

**HISTORIC AND PREHISTORIC RECONNAISSANCE SURVEY
PICATINNY ARSENAL, ROCKAWAY, NEW JERSEY**

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MANAGEMENT ABSTRACT

In August 1989 The Public Archaeology Laboratory, Inc., under contract with Daylor Consulting Group, conducted a historic and prehistoric reconnaissance survey at Picatinny Arsenal, Rockaway, New Jersey. The report will be included as an Appendix to the Environmental Impact Statement (EIS) for the closure of Army Materials Technology Laboratory (AMTL) and addition of AMTL functions to Picatinny Arsenal, Detroit Arsenal, and Fort Belvoir. The EIS is being compiled by the New England Division, Army Corps of Engineers (NED). The Picatinny facility encompasses approximately 6,500 acres and has over 1,000 buildings.

Background research was conducted and regional prehistoric and historic period contexts were developed for the Picatinny area, along with a national military context, in order to place archaeological and historic resources within an appropriate cultural and chronological framework. A driveover/visual inspection was used in conjunction with background research to update and expand information and identify information gaps on the known and potential cultural resource database. Background research, environmental attributes and ground disturbance were used to stratify Picatinny into areas of high, moderate and low archaeological sensitivity.

Four surface collected areas of prehistoric activity had been previously documented at Picatinny Arsenal. Seven historic archaeological resources had also been previously documented within the Arsenal. The reconnaissance survey identified areas of the Arsenal having high, moderate, and low potentials for prehistoric archaeological resources. In addition, the potential historic archaeological resource base has been revised to include sixty-nine site locations. These consist of 48 residential sites, 3 institutional sites, 1 commercial site, and 12 industrial sites related to the local iron industry. Six potential Arsenal-related resources (Morris County Railroad line, 5 railroad station houses) were also identified from secondary sources.

Field and background data on historic buildings, structures, and features were collected and reviewed. No properties at Picatinny Arsenal are listed in the State and National Registers. Seven U.S. Army Category I, 55 Category II, and 248 Category III buildings were previously identified. At least two buildings (Category I) may have been demolished. Information concerning these and other elements of the Arsenal dating from 1881 to the present is discussed.

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CHAPTER I

INTRODUCTION

Scope and Authority

Scope

This report contains the results of an historic and prehistoric reconnaissance survey conducted at Picatinny Arsenal, New Jersey (Figure 1-1). The survey report will be included as an Appendix to the Environmental Impact Statement (EIS) for the closure of Army Materials Technology Laboratory (AMTL), Watertown, Massachusetts, and the addition of AMTL functions to Picatinny Arsenal, Detroit Arsenal, and Fort Belvoir. The EIS is being compiled by the New England Division, Army Corps of Engineers (NED). The Public Archaeology Laboratory, Inc. (PAL, Inc.) was subcontracted by Daylor Consulting Group of Boston, Massachusetts to conduct archival and field investigations, as well as draft and final report preparation for the reconnaissance survey at Picatinny Arsenal.

The scope of the survey encompasses prehistoric and historic period regional contexts, including the development of Picatinny Arsenal within a national military context, and descriptions of known and potential cultural resources (prehistoric archaeological sites, historic archaeological sites, historic buildings/structures/features) on the facility. The information provided in this report will be used to evaluate the effect of base closure and realignment on historic properties as well as to aid in determining the need for future historic documentation and archaeological surveys for new construction, reuse, or transfer of property.

Authority

The survey was conducted under the authority of the National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915) as amended (16 U.S.C. 470 et seq.), the National Environmental Policy Act of 1969 (P.L. 91-190; 83 Stat. 852; 42 U.S.C. 4321 et seq.), the Defense Authorization Amendments and Base Closure and Realignment Act of 1988 (P.L. 100-526; 102 Stat. 2623; 10 U.S.C. 2687), and Army Regulation 200-2 Environmental Effects of Army Actions (32 CFR Part 651). All work was accomplished in accordance with the Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, September 29, 1983).

Personnel

The primary researchers for the project were Virginia A. Fitch, Architectural Historian/Senior Archaeologist, and Suzanne Glover, Supervisory Archaeologist. They were assisted by Beth Miller, Project Archaeologist of The PAL, Inc. staff.

Facility Description

The Picatinny Arsenal, is located in Rockaway Township, Morris County, in north-central New Jersey (Figure 1-2). The Arsenal began as a U.S. Army powder storage depot in 1880 and evolved into a powder and explosive production factory and research and development facility in the twentieth century. It covers approximately 6,500 acres and has over 1,000 buildings (Figure 1-3). The majority of buildings are industrial in design and were constructed in the 1930s and 1940s. The property is generally linear in shape and extends north-south along the Green Pond River Valley and flanking

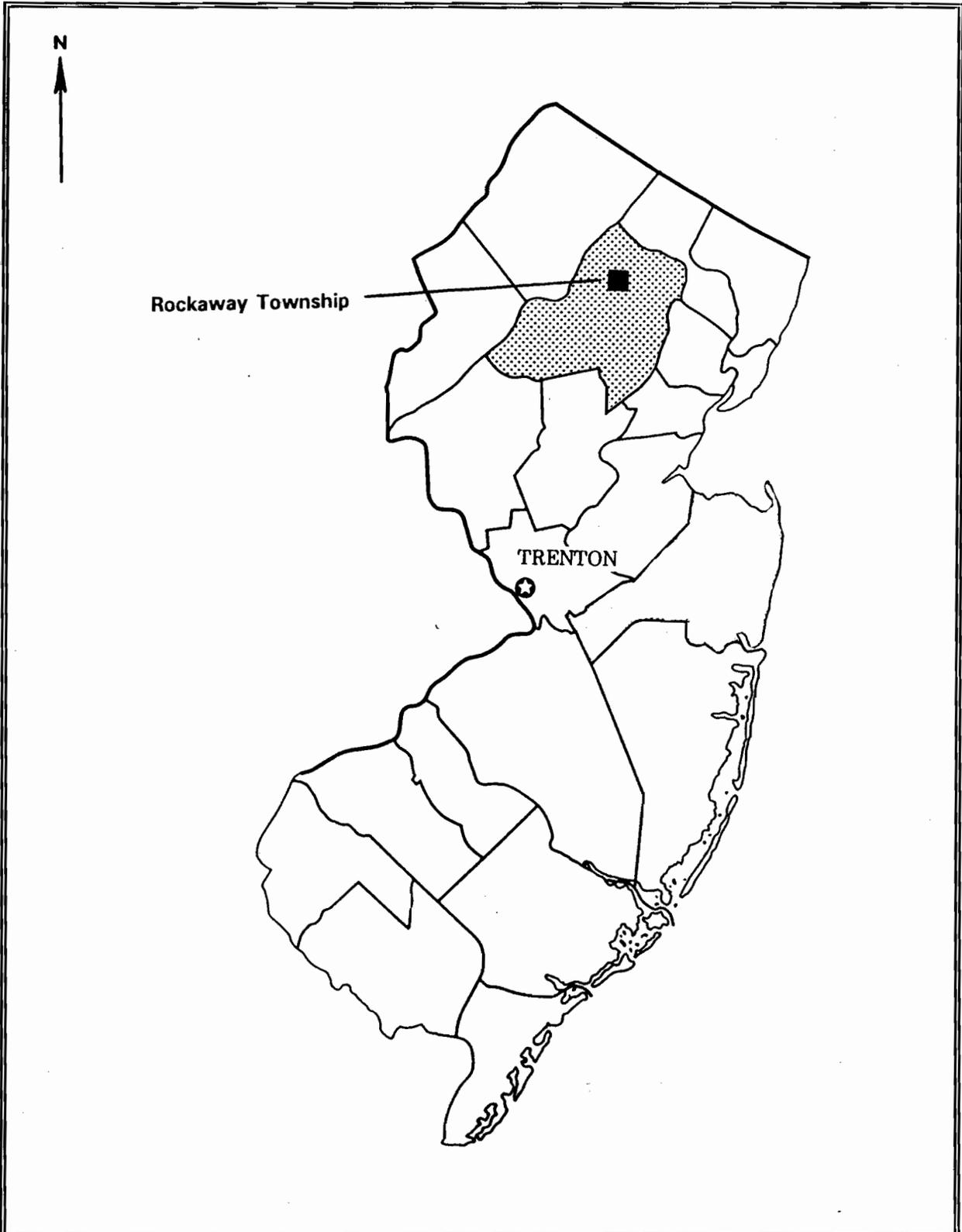


Figure 1-1. Location of Picatinny Arsenal in Rockaway Township, New Jersey.

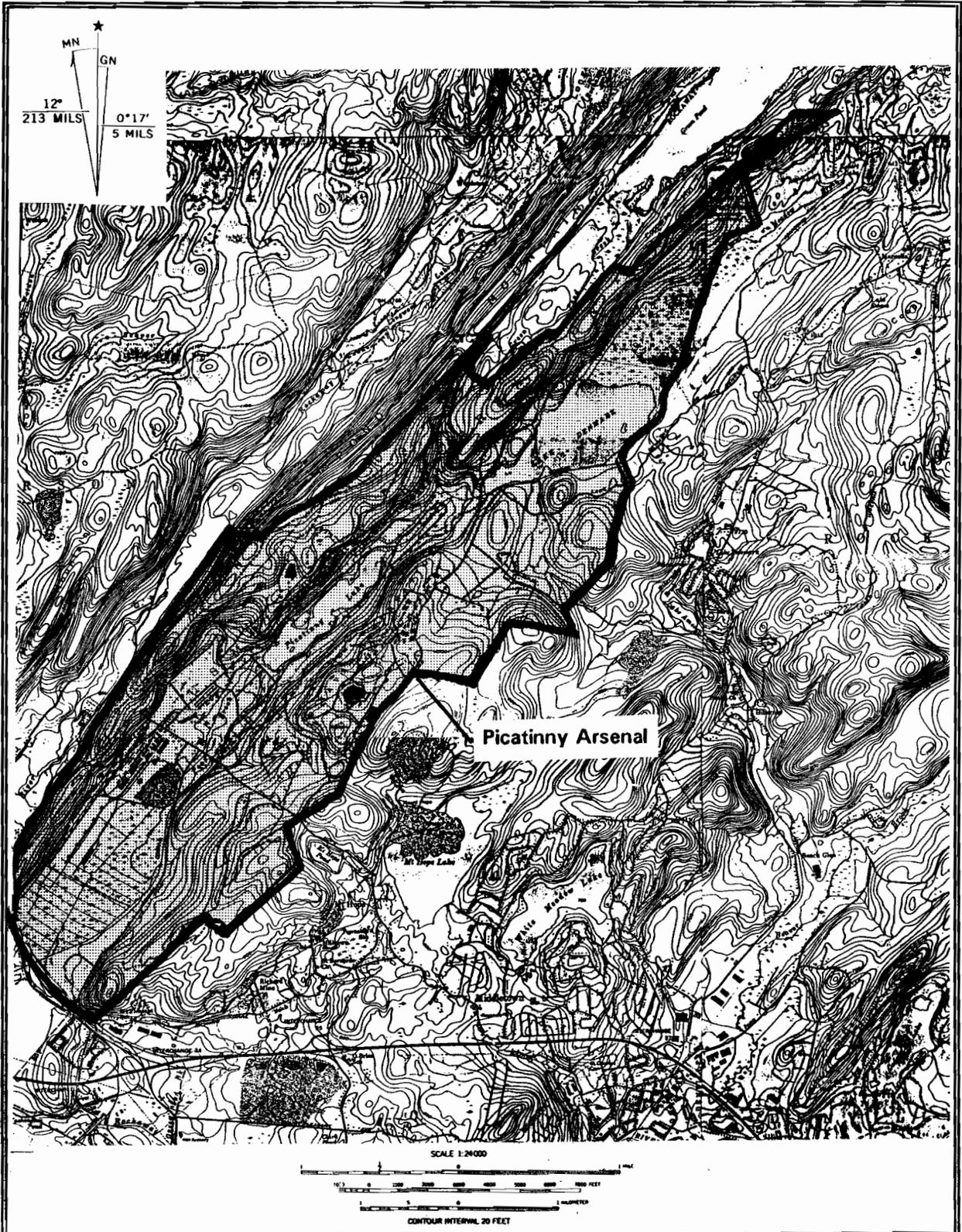


Figure 1-2. Map of the general vicinity of Picatinny Arsenal, U.S.G.S. Dover, Boonton, Newfoundland, and Franklin, N.J. quadrangles, 7.4 minute series.

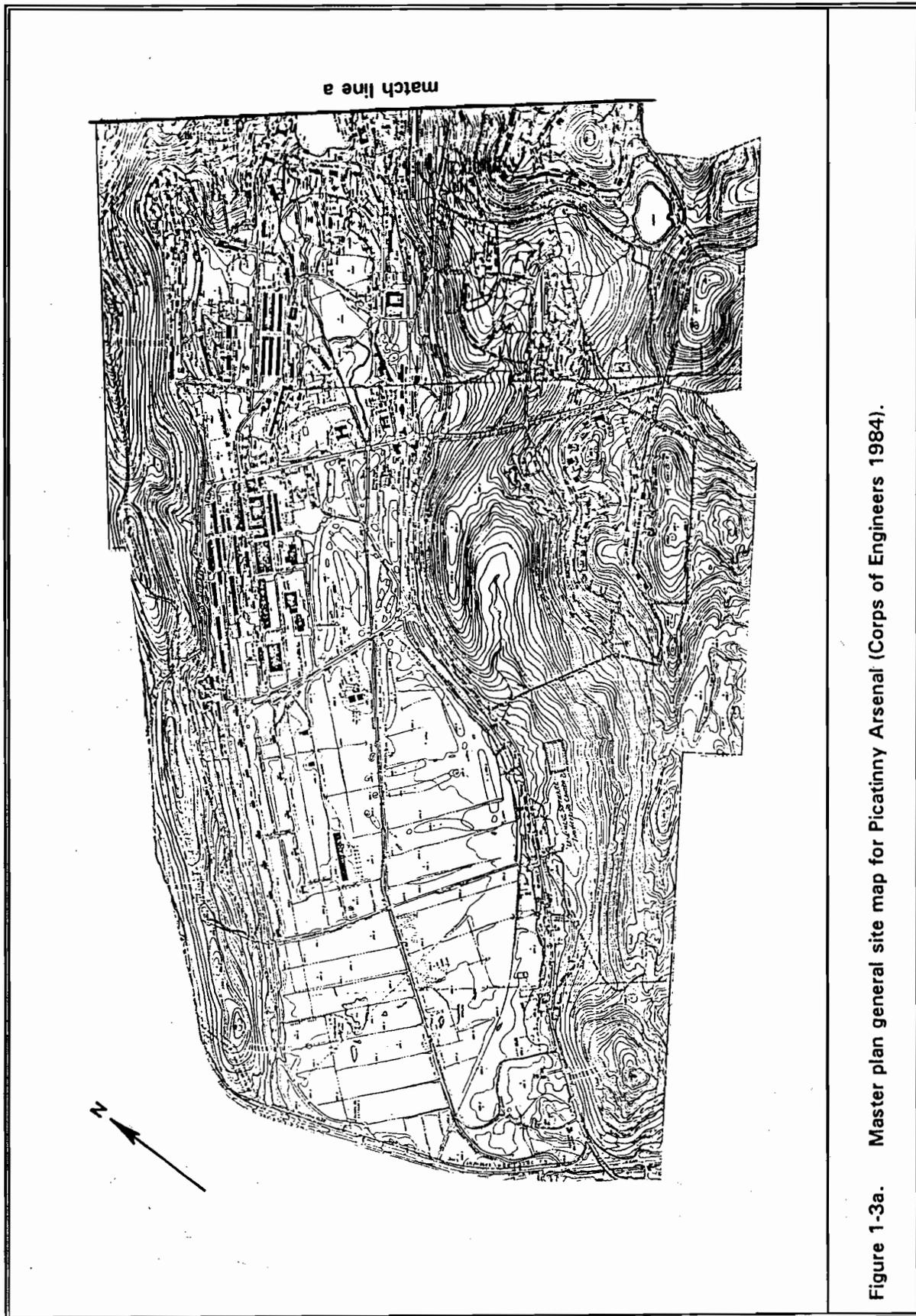


Figure 1-3a. Master plan general site map for Picatinny Arsenal (Corps of Engineers 1984).

