Assessing the Impact of Natural Gas Drilling on the Archaeological Heritage of Pennsylvania: A Case Study from Washington County

Jason Espino
Indiana University of Pennsylvania

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The study identified 60 previously recorded sites in Washington County, Pennsylvania that were affected or threatened by natural gas drilling activities undertaken from 2000 to 2010. These sites contained at least 87 components spanning the Paleoindian period through the early 20th century. Analysis of site attributes indicated that upland prehistoric sites were more likely to be affected by drilling. Moreover, Marcellus well development appears to present a greater threat to archaeological resources than conventional drilling, and the pace of development since 2006 has impacted or threatened considerably more sites. It is estimated that 100 unrecorded archaeological sites were impacted as well. Overall, the effects of drilling activities on archaeological sites are similar in scale to more strictly regulated federal and state undertakings. Changes to the permit review process as well as increased funding to the Bureau for Historic Preservation are necessary to prevent further destruction of Pennsylvania’s archaeological heritage.
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Finally, I thank my family for the support and patience they showed as I completed graduate school.
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CHAPTER 1: INTRODUCTION

Landscape archaeology is a method archaeologists use to understand past people’s interactions with the environment, which produced a stage on which they created culture. Landscape archaeology is a keen interest of mine, and when I decided to pursue graduate studies, I intended it to be the center piece of my academic career. My intent was to apply this approach to the study of the Monongahela Tradition, a group of prehistoric Native Americans that lived in southwestern Pennsylvania between A.D. 1100 and 1635 (Johnson 2001). The archaeology of the Monongahela Tradition was ripe for such an approach. Over the past several years, I acquired an understanding of their cultural tradition, and I intended to couple it with my knowledge of geographic information systems. Altogether, I felt confident that I could analyze the Monongahela Tradition landscape and provide meaningful interpretations of who these people were, what they did, and why they did those things.

My plan was to focus on Monongahela Tradition sites along Chartiers Creek, a relatively large stream found in Allegheny and Washington Counties. I became familiar with the region by directing public outreach excavations at a village site in Washington County on behalf of Allegheny Chapter #1 of the Society for Pennsylvania Archaeology. Excavations at the site uncovered trash pits, storage facilities, hearths, and other vestiges of this village (Bercel and Espino 2010). Stone tools, pottery sherds, smoking pipes, beads, and pendants are among the 20,000 items found so far. The site also produced a large amount of food refuse, such as animal bones and charred plants. Through our discoveries, my colleagues and I learned that the occupants of the village had a varied diet of domesticated plants such as corn and beans heavily supplemented with deer, turkey, fish, shellfish, and wild plants. We knew that they quarried local stones for the production of their tools, but also acquired stones from the Ohio River to the
north and from south-central Ohio. They also traded for marine shell from the Atlantic Coast, which they fashioned into jewelry.

Concurrent with the excavations, I researched other Monongahela Tradition sites in the area to help place our findings into better context. Through this, I learned that this village was among the last ones occupied before the Chartiers Valley was inexplicably abandoned in the 16th century (Espino and Bercel 2010). The distribution of villages also revealed some interesting and as-of-yet unexplained patterns. There were stark differences in where these prehistoric Native Americans chose to place their villages. Sites found in the southern portion of the watershed were seated exclusively on hilltops and other upland areas while sites in the northern portion were placed predominantly on the floodplains and terraces of Chartiers Creek. Most of the southern sites were located a short distance from a known historic Native American trail known as Catfish Path (Wallace 1998). We assume that their placement here allowed them to observe people that came into the region from the south and also gave them ready access to trade routes. In the north, villages were located farther away from the route of the same trail and closer to the main channel of the creek, where, presumably, they had easier access to resources from the stream and better soil for agriculture.

With this background, the stage was set for a study on how the Chartiers Valley Monongahela Tradition used their environment and created a landscape in which they flourished for over 400 years. The study was intended to look at villages along with hunting camps, kill sites, fishing stations, and quarries in order to better understand their settlement systems, territorial boundaries, and catchment zones. It was also going to examine relationships between sites and natural and cultural features in the landscape, such as geologic formations, types of soils, streams, primary and secondary Native American trails, and ancient earthen burial mounds.
that predate Monongahela Tradition villages. I produced a series of questions that became the focus of a research proposal. With these, my thesis was underway. For a number of reasons, however, this topic never made it to fruition.

I was aware that natural gas drilling operations was affecting archaeological sites, and that there was little government oversight of these activities. In late 2007, I learned that a site a colleague and I had recorded as part of an archaeological study in northern Westmoreland County had been partially destroyed by drillers (Bercel and Espino 2005). I thought a cultural resource management investigation of that site had been conducted prior to its partial destruction, but when I searched for it, I found out that no such investigation had taken place. I asked a number of more seasoned archaeologists as to why that might have been the case, and the general consensus was that drilling companies were not required to consider how their activities may impact archaeological sites and other historic resources. I left it at that, not pursuing the rationale behind this perception any further.

In the summer of 2010, I learned that another site had been heavily disturbed by drilling activities. This time, it made a stronger impact on me. Bill Johnson, a prominent Monongahela archaeologist, showed me a picture of a gas well that was in the process of being drilled at the Kirshner site, a well-known Monongahela Tradition village in Westmoreland County (Figure 1). The center frame of the picture showed a large impoundment pond several feet into the ground. A drilling rig, earth moving equipment, and several vehicles were located on one side of the pond. It was obvious that a number of acres had been destroyed for the placement of this well. I asked Bill to remind me of what had been found at the Kirshner site when it was partially excavated in the 1990s. He proceeded to show me pictures of the remains of houses and defensive walls, fire pits, complete ceramic vessels, stone tools, beads, pendants, and more.
importantly, human remains. Here stood a site that most archaeologists would consider significant, and a large portion of it was destroyed without any opportunity to save the information it contained.

When I started graduate school, I began to look at the underlying issues that were leading to the destruction of sites like the one my colleague and I recorded and like the Kirshner site. I was doing this to fulfill requirements for courses on historic preservation as well as archaeological laws and ethics. I looked in detail at the Pennsylvania Historic Preservation Act, Act 70 of the Pennsylvania History Code, and other legislation that affected historic properties and the energy industry at the state and federal levels. I combined that information with data on drilling activities in Pennsylvania to assess their potential effect on the archaeological heritage of the Commonwealth.
As I began to coalesce all of this information, it coincided with a proliferation of news coverage about Marcellus shale gas (Fox 2010; Hopey 2010; Maher 2010; PSUWayneCounty 2008; Rawlins 2010; Star-Telegram 2010). To say that it had become a divisive political topic is an understatement. Discussions about the economic benefits versus the potential contamination of the environment were at the forefront of such debates. In fact, these discussions came literally close to home, as my own family wrestled with a decision to lease property to a gas drilling company. In the end, we opted not to lease the land, though it led to friction among family members. In all of the coverage, I noticed that little public attention was placed on how archaeological sites were affected. There were discussions among historic preservationists and archaeologists, but we were falling short in sharing our views with the people of Pennsylvania. As a result, I decided to present what I had researched thus far at a Marcellus shale symposium hosted at Indiana University of Pennsylvania and also at a number of local archaeological organizations in western Pennsylvania (Espino 2010a, 2010b, 2011a). Eventually, these public appearances led to articles that appeared in the Pittsburgh Post-Gazette (Templeton 2011) and Archaeology Magazine (Swaminithan 2011).

The 82nd annual meeting of the Society for Pennsylvania Archaeology was among the venues at which I presented on the topic (Espino 2011b). The presentation was well-received, and it led to a few brief conversations with archaeologists and non-archaeologists. However, as I drove home, I felt dissatisfied with what I presented. It merely scratched the surface of problem that threatened hundreds of sites across the Commonwealth. I showed how drilling could be harmful to archaeological sites, but little else. Any proof I had was purely anecdotal. So as I drove, I decided to shift the focus of my thesis research. I needed to better understand the effects of drilling and share that information, a process that has culminated in the pages below. In the
end, I hope that this research will help protect, preserve, and document sites that are in danger. For without such sites, we will only have partial picture of the landscapes that our predecessors created.

This thesis is organized in a manner that will inform the reader of the overarching historic preservation issues leading to the loss of archaeological sites and how they are manifested in one of Pennsylvania’s 67 counties. Chapter 2 presents the legislation intended to protect archaeological sites and other historic properties and explains the reasons that they are not effective in their intent. Chapter 3 provides a brief background of gas drilling as well as industry regulations and drilling activities in Washington County between 2000 and 2010. Chapter 4 describes the political, demographic, and environmental conditions in Washington County. Chapter 5 provides a background to the 16,000 years of history in Washington County. Chapter 6 defines the methodology used to assess the impacts of natural gas drilling on archaeological sites. Chapter 7 provides analyses and illustrates trends in the effects of drilling on archaeological sites in Washington County. Chapter 8 provides a summary of the findings and offers recommendations to avoid unnecessary impacts to archaeological sites. Appendix I provides a list of acronyms used throughout the thesis. Appendices II and III describes the sites identified during this study.
CHAPTER 2: HISTORIC PRESERVATION POLICY IN PENNSYLVANIA

Development projects seeking permission from the Pennsylvania state government, such as the DEP-permitted well drilling sites, must consider the effects that such actions may have on historic properties in accordance to provisions in the Pennsylvania History Code. The History Code, found under Title 37 of the Pennsylvania Constitution, was put into law on May 26, 1988. The primary purpose of the History Code is to preserve and protect “the irreplaceable historical, architectural, archaeological, and cultural heritage” of Pennsylvania, a heritage that is threatened by “the rapid social and economic development of our contemporary society” (37 Pa. Cons.102). The History Code further states that “it is in the public interest for the Commonwealth, its citizens and its political subdivisions to engage in comprehensive programs of historic preservation for the enjoyment, education and inspiration of all the people, including future generations” (37 Pa. Cons.102).

In many ways, the provisions of the History Code were influenced by and have their foundation in the federal National Historic Preservation Act (NHPA). Largely the result of massive highway and dam construction projects following World War II and urban renewal during the 1950-60s, the NHPA was the culmination of decades of concern over the destruction of the historic and cultural heritage of the United States (King 1998:14-16). Ratified in 1966 and amended several times more recently, the NHPA, among its many considerations, seeks to preserve historic properties by considering the effects that Federal undertakings have on “any prehistoric or historic districts, site, building, structure, or object that is included in or eligible for inclusion in the National Register [of Historic Places; abbreviated NRHP]” (16 U.S.C. 470f). An undertaking is defined as “a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency” (16 U.S.C. 470w). They include projects
carried out by or on behalf of the government as well as those for which permits, licenses, approvals, or financial assistance are required or provided by any Federal agency. Examples of such undertakings include highway construction by the Federal Highway Administration, installation of inter-state gas lines as permitted by the Federal Energy Regulatory Commission, construction of cellular phone towers as licensed by the Federal Communications Commission, and stream crossings for natural gas pipeline construction as permitted by the Army Corps of Engineers.

Section 106 provides the framework through which Federal agencies take into account the effects of their undertakings on historic properties (16 U.S.C. 470f) while the Code of Federal Regulations provides guidance on how to comply with Section 106 (United States Code of Federal Regulations 2004). At its most basic structure, Section 106 asks Federal agencies to do the following: 1) identify historic properties within the area affected by the undertaking (36CFR800.4); 2) if historic properties are identified, determine their eligibility for inclusion in the NRHP (36CFR800.4); and 3) if a property listed in or eligible for the NRHP is adversely affected, mitigate those effects to reduce the impact on the significance of the historic property (36CFR800.6).

Following the spirit of the NHPA, and as stipulated in the Historic Preservation Act of the Pennsylvania History Code (37 Pa. Cons. 500 et seq.; abbreviated PHPA), considerations must be given to the effects that State-permitted actions have on historic resources. To this end, the History Code makes the Pennsylvania Historical and Museum Commission (PHMC) “the official agency…for the conservation of Pennsylvania’s cultural heritage” (Title 37, Pennsylvania Consolidated Statutes Section 301 abbreviated 37 Pa. Cons. 301). It also affords the PHMC the power to “initiate, encourage, support and coordinate and carry out historic
preservation efforts…” (37 Pa. Cons. 301), including archaeological surveys when a significant archaeological site may be adversely affected by any project performed, assisted, permitted, or contracted by the Commonwealth (37 Pa. Cons. 507b). The PHPA allows the PHMC to conduct or cause to be conducted an archaeological survey or archaeological field investigation of significant sites (Table 1; 37 Pa. Cons. 507a).

Table 1. NHPA and the PHPA in Comparison.

<table>
<thead>
<tr>
<th>Section 106 of NHPA</th>
<th>Level of Investigation</th>
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<td>Identification of Historic Properties</td>
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The Act 70 Amendment to the History Code

Despite similarities between the History Code and the NHPA, there are some glaring differences that resulted from a 1995 amendment to the History Code. Largely the result of successful lobbying efforts by the Pennsylvania Builders Association, legislative changes effectively placed the need for progress ahead of preserving the Commonwealth’s cultural and historical heritage (Baker 2000; Bowen and Griggs 2013). Concerns from historic preservation organizations notwithstanding, the state senate amended the Pennsylvania History Code by ratifying a piece of legislation commonly referred to as Act 70. Introduced as Senate Bill 879 on November 28, 1995 and in effect in early 1996 (Commonwealth Archaeology Program [CAP] 2000), Act 70 describes the actions that Commonwealth agencies, political subdivisions, and municipal authorities are required to follow to cooperate with the PHMC in the preservation,
protection, and investigation of historic resources (37 Pa. Cons. 507a). It also introduced several new procedures that altered how a State undertaking achieves compliance under the PHPA.

On paper, the changes do not appear far-reaching, taking up only a few lines of a legislative document. In the real world, however, Act 70 represents a whole-sale change in how historic preservation, and in particular, archaeological investigations are conducted on projects permitted or regulated by the Commonwealth. For the past fifteen years, significant archaeological sites have been destroyed by parking lots, housing developments, commercial strip malls, and mineral extraction with little concern for such adverse effects while periodic expressions of alarm by historic preservation groups have been of little consequence in changing these patterns (Baker 2000; Carr 2000; Pennsylvania Archaeological Council [PAC] 1999, 2003; Roberts 2000).

In simplest terms, the procedural changes in policy affected the manner in which archaeological surveys and field investigations are executed (Baker 2000; CAP 2000; Roberts 2000). In earlier permutations of the PHPA, the PHMC was able to conduct, or cause to be conducted, a survey to recover, preserve, or protect information from a resource during a Commonwealth or Commonwealth-assisted, licensed, or contracted project (Raber 1985: Appendix A.3.5 includes a 1976 version of the PHPA). Prior to 1996, “Pennsylvania state policy closely paralleled [Section 106 of the NHPA]” (CAP 2000:Introduction). The agency carrying out the undertaking or the individual(s) seeking permits or licenses from the Commonwealth were required by the PHMC to identify and evaluate historic resources and mitigating the effects to those resources, as well as incur the financial burden associated with this process (CAP 2000).

Since the ratification of Act 70, both the execution of the work and the associated financial obligation became the responsibility of the PHMC (37 Pa. Cons. 507b). The costs for
the investigations are to be drawn from the PHMC budget, which is developed by the agency and submitted to the governor’s office. Therefore,

the act shifted the responsibility of conducting archaeological surveys and evaluations for state-permitted projects from the permit applicant (such as developers, mining companies, etc.) to the [Bureau for Historic Preservation]. In so doing, the act transferred the cost of such surveys directly to the Pennsylvania taxpayer [Roberts 2000:66].

In other words, the money intended to fund archaeological investigations to clear development projects is raised through taxes paid by residents of Pennsylvania.

Furthermore, stipulations under the amendment lay down a series of timetables that the PHMC is required to meet during the work (37 Pa. Cons. 507b). First, the PHMC has 15 days from the notification of an undertaking to determine in writing if the action may adversely affect a historic property. Next, the evaluation of significance is required within 60 days of that determination, after which, if the resource is found to be eligible for inclusion in the National Register, a second determination stipulating plans to mitigate the adverse effect must be made within the next 15 days. Finally, within 90 days of the second determination, the adverse effects are required to be mitigated.

If the PHMC fails to make either determination described above in the specified time, then that failure is in itself a determination that evaluation and/or mitigation of historic resources are not necessary. Similarly, if the PHMC falls short of evaluating historic resources or mitigating the effects to them in the allotted time, then the agency or individual(s) carrying out
the undertaking are released from any further obligations under the History Code (37 Pa. Cons. 507b). So all told, the PHMC has a mere 150 days to clear an undertaking that will irrevocably impact a resource that is eligible or already included in the National Register. If for some reason it cannot do it under the set timetables, then the undertaking can proceed without any further consideration of the historic resource.

Additionally, changes in the legislation also stipulate that the evaluation of historic resources along with the mitigation of adverse effects cannot be conducted on private property without the consent of the property owner, a stipulation that, as shown below, has created a loophole that developers have exploited.

**The Effects of Act 70 on the Commonwealth’s Archaeological Heritage**

To meet the new demands brought about by Act 70, the PHMC established the Commonwealth Archaeology Program (CAP) in 1996 (CAP 2000). CAP’s mission was to manage and preserve archaeological sites affected by State-permitted projects, conduct archaeological research, and carry out public education efforts (CAP 2000). CAP employed a small in-house staff that handled small projects and contracted regional Cultural Resource Management (CRM) companies for large scale and complex projects. The in-house staff consisted of one full-time archaeologist, three seasonal archaeologists, and one summer intern.

From the beginning, CAP was underfunded and understaffed (CAP 2000). Initially, the Commonwealth allocated $300,000 for the program’s budget during each of the first two years. Estimates based on projects prior to 1996 suggested that CAP needed up to four times the allocated money, perhaps even more, to properly deal with the potential impacts to historic resources (CAP 2000). Between February of 1996 and December of 1999, CAP reviewed 4,419 state permits for a variety of projects (PAC 1999). Of these, 177 projects throughout Pennsylvania had the potential to adversely affect 316 sites. The majority of the projects were
resolved without any adverse effect, either because the resource was not impacted or it was not considered significant. Other projects were resolved by conducting field investigations.

Twenty-two of the 316 threatened sites were destroyed prior to any investigation. Elapsed deadlines in the review process and a lack of landowner permission are among the primary reasons for the destruction of these sites. Several of the 22 sites were considered eligible or potentially eligible for inclusion in the NRHP. Eligible or potentially eligible sites included both prehistoric and historic sites, and particularly significant sites are described below. They are derived from Pennsylvania Archaeological Council’s listing of Act 70 projects (PAC 1999) and cross-referenced with the Bureau for Historic Preservation’s (BHP) Cultural Resource Geographic Information Systems (CRGIS).

The Woodville Burial Ground site (36AL336) in Allegheny County was impacted during grading for a parking lot by Trader Jacks Development. Located in Bridgeville, the development impacted an early historic graveyard. CRGIS comments that the burials may have been of slaves associated with the Neville House, a property included in the National Register for its significance to historic events and individuals associated with early Pittsburgh history and the Whiskey Rebellion. The reason for the site’s destruction was a failure of the developer to communicate with the PHMC.

In Chester County, Locus 9 (36CH333) is described as an eligible historic resource. It is an upland Middle and Late Woodland site containing ceramics. These types of sites are rare in southeastern Pennsylvania, and if properly studied, could have reveal important information on the development of Late Woodland cultures and their settlement patterns. Unfortunately, the 15 day permit review period elapsed prior to CAP having had the opportunity to investigate the site.
Impacts occurred on a six-acre site complex (36FA0088) in Fayette County associated with the National Road. The complex, eligible for the National Register, consisted of a tavern, blacksmith shop, and wagon shop. When CAP visited the site for what they believed to be an investigation of a proposed waterline that would cross the complex, they discovered that the line had already been installed. Though the impact was limited to the width of the trench for the waterline, the disturbance may have destroyed important elements of the site and affected the integrity of this historic property.

The Coverts Crossing site (36LR75), a 4-acre multi-component site in Lawrence County, was largely destroyed because CAP was denied access to the property. Thankfully, a half-acre portion of the site had been intensively investigated during Phase III mitigation/data recovery for a bridge replacement project sponsored by the Pennsylvania Department of Transportation, and therefore, subject to NHPA regulations (MacDonald and Cremeens 2002). These investigations revealed a series of short-term Late Archaic and Late Woodland occupations. The Late Woodland occupations yielded particularly interesting data that elucidated settlement, subsistence, and lithic procurement patterns in the region. However, the excavations covered a fraction of the site and more could have been learned from it about the poorly known Late Woodland period in northwestern Pennsylvania (MacDonald and Cremeens 2002:44-45). That a portion of the site was considered eligible for the NRHP by the BHP suggests that the portion destroyed likely contained additional significant data.

Finally, a series of Archaic period sites in Chester (36CH160), Lehigh (36LH21 and 36LH149), and Northampton (36NH24) Counties were destroyed prior to CAP having had an opportunity to investigate them. In all cases, diagnostic artifacts were known to occur at the sites, and some may have been large base camps while others may have represented more
transitory camps. Each site contained a high potential for revealing important data about Archaic populations, including their settlement patterns, stone tool technologies, and subsistence economies.

In the cases above, and for that matter, in all of the projects reviewed by CAP, the effects of the undertakings were only considered on previously recorded archaeological sites. These were sites that had been identified during unrelated CRM projects or by avocational archaeologists. Act 70 made no provisions for surveys of projects that potentially would identify new archaeological sites. Obviously the number of unrecorded sites that have been destroyed by Commonwealth-sanctioned projects will never be known.

Individually, the procedures stipulated by Act 70, theoretically, could be managed. If the PHPA did not mandate financial responsibility to the PHMC or if the PHMC was adequately funded, then investigations could be carried out under the strict timetables with added personnel. Similarly, if the PHMC was required to pay for and conduct investigations but did not need to meet a strict schedule, investigations could be adequately completed over a longer period. Lastly, if access to private property was not as stringent, especially when the developer is the landowner, fewer historic resources would be destroyed without some level of investigation. Collectively, however, the procedural changes make the practice of preserving Pennsylvania’s historic resources extremely difficult.

The Historic Preservationists’ Response to Act 70

Opposition to Act 70 by historic preservationists was strong prior its ratification and in the years since (Dore 2003; PAC 1999; Siegel 2005). Non-profit advocacy organizations like the Pennsylvania Archaeological Council (PAC) and the Society for Pennsylvania Archaeology, Inc. (SPA) encouraged their members to contact state legislators with concerns over Act 70. The leadership of both of these organizations also formed a separate advocacy entity that lobbied
against the passage of Act 70, and later, for increased funding to CAP (Bowen and Briggs 2013). Similarly, the American Cultural Resource Association (ACRA), a nation-wide trade association for Cultural Resource Managers, including historic preservationists, archaeologists, historians, architectural historians, landscape architects, and geologists, also opposed Act 70. In 2003, representatives of ACRA and PAC wrote to state legislators and the governor outlining key elements of Act 70 that, as former PAC president Peter Siegel (2005) put it, “are legally destroying archaeological sites across the state.”

ACRA took a bottom-line approach to their opposition of Act 70, letting then-governor Edward G. Rendell know that placing the burden of funding historic preservation efforts mandated by Act 70 on taxpayers was unjust due to the fiscal hardships in which the Commonwealth found itself. ACRA’s position was that “Pennsylvania taxpayers should not be subsidizing permit requirements for privately funded developers” (Dore 2003). ACRA argued further that due to the fiscal situation in the state,

> [f]unding for the Commonwealth Archaeology Program (CAP), which is administered by the PHMC, has been reduced to the extent that it is nearly impossible for the PHMC to keep up with the principal mission of the State History Code, let alone providing in-house services to developers to complete their state permits [Dore 2003].

PAC approached opposition of Act 70 more comprehensively (PAC 2003; Siegel 2003), outlining many of the problems with the legislation discussed here. Like ACRA, PAC felt that placing the financial responsibility on taxpayers was unfair due to the fiscal state of the
Commonwealth, and more poignantly, because developers seeking permits were likely the sole direct profiteers from these projects. At the same time, by transferring the responsibility of the PHMC from a regulatory and review agency to an action agency, opportunities were taken away from the private CRM business sector.

Besides looking at Act 70 from a financial viewpoint, PAC also addressed concerns about the effects the legislation was having on historic resources (PAC 2003; Seigel 2003). As a result of yearly budgetary reductions in the early 2000s, the CAP team was cut to one archaeologist by 2003. The reduction in staff and money made it extremely difficult for the PHMC to meet the strict deadlines stipulated by Act 70. In other words, state-permitted projects proceeded because the PHMC did not have the time or personnel to adequately deal with the historic preservation issues associated with those projects. Moreover, PAC contended that BHP review personnel were pulled from their normal duties to work in the field, reducing the amount of time for the review of federal projects under the NHPA by 20%. Through this point, they argued that even historic resources that were protected under federal laws were put at risk because of Act 70.

PAC also described activities by developers seeking permits from the Commonwealth that they considered unethical. PAC accused some unnamed developers of applying for Commonwealth permits while delaying the Federal permit application process (PAC 1999). Since Federal projects require applicants to fund cultural resource investigations and since Federal approval supersedes State approval, by delaying, developers complied with the historic preservation laws without directly incurring the costs. Through this loop hole, the PHMC funded and carried out the necessary investigations that the developers would have been responsible for under the federal regulations. Additionally, access by CAP to properties had been denied frequently by developers-landowners, and as described above, historic resources were destroyed
without investigation because CAP was not given permission to investigate sites within proposed developments. Finally, PAC recognized a disincentive in avoiding significant archaeological sites. These types of sites were often preserved by incorporating them into open green space because of the costs associated with the mitigation of adverse effects. Since developers were no longer responsible for financing such efforts, there was little incentive to preserve sites through green space.

**The Current Status of Historic Preservation Regulation in Pennsylvania**

Today, regulations over development impacting archaeological sites and other historic properties are mainly limited to federally funded or permitted projects. Projects seeking compliance with the NHPA constitute the vast majority of historic preservation efforts in the Commonwealth. Despite efforts by ACRA, PAC, and SPA in opposing the ratification of the act and subsequent efforts to repeal it, Act 70 remains an important component of the PHPA. With the exception of one project that received outside funding, CAP has not operated since 2005 because of the financial difficulties that the Commonwealth has experienced over the past decade. As budgetary cuts have been applied year after year, the PHMC has reduced the personnel and monetary resources necessary to carry out fieldwork, analysis, and reporting for projects seeking permits from the Commonwealth. As Douglas McLaren, Division Chief of Archaeology and Protection at the BHP, recently told *Archaeology Magazine* regarding Act 70 projects, “we no longer conduct or fund such excavations” (in Swaminithan 2011:10).

