists
909 Cameron Street
Alexandria, VA 22314

FLORAL ANALYSIS OF SITE 36CH53

INTRODUCTION

There are diverse and complicated inter-relationships between food acquisition, cultivation, storage, consumption and disposal of food by-products in prehistoric sites. Botanical specimens recovered by flotation from 16 features were examined in order to advance understanding of resource availability, resource selection, and procurement for a Early-Middle Woodland Period site.

This research capitalizes on the unique interplay seeds have with culture and the environment and formulates research questions that integrate floral data into general and specific research goals for Site 36CH53. The primary research goals were threefold; to delineate prehistorically utilized floral specimens; to examine the ecosystem as reflected by the recovered floral specimens and to understand the dietary strategies as employed by this Early-Middle Woodland population.

One of the most provocative elements of the assemblage was the presence of the weedy annuals Chenopodium, Knotweed, and Ragweed. The development of plant husbandry in the Eastern Woodlands was a gradual process and the specific subsistence position of these weedy genera in the development of plant husbandry is currently the subject of increased attention and debate.

The recovered botanical data represents a range of potentially utilized plant resources. The recovery of potentially edible plants does not necessarily mean that all were culturally perceived or regularly utilized as important food. However, the archaeological representation of starchy grains, herbs, tubers, and greens may be resultant of cultural manifestations.

METHODOLOGY

Examination of biological materials was made with a binocular dissecting microscope. Each sample was systematically scanned and floral specimens were identified and counted. Each floral specimen was given a count value of one. Nutshell and wood fragments were counted and weighed in grams. Material was identified to the species level where possible. Confirmation of species was aided by the use of an extensive type collection of floral material and cross checking floral identification manuals (Fernald 1970; Gunn 1972; Mohlenbrock 1980,1981; Cox 1985; Renfrew 1973; Martin and Barkley 1961; Peterson 1977; Lawrence and Fitzsimons 1985).

Delineation of Prehistoric Specimens

Delineation of prehistoric specimens from historic specimens or natural seed rain was the first focus of analysis. The site had been plowed and farmed; thereby impacted by historic agriculturalists. Agricultural activities substantially increases the potential for prehistoric and historic admixture of botanical specimens.

To be given consideration as a potential prehistoric floral specimen two important criteria must be met. First and foremost, the botanical history of each plant recovered must be considered. Plants which are not native to America and were introduced by the colonists were obviously plants not available to prehistoric populations.

The second important criteria is that seed specimens must have been modified in a manner that allows preservation of what is really a biodegradable artifact. Understanding seed reproductive strategies has led investigators to consider only charred seed specimens as useful (and legitimate) constituents of a prehistoric archaeological floral assemblage (Minnis 1981:147; Quick 1961:94-99). The logic behind this assumption is that given normal soil conditions, seeds will either fulfill their reproductive function or will decay. The dormancy period for most plants is rarely over one hundred years (Harrington 1972). Therefore, the way that a seed enters the archaeological record is by short-circuiting that reproductive function, i.e. by charring. Desiccation is another way in which seeds can circumvent decomposition; however, the environment of the northeastern United States is such that desiccation is a very unlikely occurrence.

All factors which influence preservation must be considered because archaeological plant remains are neither a large nor representative sample of the diet. At an open site in a temperate environment very little plant material is ever preserved. In order to evade microbial action, the material must become charred, a process that requires special circumstances and rarely happens. The specimen must first find its way into a fire and ignite. Then it must be withdrawn from the flames quickly before it turns to ash, or it must be buried so deep in the coals that it cannot find enough oxygen for complete combustion (Keene 1981:183; Wetterstrom 1978:111-112). Following charring, the specimen must be protected from the elements and disturbance in order to remain intact for succeeding centuries. Finally it must endure the excavation process and the flotation procedure. Clearly, hard items are favored, whereas soft items are not.

Plant parts can be segregated into three types: those with dense inedible parts that might be discarded in or near a fire (nutshell or fruit pits); those with somewhat dense parts like small seeds which are consumed and would only be burned or buried accidentally; and those plants with no dense parts and a high water content (tubers and greens), which would ingested and unlikely to carbonize under most circumstances (Keene 1981:183).

The way in which a plant was used can certainly predispose its inclusion in the archaeological record. If a plant is utilized for it's leaves, roots, or blossoms then these parts decompose leaving nothing evident in the archaeological record. Seeds attached to a plant used for making of dye or tea, or seeds being made into mush could, however, become charred if the water was allowed to boil off (Murray and Sheehan 1984:285).

In no way do the carbonized plant remains represent a true summary of the diet of the site occupants because charring is a fortuitous but nevertheless accidental event. While it is safe to assume that the uncharred specimens within the samples are not prehistoric in origin, charring alone does not guarantee prehistoric status to a seed specimen. To assume all charred seeds within a sample to be prehistoric in origin is an assumption with a potential source of error. In fact, 18% of the charred seeds recovered from this site are not native specimens. This occurrence illustrates that charring alone does not guarantee prehistoric authenticity or utilization. It is not uncommon for modern seeds to become incorporated into prehistoric assemblages. Vertical seed dispersion can occur from plowing, root holes, drying cracks, downwashing, earthworms and other burrowing animals (Minnis1981:145; Keepax 1977). These processes cross cut cultural depositional processes.

Sources of Prehistoric Seeds

There are several sources of prehistoric seeds recovered from archaeological contexts. The most widely considered source of prehistoric seeds is direct utilization of the seeds. Many botanical artifacts are the direct result of the collection, processing and use/consumption of plant resources. Accidents in processing, burning of debris, and the burning of stored materials are the most common actions which result in the direct evidence of seed use (Minnis 1981:145). Few plant parts will be deliberately burned in a fire because most plant discard is too wet to burn readily or it may smoke or smell if burned.

Of course, another possible source of archaeological seeds is the accidental preservation of the prehistoric seed rain unrelated to any use of the seeds or plant. Naturally dispersed seeds can blow into hearths or be burned on trash middens. At this site, a total of 3% of the charred specimens may be prehistoric in origin but unrelated to prehistoric utilization. This constituent of the charred assemblage has no known utility and was most likely an accidental inclusion into the prehistoric assemblage. Plants can also become carbonized when vegetation is burned off by man or natural means. Day (1953) has documented that in historic times many native American groups in eastern North America manipulated local vegetation conditions by using fire. Intentional burning of forest cover and second growth to clear land for agricultural or hunting purposes was done to clear campsites, increase visibility, facilitate movement, eliminate rodents, improve soil fertility and foster growth of certain plant species.

The amount of plant food used by a prehistoric population may be meagerly represented in the archaeological record (Keene 1981). Because of the vagaries of survival for plants brought to open sites, quantitative summaries should be viewed with this in mind.

RESULTS

Twenty flotation samples were examined. A total of 2,484 floral elements were recovered from the sixteen pit features under study. Feature 43 contained no biological material. Table 1 lists the feature totals for all recovered specimens. Floral specimens include seeds, nutshell fragments, macrospores, and small charred wood fragments. Table 2 summarizes the general characteristics of each recovered specimen type and depicts whether or not it is considered poisonous, medicinal, edible, a flower, a tree, and if it is a plant native to America.

This analysis is in keeping with the theoretical perspective that only charred native seeds can be considered a legitimate constituent of a prehistoric floral assemblage. The assemblage contained 1,309 specimens which were not in the charred state. Approximately 52% of the total floral assemblage was not charred. Of the total uncharred seeds, 92% are not native plants. Only 18% of the charred specimens (nutshell included in calculation) were not native plants.

Non Native Specimens

The floral assemblage contained 9 seed types which are not native to America. Bristlegrass, Carpetweed, Copperleaf and Purslane are not native to America and were found exclusively in the uncharred state. This combination of being uncharred and not native provided a fairly straight forward elimination of these plant types from potential prehistoric utilization. Thistle, White clover and Chickweed were recovered in both the charred and uncharred state. Vetch and Yardgrass were recovered

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
	43		SHALLOW	None					
					Total for :	0			0
Barberry	15		U-SHAPED	Seed	Berberis vulgaris	1		X	1
					Total for Barberry :	1			1
Blue eyed grass	33		BASIN	Seed	Sisyrinchium graminoides	37		X	37
					Total for Blue eyed grass:	37			37
Bristlegrass	33		BASIN	Seed	Stellaria lutescens	1		X	0
	1	N.W. face	U-SHAPED	Seed	Stellaria lutescens	1		X	0
	10		DEEP BASIN	Seed	Stellaria lutescens	2		X	0
	17	B soil	DEEP BASIN	Seed	Stellaria lutescens	1		X	0
	2		BASIN	Seed	Stellaria lutescens	10		X	0
					Total for Bristlegrass :	15			0
Bunchberry	10		DEEP BASIN	Seed	Cornus canadensis	7		X	7
					Total for Bunchberry :	7			7
Carpetweed	10		DEEP BASIN	Seed	Mollugo verticillata	64		X	0
	17	A soil	DEEP BASIN	Seed	Mollugo verticillata	4		X	0
	17	B soil	DEEP BASIN	Seed	Mollugo verticillata	79		X	0
	13		BASIN	Seed	Mollugo verticillata	12		X	0
	19		BASIN	Seed	Mollugo verticillata	4		X	0
	32		U-SHAPED	Seed	Mollugo verticillata	10		X	0
	33		BASIN	Seed	Mollugo verticillata	120		X	0
	1		U-SHAPED	Seed	Mollugo verticillata	56		X	0

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
Carpetweed	2		BASIN	Seed	Mollugo verticillata	372		X	0
					Total for Carpetweed :	721			0
charred wood	1		U-SHAPED	Wood	undetermined	12		X	12
	32		U-SHAPED	Wood	undetermined	1		X	1
	10	uncleaned	DEEP BASIN	Wood	undetermined	15		X	15
	3		U-SHAPED	Wood	undetermined	2		X	2
					Total for charred wood:	30			30
Chickweed	33		BASIN	Seed	Stellaria media	78		X	78
	36		SHALLOW CC	Seed	Stellaria media	1		X	1
	17	B soil	DEEP BASIN	Seed	Stellaria media	2		X	2
	32		U-SHAPED	Seed	Stellaria media	2		X	2
	13		BASIN	Seed	Stellaria media	1		X	1
					Total for Chickweed :	84			84
Chokecherry	2		BASIN	Seed	Prunus virginiana	3		X	0
					Total for Chokecherry :	3			0
Clover	17	A soil	DEEP BASIN	Seed	Trifolium ssp.	1		X	0
	33		BASIN	Seed	Trifolium ssp.	71		X	71
	17	B soil	DEEP BASIN	Seed	Trifolium ssp.	27		X	27
	36		SHALLOW CC	Seed	Trifolium ssp.	2		X	2
	17	C soil	DEEP BASIN	Seed	Trifolium ssp.	1		X	0
	17	C soil	DEEP BASIN	Seed	Trifolium ssp.	6		X	6
					Total for Clover:	108			106

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
Copperleaf	33		BASIN	Seed	Acalypha virginica	80		X	0
	19		BASIN	Seed	Acalypha virginica	1		X	0
	13		BASIN	Seed	Acalypha virginica	1		X	0
	1	N.W. face	U-SHAPED	Seed	Acalypha virginica	3		X	0
	10		DEEP BASIN	ha virgini	Acalypha virginica	24		X	0
	17	B soil	DEEP BASIN	Seed	Acalypha virginica	39		X	0
	17	C soil	DEEP BASIN	Seed	Acalypha virginica	5		X	0
	2		BASIN	Seed	Acalypha virginica	57		X	0
	1		U-SHAPED	Seed	Acalypha virginica	47		X	0
					Total for Copperleaf :	257			0
Cover	17	A soil	DEEP BASIN	Seed	Trifolium ssp.	1		X	1
					Total for Cover:	1			1
Elderberry	17	B soil	DEEP BASIN	Seed	Sambucus canadensis	1		X	1
					Total for Elderberry :	1			1
False Solomansea	33		BASIN	Seed	Smilacina racemosa	1		X	1
	17	C soil	DEEP BASIN	Seed	Smilacina racemosa	1		X	1
	1	N.W. face	U-SHAPED	Seed	Smilacina racemosa	1		X	1
					Total for False Solomanseal :	3			3
Fern	32		U-SHAPED	Spores	PTERIDOPHYTA	12		X	12
	33		BASIN	Spores	PTERIDOPHYTA	270		X	270
	17	C soil	DEEP BASIN	Spores	PTERIDOPHYTA	19		X	19
	36		SHALLOW CC	Spores	PTERIDOPHYTA	17		X	17
	19		BASIN	Spores	PTERIDOPHYTA	22		X	22

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
Fern	10		DEEP BASIN	Spores	PTERIDOPHYTA	78		X	78
	17	B soil	DEEP BASIN	Spores	PTERIDOPHYTA	82		X	82
					Total for Fern:	500			500
Fescue	10		DEEP BASIN	Seed	Festuca ssp.	32		X	0
					Total for Fescue:	32			0
Goosefoot	1	N.W. face	U-SHAPED	Seed	Chenopodium ssp.	1		X	0
	17	B soil	DEEP BASIN	Seed	Chenopodium ssp.	4		X	0
	17	B soil	DEEP BASIN	Seed	Chenopodium ssp.	4		X	4
	17	A soil	DEEP BASIN	Seed	Chenopodium ssp.	1		X	0
	10		DEEP BASIN	Seed	Chenopodium ssp.	2		X	0
	33		BASIN	Seed	Chenopodium ssp.	10		X	0
	33		BASIN	Seed	Chenopodium ssp.	1		X	1
	38		SAUCER	Seed	Chenopodium ssp.	2		X	0
	17	C soil	DEEP BASIN	Seed	Chenopodium ssp.	2		X	0
	17	C soil	DEEP BASIN	Seed	Chenopodium ssp.	6		X	6
	1		U-SHAPED	Seed	Chenopodium ssp.	34		X	0
	32		U-SHAPED	Seed	Chenopodium ssp.	1		X	0
	2		BASIN	Seed	Chenopodium ssp.	4		X	0
					Total for Goosefoot:	72			11
Grape	28		SAUCER	Seed	Vitis ssp.	1		X	1
					Total for Grape:	1			1
Grass	33		BASIN	Seed	Graminae ssp.	8		X	0
	32		U-SHAPED	Seed	Graminae ssp.	8		X	0