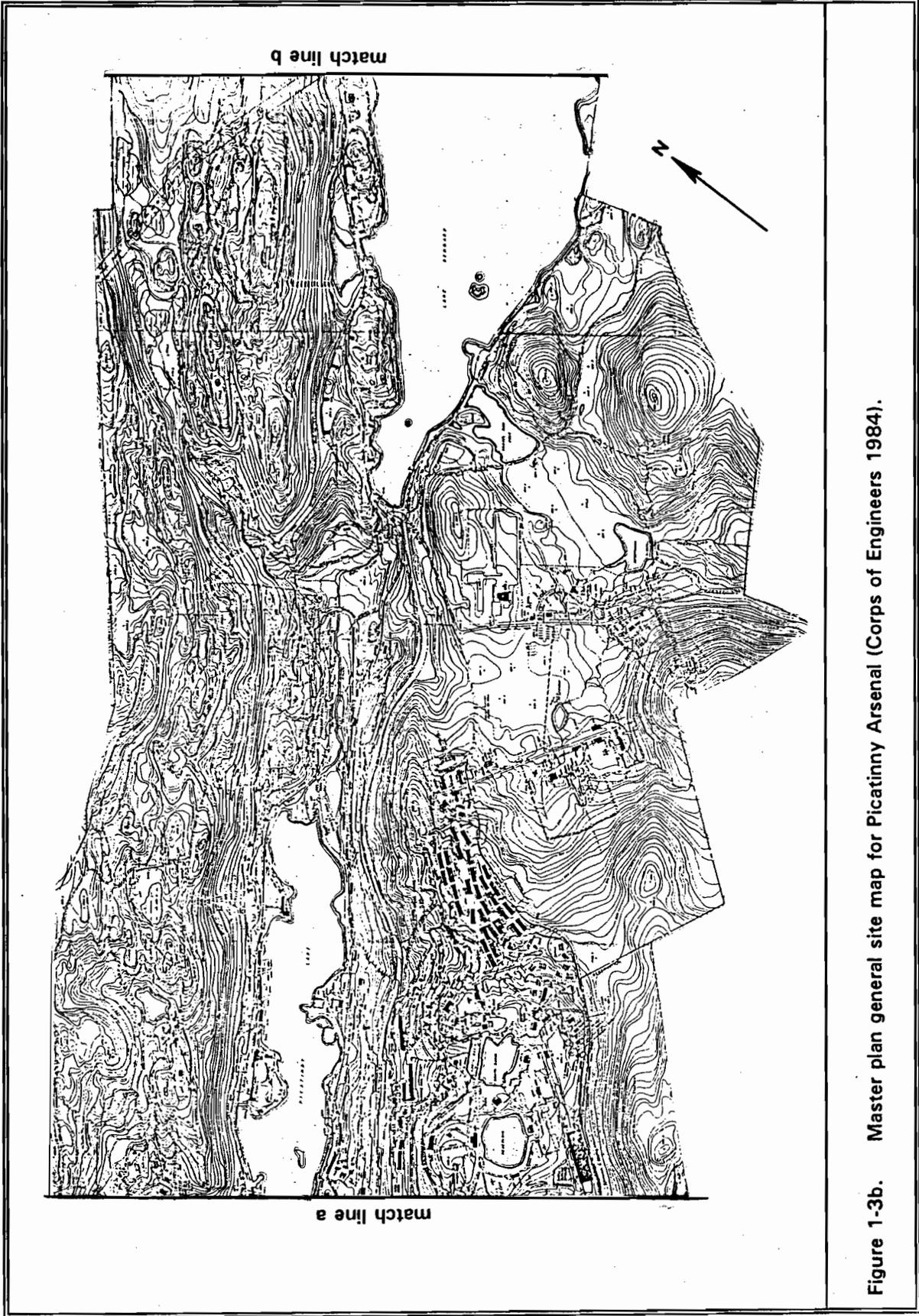


Figure 1-3b. Master plan general site map for Picatinny Arsenal (Corps of Engineers 1984).

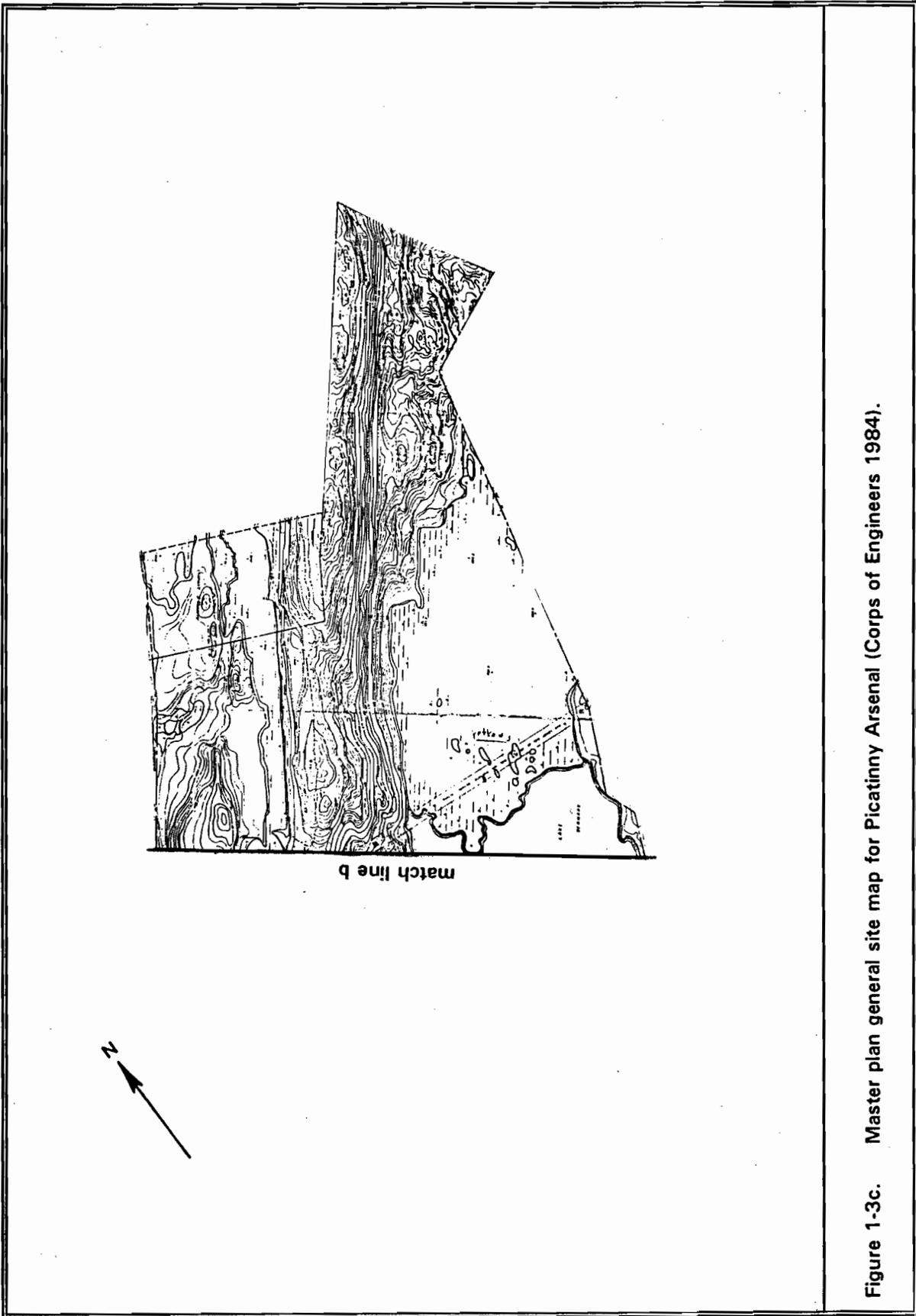


Figure 1-3c. Master plan general site map for Picatinny Arsenal (Corps of Engineers 1984).

uplands to the west and east. Several streams and manmade lakes exist, the most prominent of which are Lake Picatinny, Lake Denmark, and Green Pond Brook. Buildings are predominately situated on the valley floor in the south-central area south of Lake Picatinny. Lower density distributions of buildings characterize the extreme north and south area and the eastern uplands area. The west upland, the Green Pond Mountain ridges, has few buildings and is used for testing. Access is restricted to a number of areas of the Arsenal. Picatinny Arsenal serves as the headquarters of the U.S. Army Armament Research and Development Command (ARRADCOM).

Research Design

The reconnaissance survey conducted at Picatinny Arsenal had two objectives. The first was to provide regional prehistoric and historic contexts within which known cultural resources on the facility could be evaluated. General predictive statements concerning the potential types and distributions of prehistoric and historic archaeological sites within the installation boundaries could then be formulated, based on an assessment of the area's archaeological sensitivity.

The second objective of the reconnaissance survey was to examine the development of Picatinny Arsenal within a regional historic framework as well as a national military context. This discussion enabled the investigators to place previously evaluated historic buildings, structures, and related features within regional and national military contexts, and to identify additional potentially significant buildings/structures/features at the facility.

CHAPTER II

METHODOLOGY

Goals/Strategies

The goals of this reconnaissance survey were to provide a concise prehistoric and historic context for the facility, along with a description of known and potential historic properties and archaeological resources contained within the facility. To achieve these goals, two research strategies were employed during the survey: 1) background research/literature search and 2) field investigations/visual inspection of the project area condition and existing buildings/structures/features. This report section discusses the methods and objectives involved in each of these activities. The results of the research strategies are discussed and evaluated in succeeding sections.

Background Research/Literature Search

Data Collection

The development of a cultural resource framework or context, whether historic or prehistoric, involves the examination of all known sources of information relating to the history and prehistory of the general facility area. This includes the formulation of a detailed outline of the occupation history of the project area, along with an inventory of all known cultural resources. The background data collection for Picatinny Arsenal was organized on a hierarchical basis. The first tier in the hierarchy is the region of north-central New Jersey. The second is that of Rockaway Township in Morris County. The third is local, and includes the specific project area of Picatinny Arsenal. An additional tier for the historic development of the facility was included at the national military level in order to evaluate existing buildings/structures/features at the facility. In this way, the data collection progressed from the general to the particular, placing the facility specific cultural resources within a larger anthropological and historic framework.

State Site Files

General sources used as part of the data collection include site files maintained by the New Jersey State Museum and the Office of New Jersey Heritage (ONJH). These files contain information concerning properties listed on, determined eligible, or considered eligible to the State and National Registers of Historic Places. In addition, information concerning location, configuration, content, and period of occupation of known archaeological resources within each New Jersey County is also available in the site files. These maps and files were consulted as part of the literature search in order to arrive at a preliminary understanding of the nature and distribution of recorded cultural resources within and in proximity to the facility.

Cultural Resources Reports

The Office of New Jersey Heritage (ONJH) and New York State Museum also maintain copies of archaeological reports, cultural resource preservation planning surveys and National Register of Historic Places nomination. These published and unpublished reports of previous research conducted in the general facility area were reviewed. A series of reports concerning New Jersey's archaeological resources from the Paleolndian Period to the present, entitled A Review of Research Problems and Survey Priorities (Chesler, ed., 1982), was particularly useful in developing both the known and potential prehistoric and historic resource base for the Picatinny Arsenal area. Both the Archaeological Overview and Management Plan for Picatinny Arsenal, draft report no. 14 (Klein et al. 1986) and the

Historic Properties Report for Picatinny Arsenal (HABS/HAER 1985), prepared for the United States Army Material Development and Readiness Command (DARCOM) as part of a program agreed upon by the National Park Service, Department of the Interior, and the U.S. Department of the Army, were extensively consulted. The information contained in these reports has been consolidated, condensed, and updated as part of this reconnaissance survey.

A draft Multiple Resource National Register of Historic Places Nomination Form (ca. 1987) and the final draft of Historic American Engineering Record documentation (HAER No. NJ-36, 198) for Picatinny Arsenal were reviewed. The final HAER report and photographs are located at the Library of Congress. The status of the National Register Nomination is unknown.

Two historic preservation reports for the surrounding area were also consulted: Morris County Master Plan, Historic Preservation Element (Guter 1976) and Morris County Historic Sites and Survey [Rockaway Township only] (Acroterion 1986/87).

Town Histories and Maps

Town histories, such as The History of Morris County, New Jersey (Munsell 1882), and maps were examined in a search for possible historic and archaeological resources within the Picatinny Arsenal. These histories, along with nineteenth century maps obtained from the State Library in Trenton, and the Rockaway Township Library, were also used to provide an understanding of the historic development as well as changes in land use, topography, and watershed in this section of northern New Jersey.

Facility History and Maps

Information concerning the historic development of Picatinny Arsenal was obtained from The History of Picatinny Arsenal (Rogers 1931) as well as from the summaries provided in the archaeological overview and HABS/HAER reports for the facility. The History of the United States Army (Weigley 1984), The Sinews of War: Army Logistics 1775-1953 (Huston 1966), and The Ordnance Department: Planning Munitions for War (Green et al. 1955) served as general references for national military development trends and decisions in the twentieth century.

A series of post plans dating from the Picatinny Arsenal's establishment in 1881 to the present were reviewed in order to examine changes in internal configuration, land use, topography, and watershed within the facility boundaries. Data on the buildings within the post was collected from the Building Information Schedule for Picatinny Arsenal (Anon. 1988). The Building Schedule was obtained at the Directorate of Engineering and Housing. Additional materials relating to the history of the U.S. Army Armament Facilities and historic real estate records and photographs (1940s) were also reviewed at the Post Museum and Post Historian's office.

Environmental Data

An essential component of the background research used to evaluate the nature of the potential archaeological resource base for the facility was the ecological or physical context. This includes information on regional geology, geomorphology, and drainage patterns as well as facility-specific soil types. These categories, contributing to the general physical context of the facility, have been found to be closely linked to prehistoric and historic site distributions in New Jersey (Chesler, ed., 1982).

The bedrock and surficial geology and the geomorphology of northern New Jersey was studied in order to understand depositional, erosional, and drainage patterns (Kummel and Weller 1901; Anon.

CHAPTER II

1958; Wolfe 1977). The U.S.D.A. (Soil and Conservation Service) soil survey of Morris County, New Jersey, provided data concerning the description and distribution of natural and disturbed soil types within the Picatinny Arsenal (USDA 1976). Specific information regarding topography, soils, natural vegetation, and hydrology for the Arsenal was obtained from the United States Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey: Five Year Natural Resources Management Plan (Milio et al. 1987).

Archaeological Sensitivity

Archaeological site location and ecological data, along with a land use history, provided the framework for assessing the potential for unknown historic and prehistoric sites to exist within the facility. The results of this background research led to the stratification of the facility into zones of relative archaeological sensitivity.

The archaeological sensitivity of the Arsenal was defined as the probability for any prehistoric or historic resources to be present. Three categories were considered in rating the sensitivity of the facility: 1) environmental characteristics; 2) degree of ground disturbance; and 3) presence of known cultural resources within or in close proximity to the Arsenal. Each of these categories had measurable attributes. Table 2-1 is a list of the environmental factors that were considered in the sensitivity scheme.

Table 2-1. Environmental Attributes Contributing to Archaeological Sensitivity Rankings.

	HIGH	MODERATE	LOW
Distance to Water/Wetland	adjacent > 150 meters	150 to 300 meters	> 300 meters
Slope	minimal 0 - 3 %	moderate 3 - 15 %	steep > 15 %
Soil Type	sandy, well-drained	gravelly, fair drainage	very gravelly, poor drainage

The degree of cultural or natural ground disturbance to an area was also an important criteria used for evaluating the potential preservation of archaeological resources. Minimal disturbance includes such activities as shallow agricultural plowing, the formation of a dirt trail or road, or undergrowth vegetation clearing. Moderate disturbance could be caused by deep agricultural plowing, erosion, or grading to remove the topsoil and grubbing to remove vegetation stumps. Severe disturbance would be caused by gravel or borrow pits, machine excavation, grading, and/or artificial reconstruction of the landscape including buildings/structures and related cultural features. These types of disturbances greatly affect the chances of survival for both prehistoric and historic archaeological resources.

Prehistoric Sensitivity Assessment

The process of stratifying Picatinny Arsenal in terms of expected sensitivity for prehistoric cultural resources was organized according to environmental factors, areas of disturbance, and known prehistoric activity within and in close proximity to the facility. Since some evidence of prehistoric find

spots had been reported on the Arsenal, and several sites are situated in the general area of Rockaway Township, the sensitivity of the facility was assessed in terms of the diverse environmental characteristics and the level of previous ground disturbance.

Historic Sensitivity Assessment

Historic archaeological sensitivity was determined according to the above criteria as well as the historical demography and geography of the area and the inventory of known historic sites and districts. Historical geography, the relationship of the facility to the surrounding regions, provided an indication of the facility's connections to the economic development, persons, and events of the area. The growth and/or decline of the local population provided information concerning the types of activities and historical periods that are significant for the area. Finally, the presence of and proximity to known historic sites, districts, and the National Register properties was an indicator of the facility's historic sensitivity and significance.

Fieldwork/Visual Inspection

Fieldwork involved a driveover/visual inspection of non-restricted areas within the Picatinny Arsenal. The visual field inspection was conducted in order to examine the present physical condition of the Arsenal as well as to complete a preliminary field inventory of properties on the installation.

Physical Surface Inspection

The physical surface inspection was designed to evaluate the type and extent of previously reported ground disturbances. A field check of previously identified ground disturbance areas within the Arsenal (Klein et al. 1986) was conducted to verify disturbances, and record further cultural and/or natural alterations to the landscape. The extent and nature of documented disturbances are discussed and graphically portrayed on Arsenal maps in Chapter VI of this report. All data relating to disturbances were placed within the context of expected soil and landform characteristics of the natural environment.

Archaeological Stratification

Following the driveover/visual surface inspection, the Arsenal was stratified in terms of its prehistoric and historic archaeological sensitivity. Sensitivity is the potential for the recovery of archaeological resources. Areas of low, moderate, and high sensitivity were identified at the facility in relationship to the ecological context and land use history of differing zones within the Arsenal. The sensitivity rankings for potential prehistoric and historic archaeological sites are described and illustrated in Chapter VI.

Buildings/Structures/Features

An exterior and limited interior visual inspection was conducted of buildings, structures and related features at Picatinny Arsenal. This encompassed buildings previously identified and evaluated, including proposed National Register properties and Category I, II and III properties (HABS 1985) as well as all buildings not surveyed in previous studies. Notations were made of construction concerning building size, massing, materials, period conditions and general type. In addition, general observations were made about spatial organization, locations of buildings now demolished, landscaping elements and street fixtures which establish a characteristic setting, and discrete functional areas of facility activities.

CHAPTER II

The inspection technique was designed to provide data on the full spectrum of existing main post construction and to permit preliminary assessment of potentially important buildings, structures, or features not previously identified.