As it currently functions in regard to Act 70 projects, the BHP reviews maps provided by applicants of Commonwealth-permitted projects and compares them to their database of previously recorded sites. The BHP may then recommend an archaeological survey if an archaeological site is determined to be in the area of potential effect of the undertaking or if the undertaking occurs in an area of high probability for containing archaeological sites (McDougal
However, the BHP cannot prevent the issuance of the permit if the state agency decides that the project can proceed. As in the examples noted above, threats to and the destruction of known archaeological sites have been documented, however sparse that documentation may be. Destruction of unrecorded archaeological sites is likely happening, but there is no way of documenting it. According to the BHP, Pennsylvania has just over 21,500 recorded sites (Strattan 2011). This figure is considered a fraction of the actual number of archaeological sites in the Commonwealth, and hundreds of sites are identified and added to the list of recorded sites every year (Strattan 2011). In this light, the impact that Commonwealth-related undertakings have on historic resources will never truly be known. Hundreds of unrecorded sites, perhaps even thousands, likely have been destroyed and will continue to be threatened without adequate assessment by the historic preservation community.

**The 10-acre Exemption**

Another consequence of Act 70 and the lack of resources allocated to the PHMC is the so-called 10-acre exemption agreement between the BHP and the Pennsylvania Department of Environmental Protection (DEP) (Pennsylvania Department of Environmental Protection [PA DEP] 2002, 2007). It is this 10-acre exemption that is at the heart of concerns over the threat that natural gas drilling poses to archaeological resources. The DEP considers historical and archaeological sites to be public resources, along with state parks, forests, scenic rivers, national natural landmarks, and areas of species concern (PA DEP 2007). The exemption was introduced in a document titled “Implementation of the Pennsylvania State History Code: Policy and Procedures for Applicants for DEP Permits and Plan Approvals” (PA DEP 2002). Within the document, the DEP disclaims that:
[t]he policy and the procedures herein are not an adjudication or a regulation. There is no intent on the part of DEP to give the rules in this policy that weight or deference. The policy and the procedures merely announce the policy and establish the framework, within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant [PA DEP 2002:1].

This statement indicates that the document is not in fact a legislative decision but rather it establishes and outlines procedures for applicants to the DEP and DEP staff that are consistent with the History Code. Section C of the document specifies that the “PHMC and DEP have agreed to exempt some DEP permits and plan approvals from these procedures,” and refers the reader to a list of exemptions in Appendix 1 of the document (PA DEP 2002:3), wherein permits for projects affecting less than 10 acres are included.

The exemption is further defined in a document instructing applicants on how to coordinate a well location with public resources (PA DEP 2007). These instructions indicate that “permit applications for oil and gas wells, wastewater treatment facilities and stormwater permits are exempt from notification to the PHMC unless the area of earth disturbance will be greater than 10 acres” (PA DEP 2007:1). As discussed in Chapter 3, drilling permits, either conventional or Marcellus, do not typically exceed 10 acres. Just as important, these procedures do not account for the cumulative effect of drilling activities that include drilling pads, access roads, staging areas, impoundment ponds/dams, and transmission pipelines (Raber 1985).

The agreement between the PHMC and the DEP, especially with the language used in the instructions for coordinating a well location with public resources, alludes to a glaring flaw in the
implementation of the History Code for DEP-permitted actions affecting 10 acres or less. Since the PHMC is not being notified of such projects, they are unable to, at the very least, compare well locations with known archaeological site locations. This lack of coordination leads to an inability by the PHMC to track and document the sites that are impacted by natural gas drilling. Therefore, there is no way to know when a site has been partially or completely destroyed by drilling unless it is determined during surveys for unrelated projects or a third party documents the destruction.
CHAPTER 3: NATURAL GAS EXPLORATION

Pennsylvania has a rich history of oil and gas exploration that spans nearly 150 years. In that time, more than 350,000 oil and gas wells have been drilled state-wide (PA DEP 2009). This chapter provides a contextual background of natural gas exploration to better understand its effects on the archaeological record. The following sections provide a brief historic overview of natural gas drilling along with descriptions of the major geologic formations found in Pennsylvania that produce natural gas. They also discuss pertinent legislation governing natural gas drilling and describe the responsibilities of the lead state agency regulating these activities. Additionally, they explain trends in state-wide drilling activities over the past six years, focusing on potential threats to archaeological sites. Finally, this chapter introduces data on gas wells drilled in Washington County, Pennsylvania that form the basis for this study.

Natural Gas Drilling History and Geology

The discovery of natural gas as an energy source first occurred in Fredonia, a small town in western New York just north of the Pennsylvania border (Harper 2008:2; Harper and Kostelnik nd:19). There, William Hart dug a well eight meters (27 ft) into the ground in 1821. His efforts produced enough gas to light “two good candles,” and by 1825, enough gas was extracted to light two stores, two shops, and a grist mill (Harper and Konetski nd:19). In 1858, the Fredonia Gas Light Company formed, becoming the first gas company in North America (Harper and Konetski nd:19). Soon after, natural gas drilling proliferated along the Lake Erie shoreline, where “just about every backyard and manufacturing plant within a mile of the Lake Erie shore in Pennsylvania had at least one gas well that kept the house or business reasonably well lighted and heated” by the beginning of the 20th century (Harper 2008:3). Typically, these wells extended to depths from 61 to 305 m (200 to 1000 ft) below the surface into layers of
organic-rich shale. Gas production was minimal in terms of flow rates, but these wells tended to produce gas for extended periods of time, some even for as long as three to four decades (Harper 2008:2; Harper and Kostelnik:23).

Between 1900 and 1980, commercial gas production in the region focused on gas fields in the Lower Devonian Oriskany Sandstone (Harper 2008:3; Milici and Sweezy 2006:45). The Oriskany Sandstone is a coarse-grained to medium-grained quartz sandstone occurring throughout the Appalachian basin that was deposited in shallow marine near-shore and/or shelf environments (Milici and Sweezy 2006:44-45). Thickness of the formation normally varies between 15 and 30 m (50 and 100 ft), with a recorded maximum of 107 m (350 ft) in western Maryland (Milici and Sweezy 2006:45). It occurs at depths ranging between 550 and 2,590 m (1,800 and 8,500 ft) below the surface, and gas is found in what are referred to as stratigraphic traps (Milici and Sweezy 2006:44). Milici and Sweezy (2006:44-48) divide the formation into two assessment units based on its location within the basin. In the western half of the Appalachian basin, gas production commenced in northeastern Ohio in 1900, with additional gas fields discovered throughout eastern Ohio in the 1920s, in West Virginia in the 1930s, and northwestern Pennsylvania in the 1940s (Milici and Sweezy 2006:45). In the eastern half of the basin, production began in 1919 in Westmoreland County, Pennsylvania, and slightly later in other portions of western Pennsylvania and western and central New York.

It was during the exploration of gas in the Oriskany Sandstone that Marcellus shale was discovered to contain natural gas. As drillers sought traps in the sandstone, they penetrated the overlying Marcellus shale formation, thereby releasing gas contained within it. However, it was dismissed as a viable source because gas flows ran out quickly (Harper 2008:3). A more official assessment of Marcellus shale gas was offered in the late 1970s and early 1980s. During the
multistate Eastern Gas Shales Project (EGSP) funded by the U.S. Department of Energy, attempts were made to “determine the extent, thickness, structural complexity, and stratigraphic equivalence of all Devonian organic-rich shales” and also “to develop and implement new drilling, stimulation, and recovery technologies to increase production potential” (Harper 2008:3). The EGSP study concluded that Devonian organic-rich shales represent potentially important gas reservoirs in northwestern Pennsylvania since they were thick and close to the surface, but only if better technologies were developed for inducing and enhancing fracture systems (Harper and Kostelnik nd:33). It also regarded gas in the Marcellus shale formation as an inferior source to the conventional targets until gas prices increased and new technology to extract it was developed.

Initial exploration of Marcellus Shale gas occurred in 2003 in Washington County, Pennsylvania, but the first gas producing well was not drilled until 2005 (Harper 2008:9). As predicted by the EGSP program, the combination of rising gas prices, advancement in technology, and experience dealing with deep gas deposits all contributed to make the exploitation of Marcellus Shale gas economically feasible (Harper 2008:5).

Marcellus Shale is a type of black, organic rich shale found in the Middle Devonian-aged Marcellus formation (Harper 2008). It formed about 385 million years ago within an anoxic marine environment at the base of the Acadian mountain range (Harper and Kostelnik nd:8-11). Marcellus Shale occurs at depths that ranges between 460 to 2,835 m (1,500 to 9,300 ft) below the surface (Harper and Kostelnik nd:40). The formation is found along the Appalachian basin of New York, Pennsylvania, eastern Ohio, West Virginia, and portions of western Virginia (Milici and Swezey 2006:38). The richest deposits are located in south-central New York and northeastern Pennsylvania, where the formation is approximately 61 m (200 ft) thick. In
Pennsylvania, Marcellus Shale underlies most of the state, trending southwest to northeast along the Appalachian Plateau.

There are two primary methods of extracting gas from the Marcellus formation: vertical and horizontal drilling (Harper 2005: Figure 4). In vertical drilling, the shale is drilled into from a vertical position directly below the well pad. In horizontal drilling, the bore hole is drilled vertically until just before the shale is reached, at which time the direction of the drilling is changed so that it runs horizontally within the deposit. Horizontal drilling is a more effective method since more of the Marcellus Shale is penetrated by the drill and therefore more gas is released. Both methods require a technique that is referred to as hydraulic fracturing, or fracing. During fracing, large volumes of water mixed with sand and chemicals to reduce friction are pumped into the well at high pressure to fracture the shale, maximizing the recovery of the gas from the stratum (Harper 2008:10). Vertical wells require half a million to a million gallons of water while a horizontal well uses several million gallons during the course of drilling (Harper 2008:11-12).

**Regulation of Natural Gas Drilling**

Today, oil and gas drilling in Pennsylvania is regulated under a variety of laws including the Oil and Gas Act, Coal and Gas Resource Coordination Act, and Oil and Gas Conservation Law as well as a number of environmental laws such as the Clean Streams Law, the Dam Safety and Encroachment Act, the Solid Waste Management Act, the Water Resource Planning Act, and the Community Right to Know Act. The DEP oversees oil and gas exploration, with the Bureau of Oil and Gas Management regulating the exploration, development, and recovery of natural gas reservoirs. Their stated responsibility is to protect the Commonwealth’s natural resources and environment (PA DEP 2009).
As the regulatory agency, the DEP issues permits for the drilling of natural gas wells. The permitting process is initiated by the operator (i.e. driller) through the submission of a permit application, associated documents, and a permit fee that depends on the depth of drilling. Technical staff in the DEP review the applications to determine if the proposed well will cause environmental impacts, conflict with coal mine operations, or exceed well spacing requirements (PA DEP 2009:2). According to the DEP, the bond is an incentive to “adequately perform the drilling operations, address any water supply problems the drilling activity may cause, reclaim the well site, and properly plug the well upon abandonment” (PA DEP 2009:2). Once the well is drilled, operators are required to submit bi-annual and annual reports on well completion, waste management, production, and well plugging (PA DEP 2009).

Additional measures are stipulated in the regulations to protect surface water and groundwater from erosion and sedimentation due to earth disturbances (PA DEP 2010a:2). The DEP indicates that natural gas well construction involves “extensive earth disturbances including roads, drilling pads, and pipelines…” (PA DEP 2010a:2). For conventional gas drilling operations, the estimated total disturbance for each well is about 0.81 ha (2 ac) (Raber 1985:40). Drilling pads for Marcellus shale wells range in size from 1.21 to 2.02 ha (3 to 5 ac) depending on the depth of drilling (PA DEP 2010a:2), though total disturbance may exceed 4.05 ha (10 ac). Additional disturbances include staging areas for equipment, parking for the operators, and impoundment dams. Operators are required to employ preventative measures to reduce the amount of erosion and to restore the natural topography and vegetation of the well site within nine months of the completion of the drilling operations (PA DEP 2010a).

**State-wide Trends in Drilling Activities**

Data from the DEP’s Bureau of Oil and Gas Management on the number of wells drilled in Pennsylvania between 2005 and 2011 lists 20,376 conventional and 4,478 Marcellus wells
(Figure 2). The number of conventional wells that were drilled remained fairly constant between 2005 and 2008, ranging between 3,600 and 4,200 wells per year. From 2009 and 2011, conventional drilling decreased significantly, with fewer than 1,800, 1,400, and 1,250 wells drilled respectively. Conversely, there was a slow progression of Marcellus drilling for the first three years. A combined 47 wells were drilled between 2005 and 2007, after which the number of wells increased almost five-fold in 2008 to 210 wells. The upward trend in Marcellus drilling continued, with significant yearly increases to 795 wells in 2009, 1,446 wells in 2010, and 1,980. Not surprisingly, the number of Marcellus wells outnumbered the number of conventional wells for the first time in 2010.

Comparing figures from pre- and post-2009 is useful in evaluating increased risk to archaeological resources as a result of greater Marcellus drilling. Prior to 2009, the number of wells drilled in Pennsylvania approximated 4,000 wells per year. Conventional drilling represented the vast majority of these wells. Marcellus drilling was minimal during this period, with the first wells in the state drilled in 2005 and progressively increasing after that. Beginning in 2009, fewer overall wells were drilled, a figure resulting from decreased interest in conventional gas deposits. As conventional drilling decreased, Marcellus drilling increased substantially, with nearly four times the wells drilled in 2009 than in 2008. Subsequent drilling activities reveal a strong focus on Marcellus gas deposits, with figures for 2011 reaching nearly 2,000 wells. Based on this data, the DEP has issued substantially fewer permits to drill after 2009 despite Marcellus gas exploitation rising considerably.

Fewer wells notwithstanding, increased Marcellus drilling presented an increased risk to archaeological sites due to its greater potential for earth disturbance (Figure 3). Based on conservative ground disturbance estimates of 0.81 ha (2 ac) for conventional and 2.02 ha (5 ac)
for Marcellus Shale gas wells, drilling activities prior to 2009 disturbed an average of 3,367 ha (8,319 ac) annually, with the vast majority having resulted from conventional drilling. After 2009, drilling has disturbed, on average, 4,029 ha (9,955 ac) per year, which represents an average annual increase of over 660 ha (1,600 ac).

At this point, it is important to emphasize the nature of the effects that natural gas drilling activities can have on archaeological heritage. Except for a few instances, most recorded aboriginal sites in the state are smaller than 0.81 ha (2 ac) and few are larger than 2.02 ha (5 ac) (BHP nd). Similarly, apart from industrial complexes, recorded historic sites also tend to be smaller than the area disturbed by well drilling (BHP nd). Therefore, there are three possible outcomes of drilling a well: no impact to sites, partial destruction of one or more sites, or complete destruction of one or more sites. Moreover, the cumulative effect of these drilling activities is potentially so destructive that the PHMC recognized oil and gas drilling as threatening archaeological sites at a level similar to population growth, highway construction, surface mining, flood control projects, timbering, agricultural practices, and vandalism and looting (Raber 1985:34-43).

**Drilling Activities in Washington County, Pennsylvania**

According to annual state-wide production reports spanning the period between 2000 and 2010, drilling activities in Washington County have been extensive (PA DEP 2012). In that time, 3,357 wells were accounted for in the county. Many of these wells were drilled after 2000, but an unspecified number were drilled prior to 2000. They are included in the reports since they
Figure 2. Number of gas wells drilled in Pennsylvania (2005 and 2011).
Figure 3. Estimated acreage disturbed by drilling activities in Pennsylvania (2005-2011).
 Were in production during that year. Unfortunately, the reports do not detail the date wells were drilled. Information that is included in the reports consists of well permit number, well status (active, inactive, plugged), property name, municipality, operator, latitude and longitude, and production figures. Latitudes and longitudes for each well are presented in decimal degrees using the North American Datum (NAD) 1983 geodetic reference. Of the 3,357 wells in Washington County, 2,697 are conventional and 660 are Marcellus (Figure 4).

Figure 4. Distribution of gas wells by type in Washington County (2000-2010).
The number of the wells found in particular municipalities reveals a great range of variability in the distribution of drilling activities (Table 2 and Figure 5 and 6). Total well densities (includes conventional and Marcellus) range from zero wells in 17 of the 66 municipalities to over 5.6 wells per 1 km$^2$ (0.39 mi$^2$) in Deemston Township. Fallowfield Township has the greatest raw number of gas wells with 219. Density for conventional wells is distributed similarly. Deemstown Township exhibits the highest density with 5.16 wells per 1 km$^2$ (0.39 mi$^2$) and, again, Fallowfield Township contains the highest number of conventional wells with 217. In total, 39 of the 66 municipalities do not contain any Marcellus Shale gas wells. Hopewell and Mount Pleasant Townships are the only two municipalities whose density exceeds one Marcellus well per 1 km$^2$ (0.39 mi$^2$), with densities of 1.64 and 1.17 respectively. Canton, Cross Creek, Hopewell, Independence, Mount Pleasant, North Franklin, and Robinson all contain higher densities of Marcellus wells than conventional ones.

In assessing the potential effects that these activities have had on archaeological resources within Washington County, estimates based on figures of 0.89 ha (2 ac) for conventional and 2.02 ha (5 ac) for Marcellus suggest that 3,518 ha (8,695 ac), or 35.2 km$^2$ (13.6 mi$^2$), of land have been disturbed by the drilling activities described above. To put this figure into perspective, the amount of area potentially disturbed by drilling activities is equal to or larger than 37 of the 66 municipalities in Washington County and nearly four times larger than the size of the county seat, the City of Washington.
Table 2. Gas Wells in Washington County by Municipalities.

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Figure 5. Gas wells drilled in Washington County per township (2000-2010).
Figure 6. Density of gas wells drilled in Washington County per township (2000-2010).
CHAPTER 4: ENVIRONMENTAL CONTEXT

Political Description and Demographics

Washington County is located in extreme southwestern Pennsylvania along the Pennsylvania-West Virginia border (Figure 7). Its political boundaries are marked by the Monongahela River and Tenmile Creek to the east and south and by the political borders of Allegheny and Beaver Counties, Pennsylvania to the north and Brooke, Hancock, Marshall, and Ohio Counties in West Virginia to the west. The City of Washington, a third class city located near the center of the county, serves as the political seat. In addition, the county contains a second third class city, 32 boroughs, and 32 townships (Washington County 2011). It is governed by a three member publicly-elected commission (National Association of Counties [NACO] 2012). The county covers an area of 2,219 km² (857 mi²),

Figure 7. Location of Washington County, Pennsylvania.
As of the 2010 census, 207,820 people resided in Washington County, a growth of almost 5,000 residents from 2000 (U.S. Census Bureau 2010; Washington County 2011). Female residents (51%) slightly outnumbered males (49%), and the vast majority of the population, nearly 95%, were described as white. The remaining racial composition of the population included African American, Asian, American Indian/Alaska Native, Native Hawaiian/Pacific Islander, and other. Hispanic/Latinos comprised just over 1% of Washington County residents. More than 60% of the residents were over the age of 35 years, and statistics from the 2000 census show more deaths than births, both of which suggest an aging population. The median age of residents was 43.6 years (Washington County 2011).

Physiography and Hydrology

The county is situated within the Appalachian Plateaus physiographic province, which is a broad northeast to southwest trending highland that extends through much of the states of New York, Pennsylvania, and West Virginia and some of Alabama, Kentucky, Ohio, and Tennessee (Pirkle and Yoho 1977). The province is bounded by the Ridge and Valley province to the east and the Interior Low Plateau and Central Lowland provinces to the north and west (Fennemen and Johnson 1946). In Pennsylvania, the Appalachian Plateaus is divided into the Northwestern Glaciated, High Plateau, Pittsburgh Low Plateau, Waynesburg Hills, Allegheny Mountain, Allegheny Front, Deep Valleys, Glaciated High Plateau, Glaciated Low Plateau, and Glaciated Pocono Plateau sections.

Two of these sections occur in Washington County (Figure 8). The Waynesburg Hills covers the majority of the county. This section is characterized by a very hilly terrain with narrow hilltops and steep-sloped, narrow valleys (Sevon 2000). Relief is moderate, ranging between 182.88 and 304.80 m (600-1000 ft) while elevations reach between 258.47 and 499.26
m (848-1,638 ft) above sea level. The Pittsburgh Low Plateau section, limited to the northern portion of the county, consists of a smooth undulating surface cut by numerous, narrow and relatively shallow stream valleys (Sevon 2000). The section exhibits low to moderate relief of less than 60.96 m (200 ft) within the uplands and as much as 182.88 m (600 ft) between valley bottoms and upland surfaces. Valley sides are moderately steep except in the more gently-sloped upper reaches of streams. Elevations range from 201.17 m to 518.16 m (660 to 1,700 ft) above sea level.

Washington County lies in the Ohio River basin of the Mississippi River drainage system. The eastern and southern portions of the county drain into the Monongahela River (Subbasin 19) through Peters, Pigeon, and Tenmile Creeks along with a number of smaller tributaries. The Monongahela River then flows northward where it joins the Allegheny River in Pittsburgh to form the Ohio River. Chartiers and Raccoon Creeks drain the northern and northwestern portions of the county directly into the Ohio River (Subbasin 20). The western third of the county is drained by a number of streams that flow through West Virginia, including Buffalo, Cross, and Wheeling Creeks.

**Bedrock Geology**

The bedrock underlying Washington County consists of Permian-aged (250-290 million years) and Pennsylvanian-aged (290-330 million years) rock (Berg et al. 1980). Cyclical sequences of shale, sandstone, limestone, and clay comprise Permian bedrock while Pennsylvanian bedrock contains sequences of sandstone, red and gray shale, conglomerate, clay, coal, and limestone (Bureau of Topographic and Geologic Survey 2000). Several strata have been defined in the county, including the Casselman, Glenshaw, Greene, Washington, and Waynesburg formations along with the Monongahela group (Figure 9). These particular geologic units played important roles in the prehistoric and historic development of the county.
The Washington formation and the Monongahela group, where exposed, provided lithic material for the production of stone tools during prehistory. In total, five chert types have been identified as part of these strata (Holland 2003). They include Benwood, Monongahela, Sewickley, and Uniontown cherts in the Monongahela Group and Ten Mile chert in the Washington formation. In addition, glacially-deposited outwash in the Allegheny and Ohio Rivers, along with their south-flowing tributaries, brought a number of other cherts closer to the region, including Gull River, Onondaga, and Upper Mercer.

Historically, natural resources found within the Casselman Formation and the Monongahela Group provided opportunities for economic development during the historic growth of region. The Pittsburgh Coal seam at the base of the Monongahela Group provided an early source of coal (Carlisle et al. 1991; Wagner et al. 1970), while thick sandstone in the Casselman formation may have been quarried locally for use as construction material for buildings and building foundations (Carlisle et al. 1991). Similarly, clays found in the several strata may have provided raw materials for local brickworks.

Pedology

Washington County contains four major soil associations defined by distinctive pattern of soil, relief, and drainage (Seibert et al. 1983). They include Dormont-Culleoka, Guernsey-Dormont-Culleoka, Dormont-Culleoka-Newark, and Udorthents-Culleoka-Dormont associations. The Dormont-Culleoka association accounts for the majority of the county (approximately 75%). It is characterized as well drained, deep, sloping (ranging from 3-50%) soils that occur on hilltops, ridges, benches, and hillsides (Seibert et al. 1983). Typically, the association consists of 40% Dormont, 30% Culleoka, and 30% minor soils. Dormont soils developed in residuum of weathered shale, siltstone, limestone, and colluviums. Culleoka soils formed in residuum of weathered limestone, sandstone, siltstone, and shale (Seibert et al. 1983). Most of the
Figure 8. Physiographic sections and major streams in Washington County.

Figure 9. Bedrock geology of Washington County.
association is suitable for the development of woodlands or pasture while flatter areas are conducive for farming.

The remaining soil associations are less common. Guernsey-Dormont-Culleoka association occurs on similar landforms. Guernsey soils comprise approximately 35% of the association (Seibert et al. 1983). Guernsey soils developed in residuum of weathered clay shale, siltstone, and limestone. Most areas of this association are used for pasture, with less sloping land used for farming. Dormont-Culleoka-Newark association includes soils that are deep and range from poorly-drained to well-drained on level to very steep surfaces, including hilltops, ridges, benches, hillsides, and flood plains (Seibert et al. 1983). Newark soils, comprising about 21% of the association, developed in alluvium derived from limestone, sandstone, siltstone, and shale. Most of the association is suitable for the development of woodlands or pasture while flatter areas, especially on floodplains, are conducive for farming.

Finally, Udorthents-Culleoka-Dormont association soils occur on hills and other areas disturbed by strip mining, with Udorthents soils developing directly in the areas mined (Seibert et al. 1983). Most of the acreage associated with these soils is suitable for woodland development. If reclaimed properly, the Udorthents soils are suitable for farming.

Climate

Washington County has a humid, continental climate characterized by a significant annual range of temperature. The average annual temperature as measured at the nearby Greater Pittsburgh International Airport is approximately 50.4° F. Summers have high monthly mean temperatures as well as high maximum temperatures, small diurnal ranges, and high humidity. The average high temperature during the summer is 82° F (Washington County 2011). Winters are cool, experiencing an average high temperature of 36.5 ° F and an occasional day or two of subzero temperatures per year (Washington County 2011).
Although there is no seasonal dry period, approximately 55% of the annual precipitation falls between April and September (Seibert et al. 1983). Annual rainfall averages just over 91.44 cm (36 in) and annual snowfall accumulation averages about 114.3 cm (45 in) (Washington County 2011). The driest month of the year is December while July typically is the wettest. Usually, prevailing westerly winds bring storm systems in from the midcontinent up the Ohio River drainage into Pennsylvania (Dailey 1975). However, the region experiences effects from tropical storm systems originating in the Gulf of Mexico and Atlantic Ocean on occasion. The growing season, or the interval between the last frost in the spring and the first frost in the autumn, ranges between 109 and 149 days (Seibert et al. 1983).