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
Grass	17	C soil	DEEP BASIN	Seed	Graminae sp.	2		X	0
	28		SAUCER	Seed	Graminae ssp.	1		X	0
					Total for Grass:	19			0
Hickory	1		U-SHAPED	Nutshell	Carya ssp.	1		X	1
					Total for Hickory:	1			1
Jack in the Pulpit	28		SAUCER	Seed	Arisaema triphyllum	1		X	1
					Total for Jack in the Pulpit:	1			1
Jerseytea	33		BASIN	Seed	Ceanothus americanus	1		X	1
					Total for Jerseytea:	1			1
Jimsonweed	17	B soil	DEEP BASIN	Seed	Datura stramonium	1		X	1
					Total for Jimsonweed:	1			1
Knotweed	2		BASIN	Seed	Polygonum ssp.	5		X	0
	33		BASIN	Seed	Polygonum ssp.	2		X	0
	17	B soil	DEEP BASIN	Seed	Polygonum ssp.	1		X	0
	1		U-SHAPED	Seed	Polygonum ssp.	11		X	11
	3		U-SHAPED	Seed	Polygonum ssp.	1		X	0
					Total for Knotweed:	20			11
Oak	1		U-SHAPED	Nutshell	Quercus ssp.	1		X	1
					Total for Oak:	1			1
Pennyroyal	19		BASIN	Seed	Hedeoma pulegioides	8		X	8

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
Pennyroyal	33		BASIN	Seed	Hedeoma pulegioides	52		X	52
					Total for Pennyroyal :	60			60
Pigweed	42		U-SHAPED	Seed	Amaranthus ssp.	1		X	1
	33		BASIN	Seed	Amaranthus ssp.	3		X	0
					Total for Pigweed :	4			1
Poison Ivy	2		BASIN	Seed	Toxicodendron radicans	1		X	0
					Total for Poison Ivy :	1			0
Pokeberry	1		U-SHAPED	Seed	Phytolacca americana	2		X	0
	2		BASIN	Seed	Phytolacca americana	2		X	0
	28		SAUCER	Seed	Phytolacca americana	1		X	0
	10		DEEP BASIN	Seed	Phytolacca americana	2		X	0
					Total for Pokeberry :	7			0
Purslane	2		BASIN	Seed	Portulaca oleracea	54		X	0
	10		DEEP BASIN	Seed	Portulaca oleracea	27		X	0
					Total for Purslane :	81			0
Queen's Delight	33		BASIN	Seed	Stillingia aquatica	1		X	1
					Total for Queen's Delight :	1			1
Ragweed	42		U-SHAPED	Seed	Ambrosia ssp.	1		X	1
	14		BASIN	Seed	Ambrosia ssp.	1		X	1
	17	A soil	DEEP BASIN	Seed	Ambrosia ssp.	27		X	27
	33		BASIN	Seed	Ambrosia ssp.	5		X	5

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
Ragweed	13		BASIN	Seed	Ambrosia ssp.	3		X	3
	10		DEEP BASIN	Seed	Ambrosia ssp.	1		X	1
	19		BASIN	Seed	Ambrosia ssp.	2		X	2
	17	C soil	DEEP BASIN	Seed	Ambrosia ssp.	7		X	7
	3		U-SHAPED	Seed	Ambrosia ssp.	10		X	10
	17	B soil	DEEP BASIN	Seed	Ambrosia ssp.	37		X	37
	17	B soil	DEEP BASIN	Seed	Ambrosia ssp.	11		X	0
	2		BASIN	Seed	Ambrosia ssp.	3		X	3
					Total for Ragweed:	108			97
Serviceberry	1		U-SHAPED	Seed	Amelanchier canadensis	11		X	11
	1	N.W. face	U-SHAPED	Seed	Amelanchier canadensis	2		X	2
					Total for Serviceberry :	13			13
Skull cap	17	A soil	DEEP BASIN	Seed	Scutellaria galericulata	1		X	1
					Total for Skull cap:	1			1
Smartweed	2		BASIN	Seed	Polygonum pensylvanicum	2		X	0
					Total for Smartweed:	2			0
Sow thistle	13		BASIN	Seed	Sonchus asper	2		X	0
	1		U-SHAPED	Seed	Sonchus asper	1		X	0
					Total for Sow thistle:	3			0
Thistle	1	N.W. face	U-SHAPED	Seed	Cirsium ssp.	2		X	2
	2		BASIN	Seed	Cirsium arvense	6		X	6
	2		BASIN	Seed	Cirsium ssp.	82		X	0

TABLE 1 FLORAL SPECIMENS FROM 36CH53

COMMON NAME	FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	#	WGT	<.1	C
					Total for Thistle:	90			8
undetermined	1	N.W. face	U-SHAPED	Nutshell	undetermined	1		X	1
	10		DEEP BASIN	Nutshell	undetermined	22	0.2		22
	17	C soil	DEEP BASIN	Nutshell	undetermined	7	0.1		7
	33		BASIN	Nutshell	undetermined	7	0.1		7
	38		SAUCER	Nutshell	undetermined	22	0.1		22
	19		BASIN	Nutshell	undetermined	5	0.1		5
	28		SAUCER	Nutshell	undetermined	5	0.1		5
	17	B soil	DEEP BASIN	Nutshell	undetermined	112	0.4		112
	17	A soil	DEEP BASIN	Nutshell	undetermined	5		X	5
	1		U-SHAPED	Nutshell	undetermined	1		X	1
					Total for undetermined:	187			187
Vetch	1		U-SHAPED	Seed	Vicia angustifolia	1		X	1
					Total for Vetch:	1			1
White clover	13		BASIN	Seed	Trifolium repens	7		X	7
					Total for White clover:	7			7
Yardgrass	1		U-SHAPED	Seed	Eleusine indica	1		X	1
					Total for Yardgrass:	1			1
					Total:	2,484	1.1		1,175

TABLE 2 SPECIMEN INDEX

SPECIMEN NAME		CHARACTERISTICS					
BOTANICAL	COMMON						
Berberis vulgaris	Barberry		X	X		X	X
Sisyrinchium graminoides	Blue eyed grass				X		X
Stellaria lutescens	Bristle grass						NO
Cornus canadensis	Bunchberry			X		X	X
Mollugo verticillata	Carpetweed			X			NO
Stellaria media	Chickweed		X	X			NO
Prunus virginiana	Chokecherry			X		X	X
Acalypha virginica	Copperleaf						NO
Sambucus canadensis	Elderberry		X	X		X	X
Smilacina racemosa	False Solomonseal		X	X	X		X
PTERIDOPHYTA	Fern		X	X			X
Festuca ssp.	Fescue						NO
Chenopodium ssp.	Goosefoot		X	X			X
Gramineae ssp.	Grass						NO
Vitis ssp.	Grape		X	X			X
Carya ssp.	Hickory			X		X	X
Arisaema triphyllum	Jack in Pulpit		X	X			X
Ceanothus americanus	Jerseytea		X	X			X
Datura stamonium	Jimsonweed	X	X				X
Polygonum sp.	Knotweed	X	X	X			?
Quercus ssp.	Oak			X		X	X
Hedeoma pulegioides	Pennyroyal		X	X			X
Amaranthus sp.	Pigweed			X			?
Phytolacca americana	Pokeberry	X	X	X			X
Toxicodendron radicans	Poison Ivy	X					X
Portulaca oleracea	Purslane			X			NO
Stillingia aquatica	Queen's Delight						X
Ambrosia ssp.	Ragweed			X			X
Amelanchier canadensis	Serviceberry		X	X			X
Scutellaria galericulata	Skull Cap		X				X
Polygonum Pensylvanicum	Smartweed	X		X			X
Sonchus asper	Sow thistle			X			NO
Cirsium sp.	Thistle			X			NO
Cirsium arevense	Thistle			X			NO
Vicia angustifolia	Vetch						NO
Trifolium repens	White clover		X	X			NO
Eleusine indica	Yardgrass						NO

exclusively in the charred state however are not native plants.

Non Charred/Non Native

Carpetweed (*Mollugo verticillata*) is a weed which has been naturalized throughout North America but is not a native plant. Carpetweed is an annual weed with a deep taproot which became naturalized from tropical America (Cox 1985; Fernald 1970). It is not an early spring plant; but rather germination usually occurs later in the season when conditions are more like those of its warmer native habitat. Its late start is compensated for by a very rapid rate of growth in summer and fall when it becomes a nuisance in cultivated areas. It is a common weed in a variety of environmental settings. Although the plant can be cooked and eaten as a potherb it was not available to native populations. Fifty five percent of the uncharrred specimens were Carpetweed. A total of 721 Carpetweed specimens were recovered from the features under study: Feature 1 (56); Feature 2 (372); Feature 10 (64); Feature 13 (12); Feature 17 A soil (4); Feature17 B soil (79); Feature 19 (4); Feature 32 (10); Feature 33 (120).

Bristlegrass (*Stellaria lutescens*) was introduced from Europe and has become a serious pest of croplands and gardens. Their short production season makes them undesirable as pasture grasses (Martin 1972:26). A total of 15 non charred Bristlegrass specimens were recovered.

Copperleaf (*Acalypha virginica*) is a genus of about 200 species introduced from the tropics and subtropics (Martin 1972:78). It is a common weed of pastures, woods, cultivated fields, gardens and waste places. Copperleaf belongs to the spurge family Euphorbiaceae. Copperleaf seeds are eaten freely by gamebirds and songbirds. Plants grow to a foot or two high and the leaves turn copper color when mature (Martin 1972). A total of 257 seeds were recovered from the features under study: Feature 1 (47); Feature 1 N.W. face (3); Feature 2 (57); Feature 10 (24); Feature 13 (1); Feature 17B (39); Feature 17C (5); Feature 19 (1); Feature 33 (80).

Two different varieties of Thistle were recovered in the non-charred state. Sow Thistle (*Sonchus asper*) was represented by 3 specimens and an additional 82 Thistle (*Cirsium ssp.*) specimens that could not be identified to species were also present. Thistle is a field weed native to Europe. It is hypothesized that thistle arrived in shipments of grain and thus spread to America (Scott 1984:60).

Purslane (*Portulaca oleracea*) became naturalized after it's introduction to this continent from Europe (Peterson 1977; Fernald 1970; Knap1979). Purslane is a native plant of India which was adopted as a choice vegetable in Europe and was brought to America with the first settlers. Purslane was adopted by native North Americans who used the ground seeds as a breadstuff and meal. By virtue of the fact that Portulaca was not available to prehistoric inhabitants, it would not be expected to be present in prehistoric assemblages. A total of 81 uncharrred Purslane seeds were recovered.

A total of 19 grass (*Graminae ssp.*) seeds were recovered from the features under study. None were charred. It is suspected that these uncharrred seeds are resultant of the intensive farming practiced at the site area and that they are not native grass. The seeds most likely represent an introduced species of grass.

Fescues (*Festuca ssp.*) compose a large genus of forage and turf grasses. They are believed to have been introduced from Europe, probably England, where it is a standard grass (Dayton 1948:673). A total of 32 uncharred specimens were recovered from the features under study.

Charred/Non Native

Eight charred Canada Thistle (*Cirsium arvense*) specimens were recovered from Features 1 (2) and Feature 2 (6). Canadian Thistle is of European origin (Martin 1972:144) and although charred specimens are present it cannot be considered prehistoric in origin.

Vetch (*Vicia angustifolia*) is a climbing vine which was also introduced from Europe and is now found in abandoned fields, along roadsides, and in waste areas (Cox 1985:217). One charred specimen was recovered from Feature 1.

Chickweed (*Stellaria media*) was introduced from Europe and is now a very common plant in North America. It is likely that while importing desired plants, the colonists also imported some weeds. In fact, a traveler in 1740 reported that old English garden weeds such as Motherwort, Groundsel, Chickweed, and Wild Mustard had clung to the Englishmen where ever he trod (Earle 1974). Presumably, Chickweed gets its name from the fact that domestic chicks as well as doves, quail and sparrows favor it as a dietary item. Seeds maintain their viability after passing through the digestive tract, therefore birds and mammals that eat the plant serve as agents of dispersal. Despite the fact that this specimen is charred it seems unlikely that it was a component of the prehistoric floral assemblage. A total of 84 charred chickweed specimens were recovered from the features under study:Feature 33 (78); Feature 13 (1); Feature 17B (2);Feature 32 (2); Feature 36(1).

White Clover (*Trifolium repens*) is a perennial introduced from Europe. Clover is a rich source of protein, calcium, and vitamins for all classes of livestock. Fields of clover were planted both as a source of farm animal food as well as for crop rotation; a measure to prevent erosion; and to cut down on other weeds (Hedrick 1950). White clover has nitrogen-fixing nodules on its roots that enrich the soil and is a valuable hay and pasture plant (Cox 1985:215). White clover was recovered in both the charred (7) and non charred (2) state.