CHAPTER III

PHYSICAL CONTEXT

Earth Resources

New Jersey Highlands

Picatinny Arsenal is located on the Dover, Boonton, Franklin, and Newfoundland U.S.G.S. quadrangle maps (7.5 minute series) in Rockaway Township, New Jersey. The area encompassed by these quadrangles lies within the New Jersey Highlands physiographic province (Figure 3-1). The New Jersey Highlands zone, a part of the Reading prong of the New England physiographic province, is characterized by northeastward trending accordant ridges with elevations ranging from 1,000 to 1,500 feet above sea level (Fenneman 1938). These broad, rounded, or flat-topped ridges are separated by long narrow valleys ranging from 300 to 600 feet below ridge crests. The ridges and valleys that comprise the Highlands are drained by a series of glacial ponds, lakes, marshes, rivers, and numerous feeder streams that flow in a general north-south direction. These freshwater bodies eventually drain into the Passaic River.

Bedrock Geology

The topography in the region of the New Jersey Highlands is controlled by the structure and lithologic character of the underlying bedrock. The majority of the mountainous ridges is underlain by PreCambrian gneissic bedrock. This gneissic bedrock has a mixed mineralogy of magnetite (iron ore), oligoclase, quartz, and lesser amounts of orthoclase, hornblende, and biotite (USDA 1976). Sedimentary bedrock of Cambrian and Silurian ages overlie the PreCambrian igneous and metasedimentary rocks along some ridges and in the valleys (Kummel and Weller 1901).

The eastern and southeastern ridges of the Arsenal consist of the older consolidated PreCambrian gneiss. The northwestern ridge, called Green Pond Range, is underlain by the younger consolidated Paleozoic Age Longwood shale (200 feet thick) and Green Pond conglomerate (1200 feet thick). The valley area of the Arsenal consists of Cambrian Age Kittatinny limestone (2500 feet thick) and Hardyston quartzite (200 feet thick) (Anon. 1958). These prominent and resistant massive bedrock formations result in a general topography marked by an abundance of stones and boulders, with frequent outcroppings.

Surficial Geology

The present topography of the general Arsenal vicinity shows the effects of Pleistocene glaciation. The region was subjected to repeated periods of glaciation which resulted in both the scouring of underlying bedrock and the deposition of glacially mixed and transported material. These activities also altered the drainage pattern, with the formation of several glacial lakes. Both glacial Lake Passaic and Green Pond were formed during the retreat of the Wisconsin glacier approximately 14,000 years ago. During the time that these areas were lakes, glacial meltwater deposited fine-textured sediment at the bottom. As the ice melted and an outlet developed, the lakes drained, leaving nearly level basins of mainly silty and clayey material (USDA 1976). Numerous natural kettles, or basins, were created within these formerly glaciated areas.

The terminal moraine of the final Wisconsin glacial stage forms a relatively shallow mantle (10 feet to 150 feet thick) over the bedrock. This mantle is comprised mainly of glacial till deposits. The thicker till deposits of unstratified boulders, pebbles, sands, and clays are found in the stream valleys and depressions, while sporadic and thin deposits are situated on the hill slopes and ridges (Anon. 1958).

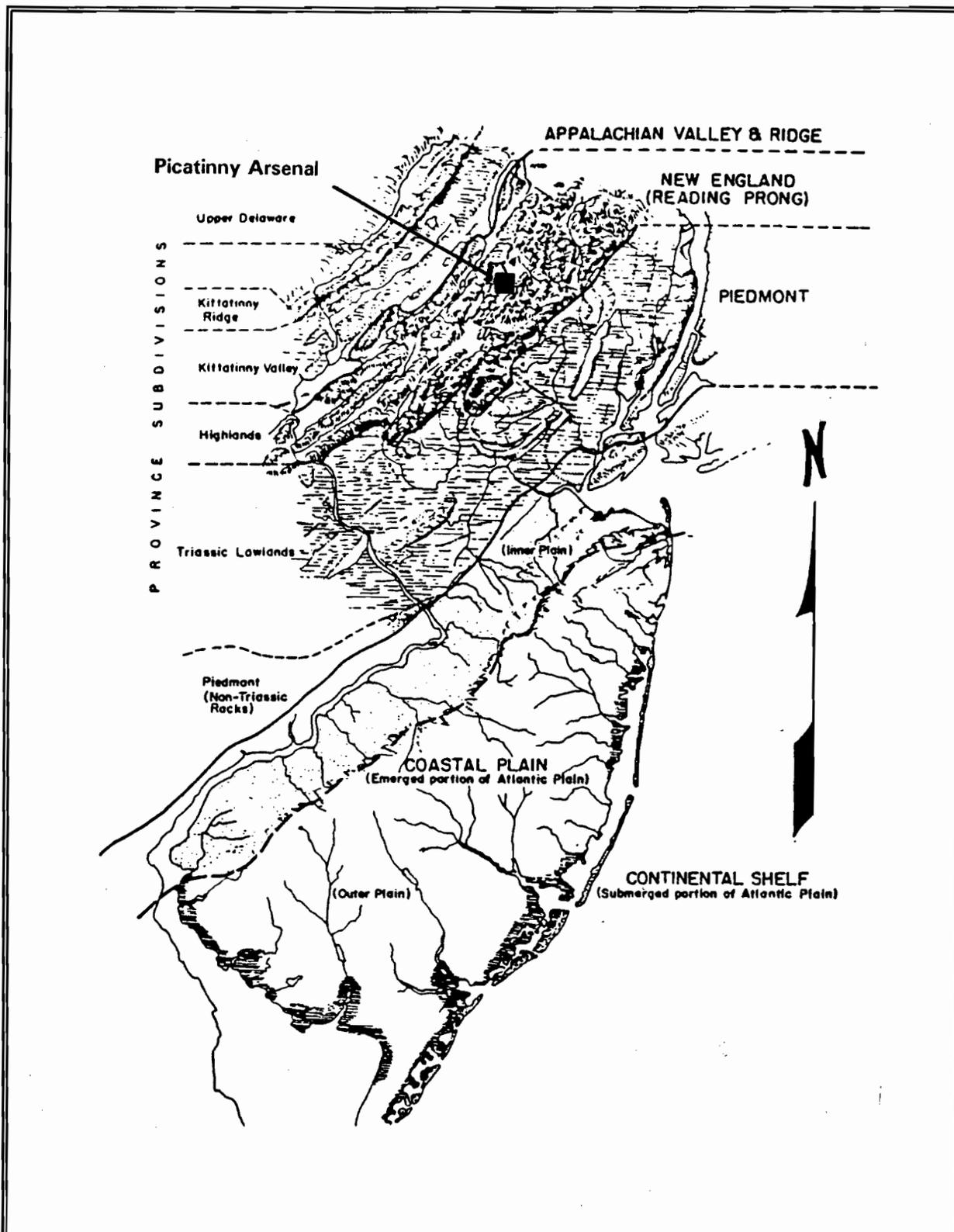


Figure 3-1. Physiographic provinces of New Jersey (source: Fenneman 1938).

Smaller glacial outwash deposits also occur in the region. These stratified sands, clays, and gravel are found mainly on well-drained river terraces in the valleys. An area of stratified glacial outwash occurs in the valley at the southern end of Picatinny Lake (USDA 1976).

Soils

The principal soil types found within the Picatinny Arsenal boundaries belong to the Rockaway-Hibernia-Urban land association. These upland soils formed in young glacial till deposits, and are well-drained to somewhat poorly drained, gravelly to extremely stony sandy loams. The Hibernia very stony loams and the Ridgebury extremely stony loams are deep, somewhat poorly to poorly drained soils in upland areas of 3 to 25 percent slope. Although depth to bedrock is greater than ten feet, natural fertility and available water capacity are moderate, and the permeability is slow. These soils are found along the lower portions of the western and eastern ridges within the Arsenal.

The ridges themselves are characterized by a combination of Rockaway gravelly to extremely stony sandy loams and the Rockaway-Rock outcrop complex. These soil types are situated in areas having 3 to 45 percent slopes. Rockaway soils range from less than two feet to more than ten feet to bedrock, and are moderately well to well drained upland types. The natural fertility and available water capacity of these soils is low to moderate, and permeability is slow. The rock outcrops consist of large stones and boulders of mostly hard granitic gneiss or Green Pond conglomerate, and bedrock is present at the surface (USDA 1976). These soil types and rock outcrops extend from the southernmost limits of the ridges within the Arsenal to the northern areas along either side of Lake Denmark.

A smaller zone of soils that formed in glacial outwash deposits lies to the south of Picatinny Lake in the valley area of the Arsenal. These outwash soils belong to the Carlisle-Parsipanny-Preakness association. These soils consist of deep, moderate to poorly drained mucks, silt loams, and sandy loams found in depressions and along low-gradient streams. The Preakness and Pompton sandy loams are deep, somewhat poorly drained soils found on nearly level outwash terraces. Their natural fertility and available water capacity is moderate, with a moderately rapid permeability. The Pompton sandy loam is found in the southernmost portion of the Arsenal east of Green Pond Brook. This soil type formed in glacial fluvial deposits and occurs on nearly level slopes. Pompton soils are deep and somewhat poorly drained.

A large area of organic soils also characterizes the central valley portion of Picatinny Arsenal. Adrian muck is found in the area south of Picatinny Lake surrounding Green Pond Brook, and Carlisle muck exists north of Lake Denmark. These very poorly drained organic soils are common in depressions or kettles and adjacent to streams or the uplands. Depth to bedrock is greater than ten feet, available water capacity is high, and permeability is rapid. These organic soils have the potential for intensive production of vegetables or specialty crops, but require extensive drainage outlets and protection from flooding (USDA 1976).

Along with these glacially derived deposits of till and outwash soils, several areas of artificial soil complexes exist within the valley portion of the Arsenal. These include an area of made land, identified as a sanitary land fill, which is situated to the east and west of Green Pond Brook from the railroad easement to Phipps Road. This made land consists of fill material that varies in composition and physical characteristics. An Arsenal historical report indicates that a burning grounds area lies over reclaimed swampland in the southeast section of the Arsenal along Green Pond Brook. This burning ground contains explosive scrap and miscellaneous materials (Anon. 1944). The area of made land is identified as the Pyrotechnic Testing Range and Burning Ground on the most recent general site map of the Arsenal (Corps of Engineers 1984).

Urban land and Urban land portions are also present in the nearly level area south of Picatinny Lake, along its eastern margin, and between Picatinny Lake and Lake Denmark. This complex consists of areas in which the natural soils have been reworked beyond recognition by development activities. The surface has been smoothed and in most places leveled. The urban portions within the Arsenal boundaries are largely covered by buildings, parking lots, and paving.

Several areas of sand and gravel pits are situated within Picatinny Arsenal. These pits consist of open excavations and adjoining areas of fill material removed during the mining of sand, gravel, and borrow material. This land type occurs in areas of Otisville and Riverhead outwash sands and gravels, although some pits are in areas of stony glacial till. The pits are both active and abandoned, are situated on the upland slopes, and have depths of six to twenty feet below surface.

Tree and Vegetation Cover

Approximately two-thirds (4,164 acres) of the Arsenal is forested with the predominant tree species of a mixed oak type (Milio et al. 1987). The principal understory species are Mountain Laurel, Great Rhododendron, Japanese Barberry, and Flowering Dogwood. This vegetation grows naturally throughout the general Arsenal vicinity. The forest cover is secondary growth, resulting from extensive tree-clearing activities associated with historic period iron mining and smelting industries.

Planted areas on the Arsenal include improved and semi-improved grounds where landscaping activities occur on a regular basis. Improved grounds are intensively managed and include administrative areas, recreation areas, main entrances to the Arsenal, and resident housing. Semi-improved grounds are the less intensively managed areas and roadways associated with research and testing buildings as well as with storage buildings and outer patrol roads. Planted tree species include spruce varieties, ash, cherry, willow, magnolia, hickory, apple, and pear. Shrubs that comprise the landscaping design consist primarily of azalea varieties, barberry, boxwood, lilac, forsythia, and holly varieties (Milio et al. 1987).

Water Resources

Rockaway River Basin

The Rockaway River is the major north-south drainage basin in this portion of the Highlands region (Figure 3-2). The minor basins of Green Pond Brook, Richard Mine Brook, and Burnt Meadow Brook are contributing tributaries which flow southward to join the Rockaway River. Picatinny Arsenal lies within the minor Green Pond drainage basin. Green Pond, a 500 acre natural glacial lake, lies directly northwest of the Arsenal. This freshwater natural pond is drained by Green Pond Brook which is joined by Burnt Meadow Brook south of Lake Denmark. This confluence continues southward through Picatinny Lake where Green Pond Brook flows south to the Rockaway River in Wharton.

Facility Drainage Patterns

The principal freshwater features entirely within the Arsenal's boundaries are Lake Denmark and Picatinny Lake. Lake Denmark covers an area of 194 acres with a large zone of associated wetlands and streams to the north. This freshwater lake was artificially created by the damming of Burnt Meadow Brook during the mid-eighteenth century for water power to supply the Upper Forge industrial complex. Picatinny Lake, covering 108 acres, is also an artificial freshwater body created at the same time to supply the Middle Forge industrial complex (Boyer 1931). Subsequent Arsenal-related

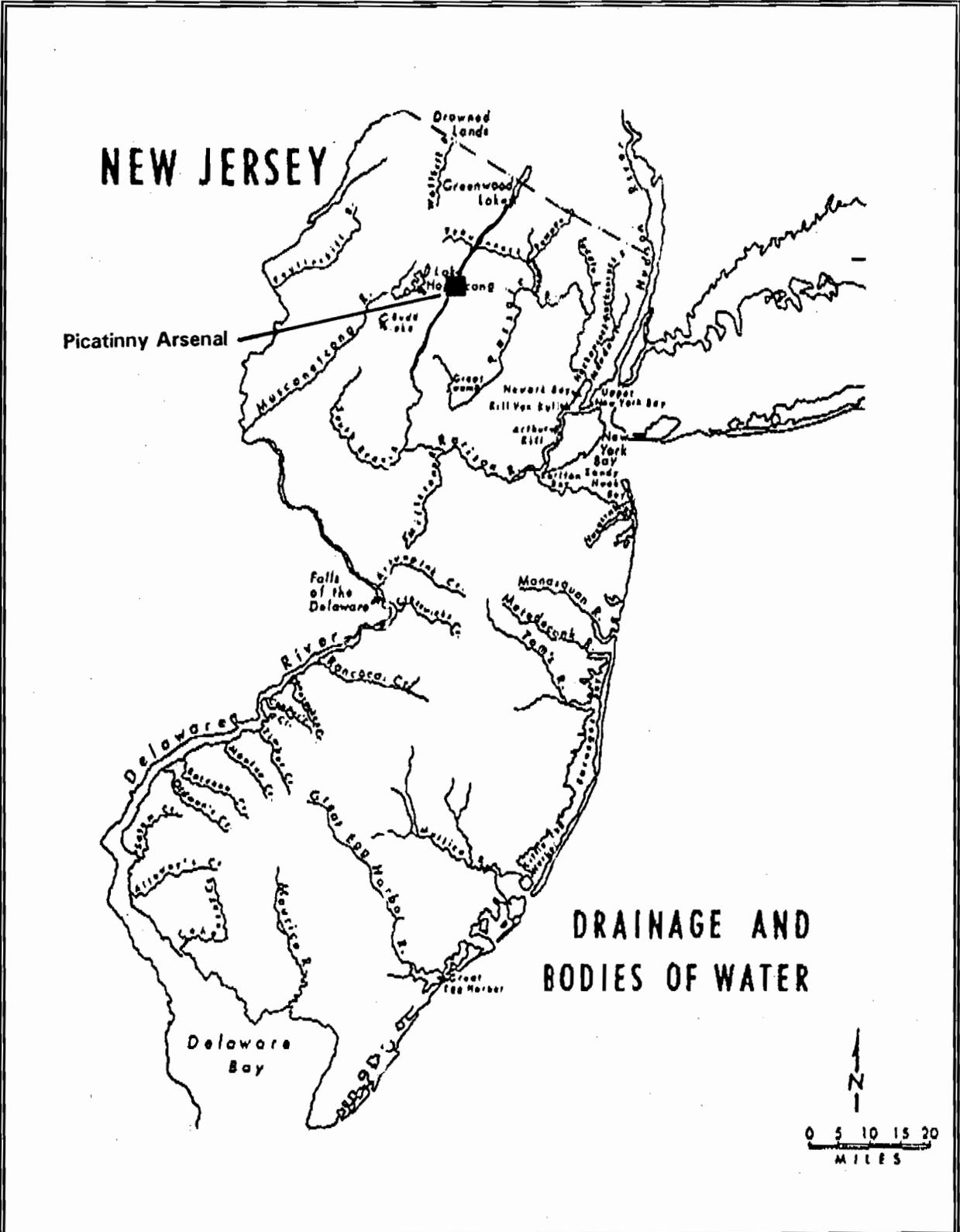


Figure 3-2. Location of Picatinny Arsenal within the Rockaway River drainage basin.

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improvement activities following the 1881 purchase of the parcel by the United States Army enlarged Picatinny Lake to its present size and shape (Robinson 1887).

The principal natural drainage channels flowing in a southerly direction through the Arsenal are Green Pond Brook, Burnt Meadow Brook, and Bear Swamp Brook. The main drainageway through the installation is Green Pond Brook. This brook drains an area of 8,338 acres from Green Pond to its exit point at the southern end of the reservation. Numerous natural and artificial feeder streams and wetland areas exist in association with Green Pond Brook.