**Flora and Fauna**

Washington County lies in Braun’s (1950) Mesophytic Appalachian Oak Forest region, which is a widespread and diverse forest type specific to southwestern Pennsylvania. Dominant trees include tulip, sugar maple, American beech, basswood, northern red oak, cucumber-tree, wild black cherry, white ash, black walnut, shagbark hickory, Ohio buckeye, and yellow buckeye (Smith 1989; Utech 1989; Zimmerman et al. 2012). Eastern hemlock may occur, but it is not characteristically a dominant type. Prior to a devastating blight in the early 1900s, the American chestnut was also common. A number of species related to the Northern Hardwood Forest type occur in the region as well, such as white pine, hemlock, sugar maple, beech, and American basswood (Smith 1989; Utech 1989). Other flora includes eight different species of shrubs, including wild hydrangea and witch hazel, along with a rich inventory of over 22 herbaceous floral species (Zimmerman et al. 2012).

The regional animal population includes a wide range of terrestrial and avian fauna representative of the Carolinian biotic zone (Dice 1943). Common mammals include the white-tailed deer, black bear, gray and red fox, several species of squirrels and bats, skunk, chipmunk,
groundhog, raccoon, cottontail rabbit, porcupine, opossum, meadow and woodland voles, meadow jumping and white-footed mice, mink, and muskrat (Doutt et al. 1977). This inventory included mountain lion, timber wolf, elk, wildcat, otter, wild turkey, and passenger pigeon less than 200 years ago.

Over 30 species of birds constitute the regional avian assemblage. Among the most common indigenous species are the ruffed grouse, Carolina wren, cardinal, robin, and red-bellied woodpecker (Sutton 1928). Additionally, several species of birds were introduced during historic times, including the rock dove, sparrow, ringneck pheasant, and starling. Terrestrial and riverine reptiles are dominated by the black snake, garter snake, copperhead snake, and box and snapping turtles. Amphibian animals include tree frogs, bullfrogs, toads, and several species of salamanders. Freshwater mollusks, while abundant during prehistoric times, are now almost wholly absent. Over 159 species of fish have been recorded in Pennsylvania (Cooper 1983). The most common species in the region include perch, pike, bass, trout, and carp.
CHAPTER 5: CULTURAL DEVELOPMENT IN WASHINGTON COUNTY

Washington County contains one of the longest records of human history in North America. Spanning almost 16 millennia and documented in more than 1,500 recorded archaeological sites (Figure 10), this historic record began during the last Ice Age when people crossed into the Western Hemisphere and continues to the present day. During that time, countless people have made the region their home, living off the vast natural resources present in the county. The following chapter summarizes current knowledge of the various cultural groups that inhabited the county, from the highly nomadic hunter-gatherers that first stepped into the forested valley of Cross Creek to the coal miners and farmers of the 20th Century.

Figure 10. Distribution of archaeological sites in Washington County
Paleoindian Period (ca. 16,000-9,000 B.P.)

The chronologic framework used for Paleoindian sites in Washington County is derived from Carr and Adovasio’s (2002:3-4) temporal divisions across Pennsylvania. They divide the Paleoindian period into three sub-periods of Pre-Clovis (16,000-11,500 Before the Present [B.P.]), Early Paleoindian (11,500-10,000 B.P.), and Late Paleoindian (10,000-9,000 B.P.). In total, 28 sites in Washington County contain 30 Paleoindian components, including 4 Pre-Clovis, 17 Early Paleoindian, 2 Late Paleoindian, and 7 unidentified Paleoindian.

Pre-Clovis Sub-Period

In general, Pre-Clovis sites from across North and South America are defined as highly ephemeral and extremely rare (Carr and Adovasio 2002:13). In Pennsylvania, the Pre-Clovis sub-period dates between ca. 16,000 and 11,500 B.P. It is recognized by a core and blade lithic industry that incorporated the use of prismatic blades and unfluted bifaces considered similar to the Eurasian Upper Paleolithic lithic technologies (Carr and Adovasio 2002).

A type of these bifaces found in Washington County includes the Miller Lanceolate, originally identified at the Meadowcroft Rockshelter (36WH297) near Avella in a deep layer dated to between 11,300±700 and 12,800±870 B.P. (Carr and Adovasio 2002:8). Based on very limited data, subsistence strategies appear to have been fairly generalized with no evidence for big game hunting. Pre-Clovis settlement patterns are difficult to define due to the paucity of sites. Adovasio (2002: 257) sees Pre-Clovis sites representing a “pioneer phase” of colonization, in which sites are few and highly transient while the more frequently occurring fluted biface sites of the Early Paleoindian period represent the “residential phase” of colonization.

Early Paleoindian Sub-Period

The Early Paleoindian sub-period dates between 11,500 and 10,000 B.P., and is marked by a lithic industry of fluted bifaces, utilized flakes, and standardized unifacial flake tools such
as endscrapers, sidescrapers, wedges, burins, gravers, and awls (Carr and Adovasio 2002:23-28). A variety of fluted bifaces are recognized, of which Clovis-like types are the earliest and most common forms recovered in Pennsylvania (Carr and Adovasio 2002). Slightly later fluted bifaces include Cumberland, Barnes, Debert, Crowfield, Holcombe, and Plano varieties (Carr and Adovasio 2002:14-21; Fogelman and Lantz 2006:26-36).

In western Pennsylvania, Lantz (1984:211-212) identified five types of site, including kill sites, lowland waterside camps, upland camps, trail camps, and quarry/tool reduction sites. He noted that upland camps are more prominent in the unglaciated section of the Appalachian Plateau physiographic province (Lantz 1984:212), a pattern that Carr and Adovasio (2002:39) also recognized. Carr and Adovasio (2002:39) also identified a higher diversity of topographic settings for sites in the Appalachian Plateau, suggesting an equally diverse hunting and foraging subsistence strategy. High quality lithic materials appear to have been preferred, a number of which required travel or trade to access (Lantz 1984:212, also Table 1). Carr and Adovasio (2002:41) defined procurement strategies as cyclical in the use of Coshocton chert from east-central Ohio and Onondaga chert from western New York with some utilization of local cherts.

Early Paleoindian occupation of Washington County was likely a component within a broader regional settlement system. Sites in the region likely served as small, temporary habitation or specialized procurement loci for relatively mobile foragers. Lantz (1984:212) noted that the distribution of a number of sites in Washington and Allegheny Counties correspond to the presence of Catfish Path, a north-south historic Native American trail (Wallace 1998:32). This trail may have served as a “path of least resistance” for migrating game, and Paleoindian sites along it may represent hunting camps or monitoring stations for tracking such resources. The presence of Paleoindian tools that were made from Flint Ridge and Upper Mercer
cherts indicates that considerable travel into Ohio for the acquisition of stone materials occurred. During such trips, these Paleoindian groups may have temporarily coalesced with others for the exchange of goods and marriage partners at places like Nobles Pond (33ST357), a large aggregate camp in Stark County, Ohio (Seeman 1994).

Late Paleoindian Sub-Period

The Late Paleoindian sub-period dates between 10,000 and 9,000 B.P. Late Paleoindian sites across Pennsylvania typically exhibit similar spatial patterning as Early Paleoindian sites (Carr and Adovasio 2002:42), however there are fewer sites. Carr and Adovasio (2002:42) suggested that a population decrease in Pennsylvania occurred due to changing environmental conditions, adding that Paleoindian groups may have migrated southward away from the pine forests that dominated much of Pennsylvania at the time. While a population decrease is apparent, difficulties in recognizing Early Holocene diagnostic artifacts may also help explain the overall lack of sites from this sub-period. Late Paleoindian diagnostics include unfluted lanceolates along with Dalton and Hardaway bifaces (Justice 1987). Some Early Archaic types such as Palmer and Kirk corner-notched bifaces may be contemporary to Late Paleoindian diagnostics (Justice 2009), suggesting that a lack of unfluted bifaces, Daltons, and/or Hardaways is not necessarily evidence for an absence of Early Holocene populations.

Archaic Period (ca. 9,900-3,100 B.P.)

Despite the greater number of sites in Pennsylvania ascribed to the Archaic period, it is as poorly understood as the Paleoindian period. The Archaic period was originally used to account for the time between the highly mobile hunter-gatherers of the Paleoindian period and the more sedentary agriculturalists of the Woodland period, a period often seen as lacking cultural development. However, recent research in the Eastern Woodlands have shown that there were considerable cultural changes during the Archaic period (Emerson et al. 2009; Sassaman 1996,
2010), including shifts from foraging to collecting subsistence practices, initial domestication of plants, technological innovations such as ceramic production, and some development of social complexity.

Based partly on Carr’s (1998a, 1998b) chronology, the Archaic period is divided into Early (9,900-8,900 B.P.), Middle (8,900-5,500 B.P.), and Late (5,500-3,100 B.P.) sub-periods. This chronology places sites bearing bifurcated and related bifaces firmly in the Middle Archaic sub-period and Otter Creek, Big Sandy II, and Brewerton Series types in the Late Archaic sub-period.

**Early Archaic Sub-Period**

The Early Archaic sub-period dates between 9,900 B.P. and 8,900 B.P., overlapping the Late Paleoindian sub-period by nearly 1000 years. Carr (1998a:48) and Carr and Adovasio (2002:42-43) defined settlement and resource procurement patterns of Early Archaic populations in Pennsylvania as extensions of patterns seen in the earlier Paleoindian period. Site densities exhibit a slight overall increase between the Paleoindian period and the Early Archaic sub-period, and a marked increase between the Late Paleoindian and Early Archaic sub-periods. Increasing population size and a reoccupation of the region after the purported Late Paleoindian abandonment may explain the increased number of Early Archaic sites.

Lithic procurement strategies that focus on exotic materials for tool production are also similar. Diagnostic artifacts of the Early Archaic period include Palmer/Kirk Corner-notched, Charleston, Kessel, and Kirk Stemmed bifaces (Carr 1998a:46-48). Early Archaic tool kits also included utilized flakes, unifacial tools, modified bone and wood, and basketry, as seen at Meadowcroft Rockshelter (Adovasio et al. 1998:19). As with the Paleoindian period, subsistence strategies are poorly known. Nevertheless, the available data suggests that the end of
Early Archaic marks the end of a cultural tradition that encompasses both the Paleoindian and Early Archaic periods (Carr 1998a; Carr and Adovasio 2002).

The distribution of sites in the county exhibits a shift away from upland settings, with nearly half of the sites situated in lowland environments as opposed to almost a third during the Paleoindian period. Adovasio et al. (1998) and MacDonald (2003:40) noted a similar trend in the Cross Creek and Raccoon Creek drainages, respectively. These patterns suggest more favorable conditions in these environments resulting from warmer climate conditions of the early Holocene epoch. As with the Paleoindian period, Early Archaic sites in Washington County likely were components within a broader regional settlement system. However, evidence from the Everett Bombarger #2 (36WH742) and #3 (36WH866) sites, both situated on or near floodplains associated with Ten Mile Creek, may suggest a transition in settlement and subsistence systems began during the Early Archaic period. Both sites produced multiple Kirk Corner-notched bifaces and may have functioned as base camps in lowland settings, with nearby upland sites used as seasonal procurement camps (sensu MacDonald 2003:36), beginning both a pattern of decreased overall mobility and increased regionalization of populations more commonly seen during later periods. Lithic procurement strategies appear to be as varied as during the Paleoindian period.

Middle Archaic Sub-Period

The Middle Archaic sub-period dates between 8,900 and 5,500 B.P., marked by the appearance of bifurcated bifaces, including MacCorkle, LeCroy, and St. Albans varieties earlier in time and Kanawha, Stanly, and Neville types slightly later. Carr (1998b) recognized the Middle Archaic sub-period as distinct from the preceding periods based on site densities and lithic procurement strategies. His analysis of the distribution of Middle Archaic sites in Pennsylvania showed a two to threefold increase in the number of sites. He suggested that the
increase in population was related to the spread of deciduous vegetation into Pennsylvania between 9,000 and 8,000 B.P. (Carr 1998b:87).

Lithic procurement strategies shifted to a strong focus on locally available, sometimes inferior, raw materials, indicating a transition from curated tool kits seen earlier to expedient lithic technologies. Though not entirely clear, the newly developed technology utilized fewer formal unifacial and bifacial tools and more retouched flakes. Altogether, the data suggest that the potential change in foraging strategies seen during the Early Archaic sub-period were more common during the Middle Archaic sub-period (Carr 1998b:88; Cowin 1991). It appears that such strategies utilized logistical movement between base camps and seasonal resource procurement sites within a more constricted catchment zones.

As with the Early Archaic period, about half of the Middle Archaic sites are situated in lowland environments. At least five sites in the county contained more than five diagnostic artifacts, suggesting their possible use as base camps. They include the Indian Ridge/Old Delaware Camp (36WH21), Wylie #1 (36WH274), MS #104 (36WH409), Shidler Monongahela Village (36WH813), and the Everett Bombarger #3 (36WH866) sites. As noted above, the Everett Bombarger #3 site also may have functioned as a base camp during the Early Archaic sub-period. Adovasio et al. (1998:19) noted a re-occupation of Early Archaic sites in the Cross Creek drainage during the Middle Archaic sub-period as well. Subsistence data for the period are meager, though information from Meadowcroft suggests a continued reliance on hunting and collecting of wild plants.

Raw materials for the majority of Middle Archaic diagnostic artifacts in the county are identified as chert/flint, with few manufactured from Flint Ridge, Kanawha, Gull River, and Onondaga cherts. The chert/flint designations suggest increased use of local and regional
materials such as Monongahela, Uniontown, Ten Mile, Loyalhanna, and other local chert varieties (MacDonald 2003:45). Altogether, Middle Archaic site distribution and lithic material data indicate increased population density coupled with decreased mobility, catchment zone size, and access to exotic goods.

Late Archaic Sub-Period

The Late Archaic sub-period dates between 5,500 and 3,100 B.P. It is often seen as a time of amplified population diversity. Several traditions have been identified across Pennsylvania and neighboring regions based on biface styles and other artifact and settlement traits. In Pennsylvania, the ubiquitous Otter Creek, Brewerton, and Lamoka-style bifaces along with the occasional Vosburg types suggest association with the Laurentian tradition of northern and central New York and the Great Lakes region. However, this association may be based only on stylistic similarities of certain biface types and not on a true cultural relationship. Pennsylvania’s Laurentian components usually lack the full suite of lithic, groundstone, and bone artifacts typically linked with the tradition (Funk 1988:28). Steubenville Stemmed and Lanceolate bifaces indicate affiliation with the Panhandle Archaic (Mayer-Oakes 1955:132-136). Broad- and narrow-bladed bifaces such as Bare Island, Lehigh/Koens-Crispin, Orient, Pequea, Perkiomen, Poplar Island, Savanna River, Snook Kill, and Susquehanna, along with steatite, show relationships with Transitional Archaic groups from central and eastern Pennsylvania (Custer 2001). Chronologically, it appears that Laurentian-related traits preceded both Panhandle and Transitional Archaic ones, though they sometimes co-occur at sites, suggesting a brief period of temporal overlap (MacDonald 2003:50).

Despite the uncertainty of cultural complexes and their relationships to one another and to those in the surrounding region, there are a number of identifiable changes from the preceding Middle Archaic sub-period. Expansion of biomasses during the Late Archaic is attributed to
environmental warming, resulting in increased availability and diversity of resources. Foraging strategies that developed earlier were well-entrenched by the Late Archaic period, incorporating use of base camps situated on terraces of major waterways and specialized resource procurement sites in upland settings that were intended for plant, animal, and lithic exploitation (Cowin 1991:48; Raber et al. 1998:126-127).

The majority of Late Archaic sites in Washington County represent Laurentian tradition occupations, typically marked by the ubiquitous Brewerton series bifaces. Adovasio et al. (1998) noted a dramatic increase in Late Archaic and Terminal Archaic sites in the Cross Creek drainage, with settlement patterns focused on base camps in lowland settings and smaller resource procurement camps located in upland settings. Subsistence patterns show an increase in the exploitation of riverine resources, such as shellfish and fish, while lithic procurement strategies indicate a reliance of locally-procured raw materials. Similar settlement, subsistence, and lithic procurement patterns are evident in the Raccoon Creek watershed (MacDonald 2003), and likely throughout Washington County. However, MacDonald (2003:66) noted some major differences in Laurentian and Panhandle Archaic settlement systems. The density of Panhandle Archaic sites was less than Laurentian tradition sites across Cross Creek and Raccoon Creek watersheds. While less, Panhandle Archaic sites occurred on more diverse topographic settings. Finally, Panhandle Archaic sites exhibited a wider range of tool types and features, including human and dog burials, than Laurentian tradition sites.

Woodland Period (ca. 3,100 – 315 B.P.)

Traditionally, the Woodland period has been used to describe substantial changes to subsistence practices, settlement patterns, technology and social organization. The domestication of plants along with food production is a key marker of subsistence change, although these processes began during the Archaic period in the Northeast and the Midwest.
Related changes to settlement patterns, technology (ceramic production), and social organization conventionally ascribed to the Woodland period also took roots during the Archaic period. Nevertheless, important aspects that developed during the Woodland period in western Pennsylvania include the establishment of extensive interaction networks and, later, the nucleation of scattered populations. The Woodland period is divided into Early (3,100-1,900 B.P.), Middle (1,900-1,500 B.P.), Late (1,500-900 B.P.), and Late Prehistoric (900-315 B.P.) (Adovasio et al. 2003; Johnson 2001; Mayer-Oakes 1955).

Early Woodland Sub-Period

The Early Woodland sub-period in the Upper Ohio Valley dates between 3,100 and 1,900 B.P., and is recognized as a continuation in trends that were present during the Late Archaic sub-period, such as increasing population densities along with similar site distributions and resource procurement strategies (Adovasio et al. 2003:74-75). The earliest evidence for domesticated plants and ceramic technology in the region occurred within transitional Late Archaic-Early Woodland deposits at Meadowcroft Rockshelter, dating to 3065±80 rcybp (Adovasio et al. 2003:67). During the initial stages of the Early Woodland sub-period, cultural trends followed Transitional Archaic patterns for the Northeast and Great Lakes regions. In particular, biface types such as Meadowood and Forest Notched appear to be derivatives of Fishtail and Broadspur traditions.

Around 2,500 B.P., cultural influence in the region shifted westward towards Adena populations of the Middle Ohio Valley. This shift resulted in the appearance of extensive interaction networks, as evidenced by the frequent occurrence of Flint Ridge chert and other exotic items in Upper Ohio Valley sites (Mayer-Oakes 1955). Related, increased contact with Middle Ohio Valley populations led to the adoption of certain rituals, including burial mound construction. Burial mound complexes in the region exhibit a great deal of variability in size,
structure, and number of interments (Dragoo 1989; Mayer-Oakes 1955; McMichael 1956).

Burial mounds located along the Ohio and Monongahela Rivers are generally large with multiple burial episodes and greater number of individuals. Such mounds include Grave Creek and Cresap in West Virginia, McKees Rocks (36AL06) and Peter Creek (36AL277) in Allegheny County, and Crall (36WH1061) in Washington County. Typical Adena-related diagnostic artifacts include Cresap, Adena Ovate Base, Adena Stemmed, and Adena Robbins bifaces along with Half-Moon Cord-Marked pottery, a variant of the thick, grit-tempered, and aptly-named Fayette Thick pottery from the Middle Ohio Valley. Other artifacts commonly found include stone tubular pipes, stone gorgets, and Adena Plain pottery (Mayer-Oakes 1955).

In Washington County, overall site numbers are fewer than the preceding Late Archaic sub-period, however site density increased when considered on a components per decade basis, particularly in the Chartiers Creek, Cross Creek, and Raccoon Creek watersheds (Adovasio et al. 2003; MacDonald 2003). The majority of Early Woodland sites pertain to Adena-related occupations, with few sites yielding Meadowood, Forest Notched, or other initial Early Woodland diagnostic artifacts. The distribution of sites also indicates a continued exploitation of lowland and upland resources. While Meadowcroft Rockshelter has yielded putative evidence for the use of domesticated plants such as squash and maize, evidence for such subsistence practices are not common. More commonly, sites tend to contain evidence for a varied diet of wild plants, game, and riverine resources (MacDonald 2003:73).

Besides the Crall Mound, most of burial mound sites in Washington County represent interior sites located away from major rivers that tend to be smaller and contain fewer individuals. These include the Ten Mile Park (36WH07), Mathis Mine/Courtney (36WH29/31), Linn (36WH36), Meadows (36WH276), and Pollock’s Hill (36WH721) (Dragoo 1955; Maurer
MacDonald (2003:80) suggests that settlement patterns in the Raccoon Creek and Cross Creek watersheds centered around habitation and mound sites within the valleys of large streams and resource procurement sites along smaller streams and in the uplands. Large mound sites and complexes may have represented locations for ceremonial aggregation. While burial mounds had other explicit ceremonial functions, large sites such as McKees Rocks and Grave Creek may have been used to integrate a broader regional population while the smaller interior mounds served to coalesce local communities.

**Middle Woodland Sub-Period**

The Middle Woodland sub-period in the Upper Ohio Valley represents a brief interlude dating between 1,900 and 1,500 B.P that coincides with the appearance, development, and collapse of the far-reaching Hopewell culture in the Middle Ohio Valley (McConaughy 2012). In the Middle Ohio Valley, late Adena evolved directly into early Hopewell within four tributaries in southern Ohio (Greber 1991), and regions outside of these core areas exhibit less intense Hopewell characteristics, including the Upper Ohio Valley south of the Wisconsin terminal moraine. Similarly, ceremonial mound and earthwork sites are relatively few. Diagnostic Middle Woodland artifacts include Snyders, Manker Stemmed, Low Flared Base, and Fox Creek bifaces as well as limestone-tempered Watson Ware pottery.

Habitation sites in the region are poorly documented. The available evidence indicates a lack of village or other form of permanent settlement, with large seasonal base camps likely placed along major waterways (McConaughy 2012). Such sites may have included the Ohiovie (36BV09), Georgetown (36BV29), and Industry sites (36BV128) along the Ohio River in Beaver County and the Fairchance site also along the Ohio River in Marshall County, West Virginia (MacDonald 2003; McConaughy 2012). Commonly, Middle Woodland burials were incorporated into earlier Adena-related mounds, such as the McKees Rocks mound
Where they do occur, mounds consist of earth and stone slab constructions that contain little grave furniture. Interestingly, Middle Woodland ceremonial sites on the periphery tend to demonstrate a mixture of Adena and Hopewell traits (Dancey 1991; George 1978; McMichael and Mairs 1969; Mortine and Randles 1978), suggesting continuity in local development while incorporating aspects of the far reaching cultural manifestations in the Middle Ohio Valley.

In Washington County, subsistence and settlement data suggest more intensive strategies that were present during the Late Archaic and Early Woodland sub-periods (Adovasio et al. 2003:74). Generally, site densities rose and food production intensified. Evidence of Eastern Agricultural Complex domesticates becomes more frequent at Middle Woodland components (Adovasio et al. 2003; King 2004; McConaughy 2012), including those at Meadowcroft Rockshelter and the Dunsfort site (36WH477). Use of non-native cultigens, while highly uncommon at this time, is documented at Meadowcroft Rockshelter as well (Adovasio et al. 2003). Archaeological and botanical data also indicates heavy use of wild plants and nuts along with the organization of specialized procurement camps for the exploitation of such resources (George 2004).

**Late Woodland Sub-Period**

The Late Woodland sub-period dates between 1,500 and 900 B.P, marking cultural development that followed the collapse of the Hopewell culture and its influence in the Upper Ohio Valley and development that preceded the fully sedentary village agriculturists of the Late Prehistoric Monongahela Tradition (McConaughy 2012). Until recently, this period of time was usually subsumed into the later stages of the Middle Woodland sub-period while the Late Woodland classification was reserved for sites pertaining to the Monongahela Tradition (see below). As a result, changes to settlement, subsistence, technologic, and resource procurement...
patterns for post-Hopewellian cultural groups and the mechanisms that led towards increased complexity, nucleation, and sedentism during the Late Prehistoric sub-period are obfuscated by earlier classification systems (see MacDonald 2003). Nevertheless, the data reveals trends similar to those in the Middle Ohio Valley.

Technologic and economic changes that occurred during the Late Woodland sub-period include the introduction of the bow and arrow and intensification of maize production, though the latter has been difficult to document in the region. Settlement patterns likely consisted of dispersed farmsteads and hamlets in similar settings as Middle Woodland base camps, such as the Watson Farm site in Hancock County, West Virginia (McConaughy 2012). Interior and upland settings were likely used for specialized resource procurement activities. Mound building continued through the Late Woodland period, consisting of stone slab constructions with little grave furniture (Cowin 2003). Late Woodland diagnostic artifacts include Chesser Notched, Jack’s Reef Corner Notched, Raccoon Notched, Levanna, Garver’s Ferry, Murphy’s Stemmed, Bennington Corner-Notched, Kiski Notched, and Levanna bifaces, several of which probably represent true arrow tips (Seeman 1992). Limestone tempered Watson ware remains diagnostic of this period, although vessels became progressively thinner.

Development of Late Woodland cultural groups in Washington County is difficult to document as a result of changing perspectives on what constitutes Middle Woodland versus Late Woodland. Sites containing Late Woodland diagnostics as defined here have often been classified as Middle Woodland (Adovasio et al. 2003; MacDonald 2003). Despite these difficulties, it appears that Raccoon Creek functioned as a center of Late Woodland development (Lantz 1989). Dozens of sites in the valley in both Washington and Beaver Counties contained Raccoon Notched bifaces, a local variant of the Jack’s Reef Corner-Notched biface type, and
none of these sites appear to represent habitation sites. The presence of these points indicates the importance the valley served in hunting and gathering activities by the regional population (MacDonald 2003). Washington County’s other stream valleys may have functioned similarly for groups living along the major river systems. Burial ceremonialism during the Late Woodland sub-period is not elaborate, although the use of stone and earth mounds continued. The Avella Mound (36WH415) appears to represent an accretional mound containing at least 14 individuals buried in stone crypts during a 300-year span (Applegarth and Cowin 1984; Cowin 2003). The re-use of Early and Middle Woodland mounds is evident as well, including the Mathis Mine/Courtney Mound where three individuals were buried above an Early Woodland earthen mound (Tanner et al. 2012).