Yellow,White and Red clovers were introduced from Europe. A total of 107 clover specimens were recovered in the charred state, however they could not be identified to species. Given the intensive agricultural use of the site area it would be the most prudent course to assign these clovers as introduced species.

One Yardgrass (*Eleusine indica*) seed was recovered in the charred state from Feature 1. This is an annual grass introduced from Asia and is our only common weedy representative of a genus of six species native to warmer parts of the Old World (Martin 1972:19). Yardgrass or goosegrass is a weed of gardens, vacant lots and other waste places.

Uncharred Specimens

Approximately 52% of the floral assemblage was uncharred. The uncharred specimens are considered modern in origin and representative of the present day environmental conditions. The following gives a brief review of the exclusively uncharred specimens of the assemblage.

Chokecherry (*Prunus virginiana*) is a small tree or shrub which bears small berries (the size of peas) in July and August. The berries are so astringent as to pucker the mouth and affect the throat. The astringent quality disappears when cooked (Medsger 1966:50). Three specimens were recovered from the features under study.

Poision ivy (*Toxicondendron radicans*) is a native climbing vine which is a nuisance not only to the farmer but to the public. Contact with the weed can cause a dermatitis rash. One uncharred seed was recovered.

Pokeberry (*Phytolacca americana*) is a native perennial whose young shoots can be cooked as greens. The root, the mature plant and the seeds are poisonous. The Pamunky Indians of Virginia used a tea made by boiling the berries (Cox 1985:242). Pokeberry is a common weed found in pastures, fields and waste places. Seven uncharred seeds were recovered.

Smartweeds (*Polygonumn pensylvanicum*)are members of the buckwheat family and are liabilities as weeds but provide a valuable source of wildlife food (Martin 1972:40). They contain an acrid juice which can sting the skin hence the name smartweed. They are partial to moist soil, cultivated fields and ditches. Two uncharred specimens were recovered.

Uncharred and non-native specimens are recorded on the catalog sheets (Appendix 1), Table 1, Table 2, and Table 3 but are excluded from further intensive analysis and discussion.

Goosefoot,Ragweed, Pigweed, and Knotweed seeds were recovered in the non-charred state. However these specimen types were also recovered in the charred state and will be discussed in that category.

Potentially Utilized Charred Specimens

Only charred native species can be eligible for prehistoric utilization. As discussed earlier, meeting these two criteria certainly does not guarantee prehistoric utilization. Table 3 lists all specimens recovered and summarizes data concerning it's potentiality as a prehistorically utilized resource. If a seed type is not native then it is not potentially available to the prehistoric population under study. If a seed type is not charred then it is assumed not to be prehistoric in origin. If a seed type is recovered in the charred state but there is no documented or known use for the plant then it is not characterized as a potentially utilized resource.

Table 4 lists only charred native specimens which all have potential utility to a prehistoric population. Table 5 categorizes the distribution of plant food by the categories of nuts, bush fruit, tree fruit, tubers, greens, starchy seeds, and herbs. Some of the plant types fall into more than one category. For example, Chenopodium is comprised of greens as well as starchy seeds and is therefore repeated in each appropriate category. The data is categorized in this fashion because more than one element of the plant may have been used and more importantly the various elements may be available at different times of the year. Table 5 indicates the seasonal availability of the nuts, bush fruit, tree fruit, tubers, greens, starch seeds and herbs. The following is a description of each plant type recovered which was potentially utilized by the prehistoric population under study.

False Solomon Seal (*Smilacina racemosa*) is a native perennial with aromatic berries that persist into autumn. The berries are favored by birds as well as mammals. The name False Solomonseal refers to the resemblance of this plant to Solomonseal; however it differs in having the flowers in terminal clusters rather than in the axils of the leaves. It is common to moist woods of the Northeast. The young shoots can be eaten raw or cooked like asparagus. The berries and rootstocks are also edible but the berries are mildly cathartic and the rootstocks must first be soaked overnight in lye (or ashes) and then parboiled (Peterson 1977:52). It is possible that this method of preparation is responsible for its inclusion in the archaeological record. A total of three specimens were recovered from Features 1, 17C, and 33.

Pennyroyal (*Hedeoma pulegioides*) is a native American aromatic herb of

TABLE 3 ABORIGINAL POTENTIAL SUMMARY

Specimen	Native	Not Native	Charred	Uncharred	POTENTIAL
Barberry	X		1		yes
Blue eyed grass	X		37		no
Bristle grass		X		15	no
Bunchberry	X		7		yes
Carpetweed		X		721	no
Chickweed		X	84		no
Chokecherry	X			3	no
Copperleaf		X		257	no
Elderberry	X		1		yes
False Solomanseal	X		3		yes
Fern	X		500		yes
Fescue		X		32	no
Goosefoot	X		11	61	yes
Grape	X		1		yes
Jack in Pulpit	X		1		yes
Jerseytea	X		1		yes
Jimsonweed	X		1		yes
Knotweed	X		11	9	yes
Pennyroyal	X		60		yes
Pigweed	X		1	3	yes
Pokeberry	X			7	no
Poison Ivy	X			1	no
Purslane		X		81	no
Queen's Delight	X		1		no
Ragweed	X		97		yes
Serviceberry	X		13		yes
Skull Cap	X		1		yes
Smartweed	X			2	no
Sow Thistle		X		3	no
Canada Thistle		X	6		no
Thistle		X	2	82	no
Vetch		X	1		no
White clover		X	7	2	no
grass		?		19	no
Oak	X		1		yes
Hickory	X		1		yes
charred wood	X		30		yes
clover		?	107		no
Yardgrass		X	1		no
Nutshell	X		187		yes

TABLE 4 DISTRIBUTION OF CHARRED SPECIMENS

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1
1		U-SHAPED	Nutshell	Carya ssp.	Hickory	1		X
			Seed	Vicia angustifolia	Vetch	1		X
			Nutshell	Quercus ssp.	Oak	1		X
			Nutshell	undetermined	undetermined	1		X
			Wood	undetermined	charred wood	12		X
			Seed	Amelanchier canadensis	Serviceberry	11		X
			Seed	Eleusine indica	Yardgrass	1		X
			Seed	Polygonum ssp.	Knotweed	11		X
					Total for :	39		
	N.W. face	U-SHAPED	Seed	Smilacina racemosa	False Solomanseal	1		X
			Seed	Amelanchier canadensis	Serviceberry	2		X
			Seed	Cirsium ssp.	Thistle	2		X
			Nutshell	undetermined	undetermined	1		X
					Total for N.W. face:	6		
					Total for 1:	45		
2		BASIN	Seed	Cirsium arvense	Canada Thistle	6		X
			Seed	Ambrosia ssp.	Ragweed	3		X
					Total for :	9		
					Total for 2:	9		
3		U-SHAPED	Wood	undetermined	charred wood	2		X
			Seed	Ambrosia ssp.	Ragweed	10		X
					Total for :	12		

TABLE 4 DISTRIBUTION OF CHARRED SPECIMENS

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1
					Total for 3:	12		
10		DEEP BASIN	Nutshell	undetermined	undetermined	22	0.2	
			Spores	PTERIDOPHYTA	Fern	78		X
			Seed	Cornus canadensis	Bunchberry	7		X
			Seed	Ambrosia ssp.	Ragweed	1		X
					Total for :	108		
	uncleaned	DEEP BASIN	Wood	undetermined	charred wood	15		X
					Total for uncleaned :	15		
					Total for 10:	123		
13		BASIN	Seed	Trifolium repens	White clover	7		X
			Seed	Stellaria media	Chickweed	1		X
			Seed	Ambrosia ssp.	Ragweed	3		X
					Total for :	11		
					Total for 13:	11		
14		BASIN	Seed	Ambrosia ssp.	Ragweed	1		X
					Total for :	1		
					Total for 14:	1		
15		U-SHAPED	Seed	Berberis vulgaris	Barberry	1		X

TABLE 4 DISTRIBUTION OF CHARRED SPECIMENS

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1
					Total for :	1		
					Total for 15:	1		
17	A soil	DEEP BASIN	Seed	Trifolium ssp.	Cover	1		X
			Seed	Ambrosia ssp.	Ragweed	27		X
			Seed	Scutellaria galericulata	Skull cap	1		X
			Nutshell	undetermined	undetermined	5		X
					Total for A soil:	34		
	B soil	DEEP BASIN	Seed	Trifolium ssp.	Clover	27		X
			Spores	PTERIDOPHYTA	Fern	82		X
			Seed	Datura stramonium	Jimsonweed	1		X
			Seed	Sambucus canadensis	Elderberry	1		X
			Nutshell	undetermined	undetermined	112	0.4	
			Seed	Stellaria media	Cnickweed	2		X
			Seed	Ambrosia ssp.	Ragweed	37		X
			Seed	Chenopodium ssp.	Goosefoot	4		X
					Total for B soil:	266		
	C soil	DEEP BASIN	Seed	Ambrosia ssp.	Ragweed	7		X
			Spores	PTERIDOPHYTA	Fern	19		X
			Seed	Chenopodium ssp.	Goosefoot	6		X
			Seed	Smilacina racemosa	False Solomanseal	1		X
			Seed	Trifolium ssp.	Clover	6		X
			Nutshell	undetermined	undetermined	7	0.1	
					Total for C soil:	46		

TABLE 4 DISTRIBUTION OF CHARRED SPECIMENS

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1
					Total for 17:	346		
19		BASIN	Spores	PTERIDOPHYTA	Fern	22		X
			Nutshell	undetermined	undetermined	5	0.1	
			Seed	Hedeoma pulegioides	Pennyroyal	8		X
			Seed	Ambrosia ssp.	Ragweed	2		X
					Total for :	37		
					Total for 19:	37		
28		SAUCER	Seed	Arisaema triphyllum	Jack in the Pulpit	1		X
			Nutshell	undetermined	undetermined	5	0.1	
			Seed	Vitis ssp.	Grape	1		X
					Total for :	7		
					Total for 28:	7		
32		U-SHAPED	Wood	undetermined	charred wood	1		X
			Seed	Stellaria media	Chickweed	2		X
			Spores	PTERIDOPHYTA	Fern	12		X
					Total for :	15		
					Total for 32:	15		
33		BASIN	Seed	Trifolium ssp.	Clover	71		X
			Seed	Smilacina racemosa	False Solomanseal	1		X

TABLE 4 DISTRIBUTION OF CHARRED SPECIMENS

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1
33		BASIN	Seed	Ceanothus americanus	Jerseytea	1		X
			Spores	PTERIDOPHYTA	Fern	270		X
			Seed	Stellaria media	Chickweed	78		X
			Seed	Ambrosia ssp.	Ragweed	5		X
			Seed	Sisyrinchium graminoides	Blue eyed grass	37		X
			Seed	Stillingia aquatica	Queen's Delight	1		X
			Seed	Chenopodium ssp.	Goosefoot	1		X
			Nutshell	undetermined	undetermined	7	0.1	
			Seed	Hedeoma pulegioides	Pennyroyal	52		X
					Total for :	524		
					Total for 33:	524		
36		SHALLOW CONE	Spores	PTERIDOPHYTA	Fern	17		X
			Seed	Stellaria media	Chickweed	1		X
			Seed	Trifolium ssp.	Clover	2		X
					Total for :	20		
					Total for 36:	20		
38		SAUCER	Nutshell	undetermined	undetermined	22	0.1	
					Total for :	22		
					Total for 38:	22		
42		U-SHAPED	Seed	Ambrosia ssp.	Ragweed	1		X
					Total for :	1		

TABLE 4 DISTRIBUTION OF CHARRED SPECIMENS

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1
					Total for 42:	1		
					Total:	1,174		

TABLE 5 SEASONAL AVAILABILITY OF RECOVERED PLANT FOOD

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	HABITAT
Nuts													
Hickory										X			moist woods, river banks
Oak									X	X			wide range
Bush Fruit													
Elderberry							X	X					moist woods
False Solomanseal								X	X	X			moist woods
Serviceberry						X	X	X	X				moist woods
Barberry								X	X	X	X		old fields, thickets
Bunchberry							X	X	X	X			shady woods
Vine Fruit													
Grape								X	X	X	X		thickets, edges of woods
Tubers													
False Solomonseal				X	X								moist woods
Fern				X	X	X							moist woods
Jack-in-the Pulpit				X	X				X	X			moist woods
Greens													
Goosefoot						X	X	X					disturbed ground
False Solomonseal				X	X	X	X						moist woods
Ferns				X	X	X							stream/river banks, woods
Pigweed				X	X								disturbed ground
Knotweed				X	X	X							disturbed ground
Starchy Seeds													
Knotweed	X								X	X	X	X	disturbed ground
Ragweed									X	X	X		disturbed ground
Pigweed	X								X	X	X	X	disturbed ground
Goosefoot									X	X	X		disturbed ground
Herb													
Pennyroyal						X	X	X	X				moist woods
New Jersey Tea						X	X	X					open woods
Pigweed				X	X								disturbed ground
Jimsonweed							X	X	X	X			cultivated & waste places
Skull Cap					X	X	X						moist woods
Ragweed									X	X	X		disturbed ground
False Solomonseal				X	X	X	X	X	X	X	X		moist woods

the mint family. It is found in woods, fields and is widespread in the Eastern United States. It has a long list of medicinal uses thought to have been developed by the Indians. It was used as an insect repellent by rubbing the fresh leaves upon the skin (Krause 1983:173). An observer writing in the Aborigines of Virginia in 1608 noted that plants of the mint family were often mixed with bear grease to facilitate spreading it upon the body (Kavasch 1979:143). According to early accounts the Indians were generally free of skin diseases and maintained healthy skin by frequently "washing" the skin with the oils of fishes and the fats of eagles, raccoons or bears and mixing it with certain herbs to lend fragrance and added protection (Kavasch 1979:143).