The most notable artificial drainage system is found at the large, nearly level area in the southern third of the Arsenal. Prior to military occupation, an extensive natural wetland zone surrounded Green Pond Brook south of Picatinny Lake (Lightfoot and Geil 1853; Hopkins 1867). The 1881 purchase of the parcel led to the reclamation of this wetland area for buildings, research, and testing facilities as well as agricultural lands. Ground improvements consisted of the construction of over 10,000 feet of ditches dug to drain the land into Green Pond Brook. These initial activities occurred between 1881 and 1883. They were intended to clear and drain the low ground for permanent use, with future underdraining via tile drain pipes (Anon. 1882/1884). Since these operations, an extensive drainage channeling system, including storm drains, tile drains and culverts has been created across the southern half of the central valley portion of the Arsenal (Milio et al. 1987). These artificial drainage patterns are indicated by dotted lines on the general site map (Anon. 1984).

Burnt Meadow Brook drains the northeastern portion of the Arsenal to its junction with Green Pond Brook immediately south of Lake Denmark. A 385 acre wetland zone exists at the northeast end of the Lake. Bear Swamp Brook, a minor tributary of Green Pond Brook, naturally drained the southwestern ridge area of the Arsenal. However, the natural drainage pattern of this brook was significantly altered to accommodate military facilities. Other secondary artificial water sources within the Arsenal's boundaries include dams, reservoirs, basins, and small drainage channels used for recreational and functional purposes. These artificial freshwater bodies were created by the damming of various natural feeder streams running in a southerly direction from both the east and west ridges surrounding the Arsenal.

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PREHISTORIC CONTEXT

New Jersey Highlands

The general vicinity of Picatinny Arsenal is characterized by northeastward trending accordant ridges separated by long, narrow valleys. The Green Pond Mountain range to the immediate northwest of the Arsenal and the Copperas Mountain range to the immediate northeast dominate the valley region of Rockaway Township. This valley is drained to the south by Green Pond Brook and the Rockaway River. These north-south oriented mountain ridges and valleys together with the drainage system form the central portion of the New Jersey Highlands physiographic zone.

The results of recent archaeological research indicate that physiographic zones (and related drainage systems) were a basic framework for prehistoric settlement systems and resource exploitation territories. From as early as the PaleoIndian prehistoric period to the early historic period, various types of data, such as lithic resource use and ethnohistoric descriptions of traditional land holdings, suggest that Native American land use systems were oriented to regional physiographic zones and related river drainages (Chesler, ed., 1982).

This type of geographic (cultural geographic) approach emphasizes the importance of context for interpreting and understanding known and potential prehistoric cultural resources in terms of both regional and local patterns. The broad processes of change in prehistoric settlement/land use systems, and the characteristics of known and potential site types at Picatinny Arsenal, can be defined within this regional context.

Prehistoric Cultural Chronology

Information concerning prehistoric settlement patterns and subsistence strategies for the Highlands province in New Jersey comes from both avocational collections and professional archaeological surveys. The extant data base has enabled researchers to compile a series of regional prehistoric cultural chronologies within which known and potential site types and distributions can be studied (Table 4-1). The chronology for northern New Jersey has been largely formulated from known prehistoric cultural associations and chronologies in New York (Ritchie 1969) and New England (Snow 1980).

PaleoIndian Period (12,000 - 10,000 B.P. or 10,000 - 8000 B.C.)

Artifact assemblages from the PaleoIndian Period provide the earliest documented evidence for human occupation in northern New Jersey. Occasional isolated finds characterize the bulk of the area's data base. Documented relatively intact PaleoIndian sites yielding diagnostic artifact assemblages are scantily represented in the archaeological record. Six fluted projectile points have been identified in avocational collections from three different locations in Morris County. The Highlands region contains fifteen fluted projectile points, or 7% of the total number recorded in New Jersey. Although this frequency is most likely skewed by collector bias, the differential distribution of fluted points probably reflects the general PaleoIndian settlement pattern (Marshall 1982).

Table 4-1. Prehistoric Cultural Chronology for Northern New Jersey¹

<u>General Period</u>	<u>Identified Temporal Subdivisions</u>	<u>Cultural Aspects</u>
PaleoIndian		
12,000-10,000 B.P.** (10,000-8,000 B.C.)	(1) Eastern Clovis (2) Plano	Hunting of migratory game animals by small groups with a specialized, sophisticated lithic technology was the rule for highly mobile bands of hunter-gatherers.
Early Archaic		
10,000-8000 B.P. (8000-6000 B.C.)	(1) Bifurcate-Base Point Assemblages	Few sites are known, possibly because of problems with archaeological recognition. This period represents a transition from specialized hunting strategies to the beginnings of a more generalized hunting and gathering adaptation due in part to changing environmental circumstances.
Middle Archaic		
8000-6000 B.P. (6000-4000 B.C.)	(1) Morrow Mountain/Stanley (2) Neville-like	Regular harvesting of anadromous fish and various plant resources is combined with generalized hunting. Major sites are located at falls and rapids along major river drainages. Ground stone technology is first utilized. There is a reliance on local lithic materials for a variety of bifacial and unifacial tools.
Late Archaic		
6000-3000 B.P. (4000-1000 B.C.)	(1) Brewerton (2) Small Stemmed Point Assemblage	Intensive hunting and gathering was the rule in diverse environments. Evidence for regularized shellfish exploitation is first seen during this period. An abundance of sites, including rockshelters, suggests increasing populations, with specialized adaptations to particular zones.
Early Woodland		
3000-1500 B.P. (1000 B.C.-500 A.D.)	(1) Meadowood (2) Middlesex	A scarcity of sites suggests population decline. Pottery was first (?) made. Little is known of social organization or economy, although evidence for complex mortuary rituals is present. Influences from the mid-western Adena culture are seen in some areas.
Middle Woodland		
1500-1100 B.P. (500-900 A.D.)	(1) Buskhill (2) Point Peninsular	Economy focused on coastal resources. Horticulture may have appeared late in period. Hunting and gathering was still important. Population may have increased from the previous low in the Early Woodland. Extensive interaction between groups throughout the northeast is seen in the widespread distribution of exotic lithics and other materials.

¹ Source: Chesler, ed., 1982, Ritchie 1969, Snow 1980

* Termed Phrases or Complexes

** Before Present

Table 4-1 (Continued).

<u>General Period</u>	<u>Identified Temporal Subdivisions</u>	<u>Cultural Aspects</u>
Late Woodland		
1100-400 B.P. (900-1600 A.D.)	(1) Pahaquarra (2) Proto-Munsee	Horticulture was established in some areas. Coastal areas and large river valleys seem to be preferred. Large groups sometimes lived in unfortified villages, and may have been organized in complicated political alliances. Most groups appear to have relied mainly on hunting and gathering.
Protohistoric and Contact		
400-300 B.P. (1600-1700 A.D.)	(1) Delaware	Groups such as the Munsee-speaking Lenape or Minisink were settled in the area. Political, social, and economic groups were relatively complex, but underwent rapid change during European Colonization.

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The most important PaleoIndian site in the Highlands region is the Plenge Site. This site lies on a gently sloping terrace overlooking the Musconetcong River in Warren County. A number of fluted points as well as associated knives, scrapers, gravers, unifacial tools, hammerstones, and chipping debris were surface collected from this site (Kraft 1973). Professional archaeologists have interpreted the site as a seasonal base camp visited during resource exploitation movements between the Delaware River and the lakes region of northern New Jersey (Kraft 1977).

Recent archaeological investigations of PaleoIndian sites have discovered that PaleoIndian tool assemblages relied on the exploitation of cryptocrystalline cherts. Site distributions during the PaleoIndian Period appear to be oriented toward outcrops or riverine deposits of cryptocrystalline material (Gardner 1980). The Highlands region contains several areas of primary chert sources which may have been utilized by PaleoIndian populations. The Late Silurian formations of the Highlands mountainous ridges include limestone deposits which may contain cherty material. Upper deposits of Kittatinny Limestone are characterized by thin and thick gray or blue cherty magnesium limestone. This bedrock underlies the valley area of Picatinny Arsenal. Four of the six fluted points found in Morris County are manufactured from jasper and gray chert lithic materials (Marshall 1982).

PaleoIndian populations occupying the Highlands region were likely highly mobile groups of hunter/gatherers who practiced the seasonal exploitation of natural food resources and raw materials. A number of environmental features in the Highlands region have been identified as favorable locations for PaleoIndian deposits based on the known locations of sites. These include floodplains and river valleys as well as secondary streams and drainages and upland area bluffs and ridgetops (Marshall 1982). Types of activities carried out at these sites would include lithic quarry extraction, animal processing, hunting, and fishing. The immediate vicinity of Picatinny Arsenal may have been utilized for both lithic resource extraction and hunting/gathering activities due to its location in a secondary stream river valley surrounded by lithic outcrops along the mountainous ridges.

Early Archaic Period (10,000 - 8,000 B.P. or 8000 - 6000 B.C.)

The Early Archaic Period represents a continuous cultural adaptation to the new environments emerging following the retreat of the final Wisconsin glacier. The Early Archaic Period in New Jersey is characterized by a hunting and gathering economy based upon the seasonal exploitation of natural resources by relatively small, mobile bands. In the Highlands region, the numerous ridges and valleys continued to provide ecological resources that invited exploitation and temporary settlement during the Early Archaic Period. Glacial ponds and lakes, such as Green Pond, marshes, rivers, and numerous feeder streams were the settings for a wide diversity of natural food resources. The nearby mountainsides contained overhangs or rock shelters which served as stop-overs and short-term abodes for lithic resource procurement.

The hilly, mountain, and lakes topography with its network of stream drainages would have provided excellent campsites and rock shelters for the transitory Early Archaic groups of hunter/gatherers. Numerous Highlands region river drainages and tributary streams have produced prehistoric occupations that have been known and collected since the early twentieth century (Skinner and Schrabisch 1913). Two of these sites, 28-MR-42 and 28-MR-43, lie within a three-mile radius of Picatinny Arsenal in Jefferson Township (Table 4-2). Site 28-MR-42 is located along the northeast bank of Lake Hopatcong, approximately three miles west of the Arsenal. Site 28-MR-43 is situated one mile north of Lake Denmark. Both sites are described as containing a scatter of Archaic Period artifacts including diagnostic bifurcate-base projectile points.

Table 4-2. Recorded Prehistoric Archaeological Sites Within a Three-Mile Radius of Picatinny Arsenal.

TOWNSHIP	SITE NO.	SITE NAME	CULTURAL AFFILIATION	REFERENCE
Jefferson	28-MR-33	Unnamed	Unknown	N.J. State Museum Site Files
	28-MR-34	Unnamed	Unknown	N.J. State Museum Site Files
	28-MR-35	Unnamed	Unknown	N.J. State Museum Site Files
	28-MR-36	Split Rock Reservoir	Unknown	N.J. State Museum Site Files
	28-MR-42	Unnamed	Archaic	Skinner and Schrabisch 1913
	28-MR-43	Unnamed	Archaic	Skinner and Schrabisch 1913
Rockaway	28-MR-220	Ground Bee Rock Shelter	Unknown	Rutsch et al. 1986

Recent professional archaeological surveys in the Highlands region have discovered that many of these early reported prehistoric sites have been destroyed by urbanization as well as by inundation resulting from the creation or expansion of bodies of water during damming activities (Kraft 1982a). Types of sites that have been recorded in the Morris County area for the Archaic Period include rockshelters or caves near springs, lakes, or marshes. Numerous river valley marshlands are also the locations of Archaic Period encampments.

*Middle Archaic Period
(8000 - 6000 B.P. or 6000 - 4000 B.C.)*

Evidence for Middle Archaic occupation in northern New Jersey is based on typological projectile point similarities with southeastern Morrow Mountain and Stanley types or with Neville-like points from New England. Only one deeply stratified site, the Rockelein Site, in the Upper Delaware Valley has yielded in situ diagnostic artifacts of the Middle Archaic Period (Kraft 1982a). Some additional information on Middle Archaic settlement patterns in the Highlands region has been provided by avocational artifact collections. Several of the artifact collections dating from the early twentieth century reportedly contain diagnostic Stanley and Neville point types. Sites 28-MR-42 and 28-MR-43 may have contained similar diagnostic artifacts (N.J. State Museum Site Files).

Middle Archaic projectile point types have been reported in surface collected artifact assemblages from riverine, lacustrine, and marshland settings across this section of New Jersey. The majority of these sites are multi-component occupations, although no focal area of Middle Archaic settlement has been identified in the Highlands region.

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Late Archaic Period (6000 - 3000 B.P. or 4000 - 1000 B.C.)

The distribution, size, and frequency of Late Archaic Period sites in the Highlands region are slightly better documented in the archaeological record. A recent re-excavation of a rockshelter site discovered in the early twentieth century represents one of the few known Late Archaic occupations in the area. This site is situated in the township of Wayne, and yielded numerous diagnostic Small Stemmed and Brewerton projectile points as well as floral/faunal remains and intact features (Lenik 1985).

The Ground Bee Rockshelter (28-MR-220), recently identified during a cultural resources survey for the Hydroelectric facility and transmission lines in Rockaway and Jefferson Townships may also have been utilized by prehistoric groups during the Archaic period. A variety of lithic debitage, including chert, argillite, and quartzite flakes, was found in association with charcoal fragments (Rutsch et al. 1986). This rockshelter lies less than one mile west of Picatinny Arsenal at the base of an escarpment near Longwood Lake. Projectile points diagnostic of the Late Archaic Period are commonly made out of these types of locally available material (Kraft 1982).

Early/Middle Woodland Period (3000 - 1500 B.P. or 1000 B.C. - 900 A.D.)

The Highlands region in north-central New Jersey has not been well documented for prehistoric occupations during the Early and Middle Woodland Period. The nearby Delaware River Valley north of the Delaware Water Gap to the west and the Passaic and Raritan River Valleys to the east provide the bulk of information concerning prehistoric settlement and subsistence patterns during this period. Several small habitation sites contain diagnostic Meadowood projectile points. All of these sites are small in areal extent and exhibit low densities of cultural materials, suggesting short-term camp sites used by small groups for resource procurement activities. Vinette I ceramics have also been found in association with Meadowood points at several of the sites in the Upper Delaware Valley (Williams and Thomas 1982).

Several cremation burials associated with the Middlesex Phase of the Early Woodland Period have also been found along the Upper Delaware River Valley (Cross 1956; Carpenter 1950; Kraft 1978a). Some researchers have suggested that these sites are the remains of an Adena group migrating from Ohio into the Champlain drainage via Chesapeake Bay and the Delaware River Valley (Williams and Thomas 1982). One of the most important burial sites related to this mortuary complex is the Rosenkrans Site located on the Wallpack Bend peninsula at the southwestern most tip of Sussex County. A recent archaeological study of excavations conducted at the site in the 1930s and 1940s identified thirteen human burials and associated grave goods as being analogous to those of the Midwestern Adena sites (Kraft 1976). The site's location on a sandy bluff overlooking the upper Delaware River lacked any surface indication of its presence. The existence of related habitation sites and other Middlesex burials in the greater region of northwest New Jersey cannot be discounted.

Occupations succeeding the Meadowood and Middlesex Phases also exist in the Upper Delaware Valley. Limited occupation areas designated as belonging to the Bushkill Complex have been found at a number of multi-component sites on low terraces bordering the Delaware River. Diagnostic artifact assemblages include Rossville and Lagoon point types as well as net-marked ceramic varieties. A wide distribution of Rossville points has been identified from surface surveys in the northeastern area of the Passaic River Basin (Williams et al. 1978). This indicates that contemporaneous sites should occur across the northern central section of New Jersey from the upper Delaware Valley east to the Passaic River basin.

In the Upper Delaware River Valley there is also evidence for prehistoric occupations sharing the technological traditions of the Point Peninsular Phase of central New York. The Faucett Site, located along the upper river valley, yielded diagnostic Jack's Reef projectile points along with cord-marked and dentate-stamped decorated ceramics (Kinsey 1975).

*Late Woodland Period
(1100 - 400 B.P. or 900 - 1600 A.D.)*

Although the Highlands region has not been systematically studied for Late Woodland Period occupations, a number of archaeological excavations have been conducted in the nearby Delaware River Valley north of the Delaware Water Gap (Kinsey et al. 1972; Kraft 1975, 1978a). Almost no Late Woodland Period sites have been scientifically excavated and reported from major drainage systems in northeastern New Jersey such as the Passaic and Raritan. The Pahaquarra Culture represents the prehistoric groups occupying the greater Upper Delaware River Valley region during the early part of the Late Woodland Period. Sites associated with this culture consist mainly of small, unfortified villages where archaeological excavations have identified a complex artifact assemblage, as well as evidence of house patterns (Kraft 1982b). These semi-permanent village settlements suggest that some degree of horticulture was being practiced, although hunting and gathering continue to comprise the bulk of subsistence activities. Technological advances in ceramic manufacture are also evidenced in the artifact assemblages from these sites.

The Proto-Munsee Culture characterizes the latter part of the Late Woodland Period in northwest and north central New Jersey. Numerous groups associated with the Munsee-dialect speaking Algonkian Delawares occupied the area from circa 650 B.P. to 400 B.P. (1350 - 1600 A.D.) (Goddard 1974). Although no archaeological evidence for Late Woodland sites associated with this culture has been identified in north central New Jersey, ethnohistoric accounts reveal that groups lived in small and politically independent bands. The limited historic and archaeological evidence from the Upper Delaware River Valley suggests that Proto-Munsee groups lived in small unfortified hamlets consisting of one or a few round-ended longhouses (Kraft 1970, 1975, 1978b). Hunting, gathering, fishing, and horticulture continued in the tradition of the earlier Pahaquarra Culture. A variety of cultigens including maize, beans, squash, pumpkin, and tobacco were standard crops cultivated at that time.