*Late Prehistoric Sub-Period*

The Late Prehistoric sub-period dates between 900 and 315 B.P., and following Johnson (2001), is further subdivided into three temporal units of Early (900 -700 B.P.), Middle (700-370 B.P.) and Late (370-315 B.P.) Monongahela periods. Within that time, the Monongahela Tradition developed from earlier Late Woodland cultural groups and became the principal cultural manifestation in the Upper Ohio Valley (Maslowski 1984). Monongahela Tradition groups were sedentary village dwellers, which is a marked change from the preceding Middle and Late Woodland settlement pattern. Sedentary settlements were facilitated by an intensification of food production, with maize, beans, and squash as the primary staples (Hart and Means 2002; Johnson et al. 1989:15). Perhaps the most important benefit of food production was its general predictability. Agriculture allowed Monongahela groups to plan for leaner seasons by storing additional produce and supplementing their diet through hunting, fishing, and collecting wild plants and nuts (Johnson et al. 1989:15-16). It also led to higher population densities.
Villages are the most archaeologically visible Monongahela Tradition settlement, with over 74% of their sites identified as villages and the majority of these villages situated in upland settings (Hasenstab and Johnson 2001; Johnson 2001:68-69; Johnson et al. 1989:1-9). Typical Monongahela villages consisted of an outer palisade with a concentric ring of houses surrounding an open plaza (Johnson et al. 1989; Means 2007). Later in time, villages became larger and their organization more complex, with some Middle and Late Monongahela period villages exhibiting multiple palisades and multiple house rings.

A variety of features were typically placed within the house ring, including domestic structures, unattached storage facilities, fire pits, smudge pits, refuse pits, and burials. Houses were usually circular or oval, ranging between three and ten meters in diameter and estimated to have held seven or eight individuals (Johnson et al. 1989:12-13; Means 2006). Some of these domestic structures, especially later in time, had one or more pear-shaped storage facilities attached to them. Occasionally, burials were placed beneath house floors, but these were almost exclusively of young children or infants. Plazas were usually devoid of domestic activity, although some villages show evidence that a large hearth and/or post once stood at the center of the village for ritual use (Means 2007). With increased complexity during the Middle and Late Monongahela periods, specialized structures such as petal and charnel houses were incorporated into the organization of some villages (Anderson 2002).

Other types of Monongahela Tradition sites include smaller hamlets and farmsteads, and even smaller specialized resource procurement sites, such as hunting camps, fishing stations, lithic workshops, bivouacs, and rock shelters. With few exceptions, the role of these types of sites in Monongahela settlement patterns is often overlooked (Church 1995; Fryman 1984; Raber 2009; George 1984; Means 1999). Monongahela groups did not practice burial mound
construction, although on occasion buried individuals within earlier Woodland mounds, including the McKees Rocks and Pitt Gas (36GR254) mounds (Henshaw and Owens 2004; Mayer-Oakes 1955; McMichael 1956). Monongahela Tradition diagnostic artifacts are many, and include small Madison bifaces, a variety of pottery types, cannel coal pendants, clay smoking pipes, and tubular bone beads (Johnson et al. 1989). Early Monongahela Tradition pottery consisted of limestone-tempered and mixed limestone- and shell-tempered wares, sometimes heavily decorated with incised lines that gradually transitioned into shell-tempered, largely undecorated wares (Johnson 2001).

Around 400 B.P., an intrusive cultural group from eastern Ohio known for their distinct pottery established a number of settlements in the Upper Ohio Valley. These settlements, attributed to the Wellsburg phase based on the presence of simple-stamped ceramics and pottery vessels with sub-lip punctuations, included the McKees Rocks village (36AL16) in Allegheny County and a component at the Lower Georgetown site (36BV29) in Beaver County (Buker 1968; Mayer-Oakes 1955). Their ceramics also appeared at a handful of Monongahela Tradition villages in Washington County. The nature of interactions between these distinct Late Prehistoric groups is uncertain, and may have taken a number of forms including competition over resources, cooperation between communities, or general avoidance.

A number of villages persisted into the Protohistoric period as the Monongahela Tradition territory contracted into Greene County (Johnson 2001), but by about 315 B.P., evidence of the Monongahela Tradition is no longer present in the Upper Ohio Valley. Various interpretations have been offered to explain their disappearance from the archaeological record. One scenario posits that conflict with the Seneca resulting from control over the fur trade drove the Monongahela from the region and they consequently sought refuge with the Susquehannock
Another theory explains that the dispersal of the Monongahela by the Seneca was greatly facilitated by deteriorating climate conditions after A.D. 1550. Specifically, it suggests that two severe drought episodes between A.D. 1587 and 1589 and again between A.D. 1607 and 1612 caused enough stress to shrink Monongahela territory, and compounded by the Seneca raiding parties, the Monongahela abandoned the Upper Ohio Valley (Richardson et al. 2002:90). A third hypothesis suggests that European-borne diseases such as influenza resulting from increased interactions with tribal groups in direct contact with the British colonies decimated Monongahela populations I remaining Monongahela groups amalgamated with the Fort Ancient of the Middle Ohio Valley (Herbstritt 2003:35-39). The region was deserted until Delaware, Shawnee, and other tribal groups were pushed westward by Euro-American encroachment in the early 18th Century.

Contrasting the focus on large river systems during the Middle and Late Woodland sub-periods, the distribution of Late Prehistoric sites in Washington County indicates a shift towards the permanent occupation of smaller watersheds. In particular, clusters of sites occur along Chartiers, Raccoon, and Tenmile Creeks, and few sites are located upland from the stream valleys. The lack of sites in the uplands and near the drainage divides of these watersheds indicates the presence of buffer zones around core areas of Monongahela occupation. This suggests that at least south of the Ohio and west of the Monongahela Rivers, Monongahela settlement patterns were drainage-focused, and sites within these drainages may correlate to cultural, ethnic, or societal groups (Espino and Bercel 2010).

Such a shift in settlement patterns may have been in response to increasing population densities in the region and competition over resources. Interestingly, cordage-twist data as compiled by Johnson (2012) supports this notion. For instance, ceramics from the Chartiers
Valley exhibit a considerable higher use of final s-twisted cords than pottery in the surrounding valleys. Furthermore, this preference seems to be evident throughout their occupational history in the valley, suggesting cultural continuity for at least 500 years within the drainage. Interestingly, the Chartiers Creek watershed was abandoned around 450-400 B.P. (Espino and Bercel 2010), and their departure may have coincided with the establishment of the McKees Rocks village at the mouth of Chartiers Creek by Wellsburg groups. Monongahela settlements along Raccoon Creek may have also been withdrawn around the same time. The abandonment of the Chartiers Creek valley also predated the disappearance of the Monongahela Tradition from the Upper Ohio Valley by at least a century.

**Historic Period (ca. 315 B.P. to Present)**

**Contact Era**

For nearly a century, southwestern Pennsylvania remained largely unoccupied after the abandonment of the region by the Monongahela Tradition. Beginning in the 1720s, displaced groups of Native Americans from eastern Pennsylvania settled the region. Delaware, Iroquois, Mingo, and Shawnee groups established multi-ethnic communities along the Allegheny, Ohio, and Monongahela rivers (Kent et al. 1981). Catfish Camp, named after the influential Delaware Indian, was among these communities. He established the camp around 1757 in present-day City of Washington, at the intersection at least three major Indian trails (Wallace 1998). At this crossroad, Catfish Path led northward along Chartiers Creek to the Forks of the Ohio River and southward to the east-west Warriors Branch of the Catawba Path. The Mingo Path, an offshoot of Nemacolin’s Path led southeastward towards Cumberland, Maryland. Finally, Glades Path crossed Catfish Camp connecting indigenous communities to the east, including Raystown (present-day Bedford), with the Ohio River near Wheeling, West Virginia. A system of secondary trails that connected major and minor settlements was likely present as well.
In the mid-18th Century, a number of geopolitical events transpired in the region as the French and British laid claim to the territory west of the Allegheny Mountains (Anderson 2001). Known as the Ohio Country, its ownership was contested during King George’s (1740-1748) and the French and Indian (1754-1763) wars, both North American stages of larger global-scale conflicts. The conflicts were predominantly economic since territorial expansion would provide, among other things, more access to furs for the important fur trade (Ward 2003). Additionally, control over the area would give the British millions of acres of land to settle, while for the French, it would link their colonies in Canada with French Louisiana’s capital of New Orleans via the Ohio and Mississippi Rivers (Ward 2003). In 1749, Celeron de Bienville’s expedition into the Ohio Country from Montreal encountered large numbers of British traders along the Allegheny and Ohio Rivers (Hurt 1996). A few years later, the French erected a number of forts to legitimize their claim to the territory. In all, they constructed four forts from the south shore of Lake Erie to the Forks of the Ohio (Hunter 1960).

In 1753, a small party led by a young George Washington traveled along the Monongahela, Ohio, and Beaver Rivers on their way to Fort Le Boeuf on the Allegheny River on behalf of the governor of Virginia, Robert Dinwiddie (Darlington 1893; Washington 1893). The purpose of the envoy was to diplomatically expel the French from the Ohio Country. When the mission failed, the British conducted a series of campaigns between 1754 and 1758 to sack Fort Duquesne at the Forks of the Ohio and drive the French from the Ohio Country. These expeditions were led by Washington, as Lieutenant Colonel, in 1754, General Edward Braddock in 1755, and, finally, General John Forbes in 1758 (Anderson 2001). During Forbes’ campaign, the British found an abandoned Fort Duquesne. With the erection of Fort Pitt in 1761 on the
same site, the British effectively gained control of the Ohio Country, which was made official in 1763 with the signing of the Treaty of Paris (Anderson 2001).

**Euro-American Settlement Era**

From Pontiac’s Rebellion in 1763 through the American Revolution and into the post-Revolutionary Period, Euro-American settlement of the Ohio Country was slowed by Native American resistance. Initial settlement in Washington County, consisting of dispersed log cabins, occurred around 1766-1767 (Crumrine 1882). At the time, Virginia and Pennsylvania both claimed the territory. Between 1769 and 1780 Washington County was considered by Virginian sympathizers as part of Augusta and slightly later, the District of West Augusta (Crumrine 1882). In contrast, their Pennsylvanian neighbors considered the same territory to be part of Cumberland County, then Bedford (1771), and part of Westmoreland County (1773) (Martin 1938). Towns sprung up in the county around 1774, including the village of Augusta and one at Catfish Camp (Marotta 1985). As additional settlers moved to the area, Washington flourished, incorporating mainly Scots-Irish Baptists and Presbyterians immigrants (Creigh 1871; Forrest 1926). However, growth was tempered by a constant fear of Native American raids, resulting in the construction of small fortifications and blockhouses throughout the area (Albert 1896).

With the Pennsylvania-Virginia boundary dispute settled in 1781, the Pennsylvania legislature passed an act creating the county of Washington from Westmoreland County on March 28, 1781. Catfish Camp, later renamed Washington, was selected as the political and judicial seat. The original boundary included all of Greene and Beaver Counties and a considerable portion of Allegheny County divided into 13 townships (Caldwell 1876). However, its dimensions were reduced in 1788 to establish Allegheny County, in 1796 for Greene County,
and in 1800 for Beaver County (Caldwell 1876; Clint 1977). General Anthony Wayne’s victory at the Battle of Fallen Timbers in western Ohio in 1794 and the conclusion of the Treaty of Greene Ville in 1795 finally secured the frontier from further Native American attacks, thereby opening the region for sustained and unfettered Euro-American settlement (Buck and Buck 1939).

**Industrial Development Era**

Development in Washington County took place primarily along the Monongahela River and Chartiers Creek. There, many of the towns grew around the sites of early grist and saw mills. Subsistence farming was replaced with commercial farming as wheat became a widely cultivated cash crop (McFarland 1910). By the mid nineteenth-century, the sheep industry was the primary revenue-producing activity in the county and remained so until the turn of the century (Clint 1977).

Growth along the Monongahela River and Chartiers Creek continued, and other parts of the county were settled with the construction of the National Road in 1818, the Washington and Pittsburgh Turnpike in 1835, and the Chartiers Valley Railroad in 1871 (Crumrine 1882; Forrest 1926; Marotta 1985; McFarland 1910). At this point, land use shifted from predominantly agricultural to more industrial. A rapid population increase followed the discovery of coal, oil, and natural gas in the late 19th century. As a result, farmland was developed into towns to accommodate the miners and their families, thus causing significant increases in land values. All the while, sheep farming and wool production became less profitable by comparison (Clint 1977).

The first major industry to enter Washington County was oil drilling in the 1860s (Clapp 1907). Several wells drilled by the Washington Oil Company struck oil, although they were quickly abandoned due to also striking natural gas deposits that had little market value at the
time (Marotta 1985). In 1880, the largest natural gas strike was made on the site of the McGuin farm by the Morgan Oil Company (Clapp 1907). While this well was famous for its strength, it was the Hess well drilled in 1884 by the People’s Light and Heat Company that marked the beginning of widespread use of natural gas in Washington County (Marotta 1985). The apparently unlimited amount of natural gas ushered in the greatest industrial boom that Washington County had known, and the clean fuel was an attraction for both residential and commercial customers, since it could be used to better advantage than either coal or coke, and natural gas was cheaper (Marotta 1985). By 1886, dozens of wells in Washington County were supplying natural gas to Pittsburgh. Oil production, while profitable at first, quickly waned (Clapp 1907).

Coal mining ushered in the second period of industrialization of Washington County. The opening of the Pittsburgh Southern and the Chartiers Valley railroads expanded markets, leading to increased production in the mines along these corridors. Several mining companies linked their mines to main railways through rail spurs (Forrest 1926; Crumrine 1882). By the turn of the 20th century, lowering transportation costs was pivotal in maximizing profits. As a result, several companies consolidated and others established transportation subsidiaries (Marotta 1985). At the same time, companies established company towns near their mines, complete with housing, stores, infirmaries, and recreational facilities (Marotta 1985). Around World War I, mining methods shifted from shaft mining to a method of strip mining utilizing steam-powered shovels (Forrest 1926), with perhaps the earliest strip mine located in Chartiers Township.

When coal production in Washington County peaked in 1919, 65 companies operated 104 mines with an annual production of over 18 million tons of coal. At that time, coal mining was the largest single industry in the county (Marotta 1985; Forrest 1926). However, by 1926,
problems with labor unions and economic recession led to mine closures and production cuts (Forrest 1926). Today, only three mines employing 118 employees are in operation (Washington County 2011).

After fossil fuel production declined, farming once again became a major source of income for many of Washington County residents. Beginning in the 1930s, the chief source of farm income in Washington County was the dairy industry, with a peak production period lasting from 1945 through 1950 (Marotta 1985: 9-11). Agricultural products totaled 36.4 million dollars in 2007, with poultry and livestock providing the largest capital (Washington County 2011). Today, the county has over 2,000 registered farms, accounting for more than 80,937 ha (200,000 ac) of land (Washington County 2011).
CHAPTER 6: METHODOLOGY

Over the past twenty-five years, historic preservationists have been concerned over the destruction of archaeological sites by natural gas drilling stemming from expansive ground disturbances associated with drilling operations (Raber 1985:40-41). However, there have been few efforts to systematically document these effects. This research project attempts to measure the impact that natural gas drilling has had on known archaeological sites in Washington County. It also offers methods through which the impact in other regions of Pennsylvania can be measured. Through this first step, it may be possible to better understand the overall impact that these loosely-regulated activities have had on the archaeological heritage of Pennsylvania.

Washington County was selected as a case study for two reasons. First, it contains the highest density of recorded archaeological sites per square mile as well as the second highest number of recorded sites among Pennsylvania’s 61 counties (Strattan 2011). Secondly, it is one of the counties that is most heavily impacted by both conventional and Marcellus drilling operations (PA DEP 2012). Both of these characteristics make Washington County ideally suited as a case study through which the effects of natural gas exploitation on archaeological heritage can be measured. The research will focus on gas wells drilled during an 11-year period between 2000 and 2010.

At its core, this project is a spatial analysis of the geographic proximity of archaeological sites in relation to gas well locations. Therefore, defining sites that have been impacted is based on the amount of area, if any, that well locations and their development overlap archaeological sites. Such instances are considered impacted sites, and these sites were examined to determine the degree of impact to the site and the site’s potential eligibility for inclusion in the NRHP.
The following sections describe the primary datasets used for the study along with the methodologies that were employed in identifying impacted sites, measuring the level of impact to those sites, assessing their significance, and placing the results into a meaningful context within historic preservation efforts.

**Description of Datasets**

Three primary datasets were used in this study. Two of these are used to directly measure the impact that drilling activities have had on archaeological sites. The third dataset helps place the results into context by comparing the effects of drilling with those of federally-permitted projects that mandated cultural resource investigations during the same 11-year span.

**Archaeological Site Dataset**

As discussed in Chapter 5, there are 1,525 recorded archaeological sites in Washington County. Sites are broadly classified into two categories, prehistoric and historic (BHP 2012). Prehistoric sites range from small campsites with thin scatters of artifacts to large multi-acre villages containing thousands of artifacts and features. At a minimum, two to three culturally modified objects within 15 m of each other or the presence of a single subsurface cultural feature such as a fire pit constitute a pre-contact site (BHP 2012). Historic sites date from after the point of continued Native American and European contact until 50 years ago (BHP 2012). These sites include debris scatters that contain diagnostic artifacts (i.e. certain types of ceramic or glass artifacts), above ground and subsurface structures with associated debris scatters, and any industrial locality.

Archaeological sites are recorded with the BHP through the completion of a Pennsylvania Archaeological Site Survey (PASS) form. PASS forms contain information that describe the site’s location, contents, and age, if possible. Each site is assigned a number based on the Smithsonian’s Trinomial Site Designation System. This system is comprised of a three-part
alphanumerical identification that denotes the state and county in which the site is located and a sequentially-assigned site number for that county. For instance, for a site designated 36WH0001, “36” refers to Pennsylvania’s numerical code, “WH” refers to Washington County’s abbreviated code, and “0001” refers to the first site recorded in the County.

Site data recorded on the PASS forms are available through CRGIS, a map-based inventory of historic and archaeological sites stored in the files of the BHP. CRGIS is a cooperative venture of the PHMC and the Pennsylvania Department of Transportation (PennDOT) that is updated constantly as new data emerges. For this project, geographic data on recorded archaeological sites were drawn from CRGIS. The PHMC provided a Geographic Information System (GIS) shapefile and a Microsoft Access database of all known archaeological sites in Washington County as of 2011. According to the PHMC’s data quality statement regarding site data in the CRGIS, “all recorded archaeological sites that have locations are mapped and labeled [and] sites are being added as [they are] received” (PHMC 2012). In total, only 300 sites, or slightly over 1% of all known sites in Pennsylvania, do not have site locations. Therefore, the data from Washington County is considered current and complete.

Both professional and avocational archaeologists have been active in the recordation of archaeological sites since a system for such a process was first established in 1930 through the Pennsylvania Indian Survey (Fritz 2009; Held et al. 2012; Pittsburgh Post-Gazette Staff 1930). As a result, the quality of the data varies greatly based on the backgrounds of the recorders as well as technological innovations since then, such as the use of GIS and Global Positioning System (GPS). PASS requirements for site locations include Universal Transverse Mercator (UTM) coordinates for the site, and additionally, the BHP requests that site boundaries be outlined on a map (BHP 2007:5-6). Site boundaries are determined by the individuals recording
the sites. More often than not, boundaries have been drawn free-hand on USGS 7.5’ quadrangles for inclusion in the PASS with few of the boundaries based on systematic mapping of excavation results or the distribution of surface-recovered artifacts. In many instances, site boundaries represent buffers drawn around a single point mapped as the location of the site at the time of the original PASS form submission. Therefore, unless site boundaries were delineated systematically, those represented in CRGIS may need updating as new information is gathered.

The shapefile produced by the PHMC is projected using the North American Datum (NAD) 1983 geodetic reference in decimal degrees. Data fields for each site are limited to a database identification key, site name, and the trinomial site designation. Information on each site was therefore cross-referenced to the much fuller Microsoft Access database and the web version of CRGIS. The shapefile displays archaeological sites as polygons. These polygons represent the boundaries of the site as they were recorded and/or updated in the PASS files.

Natural Gas Well Dataset

Chapter 3 introduced the natural gas well data used for this project. These data were derived from annual state-wide production reports spanning the period between 2000 and 2010 (PA DEP 2012). In that time, 3,358 wells were located in the county, including 2,697 conventional and 661 Marcellus wells. Reports for each year were accessed as Comma Separated Values (CSV) files through Microsoft Excel. Information in the reports consist of well permit numbers, well status (active, inactive, plugged), property name, municipality, operator, latitude and longitude, type of well, and production figures. Latitudes and longitudes for each well are presented in decimal degrees using the NAD 1983 geodetic reference.

Once accessed, the records pertaining to Washington County from each report were extracted and a new Excel spreadsheet was created with only those fields. Initially, the spreadsheet contained over 12,000 records. These records were sorted by well permit number,
and duplicates were identified and deleted. The duplicates represented wells that were in production for multiple years and appeared in more than one report. Deletion of duplicates resulted in 3,517 records. Subsequently, geographic data were examined for these records, and a number of errors in the geographic information were identified. In total, 33 wells did not have any geographic data, three contained coordinates that placed them outside of Washington County, and 157 wells contained coordinates for multiple locations.

For obvious reasons, wells lacking geographic information and the three wells located outside of Washington County were excluded from additional analysis. Wells with multiple locations represented duplicates of the same well permit numbers. In all cases, geographic differences were within a few hundredths of a decimal degree. When these wells were identified, alphabetical identifiers were appended to the well permit numbers to differentiate them, i.e. well permit number 125-01300A and 125-01300B. Wells with multiple locations were considered only if one of their locations were found to have impacted an archaeological site. If this occurred, additional efforts were undertaken to identify the true location of the well, such as the examination of aerial imagery.

Based on the final spreadsheet, two separate point shapefiles of conventional and Marcellus wells were created in ArcCatalog from XY tables. From the table, latitude was selected as the X field and longitude as the Y field. NAD 1983 was chosen as the geographic coordinate system (PA DEP 2011:7). The resulting shapefiles depicted the entire sample of gas wells used in this project.

*Archaeological Survey Dataset*

An important component of the project is placing the findings into a context that can help preservation efforts. To do so, the findings are compared to other forms of development that required compliance with more stringent federal historic preservation laws and regulations.
during the same 11 year period. These projects included federally-sanctioned undertakings that fell under the purviews of Section 106 of the National Historic Preservation Act and Section 4F of the Department of Transportation Act. Project variables that were considered included areal extent of the undertakings and the number of archaeological sites that were impacted, including both previously recorded sites and sites discovered during the course of the undertakings.

As with the archaeological site dataset, details on these projects were drawn from CRGIS. For each project, the data in CRGIS included Environmental Review number (ER #), report title and date, government agency associated with the undertaking, investigator, phase of investigation, area impacted by the undertaking, the number of sites identified, and a link to a digitized abstract. Many of the abstracts contained additional information that was useful, such as survey dates and whether sites identified during the investigation were considered eligible by the investigator that conducted the research. According to PHMC’s data quality statement, “an estimated 90% of the surveys have been data entered and 64% have scanned abstracts attached” (PHMC 2012). Therefore, a number of projects in Washington County may be missing from the CRGIS files.

In total, 125 cultural resource management surveys took place between 2000 and 2010. Of these, 109 were Phase I level projects, which represent the identification component of cultural resource investigations. Of the Phase I projects, 104 were completely contained within Washington County and five extended beyond the county boundaries. Since CRGIS only lists total project data, the five projects that extend beyond Washington County included areas and affected sites from neighboring counties. Therefore, these projects were excluded from analysis since it proved difficult to extract the information that pertained only to Washington County.
Spatial Analyses

The basic methodology employed for this project consists of spatial analyses of gas well and archaeological site locations within a GIS. A GIS is a computer-based, integrative system that joins geographic data with other types of non-spatial information, and allows for the storage, manipulation, and mapping of that information (Ormsby et al. 2004). ESRI’s ArcMap v.10.1 and ArcCatalog were used for these analyses. Prior to analyses, spatial references for the archaeological site and gas well shapefiles were transformed from their original NAD 1983 geographic coordinate system to NAD 1983 UTM Zone 17N projected coordinate system to facilitate the measurement of distances and areas in the metric system. Once spatial data on gas well and archaeological site locations were acquired, created, and re-projected, the shapefiles were layered within ArcMap for spatial analyses.

ArcMap offers a series of geoprocessing tools in ArcToolbox that allow for the evaluation of spatial relationships between different data layers. Proximity and Overlay tools were used to define spatial relationships between archaeological site and gas well locations. Initially, buffers representing the area of gas well disturbance were drawn around gas well points through ArcMap’s Buffer tool. A buffer is a Proximity tool that represents a circular area drawn at a uniform distance around a feature (Ormsby et al. 2004:301). Buffers of approximately 0.81 ha (2 ac) and 2.02 ha (5 ac) were drawn around conventional and Marcellus wells, respectively. For conventional buffers, a radius of 50.758 m was selected in the “create buffer dialog box” to produce a buffer of 8,093.91 m² (two acres = 8,093.71 m²). For Marcellus buffers, a radius of 80.255 m was selected to create a buffer of 20,234.57 m² (five acres = 20,234.28 m²).

Once the buffers were established, Intersect Overlay in the Overlay tools was used to identify the locations where the two datasets overlapped (Ormsby et al. 2004:312-313). Locations where these overlaps occurred represent affected archaeological sites, and a new map
layer was produced to represent this information. The level of impact to each archaeological site was calculated based on the extent in which the features overlapped. Sites were classified according to a nominal scale based on percentage of impact to the archaeological site, in which minimally impacted (1-25%), moderately impacted (26-50%), heavily impacted (51-75%), and nearly or completely destroyed (76-100%) represent the spectrum of impact. Figure 11 shows a schematic representation of the spatial analysis depicting the gas well location and its buffer in relation to the archaeological site. Figure 12 illustrates an actual well location and its impact to an archaeological site on an aerial image.

In addition, up-to-date aerial images were surveyed to identify actual impacts to archaeological sites using ESRI’s World Imagery dataset (ESRI 2012). This approach helped identify not only sites impacted by well pad development but also by auxiliary facilities such as access roads, impoundment dams, and staging areas. Admittedly, the approach biased the dataset towards more recently developed wells, and in particular, to Marcellus shale gas wells.

Assessing Significance of Affected Sites

Concerted efforts were made to assess the significance of affected sites in terms of the NRHP. For this project, the significance of each site is measured under Criterion D, which stipulates that a site is significant if it has yielded or has the potential to yield information important in prehistory or history at the local, regional, and/or national scale (Advisory Council on Historic Preservation [ACHP] 2008). Significance was determined based on information that the BHP implicitly deems important based on the types of data gathered through their PASS forms, including temporal ascription, cultural affiliation, site setting, type of site, size of site, presence of features, types of artifacts, and the potential to contain organic remains.
Figure 11. Schematic representation of archaeological site and gas well buffer overlap.
Figure 12. Actual representation of archaeological site and well buffer overlap.
In some cases, eligibility of some sites has already been determined. Of the 1525 sites in the county included in CRGIS as of 2011, one is listed as a National Historic Landmark, two are listed on the NRHP, five are considered eligible for listing by the BHP, 48 are considered not eligible for listing by the BHP, and 1469 have produced insufficient data to make a determination. In addition, 71 of these sites are described as demolished or 100% destroyed. Table 3 provides details about sites listed on or considered eligible for listing on the NRHP.