Pennyroyal was also used as a gentle aromatic stimulant (Harris 1985:128). The leaves and blossoms were steeped and used as a drink to relieve headaches by the Onondagas, the Apaches, and the Mescaleros (Kavasch 1979:152) as well as the Mohegan of Connecticut and the Delaware (Tantaquidgeon 1977:72;100;130). Eight specimens were recovered from Feature 19 and 52 specimens were recovered from Feature 33.

Grapes (*Vitis ssp.*), unfortunately, cannot be differentiated by species on the basis of seeds. Dense communities of grapes can remain dominant for at least 15 years in intermediate stages of forest succession (Keene 1981:77). Because grapes (and other bush fruit) tend to grow in colonies or thickets and are relatively persistent and consistent over the short run, productive localities could be returned to year after year without major investment in search time. The major cost would have been collection and processing. Most ethnobotanical sources for eastern North America refer to the use of grapes in the fresh state,however they were commonly dried, apparently with the seeds in, for later use (Gilmore 1919:102).

It is documented that Delaware and Connecticut Indians also used grape vine for mats and lashing baskets (Tantaquidgeon 1972:80). Another feature of the grape vine is its clear watery sap which is easily obtained by cutting the vine. This, in a period of drought could provide a source of liquid (Kavasch 1979:133). A single grape pip was recovered from Feature 28.

Serviceberry or Juneberries (*Amelanchier canadensis*) is a common native shrub of the Northeast. It is generally found in moist soils. The berries when fully ripe are dark purple and are sweet and edible (Medsger 1966:38-39). Lewis and Clark spoke of the fine quality of the wild fruit and the use the Indians make of it. They often crushed the berries and dried them, forming a kind of cake that could be carried on their journeys. Pieces could be broken off the mass to cook with meat or vegetable food. It was also used for pemmican-dried meat, pounded fine, mixed with dried fruit and animal fat; the mass molded in the form of cakes (Medsger 1966:38-39). A total of 13 Serviceberries were recovered exclusively from Feature 1.

Bunchberry (*Cornus canadensis*) is a native perennial shrub or small tree. The mature red berries can be eaten raw or cooked but are reported to be slightly tasteless (Cox 1985:53). A total of 7 specimens were recovered exclusively from Feature 10.

Barberry (*Berberis vulgaris*) branches were used to made pipe stems (Tantaquidgeon 1972:80). The roots of Barberry were also used medicinally and applied to bruises and cuts (Tantaquidgeon 1972:128-129). One specimen was recovered from Feature 15.

Skull Cap (*Scutellaria galericulata*) is a native perennial generally found in damp soil. There is documentation that the plant tops of the Skull Cap were used as a stomach stimulant and muscle relaxants by the Indians of the Delaware and Connecticut regions (Tantaquidgeon 1972:37). One specimen was recovered from Feature 17A.

Elderberry (*Sambucus canadensis*) is a shrub commonly found along the edges of woods or thickets. The berries are somewhat bland in taste but have a high sugar content and are one of the riches natural source of vitamin C (Gibbons 1966). Although there are some references to the aboriginal use of the fruits as food (Gilmore 1919:115) , are more references to the use of the flowers, shoots, roots, and bark for medicinal purposes. This would suggest that the berries were not considered an important source of food (Munson 1984:470). Tantaquidgeon (1972:133) reports that the blossoms and inner bark were made into a tea and used medicinally by Indians of the Connecticut and Delaware region. One Elderberry seed was recovered from Feature 17B.

Today Jimsonweed (*Datura stramonium*) is found in fields, abandoned feed lots, barnyards, and waste areas. Jimsonweed is considered a weed by contemporary standards. All parts of the plant are poisonous. The early settlers at Jamestown knew about the plant and its properties; thus the common name Jamestown Weed (Cox 1985). There is documentation that Indians of Connecticut and Delaware used the leaves and seeds in a medicinal poultice (Tantaquidgeon 1972:128;116). The leaves were crushed and applied to fresh wounds as a poultice and the seeds were pounded to make a salve (Tantaquidgeon 1972:37). One seed was recovered from Feature 17B.

Jack-in-the-pulpit (*Arisaema triphyllum*) is a native perennial which grows from one to three feet high from a starchy bulb or corm. The blossoms are followed by a cluster of green berries which become bright red when ripe and are extremely acrid. The bulb or corm is slightly flattened or turnip shaped and it is also commonly called Indian turnip. It is starchy but when raw contains calcium oxalate crystals. Eating the raw plant causes an intense burning sensation in the mouth. Boiling does not remove this property. It is only thorough drying that renders it palatable. The corm was ground into meal and baked into cakes or used as gruel (Medsger 1966:172). There is documentation that the leaves were used medicinally as a poultice by Indians in the Delaware and Connecticut area (Tantaquidgeon 1972:70;128). One seed was recovered from Feature 28.

New Jersey Tea (*Ceanothus americanus*) is a low bushy shrub generally found in open woods (Peterson 1977:18). New Jersey Tea was used medicinally by eastern Indian tribes in the form of tea made from roots (Hamel and Chiltoskey 1975:48) and leaves (Peterson 1977:18). Some tribes used an infusion made of the whole plant to treat external skin disorders (Kavasch 1979:135). A single specimen was recovered from Feature 33.

Goosefoot or Lambs Quarters (*Chenopodium ssp.*) was an important plant food historically and prehistorically in the eastern United States (Asch et al. 1972; Asch and Asch 1977; Ford 1977; Winters 1969; Baker 1980; Hatch 1980; Seeman and Wilson 1984). Chenopodium played an important role in the changing subsistence economies of the Late Archaic through the Woodland periods. Chenopodium and other opportunistic weeds such as Amaranthus (Pigweed, Redroot, Wild Beet) were potentially important plant food for Late Archaic populations. Charred Goosefoot seeds were recovered from the following features: Feature 17B (4); Feature 17C

(6) and Feature 31 (1). A total of 61 uncharred Goosefoot seeds were recovered from Features: 1 (34); 1 N.W. face (1); 2 (4);10 (2); 17 A (1); 17B (4); 17C (2); 32 (1);33 (10); and 38 (2).

Chenopodium is a seed type which is "opportunistic" and will invade and flourish in fields, waste spaces or any bare ground that becomes available. Chenopodiums have high growth rates and produce large numbers of seeds which enables them to establish themselves quickly on bare soil. In the spring, weedy genera are available for high calcium greens and are prolific seed bearers in the late autumn. Indians harvested Chenopod seeds by pulling up the entire plant and placing it in a sack. After the plant dried, the seeds fell to the bottom of the sack and were then parched for storage and later crushed in a mortar. The meal was added to breads or cooked in a porridge (Wetterstrom 1978:110).

While there is evidence for the use of plant food during the Archaic Period (Schoenwetter 1974), the actual appearance of Chenopods and other weedy plants does not occur until Late Archaic or Early Woodland archaeological contexts. A complete review of the arguments for cultivation of Chenopodium by indigenous Americans is presented by Asch and Asch (1977), Yarnell (1965; 1964) and Struever and Vickery (1973). All of these researchers support the notion of the propagation of weeds for food; however their positions differ regarding the degree of active cultivation. The idea of encouragement versus domestication is one of the central problems of interpretation involving weed seeds and their positions in the subsistence strategies of prehistoric eastern North America. The emerging picture is one in which most researchers agree that weedy plants were manipulated by human groups but few agree on the nature and degree of manipulation involved. The specific subsistence position of the weedy genera is currently the subject of increased attention and debate.

Amaranths (Pigweed) have also been recovered in archaeological contexts in eastern North America in situations suggesting utilization and perhaps even cultivation. Gilmore (1931) examined quantities of dry-preserved material from rock-shelters in southwestern Missouri and northwestern Arkansas and identified corn, squash, and seeds of sunflower, chenopods, marsh elder, canary grass, giant ragweed, and amaranth, all in situations suggesting they had been stored. Three uncharred Pigweed seeds were recovered from Feature 33. One charred Pigweed seed was recovered from Feature 42.

Despite this finding, the use of Pigweed by aboriginal peoples is still not fully understood. Peterson and Munson (1984:317-337) present a comprehensive explanation and summary of the problems surrounding the inclusion of Pigweed as a prehistorically utilized food. There are numerous questions associated with the identification, productivity, availability, and usage of Pigweed. There are some sixty species of Amaranthus and it is difficult to distinguish between them utilizing only the seed. Pollen analysis is of no great help because it cannot differentiate Amaranth pollen to the species. Further, it is not possible to distinguish the family Amaranthaceae from Chenopodiaceae (except with an electron microscope). There is debate as to whether all species are native to America (Tucker and Sauer 1958:259-60). There is also debate as to the economic attractiveness of Pigweed to aboriginal gatherers/cultivators.

Knotweed (*Polygonum ssp.*) is an annual of North America, Europe and Asia. The recovered specimens could not be identified to species therefore it is undetermined as to whether the species are native or not. Knotweed is a weed in cultivated fields however it cannot survive in competition with other species (Cox 1985:246). The seeds are edible and can be ground for use as flour. The flour is somewhat similar to buckwheat flour. An infusion of the flowering plant has astringent and diuretic properties however it is reported to cause contact dermatitis in sensitive individuals.

Knotweed are also opportunistic plants which thrive in disturbed soil. Although Polygonum seeds have been preserved in archaeological sites, it is seldom that they occur in sufficient numbers to suggest their use as food by aboriginal peoples (Murray and Sheehan 1984:282). Polygonum shares many of the same characteristics of Chenopodium and Amaranthus in that they can appear in abundance with dense conspicuous seed heads and would have provided a readily harvestable food source.

Murray and Sheehan (1984) conducted a collecting and processing project whereby 10 species of Polygonum were collected, processed and eaten. The objective of their study was to further support or weaken the assumption that Polygonum was eaten by aboriginal peoples. They discovered variation between the numerous species of Polygonum in terms of seed production per plant, ease of collection, taste, and ease of processing. They concluded that Polygonum was probably exploited as a food because Polygonum seeds were found in contexts that included seeds of other probable food plants (e.g. Chenopodium). They further concluded that Polygonum seeds required a long collecting and processing time which resulted in relatively low yield. This would have made Polygonum an unattractive food plant however Knotweed seeds were available long after other plants had lost their seeds and thus "aboriginal man may have found in his scheduling of foodgathering activities that Polygonum could be gathered when no other food plants were available" (Murry and Sheehan 1984:295). Nine uncharred Knotweed seeds were recovered as well as 11 charred specimens from Feature 1.

Ragweed (*Ambrosia trifida*) is noted for it's allergy inducing pollen and has come to be an obnoxious farm weed. Ragweed often develops solid luxuriant stands in fields after a grain crop has been harvested (Martin 1972:130). Rigorous growths of Ragweed are usually found on fertile soil suitable for cultivated crops.

As far back as 1931 Melvin Gilmore suggested that Ragweed was cultivated by the prehistoric Ozark bluff dwellers (Gilmore 1931). Subsequent studies (Jones and Payne 1962) cast doubt on the cultigen status of ragweed. Virtually no evidence for Ragweed cultivation was forthcoming from botanical studies of Eastern North America until quite recently (Cowan 1985:214). At the Cloudsplitter rockshelter in eastern Kentucky Ragweed achenes are entirely absent from the deposits before 3000 B.P. but begin to appear in Early Woodland deposits. Ragweed is found in clear association with squash, gourd, sunflower, goosefoot, sumpweed and maygrass. Although they are usually found in low quantities in comparison to the other annuals, the association is interesting (Cowan 1985).

Ragweed harvesting experiments were conducted and it is reported that the seeds of this plant are the least efficient to harvest of any of the Eastern Complex plants and only in a dense field-type situation would it be practical (Cowan 1985:215). Charred Ragweed was recovered from Features: 2 (3); 3(10); 10 (1); 13(3);14 (1);17A (27); 17B(37); 17C(7);19 (2);33 (5); and 42 (1).

While seed-bearing weeds entail a relatively high processing cost they would also be relatively predictable and prolific resource with low search and pursuit costs (Keene 1981:90). Weedy genera require no thinning, watering, fertilizing, planting or hoeing in order to achieve significant stands, therefore the maintenance expenditure is quite low (Hatch 1980). One of the most important aspects of the opportunistic plants is that the seeds are most efficiently harvested after the first killing frost when other plant foods would have been scarce.

The largest component of the assemblage were macrospores from the fern family. A total of 500 macrospores were recovered from the features under study. PTERIDOPHYTA are plants without true flowers which reproduce chiefly by spores. Some classes of vascular cryptogams produce male microspores and larger female macrospores. Large spores can reach several millimeters in diameter. All macrospore specimens were charred and were recovered from the following features: Feature 10 (78); Feature 17B (82); Feature 17C (19); Feature 19 (22); Feature 32 (12); Feature 33 (270) and Feature 38 (17).

One of the first green edible plants in spring is the newly emerging curled frond of ferns. In early spring the new fronds could be gathered and eaten raw, cooked or simmered in soups and stews for their thickening qualities (Kavasch 1979:68). Ferns are high in oil and starch and the slender stalks could be ground into flour for bread. The rhizome (underground stem) could be baked like potatoes in hot coals. Virginia Indians used hickory ashes as seasonings for this vegetable (Kavasch 1979:72).