*Protohistoric and Contact Period
(400 - 300 B.P. or 1600 - 1700 A.D.)*

The northern New Jersey area at the time of European contact is known to have been occupied by subgroups of the Delaware or Lenape Indians. The Minisink subgroup constituted the largest Munsee-dialect speaking Algonkian Delawares who lived in the upper Delaware River Valley. Numerous other subgroups also speaking this dialect inhabited north central and northeast New Jersey. Archaeological data and ethnohistoric accounts from known sites in the upper Delaware River Valley indicate that the Native American populations were living a relatively settled existence with cultigens providing an important part of the subsistence base (Williams and Kardus 1982). Hunting, fishing, and the collecting of wild plant foods still comprised the major subsistence activities in the interior regions.

The most typical Contact Period sites found in northwest and northcentral New Jersey are aboriginal rockshelter occupations with evidence of European-made artifacts. These shelters are interpreted as seasonal occupations by small groups, who also exploited the natural resources of the mountain and lakes region from open-air hunting and gathering camps in the river valleys.

Ethnohistoric accounts have documented the existence of an extensive Contact Period trail network which passed from the Upper Delaware River Valley through central New Jersey to the coast and the

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Hudson River Valley. The most notable path was the Minisink Trail which led from the well-established Minisink Island village settlement on the upper Delaware in a southeasterly direction to Lake Hopatcong. At Lake Hopatcong it turned east, following the glacial terminal moraine to the Rockaway River. At this point it split into two trails, one continuing out into Springfield by way of Parsipanny and Hanover, while the other rejoined it after following a more southerly path through Morristown, Madison, and Chatham (Figure 4-1). From Springfield, the trail led south to join the Atlantic Ocean at the Navesink and Shrewsbury Rivers (Lane 1939). The main purpose of this well-traveled path was to provide a route to the shellfish resources of the coast.

The vicinity of Lake Hopatcong later became a crossroads from this trail and an east-west oriented path leading from Great Meadows and Hackettstown along the Delaware River. The presence of Contact Period Native American groups in the Green Pond and Rockaway River drainage basins is plausible due to the proximity of these major trail routes. A seasonal occupation of the Highlands area is further suggested by local Native American place names. Ethnohistoric accounts refer to a migration of Pequot Indians from the eastern section of Connecticut during the latter half of the seventeenth century. These Pequot groups would have been driven out of their indigenous homelands by the increasing European settlers arriving in New England.

The area surrounding the Jefferson and Rockaway townships is believed to have been inhabited by some of the Pequot groups who possibly intermixed with the local Lenape Indian groups. Local historians have suggested that the place name "Picatinny" originates from the Pequot word "Pikka" (meaning "like rocks broken/cracked in a campfire") and "tinny" (meaning hill or peak). This appellation would ideally characterize the massive bedrock bluff which dominates the topography of the Green Pond River valley. Picatinny Peak would have been so named by these Native American Contact Period groups (Kraft 1986).

Summary

The general vicinity of Picatinny Arsenal contains some evidence for prehistoric occupation spanning from the PaleoIndian (ca. 10,000 B.P.) through Late Woodland (ca. 1000 B.P.) and Contact (ca. 400 B.P.) periods. Recent archaeological studies in the area have identified a few sites that were previously unknown (i.e. the Ground Bee Rockshelter) as well as the existence of several site locations that were collected in the early twentieth century. The lack of documented prehistoric occupations in the Highlands region is largely a result of collector and professional bias towards the nearby Upper Delaware River Valley region. Through much extrapolation concerning site types and ranges from the Delaware River Valley sites, the Highlands region has most recently been evaluated as containing a moderate to high potential for unknown prehistoric occupations (Chesler, ed., 1982).

The immediate vicinity of Picatinny Arsenal is characterized by a ridge and valley topography with numerous secondary tributary streams that would have provided a seasonally abundant variety of natural food resources. The ridgetops would also have offered numerous rockshelters and caves that could have been utilized throughout the prehistoric period. The presence of rockshelters has been archaeologically documented in the area. Other site types would have included small, temporary resource procurement stations in the river valleys where natural food resources could be readily obtained on a seasonal or year-round basis.

The documentation of a variety of site types in similar environmental settings in the Highlands region and nearby Upper Delaware River Valley demonstrates the viability of this central Highlands area for prehistoric settlement. The riverine setting of the Arsenal Valley would have offered a wide diversity of natural resources such as fish, migratory birds, deer, and other small mammals as well as

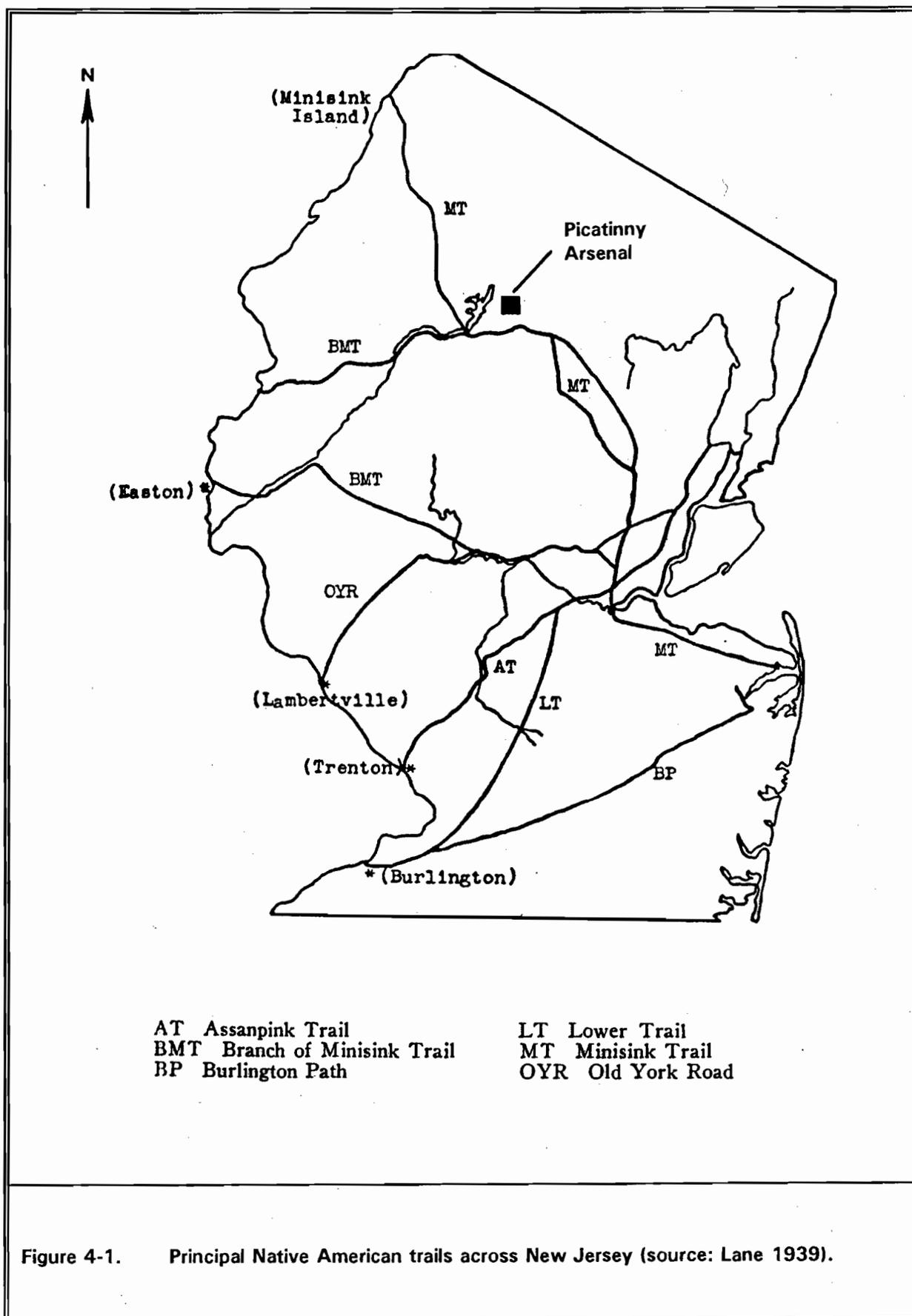


Figure 4-1. Principal Native American trails across New Jersey (source: Lane 1939).

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seasonally important food sources of nuts and berries. The surrounding ridge tops could have been used as temporary rockshelters for the extraction of lithic resources, such as chert, and for the primary reduction of the raw materials used in tool manufacture.

CHAPTER V

HISTORIC CONTEXT

Regional Chronology

[Note: This section consolidates and expands sections of the Historic Properties Report (HABS/HAER 1985) and Archaeological Overview (Klein et al. 1986)].

Colonial Period (A.D. 1665-1775)

Initial Settlement

The Highlands of north central New Jersey were settled comparatively late in the colony's history. A summary of the historic cultural chronology of New Jersey appears in Table 5-1. By the late nineteenth century a diverse ethnic mix of northern Europeans occupied the coastal lowland areas and waterways (Worton et al. 1964:1). Settlement of the Highlands, however, did not occur until the early eighteenth century. The predominant ethnic groups attracted to the Highlands were Dutch, English, Scots-Irish, German and Swiss.

Political Boundaries

The vicinity of Picatinny Arsenal was part of Burlington County from 1694 to 1714 when it became part of Hunterdon County. The Rockaway area was settled at that time (circa 1715) (Munsell 1882). In 1739 the area became part of Morris County. The present-day township of Rockaway was created in 1844 (Figure 5-1). The rugged topography and stony soil of the Highlands had relatively limited suitability for field crop farming, with the exception of the valley areas. Early agricultural settlement consisted of dispersed valley farms with animal grazing and some crop production, primarily for family needs.

Iron Working

The main attraction of the New Jersey Highlands for colonial settlers was its advantages for iron working. As the low grade bog iron ore of the coastal plains was depleted, iron mining and production moved westward, first to Morris and Passaic Counties in the early 1700s (Shea 1978:5). Iron industry technology in the colonial period required water power, timber for charcoal fuel, limestone flux, and iron ore. The Highland ridges were rich in magnetite iron ore and limestone; streams provided water power sources for furnaces and forges; and the heavy timber cover could be converted to charcoal for use as fuel. Transportation routes for exporting bar iron and finished products were another important necessity. The routes of major regional roads, and later the Morris Canal, followed by railroads, reflect the location of market destinations in the coastal lowlands.

The earliest agricultural settlement in the Green Pond Brook valley within present-day Picatinny Arsenal is not known. By 1749, however, iron working had begun with construction of a dam and "Middle Forge" by Jonathan Osborn on Green Pond Brook at the southern end of present-day, artificial Picatinny Lake (Rogers 1931). Ore may have come from the Mount Hope Mine, located approximately 1.5 miles east of the forge site. Mount Hope Mine is said to be the oldest iron mine in Morris County and possibly the country, dating back to at least 1710 (Acroterion 1986/87). It was owned by Colonel Jacob Ford of Morristown. In 1750, Ford erected a forge, sometimes known as "Lower Forge", at Mount Pleasant directly south of the Arsenal and dammed Green Pond Brook north of the "Middle Forge" at the base of present-day, artificial Lake Denmark to establish the "Upper Forge". Both the

Table 5-1. Historic Cultural Chronology for New Jersey.

<u>General Period</u>	<u>Cultural Aspects/Diagnostic Cultural Material</u>
Colonial	
1665-1775	<p>European settlement and expansion by Dutch (Hudson River, English (Navesink and Passaic Rivers) and Swedes (lower Delaware River). Agriculture is principal economic activity, along with lumbering in the Pine Barrens and ironmining in the north.</p> <p>Industrial and commercial pursuits (e.g., distilling, shipbuilding, crafts, trade, etc.) focused in urban and coastal areas. Newark and Trenton developed as emerging regional cores. Intra-coastal and international trade with other colonies, Europe, Africa, and West Indies (i.e., "triangle trade" in sugar and molasses, rum and slaves) prospered. New Jersey colonists, angered by British economic restrictions (e.g., Stamp Act 1770, Townshend Acts 1767), supported Massachusetts after The Boston Tea Party (1773).</p> <p>Imported tin-glaze earthenware, white salt-glaze, English brown, Westerwald and scratch-blue stonewares. Imported and domestic redwares. Mean pipestem bore diameter of 4-6/64 inch. Handwrought nails only. Freeblown and molded glass bottles.</p>
Federal	
1775-1830	<p>After 1776, New Jersey's strategic location between New York and Philadelphia made it a focal point of the Revolutionary War. Agriculture and iron industry suffered following Peace of Paris (1763) ending Revolutionary War. Trade and economy suffered due to Embargo Act (1807) and War of 1812. Agriculture remains basis of rural economy. Shift from agriculture to industrial based economy began with improvements of water power technology and development of new mill privileges. Villages grew around rural mills and iron forges to house workers. Development of road networks with advent of turnpikes. Coastal and riverine routes remain important transportation linkages. Construction of canals, such as Morris Canal in 1820 which provided additional transportation link between coastal and inland areas.</p> <p>Creamware and pearlware predominate ceramic assemblage. Handpainted and transfer print decorated. Small bore diameter (4/64 in.) pipestems. Both handwrought and machine cut nails. Post 1810 3-piece molded bottles introduced. First tin cans (post 1819).</p>
Early Industrial	
1830-1870	<p>Introduction of railroads (ca. 1835) revolutionized transportation network. Small lines consolidated during period, carrying passengers and freight through out region. Decline in agriculture linked to emigration of farmers to newly opened western territories and to factory and mill jobs, and due to decline in market caused by arrival of western produce via railroads. Civil War (1861-1865) generated major expansion of manufactures, including textiles, metal products and machinery. Foundations of New Jersey chemical industry laid in 1840s. Large scale immigration information from northern Europe. Europe generally to work in mills.</p>

Table 5-1. (continued)

General Period

Cultural Aspects/Diagnostic Cultural Material

Pearlware, hard white earthenware, yellowware, and domestic stoneware most common. Transfer print design technique predominates. Machine cut nails predominate. 2-piece mold bottles replace 3-piece mold bottles (post 1840). Snap-case bottle bottom finish, no pontil scar (post 1857). Mason jar patented 1858. 1867 lettered panel bottles introduced.

Pressed or sandwich-type glass (post 1827). Condensed milk can patented 1856. Vulcanization process patented by Goodyear (1839) resulted in increased production of rubber products.

Late Industrial

1870-1915

Technological developments resulted in major changes (e.g., steam power, electrification, gas lighting, etc.). Development of urban and interurban mass transportation and street rail ways results in growth of suburban communities. Arrival of large numbers of immigrants, especially from eastern and southern Europe. Expansion and development of large scale industrial concerns (chemicals, oil refining, electrical and non-electrical machinery). Agricultural production rises. Flowering of summer and resort development in coastal areas.

Hard white earthenware predominates ceramic assemblage with yellowware and domestic stoneware. Machine-made bottles most common. Semi-automatic bottling machine (post 1881); replaced by fully automatic machine made bottles (post 1903). Hutchinson stopper (post 1872/9); canning jar closure (post 1875); crown bottle cap (post 1892). 1904 double-seamed tin can introduced.

Modern

1915-present

Decline of iron industry. Rise of chemical, electrical and research and development industries beginning with World War I. Introduction of automobile and major improvements in automobile transportation network (e.g., New Jersey Turnpike, Garden State Parkway). Agriculture remains important in rural economy with market gardens shipping produce to urban areas. After World War II, growth of professional and service industries (e.g., banking, computer, defense-related, etc.), mainly located along improved transportation corridors. Gradual decline of urban core areas with suburbanization of hinterlands.

Hard white earthenware, stoneware, porcelains, and melamine (post WWII). All bottles fully automatic machine-made. Purple manganese glass. Beer can introduced 1935. Pull-tab can opening introduced 1962. Plastic products (post 1900).

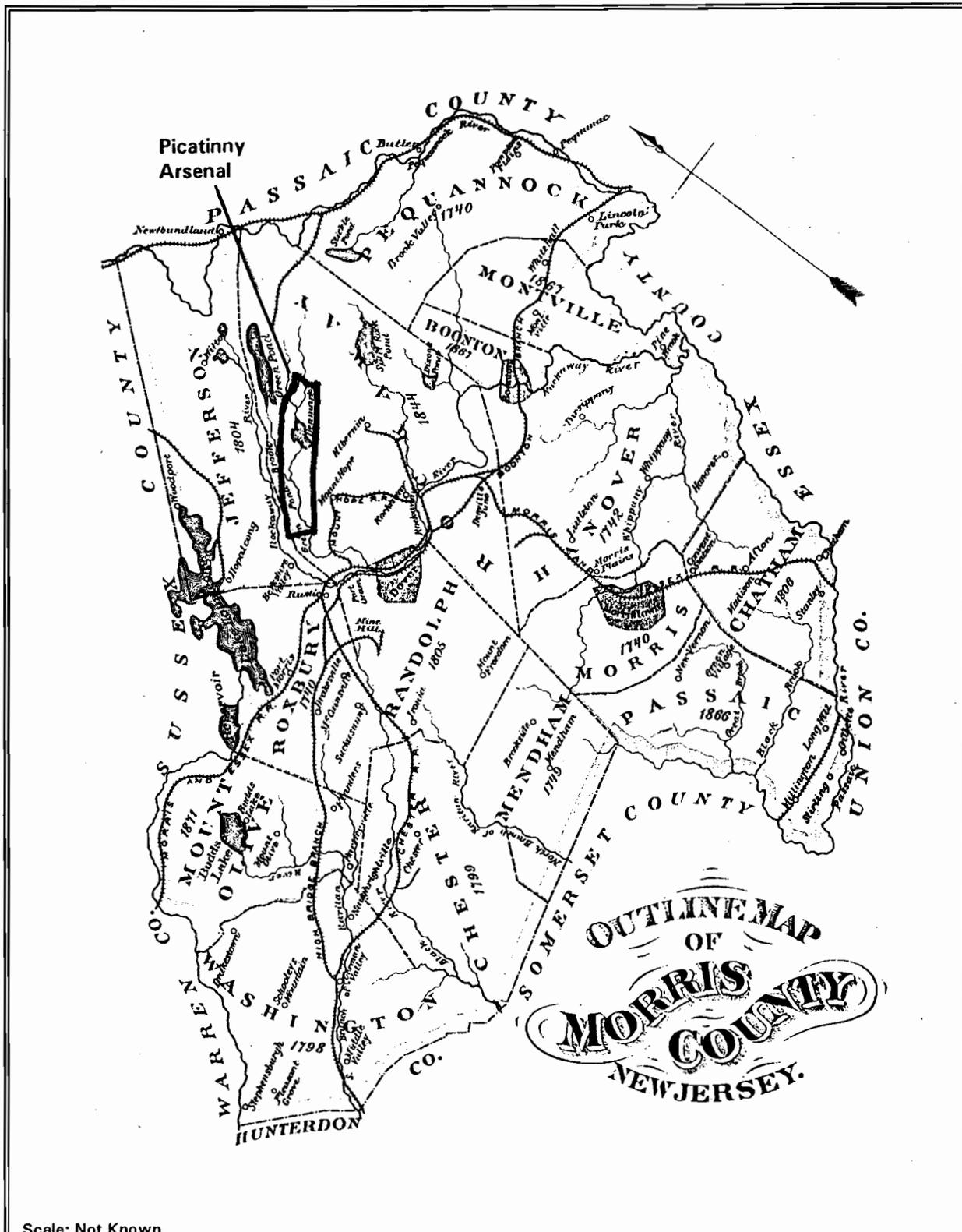


Figure 5-1. 1882 outline map of Morris County, with the location of Picatinny Arsenal (source: Munsell 1882).