Table 3. Sites Listed on or Considered Eligible for Listing on the NRHP.

<table>
<thead>
<tr>
<th>NRHP Status</th>
<th>Site Name</th>
<th>Site Number</th>
<th>Municipality</th>
<th>Period</th>
<th>Site Type</th>
<th>Status Date</th>
<th>Site Condition</th>
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<td>36WH0297</td>
<td>Jefferson</td>
<td>Prehistoric</td>
<td>Rockshelter/Cave</td>
<td>2005</td>
<td>90-100% intact</td>
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<td>Listed</td>
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<td>36WH0617</td>
<td>West Bethlehem</td>
<td>Historic</td>
<td>Commercial</td>
<td>1978</td>
<td>90-100% intact</td>
</tr>
<tr>
<td></td>
<td>“S” Bridge</td>
<td>36WH1058</td>
<td>Buffalo</td>
<td>Historic</td>
<td>Industrial</td>
<td>1975</td>
<td>11-49% intact</td>
</tr>
<tr>
<td>BHP Eligible</td>
<td>Lindley Village</td>
<td>36WH0073</td>
<td>South Strabane</td>
<td>Prehistoric</td>
<td>Village</td>
<td>2007</td>
<td>50-89% intact</td>
</tr>
<tr>
<td></td>
<td>Lindley</td>
<td>36WH0074</td>
<td>South Strabane</td>
<td>Prehistoric</td>
<td>Open, unknown function</td>
<td>2008</td>
<td>90-100% intact</td>
</tr>
<tr>
<td></td>
<td>Rice / Mon City</td>
<td>36WH0737</td>
<td>Carrol</td>
<td>Prehistoric</td>
<td>Village</td>
<td>N/A</td>
<td>90-100% intact</td>
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<tr>
<td></td>
<td>Williamson Station</td>
<td>36WH1298</td>
<td>Blaine</td>
<td>Historic</td>
<td>Unknown / Other/ Multiple Types</td>
<td>2002</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Tower 8</td>
<td>36WH1468</td>
<td>South Franklin</td>
<td>Prehistoric</td>
<td>Open, habitation</td>
<td>2010</td>
<td>N/A</td>
</tr>
</tbody>
</table>

In instances where impacted sites had already been evaluated, the assessment of significance deferred to existing determinations. For sites that have not been assessed, their significance was considered according to their potential to contribute information important to prehistory or history. If such potential was evident, sites were defined as sites that may be eligible for the NRHP (King 2004). This approach allowed for flexibility in making determinations in lieu of extensive testing often necessary for actual determinations of eligibility.
Admittedly, this approach may have overlooked sites that could be considered significant through different theoretical perspectives or with fuller data.

**Contextualizing Project Results**

In order to place the results of the project into a meaningful context, comparisons were made between the effects of drilling in Washington County with other forms of development that are more strictly regulated by historic preservation legislation. Such comparisons may show whether or not natural gas exploitation poses a similar threat as these other forms of development. The data derived from examining cultural resource surveys undertaken under Section 106 of the NHPA served as the litmus test through which the impact of drilling activities was measured. Preliminary figures derived from the 104 projects located entirely in Washington County in the same 11-year period indicate that 1,901 ha (4,698 ac) have been impacted by a variety of federal projects. Undertakings seeking permits from the US Army Corps of Engineers account for the majority of these projects. Federal Energy Regulatory Commission and Federal Highway Administration projects are also well-represented. In total, these 104 projects have impacted 95 archaeological sites, including 34 previously-recorded and 56 newly-recorded sites.
CHAPTER 7: RESULTS

In total, the study identified 74 archaeological sites that appeared to have been impacted or are in eminent danger of being impacted by wells permitted from 2000 to 2010 (Figure 13). Of these 74 sites, 13 were impacted by wells drilled before 2000 or were destroyed by other development prior to drilling. In addition, one site was not impacted by drilling activities near it despite initial indication that it was. These 14 sites were omitted from further analyses. Of the remaining 60 sites, 51 have been impacted by wells drilled from 2000 to 2010 and nine are threatened by wells permitted during the same period but had not been drilled as of December of 2012. Furthermore, 39 of the 60 sites were identified through the proximity and overlay spatial analyses and 21 of the 60 sites were identified by reviewing high resolution aerial imagery of well locations.

Figure 13. Distribution of archaeological sites identified during the study.
The following chapter synthesizes data on the 60 sites that were impacted or are threatened by drilling activities. It also identifies patterns in the effects of drilling on the archaeological heritage of Washington County and compares the effects of drilling with more strictly regulated undertakings. Appendices II and III provide details about each of the 74 sites identified during the course of this study (whether impacted or not), including site setting, size, temporal affiliation, eligibility status, information about the impacting gas wells, and the degree of impact.

**Impacted Sites**

Proximity and overlay analyses of the distribution of archaeological sites and locations of natural gas wells permitted between 2000 and 2010 identified 39 locations where well buffers and archaeological site boundaries overlapped. The overlap represents the portion of the archaeological site impacted or threatened by drilling activities. Each of these locations was verified by reviewing high resolution aerial imagery (ESRI 2012), and areas of impact were amended based on disturbances visible on the aerial imagery. Attention was given to changes in vegetation, exposed ground surface, paving, and other signs of well development. The 39 sites are summarized in Table 4.

Proximity and overlay analyses identified 18 sites that were impacted by conventional gas wells and 21 sites that were impacted by Marcellus gas wells. However, these analyses presented only a partial picture of the effects of gas drilling on archaeological sites. An additional 21 sites were impacted by well development that occurred outside of the proximity analysis buffers (Table 5). In all instances, these sites were affected by the development of Marcellus gas wells and were identified through a review of well locations on high resolution aerial imagery (ESRI 2012). Drilling pads that exceeded the 5-acre buffer estimate or facilities
Table 4. Impacted Sites Identified through the Proximity and Overlay Analyses.

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Impact Category (^a)</th>
<th>NRHP Status</th>
<th>Cultural Period</th>
<th>Well Type</th>
<th>Company</th>
<th>Year Permitted</th>
</tr>
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<tbody>
<tr>
<td>36WH0033</td>
<td>2</td>
<td>May Be Eligible</td>
<td>Prehistoric</td>
<td>Conventional</td>
<td>Kriebel Minerals</td>
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<tr>
<td>36WH0103</td>
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<td>Insufficient Data</td>
<td>Prehistoric</td>
<td>Conventional</td>
<td>CNX Gas</td>
<td>2009</td>
</tr>
<tr>
<td>36WH0123</td>
<td>2</td>
<td>May Be Eligible</td>
<td>Prehistoric</td>
<td>Marcellus</td>
<td>Range Resources</td>
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<td>Prehistoric</td>
<td>Conventional</td>
<td>Range Resources</td>
<td>2007</td>
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<td>Prehistoric</td>
<td>Conventional</td>
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<td>Insufficient Data</td>
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<td>Marcellus</td>
<td>Range Resources</td>
<td>2009</td>
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<tr>
<td>36WH0243</td>
<td>1</td>
<td>May Be Eligible</td>
<td>Prehistoric</td>
<td>Marcellus</td>
<td>Range Resources</td>
<td>2006</td>
</tr>
<tr>
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<td>Mason Stephen</td>
<td>2004</td>
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<td>Marcellus</td>
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</tr>
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<td>Site Number</td>
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<td>NRHP Status</td>
<td>Cultural Period</td>
<td>Well Type</td>
<td>Company</td>
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<td>Conventional</td>
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<td>Conventional</td>
<td>Mountain V</td>
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<td>1</td>
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<td>Prehistoric</td>
<td>Conventional</td>
<td>Consol Ind</td>
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<td>36WH1503</td>
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<td>2008</td>
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</table>

<sup>a</sup>Impact category refers to amount of site impacted, wherein Category 1 is Minimally Impacted (0.1-25%), Category 2 is Moderately Impacted (26-50%), Category 3 is Heavily Impacted ((51-75%), and Category 4 is Nearly or Completely Destroyed (76-100%).
<table>
<thead>
<tr>
<th>Site Number</th>
<th>Impact Category&lt;sup&gt;a&lt;/sup&gt;</th>
<th>NRHP Status</th>
<th>Cultural Period</th>
<th>Company</th>
<th>Year Permitted</th>
<th>Type of Impact</th>
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<td>Prehistoric</td>
<td>Range Resources</td>
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<td>Range Resources</td>
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<td>Access Road</td>
</tr>
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<td>Range Resources</td>
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<td>Prehistoric</td>
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<td>2008</td>
<td>Access Road and Well Pad</td>
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<td>2008</td>
<td>Access Road</td>
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</tbody>
</table>

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not included in the well permit geographic information such as staging areas, impoundment dams, and access roads impacted these sites. It should be noted that the identification of sites outside of the proximity buffers depended on the amount of area covered by well development and the recentness of drilling activities, both of which tended to bias towards Marcellus well development.

Drilling activities impacted or threaten sites situated in a variety of topographic settings, including floodplains, hill tops, ridge spurs, ridge tops, saddles, slopes (lower, middle, and upper), stream benches, and terraces. However, 73% (N=44) of the sites are located in upland settings (hill tops, ridges, saddles, and slopes) (Figure 14). The disparity in affected upland and lowland sites is due to 100- to 300-foot setbacks from blue-lined streams, springs, or bodies of water as identified on the most recent 7.5 USGS topographic quadrangle (58 PA Cons. 3215). Therefore, upland archaeological sites are more vulnerable to drilling activities than lowland

Figure 14. Distribution of archaeological sites according to topographic setting, all sites.
Sites. Sites located near bodies of water not identified on the topographic quadrangles are also vulnerable.

The 60 affected or threatened archaeological sites contained a minimum of 87 temporal components spanning the Paleoindian period to the early 20th century (Figure 15). Prehistoric components were overwhelmingly more likely to be impacted than historic ones. Only two of the 60 sites contained Historic components. Expectedly, fewer historic sites were affected because of 200- to 500-foot setbacks from existing buildings (58 PA Cons. 3215). By nature, most historic sites are associated with extant buildings or above-ground remnants of building foundations, and are therefore more likely to be avoided than prehistoric sites.

Impacts or threats occurred to a variety of site types (Figure 16). The major category pertained to undefined site types, or sites where a particular function cannot be attributed based on existing data. Alarmingly, nine habitation sites, three burial mounds, and two villages were impacted by drilling activities. Not only do these types of site generally contain significant data that could contribute to a better understanding of past lifeways, they also have a high potential of containing human remains. Burial mounds were created for the explicit purpose of interring the deceased (Dragoo 1989) and the burial of community members within the confines of villages was a common practice of the Late Prehistoric Monongahela Tradition (Johnson et al. 1989).

Efforts were made to assess the eligibility of affected sites for inclusion in the NRHP based on the data contained in CRGIS (Figure 17). One site, the Tower #8 site (36WH1468) was considered eligible by the BHP after Phase II investigations were conducted by Christine Davis Consultants, Inc. in 2010. An avoidance plan was drafted and no additional work was recommended, but development occurred near the site that heavily impacted it (see Appendix II). At this point, the development cannot be associated with either mining or drilling activities, or
Figure 15. Distribution of temporal components, all sites.

Figure 16. Distribution of site types, all sites.
Nearly half (47%; N=28) of the affected sites may be eligible for inclusion in the NRHP under Criterion D. Artifacts recovered from these sites indicate a strong possibility that archaeological deposits could contribute to an understanding of local, regional, or national history. However, additional investigations would be necessary to determine their eligibility. Unfortunately, impacts or potential impacts to 39% (N=11) of these sites exceeded more than half of their site areas. As heavily impacted, nearly destroyed, or destroyed archaeological resources, the integrity of their deposits may have been compromised to the extent that they cannot be eligible for inclusion in the NRHP. Forty-three percent of the affected or threatened sites have produced insufficient data to determine their eligibility. As with sites that may be eligible, added research could resolve their eligibility status. Unfortunately, 27% (N=7) of these sites have been or will be heavily impacted, nearly destroyed, or completely destroyed. Only eight percent (N=5) of the sites were considered not eligible at this point.

Figure 17. Eligibility status, all sites.
Drilling Trends and its Effects on Archaeological Sites

Overall, the data suggests that Marcellus well development presents a greater threat to archaeological sites than conventional drilling. Fifty-four percent of the sites identified through the proximity and overlay analysis were impacted or are threatened by Marcellus wells despite the fact that there were four times as many conventional gas wells drilled from 2000 to 2010 (Figure 18). The occurrence rises to 70% when the additional 21 sites are considered. This trend is further highlighted by examining temporal trends in drilling activities and how they have or will impact sites. As shown in Figure 2, Marcellus gas exploration in Pennsylvania began in 2005, and in the following years, the number of Marcellus wells that were drilled increased from two to 1,446 by 2010. Conventional gas drilling peaked state-wide between 2006 and 2008 before sinking considerably in 2009 and 2010. The majority of sites (82%, N=33) identified through the proximity and overlay analyses were impacted or are threatened by wells permitted between 2006 and 2010, and most of these (59%, N=21) by Marcellus well development (Figure 19). When considering the 21 additionally impacted sites, 87% (N=52) were impacted or are threatened by wells permitted between 2006 and 2010, with 75% (N=39) of these by Marcellus wells (Figure 20).

Moreover, Marcellus well development is more likely to severely impact or completely destroy archaeological sites (Figure 21). In total, the impact from Marcellus drilling to 15 sites was or will be greater than 50% of the site area (i.e., heavy to nearly or completely destroyed) as compared to three sites from conventional drilling. Conversely, 84% (N=16) of sites affected by conventional well development have been or will be minimally to moderately impacted (i.e. less than 50% of the site area destroyed) as compared to 63% of sites impacted or threatened by Marcellus wells.
Figure 18. Percentage of archaeological sites impacted by Marcellus and conventional well development as identified through Proximity and Overlay spatial analyses.

Figure 19. Comparison of the number of archaeological sites impacted by Marcellus and conventional wells between 2000-2005 and 2006-2010 as identified through the Proximity and Overlay spatial analyses.
Figure 20. Comparison of the number of archaeological sites impacted by Marcellus and conventional wells between 2000-2005 and 2006-2010, all sites.

Figure 21. Level of impact to sites by Marcellus and conventional wells, all sites.
One of the concerns regarding Marcellus gas production is the amount of area necessary for the development of wells, particularly with the practice of seating multiple wells in the same location (Espino 2011b; Ladlee and Jacquet 2011). According to the DEP, drilling pads for Marcellus wells range in size from 1.21 to 2.02 ha (3 to 5 ac) depending on the depth of drilling (PA DEP 2010:2), and therefore are exempt from consideration under the History Code (see Chapter 2). However, these estimates do not take into account added disturbance from access roads, staging areas, impoundment dams, and transmission gas lines. A recent study examining the footprints of 242 Marcellus well pads on 2008 aerial imagery indicated that well pads occupied on average 1.25 ha (3.1 ac) while the associated infrastructure amassed to an additional 2.31 ha (5.7 ac) of disturbance (Johnson 2010).

A review of high resolution aerial imagery of Marcellus well locations that impacted archaeological sites indicates that well pad development along with the necessary facilities can exceed the DEP’s five-acre estimates as well as the 10-acre threshold. Analysis of 20 well sites whose development area could be traced, either because the wells had been recently developed or were in the process of being developed at the time of the imagery, revealed that all 20 of the wells covered areas greater than 2.02 ha (5 ac) and nine measured more than 4.05 ha (10 ac) (Table 6). The largest of these wells approached 8.09 ha (20 ac) of land disturbance (Figure 22). These 20 Marcellus wells impacted 55% (N=33) of the affected or threatened sites. As it currently stands, development of well sites are being permitted in such a way that each component is reviewed separately (PA DEP 2010b, 2011). This project segmentation generally ensures that individual components will not exceed 10 acres. Unfortunately, the cumulative impact of the necessary development and all associated infrastructure to extract gas is not being considered.
Table 6. Summary Area of Marcellus Well Development.

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Figure 22. Example of Marcellus well development
The Effects of Natural Gas Drilling in Perspective

The scale of natural gas drilling in Washington County from 2000 to 2010 in terms of ground disturbance appears to be over twice that of federally-sanctioned undertakings regulated by Section 106, development occurring on state land and regulated by the History Code, and non-exempt coal mining CRM projects that took place during the same period (Table 7). The combined area of potential effects for 86 CRM projects required by the NHPA and History Code covered a total of 1,640 ha (4,052 ac). Estimates based on 0.81 ha (2 ac) for conventional wells and 2.02 ha (5 ac) for Marcellus wells amass to 3,500 ha (8,650 ac) of ground disturbance.

The impact to the recorded archaeological heritage of Washington County appears to be on proportional scale. As a result of archaeological investigations related to the NHPA and History Code projects, 34 previously recorded sites were identified, indicating that one previously recorded site is affected for every 48 ha (118 ac) of development. This study identified 60 previously recorded sites that were affected or threatened by drilling activities and six more sites that would have been impacted had they not been previously destroyed. Therefore, it is estimated that one recorded site is affected for every 53 ha (130 ac) of well development.

In terms of previously unknown sites, 53 sites were newly recorded during the course of investigations related to the NHPA and History Code projects. This shows that one newly recorded site is affected for every 30 ha (74 ac) of development. Proportionally, it is estimated that one previously unknown site is affected for every 35 ha (86 ac) of well development. Therefore, it is projected that 100 previously unknown sites have been affected by drilling activities. The overall effect of natural gas drilling activities on the archaeological heritage of Washington County may be the partial or complete loss of at least 166 sites (Figure 23).
Table 7. CRM Projects Undertaken from 2000 to 2010.

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Figure 23. Comparison of total affected sites between CRM projects and drilling activities.
CHAPTER 8: SUMMARY AND CONCLUSIONS

Spatial analyses and a review of high resolution aerial imagery identified 60 previously recorded sites that were affected or threatened by drilling activities undertaken from 2000 to 2010. These sites contained at least 87 separate components spanning the Paleoindian period through the early 20th century. Analysis of site attributes indicated that upland prehistoric sites were more likely to be affected by drilling. A variety of site types were affected, including habitation sites, villages, and burial mounds, although the majority of sites had not produced sufficient data to assign a function. One of the sites affected was eligible for inclusion in the NRHP and five sites were considered ineligible for inclusion. The vast majority of sites, however, may be eligible for inclusion or are undetermined due to a lack of data.

Marcellus well development appears to present a greater threat to archaeological resources than conventional drilling, and the pace of development has impacted or threatened considerably more sites since 2006. The study also determined that drilling activities are as destructive as other forms of development that are more strictly regulated by NHPA and History Code. Based on the number of newly recorded sites resulting from these types of projects, it is estimated that drilling activities from 2000 to 2010 have adversely affected 100 previously unknown sites. In all, drilling activities during that span may have adversely affected over 160 sites, or nearly 10% of the known archaeological record of Washington County.

The effects of drilling activities on archaeological sites in Washington County are alarming, and similar situations are likely present in the entire Marcellus shale region. Additional studies in other counties are necessary to understand the overall effects of natural gas drilling on the archaeological heritage of Pennsylvania. As noted earlier, Washington County contains the highest density of known archaeological sites in the Commonwealth, and the results
reported herein may be reflection of that high density. Studies in other counties where site numbers and densities are less may reveal different patterns.

In Pennsylvania, several steps are necessary to avoid unnecessary and unregulated impacts to archaeological sites. First, the DEP needs to recognize the threat that drilling activities pose to the archaeological heritage of the Commonwealth. In doing so, a reevaluation of the 10-acre exemption is necessary. The ten-acre threshold is extremely problematic for a number of reasons. Most archaeological sites in Pennsylvania are smaller than ten acres, and as shown, drilling activities related to both conventional and Marcellus well development can largely if not completely destroy sites. Moreover, since permits for activities that do not cross this threshold are not reviewed by the BHP, previously recorded sites, eligible sites, and even sites on the National Register or Pennsylvania Register of Historic Places are not protected. As such, there is no concrete way to track the impact drilling activities on the known archaeological record. By removing or decreasing the threshold, permit applications for well development can be reviewed by the BHP. At the very least, the BHP can then notify the permit applicant if a known archaeological site falls within their project area, and steps to avoid archaeological sites can be taken. As it currently stands, the lack of BHP review does not allow for this basic information to be known, and therefore, avoidance strategies cannot be developed.

Secondly, the practice of project segmentation should cease, and the cumulative effects that developing a well causes must be assessed together. Consideration of these cumulative effects should include the development of the well pad along with related facilities that make the function of the well possible, including access roads, impoundment dams, and gas transmission lines in their entirety (McDougal 2013). Assessing the cumulative effects may show that well development often times exceeds the 10-acre threshold. One way to ensure that the cumulative
Thirdly, the DEP, BHP, and oil and gas industry should commit to developing strategies that will help avoid archaeological resources. These strategies may include the use of predictive models or GIS-based analyses to develop areas of high probability for containing archaeological resources (Espino and Shamsi 2013). Other strategies could include archaeological testing at known sites or in areas of high probability in lieu of testing that often occurs in areas of low potential for archaeological resources as required by the U.S. Army Corps of Engineers (McDougal 2013). Such a strategy would maximize the results of investigations at the level of effort already being expended.

Finally, and on a broader scale, changes to the historic preservation landscape in Pennsylvania are necessary. If Act 70 of the History Code is going to require the state government to fund and undertake archaeological surveys and investigations on projects seeking permits from the state, then the BHP needs to be funded in a way that allows them to perform their constitutional duties. The now-defunct CAP program (McDougal 2013) needs to be reinstated with proper funding. As they have shown, the CAP program successfully salvaged important information quickly and efficiently from affected sites (CAP 2000). If the BHP cannot be properly funded for political or financial reasons, then developers should be required to fund archaeological investigations for their projects. While these projects provide economic stimulus to local communities, it is the developers that stand to gain the most (Roberts 2000:66). Pennsylvania’s citizens, therefore, should not be required to subsidize their projects.

Shifting the costs of archaeological investigations to developers could be done in a number of ways. For well developers, monies set aside for financial assurance bonds for
environmental cleanup and regulation, such as those required by the Delaware River Basin Commission (Soroghan 2010), could be used in part to fund cultural resource investigations of well sites. Similarly, portions of capital raised through severance taxes of gas production could be used to properly fund the BHP and restore the CAP program. Another method would be to extend historic preservation tax incentives and/or credits beyond the rehabilitation of older buildings (National Park Service 2009) to cultural resource investigations. This may be an effective way to encourage developers to consider the effects of their projects on cultural resources, including archaeological sites.

At the very least, concerns about the impacts of natural gas drilling on the Commonwealth’s archaeological and cultural heritage need to be addressed publicly, especially because estimates of new Marcellus well pads range from 6,000 to 15,000 by 2030 (Johnson 2010). Historic preservationists must avoid complacency with the current legislation and practices, and frequently readdress the problems that Act 70 poses to preservation efforts. With the mercurial nature of politics, hopefully these concerns will eventually be heard. After all, it is the constitutional duty of Pennsylvania’s legislators and all of its citizens to ensure the protection of the Commonwealth’s cultural and historic heritage for the benefit of this and future generations.
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Ward, Matthew C.


Washington County


Washington, George.


### APPENDIX I: LIST OF ACRONYMS

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APPENDIX II: INVENTORY OF IMPACTED SITES

The following appendix provides descriptions of 61 sites that have been impacted or are soon to be impacted by drilling activities. This inventory constitutes the data used in developing the project’s results discussed in Chapter 8.

This appendix is divided into four sections based on the relationship of the gas wells and archaeological sites. The first section provides an inventory of sites that have been impacted by wells drilled between 2000 and 2010. It lists sites that were identified through the overlap of well buffers and site boundaries. The second section lists sites that fell outside of the well buffers but were impacted by well pads that exceeded their buffer area as well as auxiliary drilling facilities such as access roads, staging areas, and impoundment dams. The third section describes archaeological sites recorded after 2010 but were impacted by wells permitted between 2000 and 2010. Finally, the fourth section includes sites that are in imminent danger of destruction by wells permitted between 2000 and 2010 but were not drilled as of December of 2012.

Descriptions of the sites are based on data contained in CRGIS, and when available, in published materials. Each description includes information on the site’s location, size, contents, cultural and temporal affiliation, and potential eligibility for inclusion in the NRHP. In addition, information on the wells follow these descriptions, including the number and types of wells that impacted the site, the well operator, the area of disturbance, and the percentage of the site affected. Where appropriate, high resolution aerial imagery (0.3 m resolution) depicting impacted sites is included (ESRI 2012).
Archaeological Site – Well Buffer Intersects, Wells Drilled Between 2000 and 2010

The following section describes archaeological sites that were impacted by gas wells permitted and drilled between 2000 and 2010. These sites were identified based on the overlap of well buffers and site boundaries.

Shaffer Inc. Site (36WH0123)

The Shaffer Inc. site (36WH0123) is located on the upper slopes of a ridge spur above Cross Creek in Mount Pleasant Township. It is a multi-component site containing Early and Middle Woodland occupations as well as a Late Prehistoric, Monongahela Tradition village. The site covers an area of 0.83 ha (2.06 ac). It was recorded in 1967 through an informant interview or amateur survey, and at that time, the site was 90 to 100% intact. Midden areas were noted while Monongahela cord-marked pottery and ground or polished stone artifacts were recovered, including three discoidals that are curated at the Carnegie Museum of Natural History. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site has the potential to yield significant data concerning Late Prehistoric village life in the Cross Creek watershed, a drainage containing only three Late Prehistoric/Late Woodland villages and 15 habitation sites. Therefore, the Shaffer Inc. site may be eligible for listing.