Members of the fern family have also been documented as utilized by American Indians for medicinal purposes (Harris 1985:95). The Cherokee placed great remedial value in several species of ferns as anti-rheumatics because the unrolling of the fronds suggests the straightening out of contracted muscles and limbs. It was thought that rheumatism was caused by worms, because the cramped movements of the patient resembled those of the worm. The roots were used as a worm expellant (Harris 1985:31). Ferns were also used by East coast tribes as an absorbent dressing for open sores and wounds (Kavasch 1979:69-70).

Some plant types of the assemblage are somewhat ambiguous in the sense that they are both native and charred, thereby fulfilling two major criteria however the extent to which they were utilized in a prehistoric context is not clearly understood. While there is some evidence that some native Americans utilized some of these plants for medicinal purposes, it can't be assumed that all native groups utilized them in the same fashion. Documentation for historic Indian utilization does not necessarily imply that Early-Middle Woodland populations utilized the plants (Kavasch 1979). Further, it should be noted that just because a plant type is potentially edible does not insure that it was used by all prehistoric populations.

No Evidence for Use

Although a plant is both native to America and it's seeds are recovered in the charred state; if there is no general usefulness ascribed to the plant or there is no documented usage of the plant, it is analytically categorized as "background noise" to the assemblage. Weeds were certainly a component of the prehistoric landscape and easily become incorporated into a prehistoric assemblage. There is no documentation or evidence that Blue-eyed grass or Queen's Delight were utilized by prehistoric (or historic) populations.

Blue-eyed grass (*Sisyrinchium graminoides*) is a native grasslike perennial with a fibrous root system. Blue-eyed Grass is found in fields and meadows and is favored by birds as a source of food. A total of 37 charred specimens were recovered exclusively from Feature 33.

Queen's Delight (*Stillingia aquatica*) is a deep rooted herbaceous plant common to wooded areas. The plant emits a milky sap when broken and was used in preparations for skin disorders (Harris 1985:151-152) during historic times. However, there is no documentation that it was utilized by historic Indian populations. One seed was recovered from Feature 33.

Nutshell

Nuts from a variety of Eastern forest trees were an integral portion of the economic systems of prehistoric populations. Even after the advent of intensive maize cultivation, nuts continued to be an important collected resource.

A total of 189 very small charred nutshell fragments were recovered. No kernel fragments were recovered. The total weight of the nutshell specimens was 1.1 grams. Two different kinds of nutshell were identified and those were Hickory and Oak acorn. A total of 1 small fragment was identified as Hickory. A total of 1 acorn fragment was identified as Oak. Both identifiable fragments were from Feature 1. The remainder of recovered nutshell were pieces so small that they lacked diagnostic features necessary for a species identification.

Most of the specimens were less than .1 gram in weight and measured approximately 2 to 3 millimeters in diameter. Evaluation of the number of whole nuts represented at a site must account for weight loss in the shell as a result of charring. An experiment was performed at the Koster site in Illinois to determine the average weight loss of hickory nutshells after carbonization. The average shell weight of one nut decreased from 1.67 grams to .81 gram (Asch et al 1972). Given these calculations and applying it to the total gram weight of all recovered nutshell; only 2 whole nuts are represented within the assemblage.

Hickory (*Carya sp.*) trees grow best in well drained soils and well drained hillsides. The shagbark Hickory grows best in well drained light soils and is commonly found along riverbanks and hillsides. Hickory yield is variable from year to year and a good crop may be expected every 1-3 years. Hickory bears more consistently than acorns. Both acorns and Hickory nuts are an important wildlife food and competition with animals and insects can be great.

Oak acorns (*Quercus ssp.*) were an important food resource to the historic native populations throughout the Eastern United States (Keene 1981). Red Oak grows well in moist soils and is commonly found along stream banks. White oaks grows in a variety of habitats but does not do well in wet soils. Red oak produce bitter acorns while those of the White oak are sweet. The bitter varieties require additional processing to remove the high tannin content which causes the bitter taste.

Acorn productivity is apparently affected by the same factors that affect fruit trees, that is, hard winters, late springs, and early or hard frosts. Red oaks drop their acorns later than the other oaks with nut fall extending as late as November (Keene 1981). Production variance between trees is greater than between years. That is, those trees that exceed the annual average produced large crops with relative consistency while poor producers were consistently underproductive. In terms of exploitation, this implies that once productive trees were identified, they could be harvested annually with some degree of dependability (Keene 1981:62). Acorns were most likely harvested off the ground. Collection of acorns would probably require precise timing because a large portion of the crop falls within a relatively short period.

Hickory nut shells seem to be the one item remaining from food preparation that is consistently burned. Apparently Indians in eastern North America discovered that hickory shells make an excellent hot and virtually smokeless fire for cooking (Smith 1985:121). The proportion of Hickory shell far outweighs other shell types in prehistoric sites of the East.

The processing of nuts involves collecting, hulling, shelling and preparation. Keene (1981) developed a rank order for nuts depending on the time and energy expended to perform these processing functions. Keene determined that hickory nuts would be the least expensive to collect and process and acorns would be of intermediate expense (Keene 1981:71).

Ethnographic accounts dating from the contact period are useful in determining how people may have prepared these nuts. According to early travelers, Indians collected hickory nuts mainly for their oil, although they also ate the nut meats (Swanton 1946:364). An early historian described how the oil was extracted:

> At the fall of the leaf, they gather a number of hiccory-nuts, which they pound with a round stone, thick and hollowed for the purpose. When they are beat fine enough, they mix them with coldwater,in a clay bason, where the shells subside. The other part is an oily, tough, thick white substance, called by the traders hiccory milk, and by the Indians the flesh, or fat of hiccory-nuts, with which they eat their bread (Adair 1775:408, quoted in Swanton 1946:365).

The question of whether or not nut trees were cultivated is linked to the biology and growth habits of the native eastern North American trees. None of the nut trees are easily genetically manipulated. More importantly, most nut trees do not produce fruits until they are fairy old (Cowan 1985).

There is little reason to doubt that some simple form of arboriculture was practiced by at least late prehistoric Eastern North American populations. Simple weeding around young shoots and saplings, for instance, might have imparted an advantage to young plants by eliminating competitors. Protection of older trees in garden plots probably led to several beneficial results not only to the plants but to the human groups who utilized their products. Opening the way for a larger crop would produce more light for a tree than would normally be produced in a closed canopy forest. Fruits would probably require less effort to collect since they would be easier to reach and more visible on the ground (Cowan 1985:218-220).

Charcoal

A total of 30 very small charred wood fragments were recovered. The species of wood could not be determined. The total weight of charred wood specimens was less than .1 grams.

Wood and charcoal fragments are not direct elements of the diet. Charred wood is resistant to decay and therefore preserves well. Charcoal is commonly found in prehistoric contexts (Carbone and Keel 1985). Large concentrations of charcoal can suggest the presence of a hearth or fires. Wood, of course, was burned as fuel for fires.

Yarnell (1964:27) discussed the effects of selective firewood gathering and differential self-pruning of various trees. Unfortunately the charcoal recovery at the site area was low in frequency and small in size and not amenable to further analysis.

SUMMARY

Only 27% of the recovered specimens were potentially exploited resources of the prehistoric populations under study. Given the hypothesized long duration of occupation at the site area; this is undoubtably a scant representation of the prehistoric foodstuffs. The site area has been impacted by agricultural activities and this was indeed reflected in the seed recovery as evidenced by the high frequency of uncharred an non-native specimens inter-mixed within the pit features.

Weedy annuals played an important role in the evolution of plant husbandry in eastern North America. Some of the most prominent weedy annuals, Chenopodium, Amaranth, and Ragweed are present within the assemblage. The absence of "true" cultigen specimens and the low frequency of these primary "transitional" weedy annual limits the assessment of the populations' commitment or transition to horticulture. However, their presence is certainly the most provocative finding of the study.

The shift to an agricultural strategy is a provocative theoretical issue for several reasons. Subsistence entails the extraction of matter and energy from the natural environment in order to meet human adaptive requirements. Within environmental, biological, and cultural constraints, subsistence strategies appear to favor risk minimization. Within the concept of least-cost decision making.; agriculture has the highest initial costs related to constructing and maintaining an artificial environment. However, it also has the highest potential annual yield. Understanding the reasons for changing procurement strategies continues to be an important theoretical focus for Early to Middle Wooaland sites.

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APPENDIX 1

CATALOG

CATALOG OF FLORAL SPECIMENS 36CH53

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1	C
1		U-SHAPED	Seed	Mollugo verticillata	Carpetweed	56		X	0
1		U-SHAPED	Seed	Acalypha virginica	Copperleaf	47		X	0
1		U-SHAPED	Seed	Chenopodium ssp.	Goosefoot	34		X	0
1		U-SHAPED	Nutshell	Carya ssp.	Hickory	1		X	1
1		U-SHAPED	Seed	Phytolacca americana	Pokeberry	2		X	0
1		U-SHAPED	Seed	Amelanchier canadensis	Serviceberry	11		X	11
1		U-SHAPED	Nutshell	undetermined	undetermined	1		X	1
1		U-SHAPED	Seed	Eleusine indica	Yardgrass	1		X	1
1		U-SHAPED	Seed	Vicia angustifolia	Vetch	1		X	1
1		U-SHAPED	Seed	Sonchus asper	Sow thistle	1		X	0
1		U-SHAPED	Nutshell	Quercus ssp.	Oak	1		X	1
1		U-SHAPED	Seed	Polygonum ssp.	Knotweed	11		X	11
1		U-SHAPED	Wood	undetermined	charred wood	12		X	12
1	N.W. face	U-SHAPED	Seed	Stellaria lutescens	Bristlegrass	1		X	0
1	N.W. face	U-SHAPED	Seed	Chenopodium ssp.	Goosefoot	1		X	0
1	N.W. face	U-SHAPED	Seed	Acalypha virginica	Copperleaf	3		X	0
1	N.W. face	U-SHAPED	Nutshell	undetermined	undetermined	1		X	1
1	N.W. face	U-SHAPED	Seed	Cirsium ssp.	Thistle	2		X	2
1	N.W. face	U-SHAPED	Seed	Amelanchier canadensis	Serviceberry	2		X	2
1	N.W. face	U-SHAPED	Seed	Smilacina racemosa	False Solomanseal	1		X	1
2		BASIN	Seed	Acalypha virginica	Copperleaf	57		X	0
2		BASIN	Seed	Stellaria lutescens	Bristlegrass	10		X	0
2		BASIN	Seed	Chenopodium ssp.	Goosefoot	4		X	0
2		BASIN	Seed	Prunus virginiana	Chokecherry	3		X	0
2		BASIN	Seed	Cirsium arvense	Thistle	6		X	6
2		BASIN	Seed	Cirsium ssp.	Thistle	82		X	0
2		BASIN	Seed	Portulaca oleracea	Purslane	54		X	0
2		BASIN	Seed	Ambrosia ssp.	Ragweed	3		X	3

CATALOG OF FLORAL SPECIMENS 36CH53

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1	C
2		BASIN	Seed	Polygonum pensylvanicum	Smartweed	2		X	0
2		BASIN	Seed	Phytolacca americana	Pokeberry	2		X	0
2		BASIN	Seed	Toxicodendron radicans	Poison Ivy	1		X	0
2		BASIN	Seed	Polygonum ssp.	Knotweed	5		X	0
2		BASIN	Seed	Mollugo verticillata	Carpetweed	372		X	0
3		U-SHAPED	Wood	undetermined	charred wood	2		X	2
3		U-SHAPED	Seed	Ambrosia ssp.	Ragweed	10		X	10
3		U-SHAPED	Seed	Polygonum ssp.	Knotweed	1		X	0
10		DEEP BASIN	pha virginic	Acalypha virginica	Copperleaf	24		X	0
10		DEEP BASIN	Seed	Ambrosia ssp.	Ragweed	1		X	1
10		DEEP BASIN	Seed	Phytolacca americana	Pokeberry	2		X	0
10		DEEP BASIN	Spores	PTERIDOPHYTA	Fern	78		X	78
10		DEEP BASIN	Nutshell	undetermined	undetermined	22	0.2		22
10		DEEP BASIN	Seed	Chenopodium ssp.	Goosefoot	2		X	0
10		DEEP BASIN	Seed	Festuca ssp.	Fescue	32		X	0
10		DEEP BASIN	Seed	Portulaca oleracea	Purslane	27		X	0
10		DEEP BASIN	Seed	Stellaria lutescens	Bristlegrass	2		X	0
10		DEEP BASIN	Seed	Cornus canadensis	Bunchberry	7		X	7
10		DEEP BASIN	Seed	Mollugo verticillata	Carpetweed	64		X	0
10	uncleaned	DEEP BASIN	Wood	undetermined	charred wood	15		X	15
13		BASIN	Seed	Trifolium repens	White clover	7		X	7
13		BASIN	Seed	Ambrosia ssp.	Ragweed	3		X	3
13		BASIN	Seed	Sonchus asper	Sow thistle	2		X	0
13		BASIN	Seed	Stellaria media	Chickweed	1		X	1
13		BASIN	Seed	Acalypha virginica	Copperleaf	1		X	0
13		BASIN	Seed	Mollugo verticillata	Carpetweed	12		X	0
14		BASIN	Seed	Ambrosia ssp.	Ragweed	1		X	1
15		U-SHAPED	Seed	Berberis vulgaris	Barberry	1		X	1