Middle and Upper Forges were located within Picatinny Arsenal and are shown on Robert Erskine's 1777 map of the New Jersey Highlands and on Hills' 1781 sketch of the Northern parts of New Jersey (Klein et al. 1986:2-10). The Ford-Faesch House, constructed in 1768 and located adjacent to Mount Hope Mine, is listed in the State and National Registers of Historic Places (Guter 1976).

In 1772, Col. Jacob Ford consolidated his holdings in the area by acquiring the Middle Forge. This industrial complex was among the largest of a number of similar operations in present-day Morris County. Also in 1772, John Jacob Faesch erected the Mount Hope Furnace at Dover, south of the Arsenal.

Faesch, one of the leading iron masters of New Jersey, had come from Basle, Switzerland, as an employee of the American Iron Company (sometimes called the London Company). As early as 1767-68 he was reportedly responsible for overseeing the building of the Charlotteburg Furnace and Forge for that company. The initial input of mass capital into the developing iron industry of northern New Jersey came from the American Iron Company, an ambitious project responsible for the erection of technologically innovative works. The Continental Army saw control of the New Jersey Highlands as vital to the Revolutionary War effort because the iron works there supplied much of the cannon and shot for that army (Klein et al. 1986: 2-10).

Archaeology

No historical documentation exists for precisely what structures existed at the forges. Given the use of the word "forge" on the old maps and common eighteenth-century parlance referring to such technologically diverse extraction plants as bloomeries and blast furnaces, the nature of activity at many iron sites is speculative. In some cases a grist mill was operated from the same dam which provided water power for a forge. A forge operation would generally include structures for workers' housing and other industrial structures. A related complex of iron mines, timbering roads and slag dumps can also be expected. A "home" farm was also sometimes operated in connection with a forge or furnace site (Klein et al. 1986: 2-10). At least two limestone extraction sites have also been identified within Picatinny Arsenal (Rogers 1931:7).

Federal Period (A.D. 1775-1830)

Iron Industry

In 1778, John Jacob Faesch purchased the Middle Forge from the Ford family. He also acquired interest in the other forges and Mount Hope Mine. The Middle Forge was operated in conjunction with Mount Hope until Faesch's death in 1799. During the Revolutionary War, Faesch provided the Continental Army with bar iron, cannon, shot, shovels, axes and other iron implements. George Washington reportedly visited the Mount Hope Ironworks, and records indicate he provided Hessian prisoners to assist in the operations (Rogers 1931:5). A cemetery near the Arsenal's Mount Hope Gate is said to contain graves of the Hessians.

Following the war, Faesch served as Morris County delegate to the New Jersey State Convention which ratified the Federal Constitution. Upon his death in 1799, the Mount Hope Ironworks and other extensive iron properties passed into his sons' hands. They were unable to run the works profitably and sold them in 1809 to Moses Phillips. Phillips operated under the name Aetna Forge until 1839.

During the first quarter of the nineteenth century, the iron industry, the region's primary economic base, was generally prosperous with the exception of a slump between about 1816 and 1820 (Rogers

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1931:7). Towards the end of the period, the industry experienced depletion of forest timber and consequently of charcoal fuel supplies.

Transportation Routes

By 1800, a system of connecting roads running north-south in the Green Pond Brook valley and east-west had been established. The Mount Hope-Denmark Road ran north-south and the road between Middle Forge and Mount Hope ran east-west. From Middle Forge a road extended southward towards the regional core community of Dover along the east side of Green Pond Mountains. The first turnpike to be constructed within present-day Rockaway Township was the Dover-Sparta Union Turnpike of circa 1804, now Route 15. A major improvement to regional transportation occurred with construction of the Morris Canal (1824-31). The canal connected Phillipsburg on the Delaware River with the Hudson River at Jersey City and passed the southern end of the present-day Arsenal just above Dover.

Early Industrial Period (A.D. 1830-1870)

Political Boundaries and Population

The present-day Township of Rockaway was established in 1844 (see Figure 5-1). The earliest population figures for the town show a total of 3,139 persons in 1850. By 1870, numbers had more than doubled to 6,445, the highest number in the county (Munsell 1882).

Settlement Pattern

The distribution of settlement within present-day Picatinny Arsenal and adjacent areas in 1853 and 1868 is shown in Figures 5-2 and 5-3. At mid-century, approximately two dozen houses were distributed along the roads within the present-day Arsenal and clustered around the two forges at the southern end of Denmark Lake and Picatinny Lake, then known as Lake Clifford. Two residences were situated away from roads: H. Ford's Estate, on the ridge near the southeast corner of the Arsenal property, and Walton Farm, on the north side of Mound Hope Road. The specific reference to "farm" in the latter case suggests it may have been one of the only agriculturally-focused properties in the area. Two schoolhouses (S.H.) had also been constructed in the immediate Arsenal area. The 1863 map shows little change in settlement pattern.

Statistics available for this period indicate that in 1860 Rockaway Township contained a total of 645 dwellings, over half of which (392) were located in Rockaway Village (Munsell 1882). The village was the major settlement cluster associated with Mount Hope Iron Works/Aetna Forge and other nearby iron industrial concerns. Hibernia, a small hamlet, was located southeast of Denmark Lake, and Dover, the closest larger regional core community to the south of the present-day Arsenal in Randolph Township.

Transportation Routes

Completion of the Morris Canal in 1831 (see above) brought the first major transportation improvements to the area. The canal was constructed primarily to transport cheap Pennsylvania coal to the growing industrial centers of Newark and New York City. By 1848, Dover was linked to the east by the Morris and Essex Railroad. The line was extended westward from Dover to Phillipsburg by 1865 (Klein et al. 1986:2-11). In the 1860s, the Mount Hope and Hibernia mines constructed rail lines from their operations to the canal and railroad (Acroterion 1986/87).

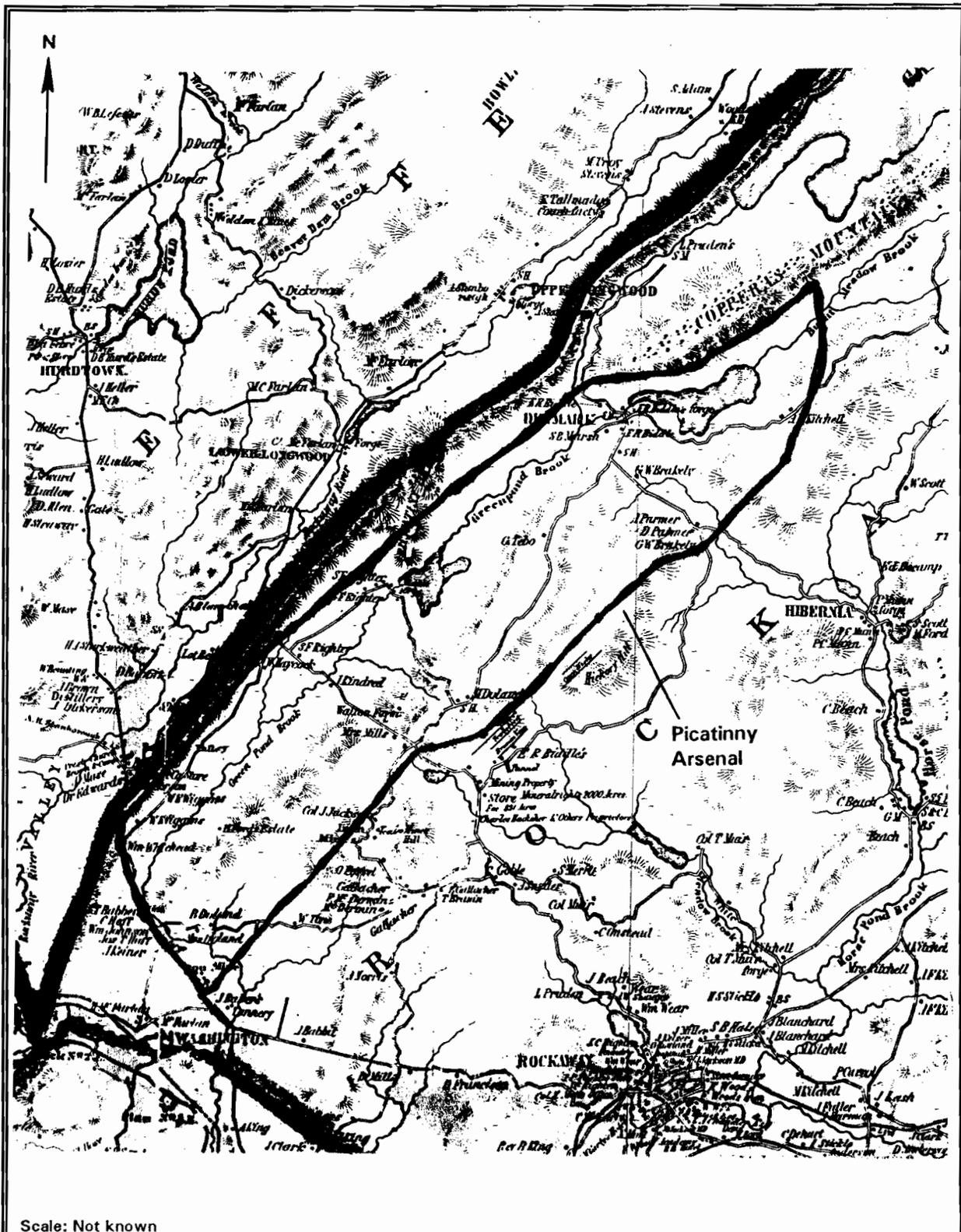
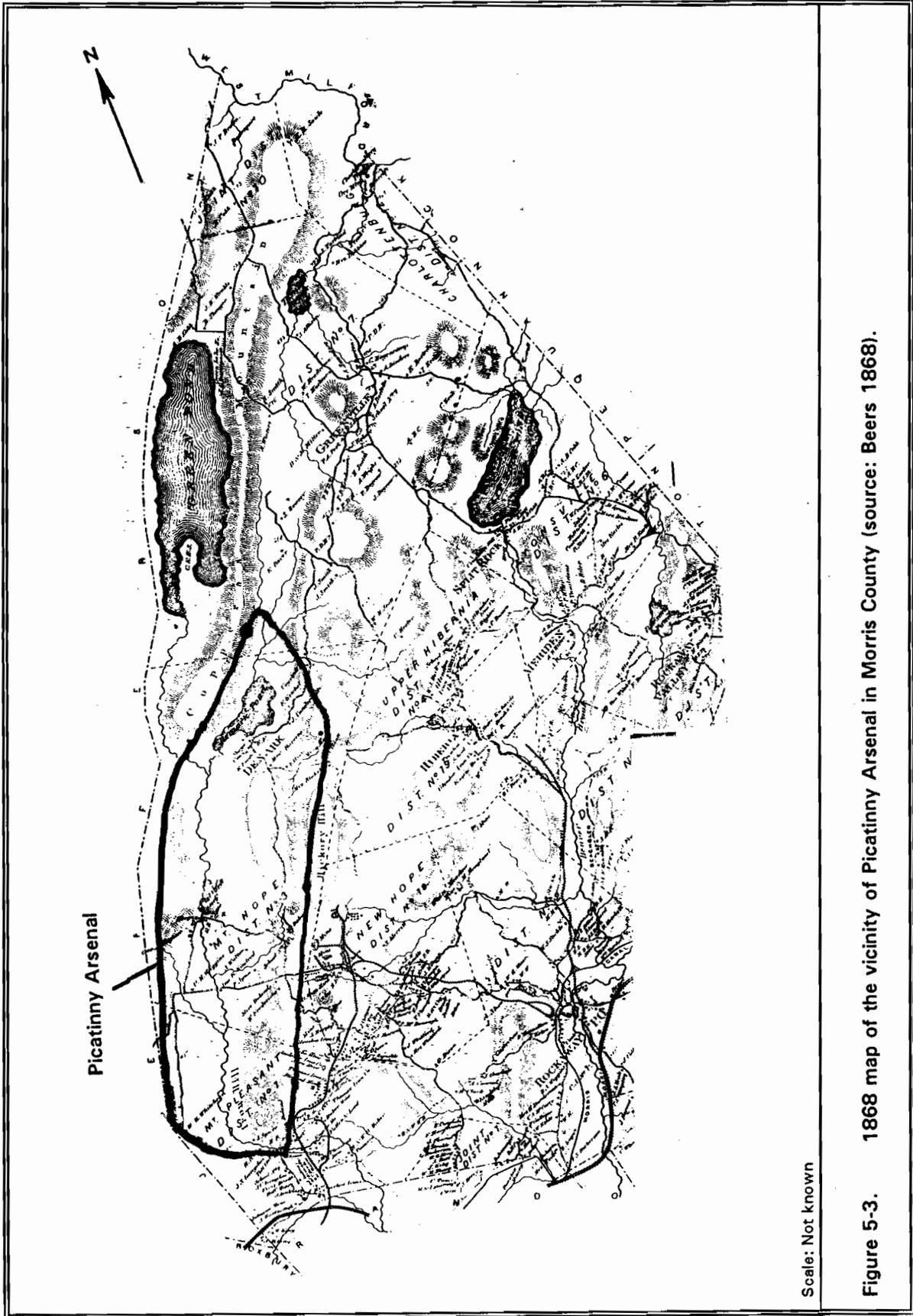


Figure 5-2. 1853 map of the vicinity of Picatinny Arsenal in Morris County (source: Lightfoot and Geil 1853).



Iron Industry

The decades of 1830s and early '40s were ones of continued prosperity for the iron industry. Coal fuel for forges, replacing charcoal, was readily available due to the Morris Canal. In addition, technological innovations in 1837 introduced the hot blast process, a markedly more efficient method of production. By the 1850s, however, the development of anthracite coal furnaces superseded the earlier charcoal-fueled forges. Only a few iron works remained in operation; the main processing was iron products rather than extraction of iron from ore.

Middle Forge

During this period, the Middle Forge at Picatinny (Clifford) Lake was owned by Jacob Righter from 1839 to 1853, and then by his son George E. Righter. The forge itself was no longer in use at the time of U.S. Government purchase in 1879. Equipment from Middle Forge is on display at Picatinny Arsenal.

Late Industrial Period (A.D. 1870-1914)

Population and Settlement Pattern

Rockaway Township's population continued to experience moderate growth in this period. In 1882 there were 7,366 inhabitants, the second highest in Morris County, and 1,052 dwellings. As illustrated in Figure 5-4, the settlement pattern remained largely unchanged in 1887; new construction concentrated in the earlier villages south and east of the present-day Arsenal.

The most significant change in land use occurred as a result of the creation of Picatinny Powder Depot in 1879 (see below). Other shifts occurred as mines closed and with the growing popularity of lake-side resorts at the turn of the century.

Transportation

In 1874 a railroad line was built from Charlottesburg south to the Green Pond Iron Mining Company's Copperas Mine. However, a depression in the iron industry led to bankruptcy of the railroad in 1875.

In 1886, Government Road was extended from a road in Spicertown to Union Turnpike. The Morris County Railroad built a line through the border depot in 1886-87 which was a vital transportation link for the depot (Rogers 1931:11).

Industry

Introduction of the Bessemer Steel Process from England in the 1860s forced the closure of numerous mines without Bessemer grade ore. With the opening of mines in the Lake Superior region in the 1880s, New Jersey mines faced stiff competition. By 1900, only about 20 mines were in operation, among them the Mount Hope Mine under control of the Empire Steel & Iron Company (Shea 1976:5; Acroterion 1986/87).