The site was impacted by a Marcellus gas well (Well Permit #125-22277) drilled by Range Resources Corporation in 2006. The well was placed approximately 30 m (98 ft) southwest of the site. Spatial analysis of the 5-acre buffer suggests that drilling activities destroyed an estimated area of 0.31 ha (0.76 ac), or 37% of the site. Aerial imagery of the location shows a largely reclaimed landscape as required by the DEP (PA DEP 2009) (Figure 13).
Figure 24. Impact to the Shaffer Inc. site (36WH0123).
**Patterson #4 (36WH0141)**

The Patterson #4 site (36WH0141) is a large, prehistoric site situated on a ridge and saddle above Millers Run in Cecil Township. The site covers an area of 1.23 ha (3.04 ac). It was recorded in 1967 through an informant interview or amateur survey, and at that time, it was 90 to 100% intact. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a home-use conventional gas well (Well Permit #125-00953) operated by New Century Energy, Inc. between 2000 and 2002. The well was drilled 12 m (39 ft) east of the site. Spatial analysis of the 2-acre buffer suggested that drilling activities destroyed an estimated area of 0.23 ha (0.58 ac), or 19% of the site. However, aerial imagery of the location shows more limited disturbance to the site (Figure 14). The actual impact of the drilling activities appears to be 0.4 ha (0.09 ac), or 3%.

**Brush Run (36WH0173)**

The Brush Run site (36WH0173) is a large prehistoric site situated on the middle slopes of a ridge spur at the headwaters of Brush Run in Cecil Township. The site covers an area of 1.28 ha (3.15 ac). It was recorded in 1967 through an informant interview or amateur survey, and at that time, it was 90 to 100% intact. An unspecified number and types of stone tools were recovered. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by four Marcellus gas wells (Well Permit # 125-23595, 125-23908, 125-23909, and 125-23994) drilled by Range Resources Corporation in 2009 and 2010. The DEP geographic data indicated that the wells were placed in the southern portion of the site. Spatial analyses of their 5-acre buffers suggested that drilling activities impacted an estimated area of 1.23 ha (3.05 ac), or 97% of the site. However, aerial imagery depicts the well site in
development, with a large pad area, impoundment dam, and other earth disturbances (Figure 15). The center of the pad is located 35 m (115 ft) northwest of the well permit locations. Therefore, the actual impact of the drilling activities appears to be 1.09 ha (2.71 ac), or 86% of the site.

*Moore Lower (36WH243)*

The Moore Lower site (36WH0243) is a small Paleoindian site situated on the lower slopes of a ridge spur above Cross Creek in Mount Pleasant Township. Recorded in 1968 through an informant interview or amateur survey, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. The PASS record for the site was updated in 2011, at which point it was described as being 11-49% intact due to private, commercial, or industrial development. According to CRGIS, stone tools and debitage were recovered, including a Clovis biface (CMNH Catalog # 6082) made from chert. The artifact was not included in Fogelman and Lantz’s (2006) inventory of fluted bifaces from Pennsylvania. In addition, CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could yield important information regarding Paleoindian settlement and resource procurement patterns. Therefore, it may be eligible for inclusion in the NRHP.

The site was impacted by a Marcellus well (Well Permit # 125-22283) drilled by Range Resources Corporation in 2006. The well was placed about 25 m (82 ft) east of the site. Spatial analysis of the 5-acre buffer suggested that drilling activities destroyed 100% of the site. However, aerial imagery of the location shows more limited disturbance to the site. (Figure 16). The actual impact of the drilling activities appears to be 0.04 ha (0.11 ac), or 15% of the site.
Figure 25. Impact to the Patterson #4 site (36WH0141).
Figure 26. Impact to the Brush Run site (36WH0173).
Figure 27. Impact to the Moore Lower site (36WH0243).
**MS #66 (36WH0375)**

The MS #66 site (36WH0375) is a large multi-component situated on the upper slopes of a ridge top along above an unnamed tributary of Cross Creek in Cross Creek Township. The site covers an area of 5.40 ha (13.36 ac). It was recorded in 1974 during University of Pittsburgh’s Cross Creek survey (Carlisle and Adovasio 1984), and at that time, it was described as 90-100% intact. Chipped stone tools and debitage were recovered from the site, including a Clovis biface made from chert. The artifact was not included in Fogelman and Lantz’s (2006) inventory of fluted bifaces from Pennsylvania. Chalcedony artifacts had also been recovered. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could provide important information regarding Paleoindian settlement and resource procurement patterns. Therefore, it may be eligible for inclusion in the NRHP.

The site was impacted by a two Marcellus wells (Well Permit # 125-22959 and 125-23515) drilled by Atlas Resources, Inc. in 2010. The wells were placed along the northeastern boundary of the site. Spatial analysis of the 5-acre buffer suggests that drilling activities destroyed an estimated area of 1.10 ha (2.73 ac), or 20% of the site. However, aerial imagery of the location shows greater disturbance to the site (Figure 17). The actual impact of the drilling activities appears to be 1.38 ha (3.42 ac), or 26% of the site. The access road for the well impacted Site 36WH519 (see below).

**J B Wilson Campsite (36WH0594)**

The J B Wilson Campsite (36WH0594) is a small Middle Woodland habitation site situated on the middle slopes of a ridge spur above Little Tenmile Creek in West Bethlehem Township. Recorded in 1978 through an informant interview or amateur survey, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries.
Middle Woodland bifaces were recovered from the site, which at that time was 90 to 100% intact with some limited natural disturbance. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the J B Wilson Campsite could contribute important information regarding Middle Woodland technology and lithic procurement strategies, both of which are poorly understood. Therefore, the site may be eligible for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-23126) drilled by Atlas Resources, LLC in 2008. The well was placed less than 45 m from the eastern boundary of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities destroyed an estimated area of 0.02 ha (0.05 ac), or 6% of the site. Aerial imagery of the location shows a predominantly wooded area cleared for the installation of the well with limited impact to the eastern boundary of the site (Figure 18). The actual impact to the site largely corresponds to the estimated impact.

36WH0690

Site 36WH0690 is a large Late Archaic site situated on a floodplain of Tenmile Creek in South Franklin Township. The site covers an area of 3.55 ha (8.76 ac). It was recorded in 1980 as part of a PHMC grant, and at that time, it was 90 to 100% intact. Late Archaic bifaces identified as Laurentian Archaic (i.e. Brewerton, Lamoka, and Otter Creek) were recovered. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, buried and intact Late Archaic features may be present due to its topographic setting, providing important information on Late Archaic chronology and subsistence. Therefore, site 36WH0690 may be eligible for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-01852) drilled by Mason Stephen in 2004. The well was placed less than 15 m from the northeastern boundary of
the site. Spatial analysis of the 2-acre buffer suggests that drilling activities destroyed an estimated area of 0.20 ha (0.50 ac), or only 6% of the site. However, the well was placed north of Cracraft Road, where only a small portion of the site sits. Aerial imagery of the location shows minimal impact to the site from the instillation of this well (Figure 19). The actual impact of the drilling activities appears to be 0.01 ha (0.03 ac), or less than 1% of the site.

Salvivi (36WH0707)

The Salvivi site (36WH0707) was a small multi-component site containing Early Archaic, Middle Archaic and Late Woodland deposits. The site was situated on a saddle at the drainage divide between Georges Run and Cross Creek in Mount Pleasant Township. Recorded in 1980, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. Chipped stone tools, lithic debitage, and fire-cracked rock were recovered from the site, which at the time was 90 to 100% intact. Diagnostic artifacts include Kirk Corner-Notched, MacCorkle, Kanawha, Laurentian Tradition, and Jack’s Reef Corner Notched biface made from a variety of local and exotic cherts (Fischer and Tippins 2013). CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may have been present on the site, possibly adding significant information concerning Middle Archaic and Middle Woodland chronology and subsistence. Therefore, the Salvivi site may be eligible for inclusion in the NRHP.

The site was impacted by a Marcellus gas well (Well Permit # 125-22508) drilled by Range Resources Corporation in 2006. The well was placed within the southwestern edge of the site. Spatial analysis of the 5-acre buffer suggests that drilling activities destroyed an estimated 100% of the site. Aerial imagery of the location shows the site largely impacted by the well’s impoundment dam, well pad, and access road (Figure 20).
Hamilton Farm (36WH0717)

The Hamilton Farm site (36WH0717) was a small Middle Archaic site situated on a ridge spur above Brush Run in Hopewell Township. Recorded in 1983, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. Chipped stone tools, including notched and stemmed bifaces, pestles/grinding stones, pitted stones, and hammer stones, were recovered from the site. At the time of recordation, the site was 90 to 100% intact. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could yield important information about Middle Archaic lithic procurement strategies based on its geologic position above chert bearing bedrock formations and the presence of lithic reduction tools such as pitted and hammer stones. Therefore, the Hamilton Farm site may be eligible for inclusion in the NRHP.

The site was impacted by nine Marcellus gas wells (Well Permit # 125-23864, 125-23905, 125-23906, 125-23970, 125-23971, 125-23972, 125-24011, 125-24012, and 125-24013) drilled on the same well pad by Range Resources Corporation in 2010. The wells were placed less than 30 m northeast of the site’s boundary. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed an estimated area of 0.27 ha (0.66 ac), or 92% of the site. However, aerial imagery of the location shows more extensive land disturbance that impacted 100% of the site (Figure 21). The same well pad also impacted the Hamilton #3 site (36WH1003) (see below).
Figure 28. Impacts to the MS #66 site (36WH0375) and Site 36WH0519.
Figure 29. Impact to the J.B. Wilson Campsite site (36WH0594).
Figure 30. Impact to Site 36WH0690.
Figure 31. Impact to the Salviv site (36WH0707).
Figure 32. Impacts to the Hamilton Farm (36WH0717) and Hamilton #3 (36WH1003) sites.
Hillside (36WH0720)

The Hillside site (36WH0720) is a small multi-component site situated on the upper slopes of ridge spur near the drainage divide between Georges Run and Cross Creek in Mount Pleasant Township. It is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. Middle Archaic, Early Woodland, and Middle Woodland deposits have been identified at the site, including an Early/Middle Woodland stone burial mound. The site is listed as being 90 to 100% intact, although the stone mound is noted as having been leveled. Stone tools, including bifurcate bifaces and celts, lithic debitage, and non-utilitarian stone artifacts such as gorgets and pendants were recovered. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. Despite previous impacts to the stone mound, the site could yield important information regarding Early and Middle Woodland social organization and stone mound construction. Therefore, the Hillside site may be eligible for inclusion in the NRHP.

The site was impacted by a Marcellus gas well (Well Permit # 125-22317) drilled by Range Resources Corporation in 2006. The well was placed less than 65 m west of the site’s boundary. Spatial analysis of the 5-acre buffer suggests that drilling activities destroyed an estimated area of 0.05 ha (0.12 ac), or 17% of the site. Aerial imagery of the location depicts a largely reclaimed landscape following DEP requirements (PA DEP 2009) (Figure 22). The actual impact to the site cannot be discerned.

Bennett Chapter 27 #1 (36WH0744)

The Bennett Chapter 27 #1 site (36WH0744) was a small multi-component habitation site situated on a terrace above Tenmile Creek in West Bethlehem Township. Recorded in 1981, it is mapped as a 0.29 ha (0.72 ac) site, and at that time, was 90-100% intact. However, the size was likely a buffer due to undefined site boundaries. Middle Archaic, Late Archaic, Early Woodland,
Middle Woodland, and Late Woodland deposits were identified at the site. Between 100 and 200 stone tools were recovered from the site, including Laurentian Tradition, Steubenville/Fox Creek, Adena, Snyders, and other notched and stemmed bifaces made from Onondaga, Flint Ridge, and other chert types. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could have provided important information regarding chronology and cultural adaptation spanning the Middle Archaic through the Late Woodland periods. Therefore, the Bennett Chapter 27 #1 site may have been eligible for listing in the NRHP.

The site was impacted by a Marcellus gas well (Well Permit # 125-24241) drilled by Atlas Resources, LLC in 2010. The well was placed less than 10 m (33 ft) southwest of the site’s boundary. Spatial analysis of the 5-acre buffer suggests that drilling activities destroyed an estimated 100% of the site. Aerial imagery of the location depicts a well pad in development and the entire Bennet Chapter 27 #1 site area under development (Figure 23).

*John Greenlee (36WH0776)*

The John Greenlee site (36WH0776) was a small Late Archaic site situated on a hilltop at the headwaters of Barrs Run in West Bethlehem Township. Recorded in 1981, it is mapped as a 0.29 ha (0.72 ac) site. However, the size was likely a buffer due to undefined site boundaries. Stone tools diagnostic of the Laurentian Archaic along with debitage and fire-cracked rock were recovered from the site, which at that time was 90-100% intact. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may have been present at the site, possibly adding significant information concerning Late Archaic chronology and subsistence. Therefore, the John Greenlee site may have been eligible for inclusion in the NHRP.
The site was impacted by a Marcellus gas well (Well Permit # 125-24189) drilled by Equitable Production Company in 2010. The well was placed less than 15 m (49 ft) southeast of the site’s boundary. Spatial analysis of the 5-acre buffer suggests that drilling activities destroyed an estimated 100% of the site. Aerial imagery of the location depicts a well pad in development for drilling and the entire John Greenlee site area disturbed (Figure 24).

**Indian Ridge Cairn Complex (36WH0781)**

The Indian Ridge Cairn Complex (36WH0781) is a very large Woodland period burial mound complex situated on ridge top above Tenmile Creek in West Bethlehem Township. Recorded in 1981, the site encompasses 15 stone mounds distributed over an area of 28.26 ha (69.84 ac). When recorded, it was 90-100% intact, with looting of some of the mounds as the primary type of site disturbance. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could yield significant information regarding Woodland period social organization, burial mound construction, and use of sacred space. Therefore, the Indian Ridge Cairn Complex may be eligible for inclusion in the NRHP.

The site was impacted by two conventional wells (Well Permit # 125-23512 and 125-23067) drilled by Atlas Resources, LLC in 2008 and 2009. One well was drilled just inside of the southern boundary of the site while the other well was drilled in the north-central portion. Combined, the wells impacted an estimated area of 1.61 ha (3.99 ac), or 6% of the site. Aerial imagery of the southern location depicts a deforested area with an existing well head and access road (Figure 25).
Figure 33. Impact to the Hillside site (36WH0720).
Figure 34. Impact to the Bennet Chapter 27 #1 (36WH744) site.
Figure 35. Impact to the John Greenlee site (36WH0776).
Figure 36. Impact to the Indian Ridge Cairn complex (36WH0781) from southern gas well.
Stopka Chapter 14 #2 (36WH0825)

The Stopka Chapter 14 #2 site (36WH0825) was a small Early Woodland period habitation and burial mound site situated on a stream bench above Tenmile Creek in West Bethlehem Township. Recorded in 1980, it is mapped as a 0.29 ha (0.72 ac) site. However, the size was likely a buffer due to undefined site boundaries. Adena Stemmed bifaces made from chert were recovered from the site, which at the time was 90-100% intact. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could have contained important information regarding Early Woodland social organization and burial mound construction. Therefore, the Stopka Chapter 14 #2 site may have been eligible for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-23071) drilled by Atlas Resources, LLC in 2008. The well was placed within the northeast portion of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities destroyed an estimated 100% of the site. Aerial imagery of the location depicts the existing well head and access road along with a reclaimed landscape (Figure 26).

Lutz #3 (36WH0984)

The Lutz #3 site (36WH0984) is a small Middle Woodland site situated on the lower slopes of a ridge spur at the headwaters of Cross Creek in Mount Pleasant Township. The site covers an area of 0.29 ha (0.71 ac). It produced stone tools, including Middle Woodland bifaces and hammer stones, lithic debitage, and fire-cracked rock. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present at the site, possibly adding significant information concerning Middle Woodland chronology and subsistence. Therefore, the Lutz #3 site may be eligible for inclusion in the NRHP.

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The site was impacted by five Marcellus gas wells (Well Permit # 125-23308, 125-23367, 125-23695, 125-23696, and 125-23705) drilled on the same well pad by Range Resources Corporation in 2008 and 2009. The wells were placed about 90 m (295 ft) east of the site’s boundary. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed an estimated area of 0.03 ha (0.09 ac), or 12% of the site. However, aerial imagery of the location shows more extensive land disturbance that impacted 0.08 ha (0.21 ac) of the site, or 30% (Figure 27). The same well pad also impacted the Lutz #4 (36WH0982), Lutz #1 (36WH0986), and Kutz #2 (36WH0987) (see below).

*Kutz #2 (36WH0987)*

The Kutz #2 site (36WH0987) was an undefined Archaic site situated on a stream bench at the headwaters of Cross Creek in Mount Pleasant Township. The site covers an area of 0.49 ha (1.22 ac). It produced stone tools, including Archaic bifaces and hammer stones, debitage, and fire-cracked rock. CRGIS indicates that the site did not yield sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may have been present at the site, possibly adding significant information concerning Archaic chronology and subsistence. Therefore, the Kutz #2 site may be eligible for inclusion in the NRHP.

The site was impacted by five Marcellus gas wells (Well Permit # 125-23308, 125-23367, 125-23695, 125-23696, and 125-23705) drilled on the same well pad by Range Resources Corporation in 2008 and 2009. The wells were placed just inside the site’s eastern boundary. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed an estimated 100% of the site. Aerial imagery of the location depicts extensive land disturbance across the entire site (see Figure 27). The same well pad also impacted the aforementioned Lutz #3 site as well as the Lutz #4 (36WH0982) and Lutz #1 (36WH0986) sites.
Kozares (36WH0994)

The Kozares site (36WH0994) is a multi-component site situated on a terrace above Chartiers Run in Chartiers Township. The site covers an area of 0.63 ha (1.55 ac). It was recorded/updated by the CMNH through a PHMC grant in the early 1990s. The site contains undefined Archaic and Middle Woodland deposits that included chipped stone tools, debitage, and fire-cracked rock. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present at the site, possibly adding significant information concerning Archaic and Middle woodland chronology and subsistence. Therefore, the Kozares site may be eligible for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-01435) operated by the Washington Energy Company, LLC between 2001 and 2002. The well was placed in the northern portion of the site. Spatial analysis of the 2-acre buffers suggests that drilling activities destroyed an estimated area of 0.29 ha (0.72 ac), or 47% of the site. Aerial imagery of the location depicts a largely reclaimed landscape following DEP requirements (PA DEP 2009) (Figure 28). The actual impact to the site cannot be discerned.
Figure 37. Impact to the Stopka Chapter 14 #2 site (36WH0825).
Figure 38. Impact to the Lutz #4 (36WH0982), Lutz #3 (36WH984), Lutz #1 (36WH0986), and Kutz #2 (36WH0987) sites.
Figure 39. Impact to the Kozares site (36WH0994).
Hamilton #3 (36WH1003)

The Hamilton #3 site (36WH1003) is a Middle Woodland site situated on a ridge spur above Brush Run in Hopewell Township. The site covered an area of 0.49 ha (1.22 ac). It was recorded through an informant interview or amateur survey, and at the time, it was 90 to 100% intact. Stone tools, including Middle Woodland bifaces and hammer stones, were recovered along with lithic debitage and fire-cracked rock. CRGIS indicates that the site had not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could have yielded important information about Middle Woodland lithic procurement strategies based on its geologic position above the chert bearing Monongahela Group bedrock formation and lithic reduction tools such as hammer stones. In addition, the presence of fire-cracked rock suggests that features may have been present on the site, possibly adding significant information concerning Middle Woodland chronology and subsistence. Therefore, the Hamilton #3 site may have been eligible for inclusion in the NRHP.

The site was impacted by nine Marcellus gas wells (Well Permit # 125-23864, 125-23905, 125-23906, 125-23970, 125-23971, 125-23972, 125-24011, 125-24012, and 125-24013) drilled on the same well pad by Range Resources Corporation in 2010. The wells were placed less than 20 m (66 ft) south of the site’s boundary. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed an estimated area of 0.48 ha (1.21 ac), or 99% of the site. However, aerial imagery of the location shows more extensive land disturbance that impacted 100% of the site (see Figure 21). The same well pad also impacted the aforementioned Hamilton Farm site (36WH717).
Eisenger (36WH1087)

The Eisenger site (36WH1087) is a multi-component Woodland period site situated on a ridge spur above Buffalo Creek in Blaine Township. The site covers an area of 0.34 ha (0.84 ac). The primary component is a Late Prehistoric, Monongahela Tradition village. The site also contains Early Woodland and Late Woodland deposits. Artifacts from the site include prehistoric ceramics, stone tools, non-utilitarian stone artifacts, bone and antler artifacts, and faunal remains. Jasper and a variety of regional and local cherts are among the lithic raw materials identified. Diagnostic artifacts include Meadowood, Raccoon Notched, and triangular bifaces along with limestone- and shell-tempered pottery. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could yield significant information about Woodland chronology and changing adaptations as well as Late Prehistoric village life. Therefore, the Eisenger site may be eligible for inclusion in the NRHP.

The site was impacted by two Marcellus gas wells (Well Permit # 125-23864, 125-23905, 125-23906, 125-23970, 125-23971, 125-23972, 125-24011, 125-24012, and 125-24013) drilled on the same well pad by Range Resources Corporation in 2010. The wells were placed just over 20 m (66 ft) north of the site’s boundary. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed an estimated area of 0.33 ha (0.81 ac), or 96% of the site. However, aerial imagery of the location shows less extensive land disturbance that impacted an area of 0.22 ha (0.55 ac), or 65% of the site (Figure 29).

Park #8 (36WH1240)

The Park #8 site (36WH1240) was a small Archaic habitation site situated on a ridge spur above an unnamed tributary of Cross Creek in Cross Creek Township. The site is located within Cross Creek County Park. Recorded in 1995, it is mapped as a 0.29 ha (0.72 ac) site. However,
the size was likely a buffer due to undefined site boundaries. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by two Marcellus gas wells (Well Permit # 125-22793 and 125-22830) drilled on the same well pad by Range Resources Corporation in 2007. The well was placed less than 20 m (66 ft) southwest of the site’s boundaries. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed an estimated 100% of the site. Aerial imagery of the location depicts extensive land disturbance across the entire site (Figure 30). In addition, the access road leading to the well pad impacted the Park #6 and #7 sites (36WH1238 and 36WH1239).

Martin #4 (36WH1344)

The Martin #4 site (36WH1344) is a small Late Archaic site situated on a stream bench above Little Chartiers Creek in North Strabane Township. The site covers an area of 0.22 ha (0.55 ac). It was recorded in 2003 through an informant interview/amateur survey by the Allegheny Chapter #1 of the SPA. Chipped stone tools, including Laurentian Tradition bifaces, and lithic debitage made from a variety of regional and local cherts were documented from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-01457) drilled by the Washington Energy Company, LLC in 2001. The well was placed just under 10 m (33 ft) southeast the site’s boundary. Spatial analysis of the 2-acre buffers suggests that drilling activities destroyed an estimated area of 0.17 ha (0.42 ac), or 77% of the site. Aerial imagery of the location shows a reclaimed landscape as required by the DEP (PA DEP 2009) (Figure 31).
Figure 40. Impact to the Eisinger site (36WH1087).
Figure 41. Impacts to the Park #6 (36WH1238), Park #7 (36WH1239), and Park #8 (36WH1240) sites.
Figure 42. Impact to the Martin #4 site (36WH1344).
Ross #3 (36WH1348)

The Ross #3 site (36WH1348) is a Late Archaic site situated on the upper slopes of a ridge spur above an unnamed tributary of Little Chartiers Creek in North Strabane Township. The site covers an area of 0.50 ha (1.24 ac). It was recorded through an informant interview or amateur survey by the Allegheny Chapter #1 of the SPA. Chipped stone tools, including Late Archaic bifaces, and debitage made from local cherts were documented from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-01456) drilled by the Washington Energy Company, LLC in 2001. The well was placed about 20 m (66 ft) northeast the site’s boundary. Spatial analysis of the 2-acre buffers suggests that drilling activities destroyed an estimated area of 0.14 ha (0.35 ac), or 28% of the site. Aerial imagery of the location shows a reclaimed landscape as required by the DEP (PA DEP 2009) (Figure 32).

Curran #2 (36WH1360)

The Curran #2 site (36WH1360) is a large Late Archaic site situated on a saddle above the South Fork of Cross Creek in Cross Creek Township. The site covers an area of 0.94 ha (2.33 ac). It was recorded in 2003 through an informant interview/amateur survey conducted by the Allegheny Chapter #1 of the SPA. Stone tools, including three Late Archaic bifaces, and lithic debitage made from a variety of regional local cherts were documented from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a Marcellus gas well (Well Permit # 125-22669) drilled by Range Resources Corporation in 2007. The well was placed just under 80 m (262 ft) east the site’s boundary. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed
an estimated area of 20 m² (215 ft²), or less than 1% of the site. However, aerial imagery of the location depicts disturbance to a smaller area than the 5-acre buffer, and the site outside of the area impacted by the well (Figure 33).

**Wilmer #1 (36WH1365)**

The Wilmer #1 site (36WH1365) is a large Late Archaic site situated on a hill top above the South Fork of Cross Creek in Cross Creek Township. The site covers an area of 0.85 ha (2.11 ac). It was recorded in 2003 through an informant interview or amateur survey conducted by the Allegheny Chapter #1 of the SPA. Chipped stone tools, including three Late Archaic bifaces, and debitage made from a variety of regional and local cherts were documented from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a Marcellus gas well (Well Permit # 125-22264) drilled by Range Resources Corporation in 2005. The well was placed just over 50 m (164 ft) northeast the site’s boundary. Spatial analysis of the 5-acre buffers suggests that drilling activities destroyed an estimated area of 0.12 ha (0.29 ac), or 14% of the site. However, aerial imagery of the location depicts disturbance to a smaller portion of the site, with an impact to an area of 0.10 ha (0.25 ac) or 12% of the site (Figure 34). In addition, the access road for the well site impacted the MS #50 site (36WH0360) (see below).
Figure 43. Impact to the Ross #3 site (36WH1348).
Figure 44. Impact to the Curran #2 site (36WH1360).
Figure 45. Impacts to the MS #50 (36WH360) and Wilmer #1 (36WH1365) sites.
The Tower #8 site (36WH1468) is a small Late Woodland habitation site situated on the middle slopes of a ridge spur above Tenmile Creek in South Franklin Township. The site covers an area of 0.27 ha (0.66 ac). Christine Davis Consultants, Inc conducted Phase I and II archaeological surveys of the site in 2010 for the Enlow Fork Mine E22 Power Line (Environmental Review #1994-2461-125). Their investigations identified large fire-cracked rock features, stone tools (including Kiski Notched bifaces), and debitage. Based on the results of the Phase II survey, the SHPO determined that the Tower #8 site was eligible for inclusion in the NRHP as a significant Late Woodland occupation along Tenmile Creek. A plan to avoid further impact to the site within the project’s APE was drafted, and no additional archaeological work was conducted.