CATALOG OF FLORAL SPECIMENS 36CH53

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1	C
17	A soil	DEEP BASIN	Nutshell	undetermined	undetermined	5		X	5
17	A soil	DEEP BASIN	Seed	Trifolium ssp.	Clover	1		X	0
17	A soil	DEEP BASIN	Seed	Chenopodium ssp.	Goosefoot	1		X	0
17	A soil	DEEP BASIN	Seed	Ambrosia ssp.	Ragweed	27		X	27
17	A soil	DEEP BASIN	Seed	Scutellaria galericulata	Skull cap	1		X	1
17	A soil	DEEP BASIN	Seed	Mollugo verticillata	Carpetweed	4		X	0
17	A soil	DEEP BASIN	Seed	Trifolium ssp.	Cover	1		X	1
17	B soil	DEEP BASIN	Seed	Acalypha virginica	Copperleaf	39		X	0
17	B soil	DEEP BASIN	Seed	Chenopodium ssp.	Goosefoot	4		X	4
17	B soil	DEEP BASIN	Seed	Chenopodium ssp.	Goosefoot	4		X	0
17	B soil	DEEP BASIN	Nutshell	undetermined	undetermined	112	0.4		112
17	B soil	DEEP BASIN	Seed	Stellaria media	Chickweed	2		X	2
17	B soil	DEEP BASIN	Spores	PTERIDOPHYTA	Fern	82		X	82
17	B soil	DEEP BASIN	Seed	Stellaria lutescens	Bristlegrass	1		X	0
17	B soil	DEEP BASIN	Seed	Trifolium ssp.	Clover	27		X	27
17	B soil	DEEP BASIN	Seed	Ambrosia ssp.	Ragweed	11		X	0
17	B soil	DEEP BASIN	Seed	Ambrosia ssp.	Ragweed	37		X	37
17	B soil	DEEP BASIN	Seed	Datura stramonium	Jimsonweed	1		X	1
17	B soil	DEEP BASIN	Seed	Polygonum ssp.	Knotweed	1		X	0
17	B soil	DEEP BASIN	Seed	Sambucus canadensis	Elderberry	1		X	1
17	B soil	DEEP BASIN	Seed	Mollugo verticillata	Carpetweed	79		X	0
17	C soil	DEEP BASIN	Seed	Smilacina racemosa	False Solomanseal	1		X	1
17	C soil	DEEP BASIN	Spores	PTERIDOPHYTA	Fern	19		X	19
17	C soil	DEEP BASIN	Seed	Chenopodium ssp.	Goosefoot	6		X	6
17	C soil	DEEP BASIN	Seed	Chenopodium ssp.	Goosefoot	2		X	0
17	C soil	DEEP BASIN	Seed	Acalypha virginica	Copperleaf	5		X	0
17	C soil	DEEP BASIN	Nutshell	undetermined	undetermined	7	0.1		7
17	C soil	DEEP BASIN	Seed	Trifolium ssp.	Clover	6		X	6

CATALOG OF FLORAL SPECIMENS 36CH53

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1	C
17	C soil	DEEP BASIN	Seed	Graminae sp.	Grass	2		X	0
17	C soil	DEEP BASIN	Seed	Ambrosia ssp.	Ragweed	7		X	7
17	C soil	DEEP BASIN	Seed	Trifolium ssp.	Clover	1		X	0
19		BASIN	Seed	Hedeoma pulegioides	Pennyroyal	8		X	8
19		BASIN	Spores	PTERIDOPHYTA	Fern	22		X	22
19		BASIN	Seed	Ambrosia ssp.	Ragweed	2		X	2
19		BASIN	Nutshell	undetermined	undetermined	5	0.1		5
19		BASIN	Seed	Acalypha virginica	Copperleaf	1		X	0
19		BASIN	Seed	Mollugo verticillata	Carpetweed	4		X	0
28		SAUCER	Seed	Arisaema triphyllum	Jack in the Pulpit	1		X	1
28		SAUCER	Nutshell	undetermined	undetermined	5	0.1		5
28		SAUCER	Seed	Phytolacca americana	Pokeberry	1		X	0
28		SAUCER	Seed	Vitis ssp.	Grape	1		X	1
28		SAUCER	Seed	Graminae ssp.	Grass	1		X	0
32		U-SHAPED	Spores	PTERIDOPHYTA	Fern	12		X	12
32		U-SHAPED	Seed	Stellaria media	Chickweed	2		X	2
32		U-SHAPED	Seed	Graminae ssp.	Grass	8		X	0
32		U-SHAPED	Seed	Chenopodium ssp.	Goosefoot	1		X	0
32		U-SHAPED	Seed	Mollugo verticillata	Carpetweed	10		X	0
32		U-SHAPED	Wood	undetermined	charred wood	1		X	1
33		BASIN	Seed	Stellaria media	Chickweed	78		X	78
33		BASIN	Seed	Mollugo verticillata	Carpetweed	120		X	0
33		BASIN	Seed	Trifolium ssp.	Clover	71		X	71
33		BASIN	Spores	PTERIDOPHYTA	Fern	270		X	270
33		BASIN	Seed	Chenopodium ssp.	Goosefoot	10		X	0
33		BASIN	Seed	Chenopodium ssp.	Goosefoot	1		X	1
33		BASIN	Seed	Ceanothus americanus	Jerseytea	1		X	1
33		BASIN	Seed	Hedeoma pulegioides	Pennyroyal	52		X	52

CATALOG OF FLORAL SPECIMENS 36CH53

FEA	SAMPLE	PIT SHAPE	SPECIMEN	SPECIES	COMMON NAME	#	WGT	<.1	C
33		BASIN	Seed	Polygonum ssp.	Knotweed	2		X	0
33		BASIN	Nutshell	undetermined	undetermined	7	0 1		7
33		BASIN	Seed	Stillingia aquatica	Queen's Delight	1		X	1
33		BASIN	Seed	Ambrosia ssp.	Ragweed	5		X	5
33		BASIN	Seed	Amaranthus ssp.	Pigweed	3		X	0
33		BASIN	Seed	Graminae ssp.	Grass	8		X	0
33		BASIN	Seed	Smilacina racemosa	False Solomanseal	1		X	1
33		BASIN	Seed	Acalypha virginica	Copperleaf	80		X	0
33		BASIN	Seed	Sisyrinchium graminoides	Blue eyed grass	37		X	37
33		BASIN	Seed	Stellaria lutescens	Bristlegrass	1		X	0
36		SHALLOW CONE	Seed	Trifolium ssp.	Clover	2		X	2
36		SHALLOW CONE	Spores	PTERIDOPHYTA	Fern	17		X	17
36		SHALLOW CONE	Seed	Stellaria media	Chickweed	1		X	1
38		SAUCER	Nutshell	undetermined	undetermined	22	0.1		22
38		SAUCER	Seed	Chenopodium ssp.	Goosefoot	2		X	0
42		U-SHAPED	Seed	Amaranthus ssp.	Pigweed	1		X	1
42		U-SHAPED	Seed	Ambrosia ssp.	Ragweed	1		X	1
43		SHALLOW	None						

APPENDIX VI:

Report on the Microwear Analysis of Selected Lithic Artifacts from the Indian Point Site (36 CH 53) and the Point Bar Site (36 CH 156)

by:

Henry Kenney

Introduction

A microwear analysis was performed on thirty-one (31) lithic artifacts from the Indian Point site (36CH53) and the Point Bar site (36MG156). The results of this analysis, with respect to the material worked and the kinematics of use, are summarized in Tables 1 and 2. While these present the essential data, a more detailed discussion of the procedures of the analysis and wear traces observed on particular implements is necessary in order to consider the behavioral implications of this brief functional study.

Equipment and Artifact Preparation

Microwear traces were identified by using the high-power optical microscopy approach developed by Keeley (1980). A Nikon Optiphot (type 108) metallographic microscope with incident light attachment was employed in the identification of wear traces. The lithic artifacts were observed at magnifications of 100x, 200x, and 400x; the observation of polish, striae, and edge damage was commonly done at 100x, with the identification of the polish and worked material being done at 200x.

All archaeological specimens were observed at 100x after washing in water to insure that pertinent mineral or organic residue present on the piece could be recovered prior to the full cleansing procedure. Following this pre-cleaning observation, each piece was placed in baths of warm 15% solutions of HCL and NaOH for 20 minutes, removing all extraneous mineral and organic residues and thereby assuring that the modifications observed represent alterations of the surface of the artifact itself.

Replication Experiments

Replication experiments were undertaken prior to the analysis of the archaeological specimens in order to insure comparability of the wear traces observed on the lithic raw materials from these sites to those occurring experimentally on English chalk flint, and observed on cryptocrystalline quartz material in other microwear studies. Each of the lithic material types present in the archaeological sample were experimentally utilized to work hide, bone, and wood. These replication pieces were subjected to the same cleansing procedure as the archaeological specimens prior to observation. Both the jasper and the unidentified chert developed microwear polishes characteristic of the materials worked that were fully comparable to those observed in previous microwear studies. The quartz, quartzite, and Allentown chert, however, presented difficulties.

Microwear polishes were not distinguishable on the highly reflective quartz utilized in the replication experiments. Similarly, use-striae were not observed. Irrespective of the material worked, a non-diagnostic abraded edge was produced. Thus, for this raw material, only abraded edges and use-retouch could be utilized to identify that the piece had been used and the kinematics of use. Given the bifacial flaking on most of the quartz pieces examined, use-retouch could not be distinguished from micro-chipping resulting from the production of the piece; abraded edges could not be securely identified as resulting from use rather than from edge "scrubbing" in preparation for pressure-flaking. Quartzite replication experiments similarly present abraded edges which are non-diagnostic of the material worked.

The lithic material tentatively identified as Allentown chert presented, surprisingly, a similar difficulty. Irrespective of the material worked, microwear polishes were not seen to develop. Repeated experiments of extended duration (e.g., wood whittling up to 25 minutes; dry-hide scraping up to 15 minutes) failed to produce the distinctive and well-developed polishes characteristic of these materials. Instead, a clearly abraded edge, identical in appearance regardless of worked material, was observed on these replication experiment pieces.

To the best knowledge of this researcher, no cryptocrystalline quartz material reliably identified as flint or chert has failed to produce such microwear polishes to date. In this researcher's own experience on more than 20 varieties of flint, jasper, and chert from various lithological formations throughout the United States, northern Europe, and the Nile valley, mircowear polishes characteristic of the material worked as first defined by Keeley (1980) are invariably produced, although slight variation in the rate of polish development, presumably dependent on surface texture and quartz "grain" size, has been observed.

Pending the outcome of a petrographic analysis of the lithic material presently recognized at the Indian Point site as Allentown chert, it is tentatively suggested that the stone used in the replication experiments and that of the archaeological tools examined is more probably a rhyolite.

Of the 31 pieces examined, 11 were quartz, quartzite, or Allentown chert (see Table 1). At best for these pieces, a possible use could be stated on the basis of areas of abrasion. Thus, the percentage of those pieces exhibiting readily identifiable use-wear traces is much higher than that suggested using the entire sample (35.4%). When jasper and chert are considered alone, the materials which display wear traces comparable to those occurring on all previously studied flints and cherts, 50% of the pieces examined exhibited micropolishes.

<u>Microwear Traces Occurring on Projectile Points and Bifaces</u>

Excluding those occurring on quartz, quartzite, and Allentown chert, all microwear traces occur on jasper, with the single exception of an unidentified chert. In every instance where post-depositional modification is absent (see below), the microwear traces indicate use of the piece as a cutting and slicing implement on hide and, almost certainly, meat.

Microwear polishes on single specimens (e.g., the Indian Point site, Feature 19; the Point Bar site 6/5 N6 E15 4A) exhibit a complex range, from plain dry-hide polish; to fresh hide polish and/or meat polish, as these two polish "types" are often similar in appearance (Keeley 1980:49,53); and wet hide polish. The latter is distinguished from fresh hide polish by its brighter appearance, and has been independently identified, experimentally and archaeologically, by this researcher and Cahen and Caspar (1984:282) as resulting from the working of soaked hides.

fracturing (e.g. a burin-like removal along one edge, snapped proximal or distal fragments, irregular, lengthwise breaks), the wear traces indicate extensive use as cutting implements. The distal fragment of a point from Indian Point, Feature 35, is particularly interesting with regard to the final utilization of these pieces. This piece preserves on its proximal (snap) surface a polish which appears to have resulted from hafting. What this indicates is that following this snap, the tool was re-hafted and utilized once again before its abandonment. While it is possible to argue that these bifacial pieces continued to be employed in their primary function as projectile points, as well as having been utilized in dismembering and hide processing, an argument similar to that made by Semenov (1964:93-94) for the use of shouldered points from the Russian Upper Palaeolithic site of Kostienki, it must equally be considered that these pieces have been employed in their final use-life solely as cutting implements. Thus, after having been used as projectile points, these tools may have come finally to be utilized as cutting implements, use as which would have resulted in the damage which made them non-functional.

It must be noted here that the wear traces reported for these bifaces do not represent "wear" resulting from edge preparation prior to pressure flaking (cf. Nance 1971; Keeley 1974). While this should be clear from the description of the disposition of the microwear traces themselves, it should also be noted that replication experiments involving such preparation "wear" were undertaken in order to control for this factor.

Lehigh Broad Point (Point Bar Site)

Since the function of broadpoints has been disputed in the literature, this example will be dealt with separately from the other bifaces. As with the other bifacial pieces, dry, wet, and possibly fresh hide (or meat?) polishes are present on the piece. These polishes are highly invasive, covering the entire surface near the distal break and are accompanied, both on the edges and interior surfaces, by striae indicative in their orientation of the use of this tool as a cutting and slicing implement. Polish "terracing", as discussed above for the other bifaces, is present on this piece; the earlier retouch scar surfaces and arrises are clearly truncated by later retouch flake removal scars which display a less well-developed polish. During its use-life this tool underwent at least one resharpening event.