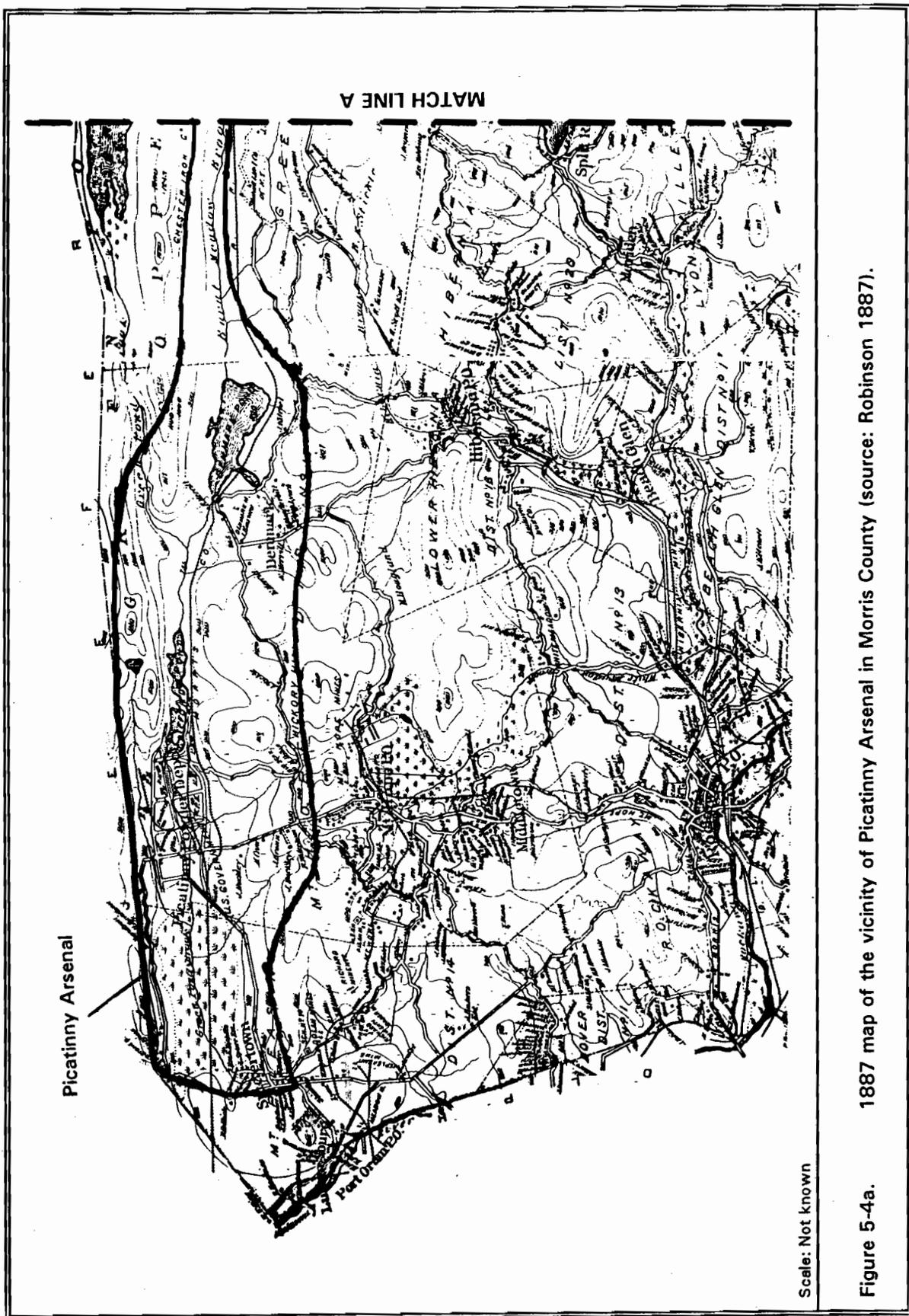
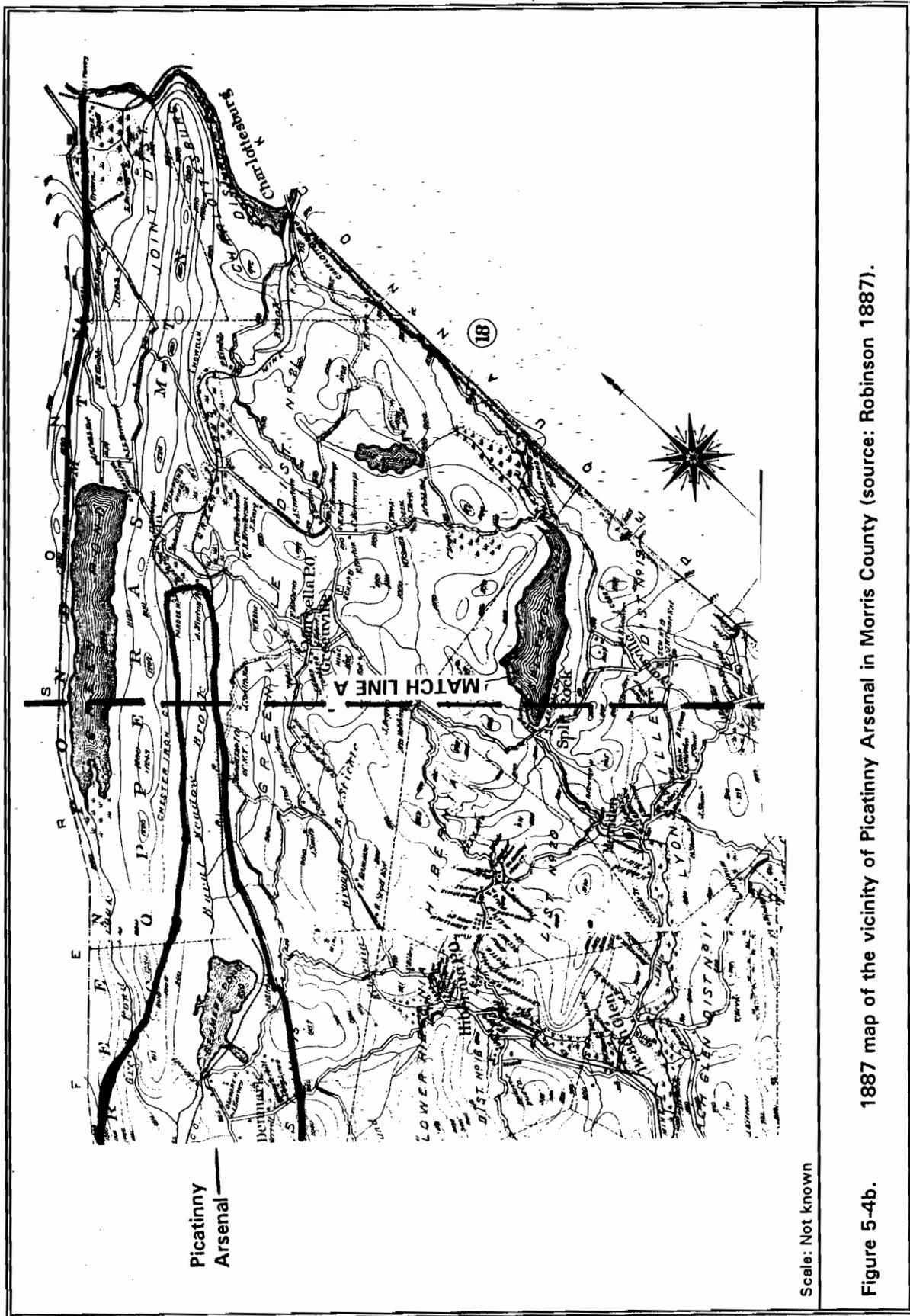


Figure 5-4a. 1887 map of the vicinity of Picatinny Arsenal in Morris County (source: Robinson 1887).



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Modern Period (1915-Present)

The population of Rockaway Township decreased dramatically in the early twentieth century with the decline of the iron industry, declining to 2,423 persons in 1940. Little new construction occurred, although resorts continued around the lakes. After World War II the population began to rise again to 4,418 in 1950, 10,356 in 1960, and 19,850 in 1980 (Anon 1969.; Anon. 1981). Much of the increase can be attributed to the automobile and improved road systems which supported new industries after 1940, and suburban development in the 1960s. Interstate Route 80, a major connector between the Newark/New York City area and the Delaware Water Gap was constructed in the 1960s and Interstate 287, a north-south highway east of Picatinny Arsenal in the 1970s.

Among the industries established in the 1940s were defense-related industries such as the Howmet Corporation, Austenal Division, manufacturers of aircraft engines and a major employer (1949), and Rockaway Tank, alloy and steel fabricators (1940) (Anon. 1969). The Mount Hope Mine under Shahmoon Industries closed in 1959; in the 1970s it was reopened by Halecrest Industries as a crushed stone quarry which remains in operation today (Acroterion 1986/87).

National Military Context

Introduction

This section of the report presents a brief overview of the historical development of United States Army ordnance, storage, production, and associated facilities. It is derived principally from three thorough sources (Green et al. 1955; Huston 1966; Weigley 1984).

Traditional Army usage defines Army logistics as consisting of four principal elements in support of military operations: 1) supply, 2) transportation, 3) evacuation and hospitalization, and 4) service (Huston 1966:viii). One vital component of supply is ordnance, or fighting equipment (Green et al. 1955). The history of ordnance production and storage is essentially industrial in nature and traced in advances in manufacturing technologies and engineering.

Colonial Period to Civil War (1620-1860)

Colonial Period

Colonial militiamen were required to be self-equipped with arms and equipment. The principle firearm was the smoothbore musket, which evolved in efficiency from primitive matchlock, to snaphance, to flintlock. In the eighteenth century, Swiss and German craftsmen on the Pennsylvania frontier developed the lighter and more accurate Pennsylvania rifle (also known as the Kentucky rifle) (Weigley 1984:9,10). Public gunpowder supplies were maintained by each militia district, and artillery by fortifications and by communities large enough to require and afford such defense.

Domestic production of gunpowder appeared in the Massachusetts Bay Colony by 1639, and a powder mill was in operation in Dorchester, Massachusetts before 1680. Cannon were cast at Henry Leonard's foundry in Lynn, Massachusetts by 1647 and at Bridgewater, Connecticut by 1648. Between the Pequot War (1639) and King William's War (1689-97), probably one-third of the muskets and small arms of the colonies were manufactured in America (Huston 1966:21).

Revolutionary War

In response to the British Act of 1774 prohibiting export of firearms to the colonies and ensuing events of the war, three strategies for ordnance supply were followed: domestic production, importation, and capture. Little emphasis was placed on development of new designs.

The first public arms factories were begun in Massachusetts, Virginia, and Pennsylvania. In Maryland and elsewhere, private contracts were let to gunsmiths, and bounties were offered to encourage manufacturing. In the winter of 1775-76, Pennsylvania arms makers manufactured more than 4,000 complete muskets. The Continental Congress also established armories in Pennsylvania and New Jersey (Huston 1966:21).

Domestic foundries produced artillery, cannon balls, and shot made from locally extracted iron. The middle states were supplied by ironworks at Philadelphia, Reading, and Warwick, Pennsylvania and Hibernia and Mount Hope Furnaces, New Jersey; the northern states by works at Saugus, Bridgewater, and Westham, Massachusetts and Hope Foundry, Rhode Island, among others. Colonies were instructed to send saltpeter and sulfur to central manufacturing locations to be made into gunpowder (Huston 1966:22-23).

Small arms and approximately 90% of the gunpowder supplies came from overseas procurement, primarily from France, Spain, Holland, Prussia, and the French, Spanish and Dutch West Indies. Foreign cannon were generally of better quality than those domestically produced, but were not readily available. American privateer raids were an important supplement to purchase and manufacture (Huston 1966:20-23).

Responsibility for distribution of ordnance supplies in the field was assigned to certain artillery officers. This group, created in 1778, represents the first use of the term, Ordnance Department (Green et al. 1955:14).

Ordnance Department - Armories and Arsenals

In 1794, Congress authorized establishment of two national armories, the first federal arms factories, Springfield Armory (1794-95) and Harpers Ferry (1796). On 14 May 1812, Congress created the Ordnance Department, which, after 1815, was responsible for supervision of government armories and private arms contracts and training of personnel (Huston 1966:15). The Ordnance Department remained in existence until the 1960s, aside from a brief merger with the Artillery Department from 1821 to 1832.

By 1820, a total of 12 arsenals had been established, and only two more were added after mid-century, until the twentieth century (Green et al. 1955:15; Huston 1966:114) (Table 5-2). The major arsenals for production were: Springfield and Harpers Ferry (small arms), Watervliet (artillery equipment and ammunition), Watertown (small arms ammunition and gun carriages), and Frankford (ammunition). Harper's Ferry was destroyed early in the Civil War (Green et al. 1955:15). Established after the Civil War, Rock Island manufactured small arms and, later, tanks, and Picatinny, originally built as a powder depot, manufactured large caliber ammunition, fuzes, and high explosives. All powder used by the U.S. Army was purchased until 1907 (Green et al. 1955:19). It was stored at depots around the country.

Throughout the nineteenth century responsibility for overseeing the national arsenals alternated between the military and private sectors. Up to 1841, there were civilian superintendents at arsenals; for 1841 to ca. 1852 ordnance officers took over, from ca. 1852 to 1861, civilians were in charge;

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and from 1861 to the present, ordnance officers have overseen operations). Until after the Civil War, Government inspection of private contractor work was essentially visual. It involved supplying a model to which the contractor would compare a finished product (Green et al. 1955:17,19).

Small Arms

Additional arms for State militia and U.S. Army use were supplied by private contract. One notable contractor was Eli Whitney, of Whitneyville, Connecticut, who demonstrated that use of jigs and machine tools could make arms with interchangeable parts. The Hall breach-loading rifle was the first of its kind in U.S. service and the first weapon to be manufactured on the interchangeable parts system in a national armory (Harpers Ferry) (Huston 1955:114). Nevertheless, interchangeable parts did not come into common military use until mid-century with the beginnings of an independent machine tool industry and of precision gage making in private industry with Government arsenals' collaboration (Green et al. 1955:15,114). At that time, in the mid-1840's, the percussion cap rifle went into wide manufacture replacing the flintlock musket, and the Samuel Colt revolver superseded cumbersome earlier pistols (Green et al. 1955:17). Important small arms manufacturers included Eli Whitney, Samuel Colt, the Ames Manufacturing Company, and the Remington Company, among others.

Table 5-2. United States Army Arsenals (1794 - ca.1900).

NAME	LOCATION	DATE	MISSION
Springfield Arsenal	Springfield, MA	1777	
Springfield Armory	Springfield, MA	1794	small arms, aircraft armament
Harpers Ferry	Harpers Ferry, VA	1796	small arms
Rome	Rome, NY	1813	
Watervliet	West Troy, NY	1814	gun carriages, artillery ammunition
Allegheny	Pittsburgh, PA	1814	gun carriages
Bellona	Richmond, VA	1816	
Pikesville	Pikesville, MD	1816	
Washington	Washington, DC	1816	gun carriages
Watertown	Watertown, MA	1816	gun carriages, small arms ammunition
Frankford	Philadelphia, PA	1816	ammunition, optical/fire control
Rock Island	Rock Island, IL	1867	small arms, tanks
Picatinny	Dover, NJ	1880	powder depot, artillery ammunition

(Sources: Green et al. 1955, Huston 1966, Weigley 1984)

The advantages and disadvantages of national versus private armories received much attention. Generally, national armories were readily available, set price standards, standardized models for production, and were less expensive. Private manufacturers seemed more likely to improve models and to experiment with new materials and methods (Huston 1966:118).

Artillery

During and following the War of 1812, the arsenals at Washington, Pittsburgh, Watervliet, and Watertown constructed gun carriages, limbers, caissons, and mounted the guns. The guns themselves continued to be produced at private foundries, such as the West Point Foundry and the South Boston Foundry. In the decades between the War of 1812 and the Civil War a new carriage system was adopted, the contest between iron and bronze for cannon continued, and the whole spectrum of artillery material was modernized and systematized. Nevertheless, the conservative inclinations of the Ordnance Department delayed implementation of European developments in rifled and breech-loading cannons until the Civil War and later (Huston 1966:118; Weigley 1984:191).

Civil War to World War I (1860-1917)

Civil War

On the eve of the Civil War the productive capacity of the Springfield and Harpers Ferry arsenals was some 22,000 pieces annually. Harpers Ferry was dismantled by the Confederates and the rifle-making machinery relocated. Production on both sides was substantial during the war. The artillery needs of both the North and South were met by a sufficiently mature industry. Northern foundries cast 7,892 cannons to meet the need; Government arsenals supplied the carriages (Weigley 1984:203).

While numerous inventions and innovations were proposed, the Army was reluctant to adopt new weapons into production and field use during wartime for fear of delays and ammunition supply problems. Notable new weapons did appear, however, including the Spencer repeating rifle and the large, cast-iron Rodman cannon and rifled Parrott artillery guns. The experience of the war suggested the need for organized peacetime research and development programs (Huston 1966:190-197).

Late Nineteenth Century

Between 1862 and 1880, the Ordnance Department undertook planning to establish a "Grand Arsenal" on the east coast. A planning study of 1875 recommended that most of the earlier arsenals be sold and that a single arsenal including a proving ground and powder depot be built. The site selected in 1880 was Picatinny Arsenal near Dover, New Jersey. The older arsenals remained in Army ownership.

After some lag time, by the end of the nineteenth century the United States began to adopt improvements earlier utilized by European countries. These included the Danish .30 caliber Krag-Jorgensen rifle, with a box magazine of five-round capacity and a firing smokeless cartridge. The Prussians had invented smokeless powder in 1865, and it was employed for general use in Europe after 1884. Smokeless propellants were a significant innovation over the long-used black powder, allowing concealment of gun positions, along with improved range, precision, and penetration. The Army did not use it for artillery, nor were European improvements in gun design adopted, until after the Spanish American War of 1898. The Army had, however, begun to experiment with new devices, including steel carriages, pneumatic or hydraulic recoil brakes, and elevating, traversing and sighting mechanisms (Weigley 1984:290,291).