The site was impacted by a conventional gas well (Well Permit # 125-02229) plugged by Consol Coal Company, LLC in 2009. The well was placed just under 40 m (131 ft) southeast of the site’s boundary. Spatial analysis of the 2-acre buffers suggests that drilling activities destroyed an estimated area of 0.03 ha (0.09 ac), or 13% of the site. However, aerial imagery of the location depicts disturbance to the site that is likely related to mining activities (Figure 35).
Figure 46. Impact to the Tower 8 site (36WH1468).
Archaeological Site – Outside of Buffer, Wells Drilled Between 2000 and 2010

The following section describes archaeological sites that were impacted by gas wells permitted and drilled between 2000 and 2010. However, these sites were not identified based on the overlap of well buffers and site boundaries. Instead, they were recognized during an examination of aerial imagery of well locations. The sites were impacted by well pads that exceeded their buffer area as well as auxiliary drilling facilities such as access roads, staging areas, and impoundment dams. In all cases, they were impacted by Marcellus drilling activities.

*Paul (36WH0124)*

The Paul site (36WH0124) is an Early Woodland site situated on a ridge spur above Cross Creek in Hopewell Township. The site covers an area of 0.88 ha (2.19 ac). It was recorded in 1967 through an informant interview or amateur survey, and at that time, it was described as 90-100% intact. Chipped stone tools, including Adena Stemmed bifaces, were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a impoundment dam and access road related to two Marcellus gas wells (Well Permit # 125-23169 and 125-23326) drilled on the same well pad by Range Resources Corporation in 2008 (Figure 36). The permitted wells are located approximately 215 m (705 ft) east of the site’s boundary. Development of the well destroyed an area of 0.82 ha (2.04 ac), or 93% of the site.
Figure 47. Impact to the Paul site (36WH0124).
Mesta (36WH0264)

The Mesta site (36WH0264) is large Middle Archaic site situated on a terrace above Peters Creek in Union Township. The site covers an area of 1.55 ha (3.82 ac). It was recorded in 1970 through an informant interview or amateur survey, and at that time, it was described as 50-89% intact. Chipped stone tools, including stemmed/notched bifaces, and faunal remains were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the recovery of faunal remains suggests that important information regarding Middle Archaic subsistence may be present at the site. Therefore, the Mesta site may be eligible for listing in the NRHP.

The site was impacted by an access road related to five Marcellus gas wells (Well Permit # 125-24030, 125-24031, 125-24032, 124-24374, and 125-24375) drilled on the same pad by Chesapeake Appalachia, LLC in 2010 (Figure 37). The permitted wells are located approximately 170 m (558 ft) north of the site’s boundary. Development of the well destroyed an area of 0.01 ha (0.04 ac), or just over 1% of the site. Aerial imagery of the location also shows extensive disturbance from industrial development.

MS #49 (36WH0359)

The MS #49 site (36WH0359) is an undefined prehistoric lithic reduction site situated on a ridge spur above two unnamed tributaries of Cross Creek in Cross Creek Township. The site covers an area of 0.29 ha (0.72 ac). It was recorded in 1974 during University of Pittsburgh’s Cross Creek survey (Carlisle and Adovasio 1984), and at that time, it was described as 50-89% intact. Lithic debitage were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. Since the locality has produced only debitage, however, it is unlikely to yield additional significant information
about the prehistory of the region. Therefore, it is considered not eligible for listing in the NRHP.

The site was impacted by an access road related to a Marcellus gas well (Well Permit # 125-22431) drilled by Range Resources Corporation in 2006 (Figure 38). The permitted wells are located approximately 230 m (754 ft) northeast of the site’s boundary. Development of the well destroyed an area of 0.01 ha (0.03 ac), or 4% of the site.

MS #50 (36WH0360)

The MS #50 site (36WH0360) is an undefined prehistoric site situated on a saddle above two unnamed tributaries of the South Fork of Cross Creek in Cross Creek Township. The site covers an area of 0.73 ha (1.82 ac). It was recorded in 1974 during University of Pittsburgh’s Cross Creek survey (Carlisle and Adovasio 1982), and at that time, it was described as 90-100% intact. Lithic debitage were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. Since the locality has produced only debitage, however, it is unlikely to yield additional significant information about the prehistory of the region. Therefore, it is considered not eligible for listing in the NRHP.

The site was impacted by an access road related to a Marcellus gas well (Well Permit # 125-22264) drilled by Range Resources Corporation in 2005 (see Figure 34). The permitted wells are located approximately 90 m (295 ft) south of the site’s boundary. Development of the well destroyed an area of 0.04 ha (0.11 ac), or 6% of the site. The same well impacted the aforementioned Wilmer #1 site (36WH1365).
Figure 48. Impact to the Mesta site (36WH0264).
Figure 49. Impact to the MS #49 site (36WH0359).
Site 36WH0479 is a small undefined prehistoric site situated on a saddle at the drainage divide between Camp Run and Brashears Run in Independence Township. Recorded in 1977 during a State or Federal compliance project, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At that time, it was described as 50-89% intact, with natural phenomena as the principal disturbance to the site. Lithic debitage were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. Since the locality has produced only debitage, however, it is unlikely to yield additional significant information about the prehistory of the region. Therefore, it is considered not eligible for listing in the NRHP.

The site was impacted by an access road related to two Marcellus gas wells (Well Permit # 125-23173 and 125-23174) drilled by Range Resources Corporation in 2008 (Figure 39). The permitted wells are located approximately 345 m (1,132 ft) southwest of the site’s boundary. Development of the well destroyed an area of 0.03 ha (0.09 ac), or 13% of the site. The same well impacted Site 36WH487.

Site 36WH0487 is a Middle Woodland site situated on the middle slopes of a ridge spur above a tributary of Sugarcamp Run in Independence Township. Recorded in 1977 during a State or Federal compliance project, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At that time, it was described as 90-100% intact. Chipped stone tools, including a Snyders biface, and lithic debitage were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.
The site was impacted by a impoundment dam related to two Marcellus gas wells (Well Permit # 125-23173 and 125-23174) drilled by Range Resources Corporation in 2008 (see Figure 39). The permitted wells are located approximately 185 m (607 ft) north of the site’s boundary. Development of the well destroyed an area of 0.06 ha (0.15 ac), or 20% of the site. The same well impacted Site 36WH479.

36WH0519

Site 36WH0519 is an undefined prehistoric site situated on saddle at the drainage divide between Cross Creek and the South Fork of Cross Creek in Cross Creek Township. Recorded in 1977, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At that time, it was described as 90-100% intact. Chipped stone tools and lithic debitage were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by an access road related to two Marcellus gas wells (Well Permit # 125-22959 and 125-23515) drilled by Atlas Resources, Inc. in 2007 and 2009 (see Figure 17). The permitted wells are located approximately 210 m (689 ft) southwest of the site’s boundary. Development of the well destroyed an area of 0.03 ha (0.09 ac), or 13% of the site. The same well impacted the aforementioned MS# 66 site (36WH375).
Figure 50. Impacts to Sites 36WH0479 and 36WH487.
McGaughey #3 (36WH0797)

The McGaughey site (36WH0797) is a small Late Archaic site situated on ridge spur above Cross Creek in Hopewell Township. Recorded in 1981, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At that time, it was described as 50-89% intact. Chipped stone tools, including Late Archaic bifaces, lithic debitage, and fire-cracked rock were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present on the site, possibly adding significant information concerning Late Archaic chronology and subsistence. Therefore, the McGaughey site may be eligible for inclusion in the NRHP.

The site was impacted by an access road related to three Marcellus gas wells (Well Permit # 125-23165, 125-23182, and 125-23300) drilled at the same well pad by Range Resources Corporation in 2008 (Figure 40). The permitted wells are located approximately 215 m (705 ft) northwest of the site’s boundary. Development of the well destroyed an area of 0.05 ha (0.12 ac), or 17% of the site.

Alex Taggart (36WH0826)

The Alex Taggart site (36WH0826) is a small multi-component site situated on ridge top at drainage divide between Brush Run and Cross Creek in Hopewell Township. Recorded in 1982 through an informant interview or amateur survey, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At that time, it was described as 90-100% intact. Late Archaic, Early Woodland, and Late Woodland deposits containing chipped stone tools, including Otter Creek and Jack’s Reef Corner-Notched bifaces, lithic debitage, and fire-cracked rock were documented at the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However,
the presence of fire-cracked rock suggests that features may be present on the site, possibly adding significant information concerning Late Archaic, Early Woodland, and Late Woodland chronology and subsistence. Therefore, the Alex Taggart may be eligible for inclusion in the NRHP.

The site was impacted by a pad containing four Marcellus wells (Well Permit # 125-23763, 125-23764, 125-23765, 125-23873) drilled at the same well pad by Range Resources Corporation in 2009 (Figure 41). The permitted wells are located approximately 115 m (377 ft) northwest of the site’s boundary. Development of the well pad destroyed an area of 0.05 ha (0.12 ac), or 16% of the site. The same well also impacted the Johnson #9 site (36WH1503).

_Pigeon Creek (36WH0918)_

The Pigeon Creek site (36WH0918) is a small multi-component site situated on an upland flat above Pigeon Creek in Carroll Township. Recorded in 1982 through an informant interview or amateur survey, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At that time, it was described as 90-100% intact. Middle Archaic and Early Woodland deposits containing stone tools and lithic debitage were recovered from the site, including notched/stemmed bifaces, Adena Stemmed bifaces, and hammer stones. A variety of lithic raw materials were documented as well, such as jasper and Flint Ridge, Onondaga, and local cherts. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site could yield important information about Middle Archaic and Early Woodland lithic procurement strategies based on its geologic position above chert bearing bedrock formations and the presence of lithic reduction tools such as hammer stones. Therefore, the Pigeon Creek site may be eligible for inclusion in the NRHP.
The site was impacted by a impoundment dam related to four Marcellus wells (Well Permit # 125-23440, 125-23995, 125-23996, and 125-23997) drilled at the same well pad by Chesapeake Appalachia, LLC in 2009 and 2010 (Figure 42). The permitted wells are located approximately 215 m (705 ft) northwest of the site’s boundary. Development of the well pad destroyed an area of 0.01 ha (0.03 ac), or 5% of the site.

*Lutz #4 (36WH0982)*

The Lutz #4 site (36WH0982) is a small Archaic site situated on stream bench at the headwaters of Cross Creek in Mount Pleasant Township. The site covers an area of 0.30 ha (0.74 ac). It was recorded through an informant interview or amateur survey, and has produced chipped stone tools, lithic debitage, and fire-cracked rock. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present at the site, possibly adding significant information concerning Archaic chronology and subsistence. Therefore, the Lutz #3 site may be eligible for inclusion in the NRHP.

The site was impacted by a well pad related to five Marcellus gas well (Well Permit # 125-23308, 125-23367, 125-23695, 125-23696, and 125-23705) drilled by Range Resources Corporation in 2008 and 2009 (see Figure 27). The permitted wells are located approximately 90 m (295 ft) northwest of the site’s boundary. Development of the well destroyed an area of 0.02 ha (0.05 ac), or 7% of the site. The same well pad also impacted the Lutz #3 (36WH0984), Lutz #1 (36WH0986), and Kutz #2 (36WH0987) sites.
Figure 51. Impact to the McGaughey site (36WH0797).
Figure 52. Impacts to the Alex Taggart (36WH0826) and Johnson #9 (36WH1503) sites.
Figure 53. Impact to the Pigeon Creek site (36WH0918).
**Lutz #1 (36WH0986)**

The Lutz #1 site (36WH0986) is a small Middle Archaic site situated on stream bench at the headwaters of Cross Creek in Mount Pleasant Township. The site covers an area of 0.35 ha (0.86 ac). It was recorded through an informant interview or amateur survey, and produced stone tools, lithic debitage, and fire-cracked rock, including three bifurcate bifaces and several hammer stones. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present at the site, possibly adding significant information concerning Middle Archaic chronology and subsistence. Therefore, the Lutz #1 site may be eligible for listing in the NRHP.

The site was impacted by a well pad and access road related to five Marcellus gas wells (Well Permit # 125-23308, 125-23367 125-23695, 125-23696, and 125-23705) drilled by Range Resources Corporation in 2008 and 2009 (see Figure 27). The permitted wells are located approximately 115 m (377 ft) east of the site’s boundary. Development of the well destroyed an area of 0.23 ha (0.56 ac), or 65% of the site. The same well pad also impacted the Lutz #4 (36WH0982), Lutz #3 (36WH0984), and Kutz #2 (36WH0987) sites.

**Carter #1 (36WH1000)**

The Carter #1 site (36WH1000) is a Middle Woodland site situated on the middle slopes of a ridgeline above an unnamed tributary of Raccoon Creek in Mount Pleasant Township. The site covers an area of 0.87 ha (2.14 ac). It was recorded through a PHMC grant, and at the time, it was described as 90-100% intact. The site produced chipped stone tools and lithic debitage. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a impoundment dam related to four Marcellus gas wells (Well Permit # 125-23693, 125-23780, 125-23781, and 125-23782) drilled on the same pad by Range
Resources Corporation in 2009 (Figure 43). The permitted wells are located approximately 195 m (640 ft) southeast of the site’s boundary. Development of the well destroyed an area of 0.59 ha (1.46 ac), or 68% of the site. The same impoundment dam also impacted the Carter #3 (36WH1007) and Carter #2 (36WH1019) sites.

Carter #3 (36WH1007)

The Carter #3 site (36WH1007) is a large multi-component site situated on a saddle above two unnamed tributaries of Raccoon Creek in Mount Pleasant Township. The site covers an area of 1.41 ha (3.48 ac). It was recorded through a PHMC grant, and at the time, it was described as 90-100% intact. The site contains Late Archaic, Middle Woodland, and Late Prehistoric deposits, including chipped stone tools, lithic debitage, and fire-cracked rock. In addition, it has produced Laurentian Archaic and Late Prehistoric triangular bifaces. CRGIS indicates that the PASS from submitter considered the site not eligible for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present at the site, possibly adding significant information concerning Late Archaic, Middle Woodland, and Late Prehistoric chronology and subsistence. Therefore, the Carter #3 site may be eligible for listing in the NRHP.

The site was impacted by a impoundment dam related to four Marcellus gas wells (Well Permit # 125-23693, 125-23780 125-23781, and 125-23781) drilled on the same pad by Range Resources Corporation in 2009 (see Figure 43). The permitted wells are located approximately 380 m (1,247 ft) southeast of the site’s boundary. Development of the well destroyed an area of 0.61 ha (1.53 ac), or 44% of the site. The same impoundment dam also impacted the Carter #1 (36WH1000) and Carter #3 (36WH1019) sites.
Carter #2 (36WH1019)

The Carter #2 site (36WH1019) is an undefined prehistoric site situated on the upper slopes of a ridgeline above an unnamed tributary of Raccoon Creek in Mount Pleasant Township. The site covers an area of 0.61 ha (1.51 ac). It was recorded through a PHMC grant, and at the time, it was described as 90-100% intact. Chipped stone tools, lithic debitage, and fire-cracked rock were recovered. CRGIS indicates that the PASS from submitter considered the site not eligible for inclusion in the NRHP. However, there is insufficient information to determine its eligibility.

The site was impacted by a impoundment dam related to four Marcellus gas wells (Well Permit # 125-23693, 125-23780 125-23781, and 125-23781) drilled on the same pad by Range Resources Corporation in 2009 (see Figure 43). The permitted wells are located approximately 320 m (1,050 ft) southeast of the site’s boundary. Development of the well destroyed an area of 0.56 ha (1.38 ac), or 91% of the site. The same impoundment dam also impacted the Carter #1 (36WH1000) and Carter #3 (36WH1007) sites.
Figure 54. Impacts to the Carter #1 (36WH1000), Carter #3 (36WH1007), and Carter #2 (36WH1019) sites.
**Park #6 (36WH1238)**

The Park #6 site (36WH1238) is a small Archaic habitation site situated on a ridge spur above an unnamed tributary of Cross Creek in Cross Creek Township. The site is located within Cross Creek County Park. Recorded in 1995, it is mapped as a 0.29 ha (0.72 ac) site. However, the size was likely a buffer due to undefined site boundaries. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by an access road related to two Marcellus gas wells (Well Permit # 125-22793 and 125-22830) drilled on the same pad by Range Resources Corporation in 2007 (see Figure 30). The permitted wells are located approximately 325 m (1,066 ft) north of the site’s boundary. Development of the well destroyed an area of 0.10 ha (0.26 ac), or 36% of the site. The same well impacted the Park #7 and #8 sites (36WH1239 and 36WH1240).

**Park #7 (36WH1239)**

The Park #7 site (36WH1239) is a small Archaic habitation site situated on a ridge spur above an unnamed tributary of Cross Creek in Cross Creek Township. The site is located within Cross Creek County Park. Recorded in 1995, it is mapped as a 0.29 ha (0.72 ac) site. However, the size was likely a buffer due to undefined site boundaries. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by an access road related to two Marcellus gas wells (Well Permit # 125-22793 and 125-22830) drilled on the same pad by Range Resources Corporation in 2007 (see Figure 30). The permitted wells are located approximately 160 m (525 ft) north of the site’s boundary. Development of the well destroyed an area of 0.03 ha (0.08 ac), or 11% of the site. The same well impacted the Park #6 and #8 sites (36WH1238 and 36WH1240).
FS 14 (36WH1262)

The FS 14 site (36WH1262) is a small historic domestic site dating between 1875 and 1925 that is situated on a stream bench above an unnamed tributary of Tenmile Creek in Morris Township. Recorded in 1995, it is mapped as a 0.29 ha (0.72 ac) site. However, the size was likely a buffer due to undefined site boundaries. The site produced transitional whiteware. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by an access road related to three Marcellus gas wells (Well Permit # 125-24308, 125-24309, and 125-24310) drilled by CNX Gas Company, LLC. In 2010 (Figure 44). The permitted wells are located approximately 235 m (771 ft) northeast of the site’s boundary. Development of the well destroyed an area of 0.08 ha (0.19 ac), or 26% of the site.

Dinsmore #3 (36WH1326)

The Dinsmore #3 site (36WH1326) is a small multi-component Archaic site situated on a saddle along the drainage divide between Cross Creek and Georges Run in Canton Township. Recorded in 2003 through an informant interview or amateur survey, the site measures an area of 0.22 ha (0.55 ac). However, the size was likely a buffer due to undefined site boundaries. It has produced chipped stone tools and lithic debitage, including Early Archaic Kirk Corner Notched, Middle Archaic LeCroy and Lake Erie bifurcated, and Late Archaic Laurentian Tradition bifaces made from a variety of local and exotic cherts (Fischer and Tippins 2013). CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by an access road related to a well pad containing a conventional and Marcellus wells (Well Permit # 125-23157, 125-23158) permitted to Range Resources Corporation in 2008 (Figure 45). The permitted wells are located approximately 243 m (797 ft)
west-northwest of the site’s boundary. Development of the well destroyed an area of 0.08 ha (0.19 ac), or 36% of the site. The same well impacted the Dinsmore #9 site (36WH1529).

E. West #1 (36WH1374)

The E. West #1 site (36WH1374) is a large Late Archaic site situated on a ridge spur above Brush Run in Hopewell Township. The site covers an area of 1.34 ha (3.30 ac). It was recorded in 2003 through an informant interview or amateur survey conducted by the Allegheny Chapter #1 of the SPA. Chipped stone tools and lithic debitage made from Onondaga and local cherts were recovered. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by the well pad and access road related to nine Marcellus gas wells (Well Permit # 125-24159-125-24163, 125-24245, 125-24246, 125-24253, 125-24280) drilled on the same pad by Range Resources Corporation in 2010 (Figure 45). The permitted wells are located approximately 105 m (344 ft) northwest of the site’s boundary. Development of the well destroyed an area of 0.49 ha (1.23 ac), or 37% of the site.
Figure 55. Impact to the FS 14 site (36WH1262).
Figure 56. Impacts to the Dinsmore #3 (36WH1326) and Dinsmore #9 (36WH1529) sites.
Figure 57. Impact to the E. West #1 site (36WH1374).
Archaeological Site Recorded after 2010 – Wells Permitted Between 2000 and 2010

The following section describes five archaeological sites that were recorded in 2011 but impacted by three well sites that were permitted between 2008 and 2010. These sites were identified before drilling occurred. Production of gas at two of the well sites began in 2009 and 2010, respectively, suggesting that PASS forms for the two affected sites were not submitted to the BHP until well after they were identified. Production of gas at the third well site had not commenced by 2010, suggesting that the site had not been developed until 2011 and after the sites had been identified and recorded with the BHP. Interestingly, the effect to these archaeological sites hints at the threat that drilling activities may be having on unidentified sites.

_Johnson #9 (36WH1503)_

The Johnson #9 site (36WH1503) is a Late Archaic site situated on a saddle above an unnamed tributary of Brush Run in Hopewell Township. The site covers an area of 0.46 ha (1.14 ac). It was recorded in 2011 through an informant interview or amateur survey conducted by the Allegheny Chapter #1 of the SPA. Two diagnostic Late Archaic bifaces made from quartzite and chert were recovered. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by four Marcellus gas wells (Well Permit # 125-23763, 125-23764, 125-23765, 125-23873) permitted to Range Resources Corporation in 2009. The well was placed less than 40 m (33 ft) from the northern edge of the site. Spatial analysis of the 5-acre buffer suggests that drilling activities destroyed an estimated area of 0.21 ha (0.53 ac), or 46% of the site. However, aerial imagery of the location shows greater disturbance to the site. Development of the well appears to have destroyed an area of 0.45 ha (1.10 ac), or 96% of the site (see Figure 41). The same well pad also disturbed the aforementioned Alex Taggart site (36WH826).
Ward #1 (36WH1504)

The Ward #1 site (36WH1504) was a multi-component Archaic site situated on a stream bench above an unnamed tributary of Georges Run in Canton Township. The site covered an area of 0.42 ha (1.05 ac). It was recorded in 2011 through an informant interview or amateur survey conducted by the Allegheny Chapter #1 of the SPA. Four diagnostic artifacts were recovered from the site, including two Early Archaic and two Late Archaic bifaces made from Onondaga, Flint Ridge, and local cherts. CRGIS indicates that the site had not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by eight Marcellus gas wells (Well Permit # 125-23151, 125-23224, 125-23974, 125-23975, 125-23976, 125-24070, 125-24119, 125-24329) permitted to Range Resources Corporation between 2008 and 2010. Six of these wells were drilled on the same well pad. The remaining two wells were permitted approximately 150 m (492 ft) to the southeast of the main well pad. However, it appears that those two well were not drilled and the locale was used as a staging area and access road for drilling activities. The wells were drilled less than 80 m (262 ft) northwest of the site’s boundary while the staging area was placed adjacent to the site. Combined, drilling activities destroyed 100 % of the site (Figure 46). The same well also impacted the Ward #2 (36WH1505) and Ward #3 (36WH1506) sites.
Figure 58. Impacts to the Ward #1 (36WH1504), Ward #2 (36WH1505), and Ward #3 (36WH1506) sites.
Ward #2 (36WH1505)

The Ward #2 site (36WH1505) is a multi-component site situated on a stream bench above an unnamed tributary of Georges Run in Canton Township. The site covers an area of 0.21 ha (0.53 ac). It was recorded in 2011 through an informant interview or amateur survey conducted by the Allegheny Chapter #1 of the SPA. Four diagnostic artifacts were recovered from the site, including one Late Woodland/Late Prehistoric and three Late Archaic bifaces made from Flint Ridge and local cherts. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by an access road related to eight Marcellus gas wells (Well Permit # 125-23151, 125-23224, 125-23974, 125-23975, 125-23976, 125-24070, 125-24119, 125-24329) permitted to Range Resources Corporation between 2008 and 2010. Six of these wells were drilled on the same well pad. The remaining two wells were permitted approximately 150 m (492 ft) to the southeast of the main well pad. However, it appears that those two well were not drilled and the locale was used as a staging area and access road for drilling activities. The wells were drilled less than 230 m (755 ft) northwest of the site’s boundary while the staging area was placed about 75 m (246 ft) to the northwest. Development of the well destroyed an area of 0.05 ha (0.13 ac), or 24% of the site (see Figure 46). The same well also impacted the Ward #1 (36WH1504) and Ward #3 (36WH1506) sites.

Ward #3 (36WH1506)

The Ward #3 site (36WH1506) is a multi-component site situated on a stream bench above an unnamed tributary of Georges Run in Canton Township. The site covers an area of 0.24 ha (0.59 ac). It was recorded in 2011 through an informant interview or amateur survey conducted by the Allegheny Chapter #1 of the SPA. Chipped stone tools were recovered from the site, including Early Archaic, Late Archaic, and Late Woodland/Late Prehistoric diagnostic
artifacts. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by an access road related to eight Marcellus gas wells (Well Permit # 125-23151, 125-23224, 125-23974, 125-23975, 125-23976, 125-24070, 125-24119, 125-24329) permitted to Range Resources Corporation between 2008 and 2010. Six of these wells were drilled on the same well pad. The remaining two wells were permitted approximately 150 m (492 ft) to the southeast of the main well pad. However, it appears that those two wells were not drilled and the locale was used as a staging area and access road for drilling activities. The wells were drilled approximately 270 m (755 ft) northwest of the site’s boundary while the staging area was placed about 145 m (246 ft) to the northwest. Development of the well destroyed an area of 0.03 ha (0.08 ac), or 14% of the site (see Figure 46). The same well also impacted the Ward #1 (36WH1504) and Ward #2 (36WH1505) sites.

*Dinsmore 9 (36WH1529)*

The Dinsmore #9 site (36WH1529) is an Archaic situated on the upper slopes of a ridge top above two unnamed tributaries of Georges Run in Canton Township. The site covers an area of 0.38 ha (0.94 ac). It was recorded in 2011 through an informant interview or amateur survey conducted by the Allegheny Chapter #1 of the SPA. Chipped stone tools were recovered from the site, including two Archaic bifaces. According to CRGIS, no determination of NRHP has been made about the site.

The site was impacted by a well pad containing a conventional and Marcellus wells (Well Permit # 125-23157, 125-23158) permitted to Range Resources Corporation in 2008. The wells were drilled approximately 35 m (115 ft) north of the site’s boundary. Spatial analysis of the 5-acre buffer related to the Marcellus well suggests that drilling activities destroy an estimated area of 0.22 ha (0.54 ac), or 58% of the site. However, aerial imagery of the location shows less
disturbance to the site. Development of the well appears to have destroyed an area of 0.13 ha (0.33 ac), or 36% of the site (see Figure 45). The same well impacted the aforementioned Dinsmore #3 site (36WH1326).
Archaeological Site – Undrilled Wells, Permitted Between 2000 and 2010

The following section describes sites that have not been impacted but are in eminent danger of partial or complete destruction from gas drilling. Each site is located within estimated areas of impact from wells that have been permitted but have not been drilled as of December 2012, as documented in production reports (PA DEP 2012) and seen in aerial imagery of the well locations (ESRI 2013).