Along the edges themselves, however, a dry hide polish is strongly indicated, along with a predominant striae orientation which is parallel or sub-parallel to the edge. The oldest surviving flake surfaces along these edges show the greatest predominance of parallel and sub-parallel oriented striae, almost to the exclusion of all other orientations. They also exhibit the most intensely developed dry-hide polish, and display a pronounced rounding of the edge.

This predominant striae orientation along the edge, while not in itself inconsistent with a slicing motion in the use of this tool with shallow penetration into the material being worked, is nevertheless inconsistent with the evidence for extensive cutting motions as indicated by the striae on the interior surfaces; the latter are characteristic of a deep penetration into or through the worked material. The patterning of wear traces along the edges suggests that the broad point was employed in either a predominantly piercing action or low-angle slicing motion; the former is an improbable use for such a tool on hide, while the latter is inconsistent with the striae orientations on the interior surfaces.

Alternatively, it may be suggested that the wear patterns exhibited on the edges of this piece result from the repeated insertion of the tool into a hide sheath. Similar patterns associated with dry hide polish have been observed on a Scottish Neolithic flint dagger by Lawrence H. Keeley (personal communication), and have been interpreted as possibly resulting from the sheathing of the piece in a leathern scabbard.

Borers

Two borers, one from each site, were examined for microwear traces. The example from the Point Bar site appears to have been used briefly to bore wood, while the example from the Indian Point site exhibited traces of bone or antler polish on the remaining portion of the borer tip, the breakage of which apparently resulted in the abandonment of the piece without an attempt to resharpen it. Both of these borers were hafted (see below).

Evidence for Hafting

Of the 20 pieces examined which occur on lithic materials known to develop microwear polishes during use, 10 (50%) exhibit wear traces which are arguably attributable to small movements of the implement within some form of haft. Of these, five are bifaces; two are distal fragments of projectile points (Indian Point, Feature 19, Feature 35); one is an irregularly fractured Lamoka-like point (Point Bar 6/5 N6 E15 4A); another is a proximal stem fragment (Indian Point, Feature 33, Level 1); and the last is the Lehigh broad point (Point Bar, 6/5 A20 E10 L4).

All of these pieces exhibit, in varying degrees of development, areas of bright, hide-like polish, with associated striae oriented in all directions with respect to the axis of the piece. On most pieces, this polish and its associated striae are rare or absent along the edges, exhibiting their best development on the interior flake arrises and along the arrises which intersect the edge. Areas where polished surfaces were truncated by subsequent retouch flake scars were not observed.

Given this distribution or disposition of bright, hide-like polish on the piece, the use of the adjacent edges to work some material such as hide is impossible. These considerations strongly suggest that this polish, with its characteristic disposition, resulted from contact with some kind of hafting arrangement.

Within the last decade, the recognition of microwear polishes resulting from the hafting of the implement has become more common (e.g., Cahen and Gysels 1983; Keeley 1982). On examples which this researcher has observed from an Epipalaeolithic Tjongerian site (illustrated in Keeley 1982), on endscrapers from two LinearBandKeramik sites in Belgium (Blicquy "Porte Ouverte" and Blicquy "Petite Rosiere"), and on a small series of burins and spalls from three late Palaeolithic sites in the Nile valley (E-78-2, E-81-1, and E-71 P7), the polish which developed from the hafting of the pieces was a very bright, soft or herbaceous plant-like polish which, unlike polishes resulting from the working of such material, exhibited a noticeably "flattish" appearance. On the burins and spalls from the late Palaeolithic Nile valley contexts, these polished areas commonly exhibited an intensely striated surface, wherein the striae were oriented at all angles with respect to the axis of the piece and displayed complex intersecting patterns. Gysels has reported a very different kind of hafting - related wear which has been argued to result from the use of hide-wrapped tools held within bone hafts (Cahen and Gysels 1983:44).

The microwear polishes present on the pieces from Indian Point and Point Bar, which are believed to result from hafting, are indeed bright but differ from those discussed above in that they are generally more hide-like and lack the "flattish" appearance which is so characteristic of hafting-related polishes on the above-noted artifacts.

For the burins and endscrapers discussed above, the polishing agent is believed to be some highly siliceous, plant-derived material which was used as a mastic in hafting these pieces. Thus, the polishing agent would be the silica included in this plant-derived mastic. The siliceous character of at least some plant-derived mastics is indicated ethnographically. For example, Tindale (1985:11) reports the use of a resin derived from the stems of porcupine grass (Trioda spp.) as a mastic among the Djaru and Kitja of the Western Desert of Australia. Given the preparation techniques described by Tindale and the well-attested occurrence of opaline phytoliths in grasses (see, for example, Wynn-Perry and Smithson 1964), the siliceous character of this mastic used in the hafting of both projectile points and knives seems likely.

The numerous striae present on the polished surfaces of the burins noted above may result from the inclusion of quartz sand as a "temper", increasing the cohesiveness of the mastic and limiting its contraction and cracking. The inclusion of ochre in mastic preserved on bladelets from Lascaux may have served a similar function (Allain 1979:100).

The less-bright character of the hafting-related polish on artifacts from Indian Point and Point Bar, in appearance more hide-like, may result from a significant contact of the hide thong or sinew bindings that may have been used in the hafting of the implements with the surface of the lithic implements themselves. Nonetheless, on two examples (both from Point Bar -- the Lehigh broad point and the borer) local areas of bright-plant-like polish do occur.

The clearest example of hafting-related polish occurs not on the bifacial projectile points but on the borer from Point Bar. On this piece, plant-like polish and an indisputable dry-hide polish grade into one another on the interior surfaces of both faces. Hafting-related polishes occur discontinuously along the edges of this bifurcate-base tool, occurring more frequently on the arrises which intersect these edges, and most extensively on the interior flake scar arrises and flake scar surfaces. Unlike the areas on projectile points which are attributed to hafting-related wear, the polished surfaces on this borer exhibit a more heavily striated character, with a variety of striae forms, from short and narrow examples, to long, deep, and wide striae. The distribution of the striae is characteristic of hafting-related wear, i.e. numerous, frequently intersecting striae without a predominant orientation with respect to the axis of the piece (cf. Cahen and Gysels 1983:44).

This borer is interpreted as having been mounted on a shaft (the use-related striae on the borer tip indicate a bi-directional rotation) using a hide or sinew and mastic binding arrangement. Areas of clear dry-hide polish indicate significant contact between the hide-thong or sinew binding and the surface of the tool, while those areas of clear plant polish reveal the interposition of the (presumably) siliceous mastic between the binding arrangement and the surface of the piece. The heavily striated surfaces indicate that a grit, possibly sand "temper", was included in the mastic.

One denticulate flake tool also displays a very extensive bright, hide-like polish which covers much of the dorsal and ventral surface (Indian Point, Feature 35). Here again, the areas of greatest polish occur on flake scar arrises, on the dorsal surface, and the interior edges of some distal flake scar surfaces on the distal-ventral surface. Much of the dorsal surface and most of the ventral surface exhibits this polish in varying degrees of development. Striae are numerous, of all varieties, and lack a clear orientation.

This unusual pattern of surface modification may have resulted from the present denticulate having, at various times, been held entirely within the hide and mastic arrangement that held the piece in the haft. The final form of this piece may represent a broken fragment which was removed from the haft. That this piece may have been rehafted prior to its final break on one or more occasions (possibly following the reduction of the working edge?) is suggested by flake scars on the distal-ventral surface, which truncate areas of better polish development and which themselves exhibit a lesser degree of polish development. Also, several "break" surfaces on this piece exhibit varying degrees of polish development. What is interpreted as the final break (post-depositional?) on this piece has an unmodified surface.

In summary, hafting-related wear traces are present on ten of the pieces examined and are indicated by a bright, hide-like polish, which presumably results from the use of a sinew or hide thong and plant-derived mastic binding arrangement for attachment of the implement to a haft. This polish is disposed on the piece in a fashion which is inconsistent with any use of the adjacent edges; associated with this polish are striae which do not present a single, dominant orientation, but are frequently intersecting and form complex reticulated patterns unlike those resulting from any known use. Replication experiments are presently underway in an attempt to verify that the particular polish-type interpreted herein as resulting from a mastic and hide binding arrangement is actually produced during use.

Implications of Resharpening and Hafting for Projectile Point Typology

Flenniken (1985) has recently observed, on the basis of experimental evidence, that the high breakage rates for projectile points resulting from use and the subsequent resharpening or repreparation of such damaged bifacial pieces can result in a point which, employing a morphological typology, must be classed as a different type from that of the original point from which it was fabricated. While this argument would appear to have some validity and, as Flenniken observes, should instill a healthy caution in the assignment of an assemblage to a "culture" on the basis of bifacial projectile point morphologies, it may be considerably expanded when pieces identified as projectile points can be demonstrated to have been utilized as hafted cutting implements in their final use-life.

There are two complicating factors that are involved here which deserve to be briefly noted. First, it is possible that many of the cutting tools discussed in this paper functioned as projectile points which, perhaps upon breakage, were re-worked and utilized in this form as hide-working and butchery tools at the site itself. In such circumstances, the "final" morphology of the projectile point may have been greatly altered from that of the initial form of the tool. As in Flenniken's (1985:266, 270-272) argument, modification may well affect the basal portion of the point, not merely through breakage resulting from use, but also possibly resulting from the necessity to "accommodate" the basal or hafted portion of the cutting implement to the configuration of the haft.

A second factor involves resharpening. Minimally, this factor will result in a decrease in width and length on the portion of the tool actually used in cutting hide and meat. While for most of the pieces examined herein no clear decrease in thickness of the piece is indicated by the resharpening events identified, at least one piece (Indian Point, Feature 35) may indicate a more drastic modification of the point involving a thinning of the piece.

Post-Depositional Modification

Two projectile points from Point Bar (6/6 N5 W25 3F; 6/6 S0 E10 3C) are interpreted as having been modified post-depositionally. Both of these pieces exhibit extensive polished areas of a locally variable bright indeterminate polish, along with striae of all varieties (cf. Keeley 1980:23), both short and extremely long. On one piece (Point Bar 6/6 S0 E10 3C), the distal break surface has this same bright polish along with an extensive micro-chipping of the break surface itself. On the other piece, extremely long, deep, and wide striae and abrasion tracks occur in both polished and unpolished areas. These do not appear to be associated with any possible use of the piece. It is worth noting that both of these pieces were recovered from an area of mixed provenience in alluvial sediments. The wear traces occurring on these pieces, both polish and striae, may result from fluviatile transport.

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TABLE 1. MICROWEAR TRACES ON LITHIC ARTIFACTS FROM 36CH53 AND 36MG156

Site	Locus	Type	Material	Utilization
36CH53	Feature 1, Unit B	Indeterminate side-notched projectile point	Allentown Chert	no wear traces
36CH53	Feature 1, Unit B	Indeterminate side-notched projectile point proximal fragment	Allentown Chert	no wear traces
36CH53	Feature 1, Unit B	Indeterminate side-notched projectile point	Quartzite	no wear traces
36CH53	Feature 1, Unit B	Indeterminate side-notched projectile point proximal fragment	Allentown Chert	no wear traces
36CH53	Feature 1, 3"-4"	Fragment of scraper	Quartz	no wear traces, abraded scraper edge
36CH53	Feature 1, 12"-13"	Continuously retouched flake	Jasper	no microwear traces
36CH53	Feature 1, 12"-13"	Flake	Jasper	no microwear traces
36CH53	Feature 2	Borer	Jasper	boring of bone or antler (hafted)
36CH53	Feature 10, E1/2, Level 12, 3"-6"	Scraper on core fragment	Jasper	no microwear traces
36CH53	Feature 10, Level 4	Bifacial fragment	Allentown Chert	no microwear traces
36CH53	Feature 10, E1/2, Level 3, 6"-9"	Biface trimming flake (?)	Jasper	fragment of hafted tool with hafting related polish
36CH53	Feature 14, Level 5, 4"-6"	Biface	Quartz	no microwear traces
36CH53	Feature 15, Level 2	Biface	Allentown Chert	no microwear traces

Table 1. (cont.)

Site	Locus	Type	Material	Utilization
36CH53	Feature 17, Level 1, Soil C	Biface	Quartz	no microwear traces
36CH53	Feature 17, Level 1, Soil C	Projectile Point	Quartz	no microwear traces
36CH53	Feature 17, Level 3, 6"-9"	Bifurcate Projectile Point	Quartz	no microwear traces
36CH53	Feature 19, surface cleaning	Projectile Point distal fragment	Jasper	cutting wet and dry hide (hafted)
36CH53	Feature 19, Level 1, 0"-2"	Flake	Jasper	scraping wet and dry hide (hafted)
36CH53	Feature 28, 5"-7" below sub-soil	Indeterminate Projectile Point	Jasper	no microwear traces
36CH53	Feature 33, Level 1	Indeterminate Projectile Point proximal fragment	Jasper	fragment of a hafted projectile point
36CH53	Feature 35	Indeterminate Projectile Point distal fragment	Jasper	cutting wet, dry and fresh hide (hafted)
36CH53	Feature 35	Denticulate	Jasper	fragment of hafted tool (hafting related polish)
36CH53	Feature 1, Unit B, 1"-2"	Flake	Jasper	no microwear traces
36MG156	6/6 S10 W5 14B	Borer	Jasper	boring of wood (hafted piece)
36MG156	6/6 N5 W25 3F	Bifurcate Projectile Point	Jasper	post-depositional surface modification
36MG156	6/6 S0 E10 3C	Bifurcate Projectile Point	Jasper	post-depositional surface modification

Table 1. (cont.)

Site	Locus	Type	Material	Utilization
36MG156	6/5 A20 E10 L4	Lehigh Broad Point	Jasper	cutting wet, dry, fresh hide (hafted);
36MG156	6/5 S5 W5 4E	Projectile Point	unidentified material	no microwear traces
36MG156	6/5 S0 E20 5B	Projectile Point	Chert	no microwear traces
36MG156	6/5 N6 E15 4A	Lamoka-like Projectile Point	Jasper	cutting dry, wet, and fresh hide (hafted)
36MG156	6/5 W20 E10 L4	Bifurcate Projectile Point proximal fragment	Chert	post-depositional surface modification

TABLE 2: LITHIC MICROWEAR SUMMARY

The Indian Point Site (36CH53), By Feature

FEATURE 1

1. Unit B (diag.); Indeterminate side-notched projectile point; Allentown Chert.

   No microwear traces are evident on this piece.

2. Unit B (diag.); Proximal fragment of indeterminate side-notched projectile point; Allentown chert.

   No microwear traces are evident on this fragment.

3. Unit B (diag.); Indeterminate side-notched projectile point; Quartzite.

   No clear use-wear traces are preserved on this piece.

4. Unit B (diag.); Proximal fragment of indeterminate side-notched projectile point; Allentown chert.

   No microwear traces are evident on this piece.

5. 3" - 4"; Fragment of scraper; Quartz.

   The scraper edge of this piece exhibits an extensive abraded area, identifiable microscopically by its roughened, matte appearance. Similar abrasion has been produced experimentally, but is not material-specific (e.g., woodworking abrades similar to hideworking). While it is possible to argue that this piece was utilized, neither the material worked nor the kinematics of use can be identified.

6. 12" - 13"; Continuously retouched flake; Jasper.

   No microwear polishes or striae occur on this piece.

7. 12" - 13"; Flake; Jasper.

   No microwear traces are evident on this piece.

FEATURE 2

1. Borer (strike-a-light); Jasper.

   The borer tip appears to have snapped off during the final use of this piece and was neither reutilized nor resharpened prior to its abandonment. Although most of the polished area on this piece was apparently carried away on the borer tip itself, clear evidence for the use of this piece in the boring of bone or antler is preserved near the break surface. Slight evidence for a dry-hide polish occurs on the edges of the proximal half of this piece and on the interior flake arrises, indicating the probable use of hide thong in binding the piece to the drill haft.

FEATURE 10

1. E 1/2, level 12, 3" - 6"; Scraper on core fragment; Jasper.

   No microwear traces related to use occur on this piece.

2. Level 4; Bifacial fragment; Allentown chert.

   No microwear traces are evident on this piece.

3. E 1/2, level 3, 6" - 9"; Possible biface trimming flake (?); Jasper.

   A bright, hide-like polish is locally present on the dorsal surface, particularly on the dorsal arrises, as well as the "ventral" surface. Striae are locally numerous in the polished areas, with many long, wide, and deep examples extending into unpolished areas. This piece is interpreted as a fragment of a biface which had been hafted. The polish is similar to those examples for which the use of a mastic and a hide-wrapping or binding is postulated (see below).

FEATURE 14

1. Level 5, 4" - 6"; Biface; Quartz.

   No clear microwear traces occur on this indeterminate projectile point; however, locally abraded areas occur on both edges as well as on the proximal edge, possible resulting from edge preparation during manufacture.

FEATURE 15

1. Level 2; Biface; Allentown chert.

   No clear microwear traces are present. However, areas of alteration occur which may result from a preliminary "scrubbing" of the edge in preparation for retouching.

FEATURE 17

1. Level 1, soil C; Biface; Quartz.

   No microwear traces are evident on this piece.

2. Level 1, soil C; Projectile point; Quartz.

No microwear traces occur on this piece.

3. Level 3, 6" - 9"; Bifurcate projectile point; Quartz.

No microwear traces were visible on this piece.

FEATURE 19

1. Surface cleaning; Distal fragment of projectile point; Jasper.

Well-developed wet and dry hide polishes occur across the distal tip of this piece, on both edges, interior arrises, and interior flake scar surfaces, diminishing toward the proximal break edge. Striae along the edges indicate a cutting motion, but a predominantly piercing motion at the distal tip itself. This piercing interpretation at the distal tip is supported by preferential polishing of the distal, "leading" edges of flake scar arrises intersecting the edge near the tip. Resharpening is evidenced by variation in polish development on adjacent flake scar surfaces; earlier flake scar surfaces are often truncated by later retouch scars with weaker polish development. This results in a "terracing" effect as one moves from the edge into the interior, encountering progressively older scar surfaces with greater or increased polish development (cf. the broadpoint discussion below).

This piece is interpreted as having been used to cut wet and dry hide and as having undergone possibly several resharpening events.

2. Level 1, 0" - 2"; Flake; Jasper.

The ventral-proximal edge of this piece appears to have been heavily used to scrape wet and possible dry hide, as well as having been more rarely used in a cutting motion. The right and left edges of this piece have been utilized less heavily in cutting the same material(s), and occasionally in a scraping motion as well. A dry-hide polish also occurs on the dorsal arrises of the proximal half, clearly unrelated to the uses mentioned above and possibly resulting from the previous occurrence of this flake on a hafted tool, bound with hide.

This piece is interpreted as having been used to scrape and cut wet and possibly dry hide, and as having been derived from a larger tool that appears to have been hafted using hide thongs or a hide-wrapping.

FEATURE 28

1. 5" - 7"; Indeterminate projectile point; Jasper.

No clearly interpretable microwear traces occur on this piece.

FEATURE 33

1. Level 1; Proximal fragment of projectile point; Jasper.

This piece exhibits a dry-hide polish along the base and on the arrises intersecting the edges. The numerous striae present may result from a grit inclusion in a mastic used in a hafting of this piece (see below on mastics and grit).

This piece is interpreted as the proximal fragment of a projectile hafted by the use of a hide binding material, which accounts for the hide polish similar to that occurring on other examples examined (see below), and possibly also the use of a mastic which incorporated a gritty material, accounting for the striae observed. The extensive hafting-related polish present on this piece cannot be accounted for by the use of this piece solely as a projectile point; sufficient movement of the piece in the haft to produce the polish development observed can only have resulted from a subsidiary use of the point possibly, as in other examples examined, a cutting tool.

FEATURE 35

1. Distal fragment of a projectile point; Jasper.

This piece exhibits polishes relating to a variety of worked materials: wet hide, dry-hide, and probably also meat. The striae indicate that a cutting motion was commonly used, with one edge more heavily used than the other. The somewhat greater polish development immediately interior of the cutting edges and the variable polish development from one arris to another along the edge indicates that the piece went through at least one resharpening event. Curiously, a bright, hide-like, hafting-related polish occurs on the proximal break surface itself, suggesting that the piece was hafted (once more?) following this break. Considering this and the evidence for resharpening, one may suggest that this piece, when hafted, was originally longer and perhaps somewhat wider, with resharpening of the piece while in the haft resulting in the present diminutive size.

This piece is interpreted as having served to cut wet hide, dry-hide, and meat, as having undergone at least one resharpening event, and as having been hafted during use.

2. Denticulate; Jasper,

As it presently exists, none of the wear traces preserved on this piece relate directly to its use in working a given material. Rather, a bright, hide-like hafting-related polish occurs over much of the piece with locally variable polish development. The area of best development occurs over most of the ventral surface, particularly the proximal half. Associated with this polish are numerous striae of all types, without a predominant orientation and frequently intersecting to form complex "cross-hatching" patterns. These striae are presumably produced by grit inclusions in the mastic which is believed responsible for this type of polish. Areas along edges with retouch scars frequently "truncate" well-developed polish areas, and exhibit internally (on the retouch scar surface) a weaker polish development. What is interpreted as the most recent break surface (post-depositional?) carries no trace of polish.

This piece is interpreted as a fragment of a tool which was formerly entirely within the hafting arrangement, such that much of the surface of this piece came into contact with a siliceous mastic which was itself interior of a hide binding or wrapping (and possibly inserted into some type of wooden or bone haft?). The areas retouched may represent "haft" accommodation retouch or result from the movement of the tool within the haft itself, of an unknown material.

The Point Bar Site (36 MG 156), By Artifact

1. Feature 1, Unit B, 1" - 2"; Flake; Jasper.

   No microwear traces occur on this piece.

2. Unit 6/6 S10 W5 14b; Borer; Jasper.

   The borer tip itself presents a relatively weakly developed wood polish, while the edges, arrises intersecting the edge, and the interior (central) arrises and flake scar surfaces exhibit areas of clear dry-hide polish, and areas of bright, hide-like polish, locally similar to herbaceous plant polish. Associated with these polish areas are numerous striations without a predominant orientation. Striae are frequently encountered intersecting in complex patterns ("cross-hatching"). The areas of hide polish are attributed to areas where the hide thong probably used to bind the borer to a drill-shaft contacted the surface, and the bright, hide-like polished areas indicate where the mastic, presumably of plant origin, was significantly in contract between the hide thong and the implement itself. The heavy striating of the surface is possibly attributable to the use of a "grit" temper in the mastic (e.g., sand). Interestingly, the hafting-related polish, which is well-developed, contrasts with the limited polish development on the borer tip itself. The presumably more slowly developing hafting-related polish here reveals a longer use-life for the tool than is indicated by the wear on the borer tip alone. Multiple resharpenings of the borer may be indicated, with the brief use on the final borer indicating a tip morphology inadequate for the task.

   This piece is interpreted as having been used to bore wood and to have been hafted using a mastic and hide binding arrangement.

3. Unit 6/6 N5 W25 3F, Bifurcate Projectile Point; Jasper.

An indeterminate, bright polish occurs sporadically on this piece, along with wide, long abrasion tracks and striae of all varieties associated with these polished areas. This is interpreted as non-use related, resulting from post-depositional aqueous transport. It should be noted that this piece was recovered in an obviously derived context (alluvial deposits).

4. Unit 6/6 S0 E10 3C; Bifurcate Projectile Point; Jasper.

Large areas of the surface of this piece, and particularly the interior arrises (central), display a bright, indeterminate polish, with extensive striation without orientation. Both are attributed to post-depositional processes as the distal break surface displays identical features. Importantly, this piece is from a derived context, in alluvial sediments.

5. Unit 6/5 A20 E10 L4; Lehigh Broad Point, proximal fragment; Jasper.

As the function of broad points is disputed, it is worth discussing the microwear traces evident using high-power optical microscopy in greater detail. Along the edges, with decreasing intensity of polish development from the distal break edge to the notches, both dry- and wet-hide polishes are present, invading into the central portion of the piece, particularly along the arrises (flake scar ridges). On the basis of the striae, the interior scar surfaces and arrises clearly indicate a cutting action, which is also present along the edges and the arrises immediately interior of the edges of the piece, although here the predominant striate orientation is parallel and sub-parallel to the edge. The oldest surviving flake surfaces along the edges of the piece are most heavily striated, show the greatest predominance of parallel and subparallel striae orientation, are rounded, and most extensively polished. This striae orientation, while not inconsistent with a slicing motion with little penetration, is inconsistent with the striation orientation of the interior and the polish formation in that area, both of which suggest a regular deep insertion into the worked material. Additionally, it should be noted that the orientation of the sub-parallel striae along the edges is the opposite of what one would expect in a "toward oneself" slicing motion. These considerations suggest that the patterning of polishing and striations along the edges results rather from a piercing or penetrating motion, an unlikely use for this tool on hide (the worked material). Alternatively, it may be suggested that this wear pattern indicated the repeated insertion of this piece into a leather sheath. It is interesting to observe that Lawrence H. Keeley has examined a Scottish Neolithic flint dagger with a similar kind of wear pattern and for which he has postulated insertion into a leather sheath (personal communication, 1979).

This broad point is interpreted as having been used to cut both wet and dry hide, although the most significant wear traces on the piece appear to result from the repeated sheathing of this piece in a leather sheath.

6. Unit 6/5 S0 E20 5B; Projectile Point; Chert.

No microwear traces are clearly preserved on this piece.

7. Unit 6/5 S5 W5 4E; Biface; Unidentified material.

No microwear traces occur on this piece.

8. Unit 6/5 N6 E15 4A; Lamoka-like Projectile Point; Jasper.

A fresh or wet-hide polish, along with a probable meat polish occurs along the edges of this piece, mainly on the arrises intersecting the edge. A better polish development occurs, although still relatively weak, on the interior arrises. The best polish development occurs on the oldest flake surface (scar) surviving on the central portion of the piece. On the basis of differential polish development along the edge between the most recent and older flake scars, at least one extensive resharpening of this tool has occurred. The base (proximal) surface exhibits a relatively bright, hide-like polish possibly resulting from a siliceous mastic and hide-thong or hide-wrapped hafting arrangement. Striae are relatively rare and with similar orientations on hafted and cutting sections: short and fine, at high-angles to the edge, parallel, and perpendicular to the edge.

This piece is interpreted as having been used to cut fresh or wet-hide along with meat. As with other cutting implements examined among this series, it may have been used in butchering of the carcass, hide removal and some initial preparation (fresh hide polish), and lastly in the later stages of hide preparation (here, wet-hide polish). At least one major rejuvenation of the cutting edge is indicated.

9. Unit 6/5 W20 E10 L4; Proximal fragment of Bifurcate Projectile Point; Chert.

This piece exhibits a locally bright-to-dull (dry-hide-like) polish along the edges and arrises. As this same polish occurs on the distal break surface it would appear to be post-depositional in origin. As with other pieces examined from this site, this piece was recovered from a secondary context.