Fisher #75 (36WH0033)

The Fisher #75 site (36WH0033) is a large Late Prehistoric habitation site, likely a village, situated on a stream bench above Pigeon Creek in Carroll Township. Officially recorded in 1951, the site was one of hundreds of sites investigated by George S. Fisher in the early 20th century (Mayer-Oakes 1955:98). As mapped, the site measures an area of 2.14 ha (5.29 ac). CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the site has the potential to yield significant data concerning Late Prehistoric village life in the Pigeon Creek watershed, a major tributary of the Monongahela River. Therefore, the Fisher #75 site may be eligible for listing in the NRHP.

A permit (Well Permit #125-22784) for drilling a conventional well near the site was issued to Kriebel Minerals, Inc. in 2010. Production reports as well as aerial imagery of the location show that development of the well has not occurred. When drilled, however, it will be placed within the southwestern boundary of the site (Figure 48). Spatial analysis of the 2-acre buffer suggests that drilling activities will destroy an estimated area of 0.80 ha (1.97 ac), or 37% of the site.

Cut/Neal Site (36WH0103)

The Cut/Neal site (36WH0103) is a large undefined prehistoric site of unknown function. The site sits on a terrace above Little Chartiers Creek in North Strabane Township. The site
covers an area of 2.29 ha (5.65 ac). It was recorded in 1963 through an informant interview or amateur survey. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

A permit (Well Permit #125-23633) for drilling a conventional well near the site was issued to CNX Gas Company, LLC in 2009. Production reports as well as aerial imagery of the location show that development of the well has not occurred. When drilled, however, it will be placed within the eastern boundary of the site (Figure 49). Spatial analysis of the 2-acre buffer suggests that drilling activities will destroy an estimated area of 0.72 ha (1.78 ac), or 32% of the site.

*J Alrutz Farm #1 (36WH0133)*

The J Alrutz Farm #1 site (36WH0133) is a large multi-component site that contains undifferentiated Archaic and Middle Woodland components. It is located on the upper slopes of a ridge spur above Cross Creek in Mount Pleasant Township. The site covers an area of 1.44 ha (3.56 ac). It was recorded in 1967 through an informant interview or amateur survey, at which time it was 90 to 100% intact. Chipped stone tools and lithic debitage were recovered, including bifaces classified as Middle Woodland. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

A permit (Well Permit #125-22453) for drilling a conventional well near the site was issued to Range Resources Corporation in 2007. Production reports as well as aerial imagery of the location show that development of the well has not occurred. When drilled, however, it will be placed within the southwestern boundary of the site (Figure 50). Spatial analysis of the 2-acre buffer suggests that drilling activities will destroy an estimated area of 0.70 ha (1.73 ac), or 49% of the site.
Figure 59. Projected impact to the Fisher #75 site (36WH0033).
Figure 60. Projected impact to the Cut/Neal site (36WH0103).
Figure 61. Projected impact to the J. Alrutz #1 site (36WH0133).
White Lawn Farm #4 Site (36WH0278)

The White Lawn Farm #4 site (36WH0278) is a small Middle Archaic habitation site located in South Strabane Township. The site is situated on a ridge top above several unnamed tributaries of Little Chartiers Creek. Recorded in 1971 through an informant interview or amateur survey, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. Stone tools, including notched/stemmed bifaces, debitage, and fire-cracked rock were recovered from the site, which at the time was 90 to 100% intact. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may have been present at the site, possibly adding significant information concerning Middle Archaic chronology and subsistence. Therefore, the White Lawn Farm #4 site may be eligible for inclusion in the NHRP.

A permit (Well Permit # 125-24262) for drilling a Marcellus well was issued to Range Resources Corporation in 2010. Production reports as well as aerial imagery of the well location show that development of the well has not occurred. When drilled, however, it will be placed at the northwestern edge of the site (Figure 51). Spatial analysis of the 5-acre buffer suggests that drilling activities will destroy an estimated 100% of the site.

FB #6 (36WH0422)

FB #6 (36WH0422) is a large Late Archaic site situated on the upper slopes of a ridge above Cross Creek in Hopewell Township. The site covers an area of 1.18 ha (2.91 ac). It was recorded in 1975 through of an informant interview or amateur survey, and at that time, it was only 50 to 89% intact, with private, commercial, and/or industrial development listed as the primary disturbance. Stone tools including Late Archaic bifaces and stonedebitage were
recovered from the site. CRGIS indicates that the site has not yielded sufficient data to
determine its eligibility for inclusion in the NRHP.

Two permits (Well Permit # 125-22682 and #125-22683) for drilling conventional wells
near the site were issued to Range Resources Corporation in 2007. Production reports along with
aerial imagery of the location shows that development of the wells has not occurred. When
drilled, however, one will be placed within the southwestern boundary of the site and the second
well further to the southwest (Figure 52). Spatial analysis of the 2-acre buffer suggests that
drilling activities will destroy an estimated area of 0.42 ha (1.03 ac), or 35% of the site.

*FB #50 (36WH0501)*

The FB #50 site (36WH0501) is an Early Archaic isolated find situated on the middle
slopes of a ridge top sitting above the South Fork of Cross Creek in Cross Creek Township.
Recorded in 1975 through an informant interview or amateur survey, the find represents a
Palmer Corner-Notched biface type. It is mapped as a 0.29 ha (0.72 ac) site, although the size is
likely a buffer around the find due to a lack of site boundaries. CRGIS indicates that insufficient
data exists about the site to determine its eligibility for inclusion in the NRHP. Since the locality
has produced only one artifact, however, it is unlikely to yield additional significant information
about the prehistory of the region. Therefore, it is considered not eligible for listing in the
NRHP.

A permit (Well Permit # 125-22708) for drilling a conventional well near the site was
issued to Range Resources Corporation in 2007. Production reports along with aerial imagery of
the location shows that development of the wells has not occurred (Figure 53). When drilled,
however, the well will be placed 21 m (69 ft) northeast of the site. Spatial analysis of the 2-acre
buffer suggests that drilling activities will destroy an estimated area of 0.11 ha (0.28 ac), or 40%
of the site.
Figure 62. Projected impact to the White Lawn Farm #4 site (36WH0278).
Figure 63. Projected impact to the FB #6 site (36WH0422)
Figure 64. Projected impact to the FB #50 site (36WH0501).
Young (36WH974)

The Young site (36WH0974) is a Late Woodland/Late Prehistoric site situated on a ridge top at the drainage divide between Chartiers and Tenmile Creeks in South Franklin Township. The site covers an area of 0.73 ha (1.81 ac). It was recorded/updated through a PHMC grant in the early 1990s, and at that time, it was 90-100% intact. The site produced stone tools, debitage, and fire-cracked rock. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present at the site, possibly adding significant information concerning Late Woodland/Late Prehistoric chronology, subsistence, and non-village life. Therefore, the Young site may be eligible for inclusion in the NRHP.

Two permits (Well Permit # 125-23485 and #125-24060) for drilling conventional wells near the site were issued to CNX Gas Company, LLC in 2009 and 2010. Production reports along with aerial imagery of the location shows that development of the wells has not occurred. When drilled, however, they will be placed within the northern portion of the site (Figure 54). Spatial analysis of the 2-acre buffers suggests that drilling activities will destroy an estimated area of 0.37 ha (0.92 ac), or 51% of the site.

Brezinski #5 (36WH1148)

The Brezinski #5 site (36WH1148) is a small multi-component Archaic site situated on the lower slopes of a ridge spur above Cross Creek in Mount Pleasant Township. Recorded in 1993 by the CMNH through a PHMC grant, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. Middle Archaic and Late Archaic deposits that included bifurcate and Laurentian Tradition bifaces were identified. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.
A permit (Well Permit # 125-22681) for drilling a conventional well near the site was issued to Range Resources Corporation in 2007. Production reports along with aerial imagery of the location show that development of the wells has not occurred (Figure 55). When drilled, however, the well will be placed 40 m (131 ft) northwest of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities will destroy an estimated area of 0.02 ha (0.05 ac), or 7% of the site. The same well will also impact the Brezinski #6 site (36WH1244) (see below).

**Vaughn (36WH1228)**

The Vaughn site (36WH1228) is a small multi-component site situated on a floodplain above Pigeon Creek in Carroll Township. The site covers an area of 0.29 ha (0.72 ac), the site was recorded by Skelly and Loy, Inc. during a Phase I archaeological survey of the Mon-Fayette Valley Expressway project, Interstate 70 to Route 51 alignment (Environmental Review # 1987-1002-042). Specifically, it was identified within a wetland replacement area. Their investigations uncovered Middle Woodland and Proto-historic deposits that contained stone tools and burned areas. Despite the Phase I survey, CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, buried and intact cultural deposits may be present at the site. Moreover, the presence of burned areas suggests features may be present on the site, possibly adding significant information about Middle Woodland and Proto-historic chronology and subsistence. Therefore, the Vaughn site may be eligible for inclusion in the NHRP.

A permit (Well Permit # 125-23773) for drilling a conventional well near the site was issued to CNX Gas Company in 2009. Production reports along with aerial imagery of the location show that development of the wells has not occurred (Figure 56). When drilled, however, the well will be placed just under 25 m (82 ft) northwest of the site. Spatial analysis of
the 2-acre buffer suggests that drilling activities will destroy an estimated area of 0.10 ha (0.26 ac), or 36% of the site.

*Brezinski #6 (36WH1244)*

The Brezinski #6 site (36WH1244) is a small Archaic habitation site situated on the lower slopes of a ridge spur above a Cross Creek in Mount Pleasant Township. Recorded in 1995, it is mapped as a 0.29 ha (0.72 ac) site. However, the size was likely a buffer due to undefined site boundaries. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

A permit (Well Permit # 125-22681) for drilling a conventional well near the site was issued to Range Resources Corporation in 2007. Production reports along with aerial imagery of the location show that development of the wells has not occurred (see Figure 55). When drilled, however, the well will be placed just under 50 m (164 ft) west of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities will destroy an estimated area of 11 m² (118 ft²), or 0.4% of the site. The same well will also impact the aforementioned Brezinski #5 site (36WH1148).

*John Kammerer Farmstead (36WH1465)*

The John Kammerer Farmstead (36WH1465) is a large historic site located in the uplands above several tributaries of Mingo Creek in Nottingham Township that dates to the early 20th century. The site covers an area of 5.70 ha (14.09). It was identified in 2010 during the course of a State or Federal compliance survey (Environmental Review # 2008-1631-125), at which time, the site was 90-100% intact. The investigations identified standing buildings/structures and foundations. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.
A permit (Well Permit # 125-22719) for drilling a conventional well near the site was issued to Mountain V Oil and Gas, Inc. in 2007. Production reports along with aerial imagery of the location show that development of the wells has not occurred (Figure 57). When drilled, however, the well will be placed about 45 m (148 ft) west of the site’s northern limits. Spatial analysis of the 2-acre buffer suggests that drilling activities will destroy an estimated area of 0.01 ha (0.03 ac), or less than 1% of the site.
Figure 65. Projected impact to the Young site (36WH0974).
Figure 66. Projected impacts to the Brezinski #5 and #6 sites ((36WH1148 and 36WH1244)).
Figure 67. Projected impact to the Vaughn site (36WH1228).
Figure 68. Projected impact to the John Kammerer farmstead (36WH1465).
APPENDIX III: ADDITIONAL SITES

The following appendix describes 12 sites impacted by drilling activities prior to 2000 or sites that had been disturbed by unrelated activities previous to drilling activities. The impacts to these sites were discovered during the course of research. They are included here simply to document the nature and extent of disturbances to these sites. These sites were not used in developing the project’s results discussed in Chapter 7.

As with the Appendix II, descriptions are based on data contained in CRGIS, and when available, in published materials. Information on the type of disturbance follow these descriptions. Where appropriate, high resolution aerial imagery (0.3 m resolution) depicting impacted sites is included (ESRI 2012).

Archaeological Site – Wells Drilled Prior to 2000

The following section describes sites that were impacted by gas wells drilled before 2000, but appeared in the DEP’s production reports used for this study (PA DEP 2012) as either plugged, inactive, or active wells.

Fort Taylor Site (36WH0005)

The Fort Taylor site (36WH0005) is a large historic military fort site situated on a terrace above Buffalo Creek in Blaine Township. It is located approximately 700 m (2,300 ft) north of Taylorstown. While little is known about its historic use (DeMay 1997), the Revolutionary War period (1775-1783) fort was constructed on the 331-acre property owned by Captain Robert Taylor of the Pennsylvania militia in 1779 (Vacca and Eisert 2005:H4). As with many Revolutionary War period small forts and blockhouses on the frontier, Fort Taylor likely protected settlers from raids by various Native American groups. The fort also served as the residence of Robert Taylor and his family.
The site covers an area of 2.32 ha (5.74 ac). It was recorded in 1950, at which time it was considered 90-100% intact. Historic ceramics were recovered along with stone tools and debitage suggesting an earlier contact period or prehistoric occupation at the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, research at the site could reveal important information about the process of Euro-American settlement expansion as well as frontier life in the early Colonial period of Pennsylvania. Therefore, the Fort Taylor site may be eligible for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit #125-21394) operated by Pennzoil Production Company that was inactive by 2000. The well was placed approximately 47 m (154 ft) southwest of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities impacted an estimated area of 0.01 ha (0.03 ac) of the site, or less than 1% (Figure 58).

O’Block Lane (36WH0196)

The O’Block Lane site (36WH0196) is a Middle Archaic site situated on a hilltop above an unnamed tributary of Millers Run in Cecil Township. The site covers an area of 1.19 ha (2.94 ac). It was recorded in 1967 through an informant interview or amateur survey, and at that time, it was 90 to 100% intact. According to CRGIS, an unspecified number and types of stone tools were recovered, although they included notched and stemmed bifaces. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a home-use conventional gas well (Well Permit # 125-00952) operated by New Century Energy, Inc. that was active in 2000. The well was placed less than 10 m (33 ft) from the southwestern edge of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities destroyed an estimated area of 0.26 ha (0.63 ac), or 22% of the site (Figure 59).
Figure 69. Impact to the Fort Taylor site (36WH0005).
Figure 70. Impact to the O’block Lane site (36WH0196).
**White Lawn Farm #1 Site (36WH0273)**

White Lawn Farm #1 (36WH0273) was a small prehistoric site situated on a hillside near the drainage divide between Little Chartiers Creek and Chartiers Creek in South Strabane Township. Recorded in 1970 through an informant interview or amateur survey, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At that time, it was only 50 to 89% intact, with the nature of the disturbances left undetermined. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-01290) operated by Pennzoil Products Company that was inactive by 2000. The well was placed within the north-central portion of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities destroyed an estimated 100% of the site (Figure 60).

**Abraham (36WH0299)**

The Abraham site (36WH0299) is a large, undefined prehistoric site situated on a terrace above Buffalo Creek in Blaine Township. The site covers an area 3.75 ha (9.27 ac). It was recorded in 1973, at which time it was considered 90-100% intact. Stone tools, debitage, and fire-cracked rock were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-21567) operated by Pennzoil Products Company that was active in 2000. The well was placed along the eastern edge of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities impacted an estimated area of 0.55 ha (1.37 ac), or 15% of the site (Figure 61).
Figure 71. Impact to the White Lawn Farm #1 site (36WH0273).
Figure 72. Impact to the Abraham site (36WH0299).
Site 36WH0578 is an undefined prehistoric site situated on the ridge top above the confluence of Buffalo Creek and one of its tributaries in Blaine Township. Recorded in 1975, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. Lithic debitage was recovered from the site, which at the time was 90-100% intact. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-21569) operated by Pennzoil Products Company that was active in 2000. The well was placed approximately 35 m (115 ft) southeast of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities destroyed an estimated area of 0.05 ha (0.13 ac), or 18% of the site (Figure 62).

**Zediker (36WH0589)**

The Zediker site (36WH0589) is an Archaic site situated on the slopes of a ridge spur above an unnamed tributary of Mingo Creek in Nottingham Township. Recorded in 1978 through an informant interview or amateur survey, it is mapped as a 0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. Stone tools, lithic debitage, and fire-cracked rock were recovered from the site. At the time was 0-10% intact, with natural phenomena as the primary disturbance. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock suggests that features may be present at the site, possibly adding significant information concerning Archaic chronology and subsistence. Therefore, the Zediker site may be eligible for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-01063) operated by Equitrans, Inc. that was active in 2000. The well was placed approximately four meters (13 ft)
northwest of the site. Spatial analysis of the 2-acre buffer suggests that drilling activities
destroyed an estimated area of 0.23 ha (0.13 ac), or 78% of the site (Figure 63).

_Ulery #1 (36WH0827)_

The Ulery #1 site (36WH0827) is a small multi-component habitation site situated on
terrace above Tenmile Creek in West Bethlehem Township. Recorded in 1981, it is mapped as a
0.29 ha (0.72 ac) site. However, the size is likely a buffer due to undefined site boundaries. At
that time, it was 90-100% intact with some disturbance by natural phenomena. Late Archaic and
Early Woodland deposits have been identified at the site, including diagnostic Laurentian
Tradition and Steubenville/Fox Creek bifaces made from chert. Stone debitage and fire-cracked
rock have been recovered as well. CRGIS indicates that the site has not yielded sufficient data to
determine its eligibility for inclusion in the NRHP. However, the presence of fire-cracked rock
suggests that features may be present at the site, possibly adding significant information
concerning Late Archaic and Early Woodland chronology and subsistence. Therefore, the Ulery
#1 site may be eligible for inclusion in the NRHP.

The site was impacted by a conventional gas well (Well Permit # 125-00700) operated by
Equitrans, Inc that was active in 2000. The well was placed almost 50 m (164 ft) southwest of
the site’s boundary. Spatial analysis of the 2-acre buffer suggests that drilling activities
destroyed only an estimated 10 m² (107 ft²), or less than 1% of the site (Figure 64).
Figure 73. Impact to Site 36WH0578.
Figure 74. Impact to the Zediker site (36WH0589).
Figure 75. Impact to the Ulery #1 site (36WH0827).
Archaeological Site – Unrelated Impacts Prior to 2000

The following section describes sites that were impacted by gas wells drilled before 2000, but appeared in the DEP’s production reports used for this study (PA DEP 2012) as either plugged, inactive, or active wells

Speers (36WH0025)

The Speers site (36WH0025) is a large, multi-component prehistoric site that sits on a terrace above the Monongahela River in Speers and Dunlevy Boroughs. The site covers an area of 4.46 ha (11.51 ac). It was inventoried by Carnegie Museum of Natural History (CMNH) during their Upper Ohio Valley Archaeological Survey of the 1950s. Mayer-Oakes (1955:106-113) description of the site was based on an examination of the Albert Bauer collection. The primary component of the site represents a Late Prehistoric, Monongahela Tradition village, although earlier Middle Archaic bifurcated and Transitional Archaic stemmed bifaces are illustrated by Mayer-Oakes (1955:112, Plate 52). The Monongahela Tradition component likely occurred during the Early Monongahela period based on a relatively high frequency of plain pottery sherds. Mayer-Oakes (1955:106) identified over 35% of the 2,414 sherds from the site as plain, and more than six percent of the sample was decorated with incisions and punctations.

Bauer’s excavations revealed a midden, a possible rectangular house, and a badly disturbed flexed burial. Additional Late Prehistoric artifacts include castellated rim sherds, a number of pipe bowl and stem fragments, several triangular and side-notched bifaces, an antler projectile point, and a hematite celt (Mayer-Oakes 1955:110, Plates 49 and 50; 111, Plate 51; 112, Plate 52; and 113, Plate 53).

CRGIS indicates that the site was re-identified in 1993 during the CMNH relocation program, at which time Speers was described as virtually destroyed. It also notes the presence of hearths and burial pit features along with triangular projectile points, stone tools,debitage,
Monongahela Plain ceramics, clay pipes, faunal remains, historic ceramics, and glass. The site was determined not eligible for inclusion in the NRHP by the submitter of the PASS in 1993 (i.e. CMNH), likely because of a loss of integrity due to impacts from nearby development. However, any portion of the site still intact may contain significant data concerning Late Prehistoric village life, and therefore, may be eligible for inclusion in the NRHP.

Spatial analysis indicated that a conventional gas well (Well Permit #125-01565) drilled by the Washington Energy Company, LLC in 2001 impacted an estimated area of 0.03 ha (0.08 ac) of the site, or less than 1%. The well was placed approximately 40 m (131 ft) east-southeast of the site. However, aerial imagery of the site location shows that this portion of the site had previously been disturbed by a housing development that destroyed most of the eastern half of the site (Figure 65). Since this portion of the site was impacted previously, the effects of drilling near the site will not be considered further.
Figure 76. Impact to the Speers site (36WH0025).
Locus 5 (36WH0934)

The Locus 5 site (36WH0934) was an undefined prehistoric site situated on the upper slopes of ridge top above an unnamed tributary of Pigeon Creek in Somerset Township. The site covered an area of 0.91 ha (2.24 ac). It was recorded originally in 1985 based on one piece of debitage and fire-cracked rock. In 1998, Big Blue Archaeological Research, Inc. conducted a Phase I survey for the Dunningsville Mine that relocated the Locus 5 site (Environmental Review # 1997-1313-125). The survey recovered five additional pieces of debitage, and defined the site as an ephemeral lithic scatter. Based on the findings of the Phase I survey, the SHPO considered the site not eligible for inclusion in the NHRP. CRGIS notes that the site was completely destroyed.

Mountain V Oil and Gas, Inc. drilled a conventional gas well (Well Permit # 125-22610) near the original location of the site in 2007. It was placed almost 50 m (164 ft) northeast of the site’s boundary (Figure 66). Since the site was completely destroyed by mining activities, the effects drilling near the site will not be considered further.

Locus 11 (36WH0935)

The Locus 11 site (36WH0935) was a large undefined prehistoric and historic site situated on a ridge spur above Pigeon Creek in Somerset Township. The site covered an area of 2.01 ha (4.96 ac). It was recorded in 1985 through an informant interview or amateur survey. In addition, WAPORA, Inc. investigated the site during a cultural resource survey of a gas pipeline (Environmental Review # 1984-1065-125). Stone tools, debitage, historic ceramics, glass, and metal were recovered from the site. CRGIS indicates that the site has not yielded sufficient data to determine its eligibility for inclusion in the NRHP. It also notes that the site was destroyed completely.
Mountain V Oil and Gas, Inc. drilled a conventional gas well (Well Permit # 125-22743) near the original location of the site in 2007. It was placed about 20 m (66 ft) east of the site’s boundary (Figure 67). Since the site was destroyed completely by the installation of the gas pipeline, the effects of drilling near the site will not be considered further.

*Hanis (36WH0954)*

The Hanis site (36WH0954) was a large multi-component habitation site situated on a stream bench above an unnamed tributary of the Monongahela River in the Borough of California. The site covered an area of 1.71 ha (4.23 ac). NPW Consultants undertook Phase I through Phase III archaeological investigations at the site in 1989 prior to the construction of the Mon-Fayette Valley Expressway (Environmental Review # 1987-1002-042). Their work uncovered Late Archaic, Middle Woodland, Late Prehistoric, and historic deposits that included storage/trash pits, notched/stemmed bifaces, and debitage. Features from the site produced four radiocarbon dates. Two of the dates have a pooled mean date of 1122±74 rcybp (2-sigma cal. A.D. 694-1030), placing the occupation within the Middle to Late Woodland period. The pooled mean of the remaining two dates place the occupation within the Late Prehistoric period with a date of 458±54 rcybp (2-sigma cal. A.D. 1324-1630). The site was eligible for inclusion in the NHRP. However, CRGIS notes that it has been destroyed completely as a result of the highway construction.

Richard H. Burkland drilled a conventional gas well (Well Permit # 125-21054) at the original location of the site in 2003 (Figure 68). Since the site was completely destroyed by the highway construction, the effects of drilling on the site will not be considered further.
Figure 77. Impact to the Locus 5 site (36WH0934).
Figure 78. Impact to the Locus 11 site (36WH0935).
Figure 79. Impact to the Hanis site (36WH0954).
Kilikowski (36WH1100)

The Kilikowski site (36WH1100) was a multi-component site situated on a ridge spur above an unnamed tributary of Pike Run in the Borough of California. The site covered an area of 0.35 ha (0.86 ac). California University of Pennsylvania undertook Phase I and II archaeological surveys of the site in 1990 prior to the construction of Malden Industrial Park (Environmental Review # 1989-0690-125). Their Phase II investigations uncovered Late Archaic and Late Prehistoric deposits that included a hearth, an undefined feature, carbonized flora, and 56 artifacts (stone tools and debitage). They concluded that the Kilikowski site was ineligible for inclusion the NHRP based on low cultural feature and artifact densities along with difficulty in separating components within a plow-disturbed context. CRGIS notes that it has been destroyed completely as a result of the industrial development.

Middle Monongahela Industrial Development drilled a conventional gas well (Well Permit # 125-21095) about 30 m (98 ft) southeast of the original location of the site in 2003 (Figure 69). Since the site was completely destroyed by the construction of the industrial park, the effects of drilling on the site will not be considered further.

Sportmen’s #2 Site (36WH1425)

The Sportsmen’s #2 site (36WH1425) was an undefined prehistoric site situated on a terrace above Little Chartiers Creek in North Strabane Township. The site covered an area of 0.27 ha (0.66 ac). It was identified in 2005 during a Phase I archaeological survey of the Linden Creek Interceptor Sewer Project conducted by Christine Davis Consultants, Inc. (Environmental Review # 2003-2069-125). Their investigations concluded that the Sportsmen’s #2 site was ineligible for inclusion the NHRP because it no longer retained integrity due to previous impacts such as road construction. CRGIS notes that it has been destroyed completely.
The site was impacted by a conventional gas well (Well Permit # 125-01453) operated by Dormont T. Lebanon Sportsmen Club that was active in 2000. The well was placed less than 40 m (131 ft) east of the original location of the site (Figure 70). Since the site was destroyed, the effects of drilling on the site will not be considered further.
Figure 80. Impact to the Kilikowski site (36WH1100).
Figure 81. Impact to the Sportmen’s #2 site (36WH1425).