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Early Twentieth Century

In 1900, research in semiautomatic rifles and more powerful machine guns was initiated, resulting in introduction of the Model 1903 Springfield rifle and the Model 1902 3-inch field gun (Weigley 1984:318). Artillery was the subject of much debate. Design modifications required continual retooling at both national and private manufacturing locations. Adoption of the Crozier-Buffington recoil mechanism for heavy gun carriages was heralded as a great advance (Green et al. 1955:18). In general, the first two decades of this century witnessed improvements at the arsenals in manufacturing techniques and organization along scientific lines of management borrowed from private industry. The system of inspection from 1870 until World War I relied on Master Armorers at each national arsenal. They were responsible for the gages needed in manufacture of arms for which his arsenal had "technical responsibility."

World War I and Inter War Periods (1917-1939)

Mobilization

The United States entry into World War I found the country generally ill-prepared for mobilization and necessitated immediate upscaling of production at national arsenals and conversion of private firms to wartime manufacturing. Many small arms businesses were already in production of foreign designs for Allied countries. The Army's liaison with civilian activities was typically carried out through the War Industries Board, established in July 1917.

Ordnance Supply

The government built or financed 16 of the 92 plants ultimately engaged in the manufacture of powder and high explosives; a comparable number of plants for loading shells, bombs, grenades, boosters, fuzes, and propellants; five of 18 gun factories of various kinds; four nitrate plants; and eight plants for the manufacture of toxic gas, gas masks, and for loading gas shells (Huston 1966:320).

Supplying troops with rifles posed no serious problem. The best rifle of the day, the Model 1903 Springfield, was being produced at the Springfield and Rock Island arsenals; production was stepped up. Three private firms manufacturing Enfield rifles for the British Army adjusted production to make a modified version which would take American ammunition. Automatic rifles and machine guns were not well developed in the United States until July 1918 when American-made Browning automatic rifles and Browning machine guns were produced. Prior to that time, troops in France carried French machine guns and automatic rifles.

The complexities of field artillery design and production led to reliance on French and British guns on the front. Of some 2,250 artillery pieces used by American forces in France, only about one hundred were American made (Weigley 1984:362). Nevertheless, while American production was small before the armistice in 1917 (1,642 complete units), in anticipation of expected major battles in 1919, which did not occur, production had reached 3,000 complete units. This number equaled that purchased abroad from the French and British.

The most highly regarded field artillery piece was the French 75mm gun, produced at newly built American plants. Manufacture of the special French recuperator, or recoil mechanism, was a notable achievement which the Germans were unable to duplicate. Watertown Arsenal supplied 743 forgings to Dodge Brothers for the only French recuperator which went into actual production before the armistice (Huston 1966:323).

The ammunition program involved construction of three bag-loading plants; six large plants for production of TNT, amatol, and picric acid; and the development of a huge shell-making and shell-loading industry, largely based on British and French shell designs; along with small arms ammunition manufacture (Huston 1966:324).

The military aviation industry concentrated on observation and bombing planes, producing the successful Liberty engine, but experienced limited successes in other areas. The tank industry barely got started before armistice, and no American tanks reached the front. Despite possession of the largest automotive industry in the world and the American invention of the caterpillar traction system, little thought had been given to armored vehicle battle application until the situation created by machine guns and barbed wire on the front (Huston 1966:325; Weigley 1984:362). By the end of the war, however, the American Tank Corps had been created, and there were 23,405 tanks on order (Weigley 1984:409).

Interwar Planning

World War I had proved the United States capabilities in major warfare abroad. The war experience had demonstrated the importance to military preparedness of maintaining material reserves and industrial production plans (Huston 1966:399). With small annual appropriations and a limited peacetime mission, planning for procurement and industrial mobilization was undertaken in the 1920s and 1930s. While the Ordnance Department arsenals were able to meet the Army's peacetime needs, it was estimated that they could supply no more than 5 to 10% of wartime arms and ammunition requirements. Thus emphasis was placed on involvement of over 10,000 industrial plants capable of a variety of military production.

Planning culminated in the final version of the Industrial Mobilization Plan of 1939. While never formally adopted, elements of the plan formed the basis for rearmament in 1940 (Huston 1966:408). One of the greatest deficiencies of the plan was lack of an effective means to stock pile and control allocation of "critical and strategic" materials such as steel, copper, aluminum, and rubber.

Actual funding for weaponry research and development comprised only about 1% of the Army budget during this period. Consequently, few major events occurred. An important exception were improvements in artillery made at the Watertown and Watervliet arsenals (see below). As part of the planning program the Ordnance Department issued "educational" orders with private commercial firms and surveyed the machine tools available for future production.

Arsenals

Six major arsenals were established by the Army between the end of the eighteenth century and the early twentieth century. Structured as manufacturing facilities, the arsenals typically were operated under a small number of military staff. Most of the administrative personnel and all the production workers were civilian, providing continuity in operations. Prior to 1940, design or redesign of any piece of equipment might be undertaken by Washington or the arsenal. The first pilot was always built at the arsenal with the appropriate "technical responsibility". Basic research laboratories were maintained at every arsenal except Springfield and Watervliet. Each had an experimental unit, shops, and administrative division.

Following the war, one of the arsenals' first tasks was in cleaning equipment and storage and the preservation of jigs, gages, and dies. Existing and new depots were used for storage and maintenance of vast amounts of ammunition.

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World War II to Present (1940-1989)

World War II

Following the German invasion of Poland in 1939, more military equipment was manufactured in the United States for Great Britain and France than for the U.S. Army. Much of the production occurred under a lend-lease program, whereby material was supplied to Britain, Russia, China, and other nations. Thus, at the Japanese invasion of Pearl Harbor in the fall of 1941, the Army was supplied with largely worn and outmoded equipment. The push for production beginning in 1941 was critical to adequate supply of American troops. With the establishment, in 1942, of the War Production Board, the principle of civilian direction of economic mobilization was set; military procurement, however, remained a military function (Huston 1966:459).

Developments in new military technology, including tanks, tank destroyers, self-propelled artillery, tactical air support, and airborne troop capabilities required new divisional structures, such as the armored infantry divisions. Troops still carried the Browning automatic rifle, supplemented by light, air-cooled machine guns. Interwar period artillery developments had produced the 105mm howitzer, which became the standard gun, supplemented by larger guns. The skilled use of the artillery is considered a major contributing factor in the American successes. The principal tank was the M-4 General Sherman, medium tank, mounting a 75mm or 76mm gun; the heavy M-26 General Sherman tank, with a 90mm gun, did not enter production until the end of the war (Weigley 1984:466-473).

Manufacturing of small arms involved the arsenals, such as the Springfield Armory, and companies such as Winchester, Remington Arms Company, and the New England Small Arms Corporation, an organization formed by six different firms. Firms which had previously been engaged in making hardware, juke boxes, and typewriters also participated. Machine gun production was a particularly successful effort which included the Rock Island Arsenal, the Colt Company, the Savage Arms Company, and several divisions of General Motors. Major producers of the 2.36in rocket launcher, the "bazooka", were the General Electric Company and the Cheney Bigelow Wire Works of Springfield, Massachusetts (Huston 1966:475,476).

Little attention had been given to commercial production of howitzers and other artillery guns. Consequently, the Watertown and Watervliet arsenals were under great pressure to expand facilities, produce weapons, and provide instruction to private companies until machine tools were available for commercial manufacture. Tank and antitank guns, aircraft and anti-aircraft guns, and self-propelled guns and howitzers comprised by far the greatest share of artillery weapons. Two major metal-working techniques developed in the interwar period at Watertown and Watervliet were employed for the first time on a large scale: cold-working and centrifugal casting (Huston 1966:477).

Government-owned, contractor-operated ammunition manufacturing plants eventually included 12 plants for the chemical components of explosives, 21 for high explosives and smokeless powder, and 25 for loading shells and bombs. Production of fuzes was centered at the Picatinny Arsenal in New Jersey. In addition, 12 contractor-operated plants were built to augment the small arms ammunition production based at the Frankford Arsenal (Huston 1966:477).

The widespread use of motor vehicles revolutionized the mobility of the American ground forces. The launching of the American tank program occurred with creation of the completely new Detroit Tank Arsenal, built by the Chrysler Corporation. Over 25% of the more than 88,000 tanks produced between 1940 and 1945 came from the Detroit Arsenal. The remainder were made by other plants, mostly operated by automobile or railway equipment manufacturers. Hundreds of companies supplied

tank components (Huston 1966:478,479). Major strides were also made in truck and aircraft production.

At the close of World War II the United States Army was overall the mightiest in the world. The county's industrial leadership played a significant role in this achievement through sheer quantities of weapons, supplies, and transport. The bulk of ordnance was manufactured by independent private contractors; although national arsenals played an important role.

Post World War II

Since World War II the mission of national arsenals has increasingly moved away from production and into research and development, except during times of conflict. This represents a major new attitude in the Army's typical historical conservatism. Efforts have focussed on future needs and improving present material. The Army uses its own laboratories, proving grounds, and test facilities, in conjunction with industry and civilian institutions, as well as foreign research.

In the 1950s and 1960s, whole new families of weapons and vehicles came into being, most notably the nuclear-powered rockets and guided missiles. Rapid changes have also taken place in conventional weapons. An important new introduction was the armored personnel carrier, later modified and called armored fighting vehicles. In recent years, research in nuclear power, laser, and computer weapons applications have expanded, in addition to ongoing testing of a variety of materials, explosives, and weapons types.

Facility History

[Text extracted and adapted from Historic Properties Report, Picatinny Arsenal, Dover, New Jersey HABS/HAER 1985]

Site Selection and Purchase (1862-1880)

Planning

The history of public involvement at the Picatinny site begins with the changes in military preparedness suggested by the experience of the Civil War. As early as 1862, the Department of War Chief of Ordnance had urged the Army to begin construction of a "Grand Arsenal" on the Atlantic seaboard. In 1866, a Board of Governors was convened by the Ordnance Department to consider the establishment and location of two powder depots on the East Coast. The requirements of the board included: 1) that the region selected be sparsely populated; 2) that the capability exist to store a large amount of powder in a location near New York City; and 3) that the site chosen be accessible to rail transportation (Anon. 1920).

After several years of study, the Board selected a site near Peekskill, NY. Though ideally suited for the Army's purposes, the cost of the Peekskill tract was prohibitive (USOD 1860-1884 Vol. 3:591). On February 9, 1880, pressed to find a site by the end of the fiscal year, the Board recommended a tract in Queensboro, NY. However, acquisition again proved difficult.

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Selection/Purchase

On February 26, 1880, the Dover, New Jersey, site was suggested though there was some question of its security from Coastal invasion (Ibid:592). Brigadier General Stephen Vincent Benet, Chief of Ordnance, quelled these concerns by personally endorsing the Dover Site:

"The geographic location near Dover is sufficiently well protected, being behind the fortification of N.Y. Harbor, nestling high among the mountains, 45 miles distant, with a closely built and highly cultivated country, and very large population intervening" (Ibid) (Figure 5-5).

The Ordnance Board completed arrangements for the purchase and 1,866.12 acres was acquired by the government for \$62,750, or about \$30 per acre (Figure 5-6; Table 5-3). A strip of land to be used as a roadway leading from Spicertown, an unincorporated village in Rockaway Township, to the depot grounds, was bought from Louis H. Spicer on May 2, 1991. Subsequent acquisitions brought Picatinny to its present size of 6,500 acres. ¹⁹⁴¹

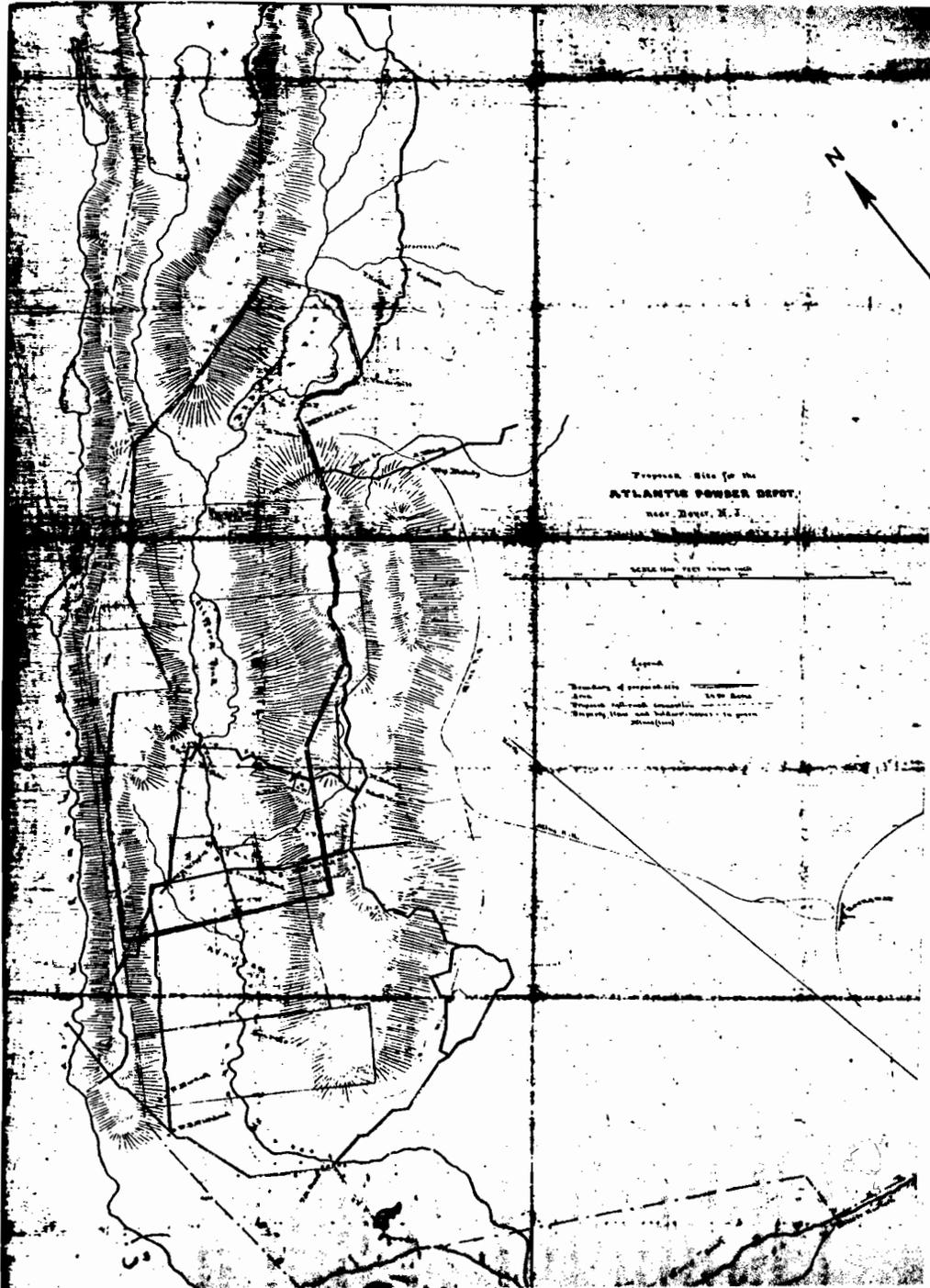
The site was established as the Dover Powder Depot (1880) and was later known as Picatinny Powder Depot (1880) and the U.S. Powder Depot (1893), until being renamed Picatinny Arsenal (1907) (Rogers 1931:52).

The decision to locate an Army installation in the rural area of northern New Jersey was a significant event in the development of Morris County.

Table 5-3. Land Purchases, Picatinny Arsenal.

DATE OF PURCHASE	NAME OF TRACT OR FROM WHOM PURCHASED	AREA (ACRES)	AMOUNT
September 4, 1880	George E. Righter	1,195.80	\$35,874
September 8, 1880	W. H. Wiggins	167.32	\$ 8,500
November 17, 1880	Edward C. Fieldler	304.20	\$ 9,126
February 7, 1881	Henry and Michael Doland	11.00	\$ 750
April 20, 1881	John E. Kindred	187.80	\$ 8,500
May 12, 1881	Lewis H. Spicer	8.50	\$ 200
February 1, 1887	Morris Co. RR. Co. (lease)	9.30	
July 30, 1918	Thomas Robinson	56.00	\$ 7,500
Fenced 1926	North Tract	± 1,000.80	seizure
circa 1928	Anderson Tract	± 6.00	?
circa 1928	Lidgerwood Tract	± 323.00	?
circa 1941	Spicertown Tract	± 1,000.00	?

(Source: Rogers 1931)



Scale: Not known

Figure 5-5. (1880) Proposed site for the Atlantic Powder Depot near Dover, New Jersey (source: Rogers 1931).

Early Development, Dover Powder Depot (1880-1906)

Construction for Powder Storage, 1880-1890

The new depot's first decade witnessed construction of storage magazines, officers' quarters, stables and service buildings. The first structure, a powder magazine measuring 200 x 50 feet with a six foot basement, was started on September 16, 1880 and completed in 1881 at a cost of \$51,700. It was designed to store 10,000 lbs. of black powder.

By early 1882, the 150 men employed at the depot were primarily engaged in stone quarrying and building construction. In May 1882, however, the original government appropriation was depleted and the remaining workers, only 22 men, were engaged in farming the land (The Jerseyman May 26, 1882:3). A second appropriation, in the summer of 1882, allowed construction to continue. By June 1883, a work force of 75 men was finishing work on the second powder magazine which was completed by the end of 1883 (The Jerseyman June 8, 1883:3).

The third and fourth magazines and an office were completed in 1885, while the fifth "original" magazine was not completed until 1890. Ordnance Department Chief Brig. Gen. Benet approved the first formal plan for the Picatinny Powder Depot in 1885 (Figure 5-7). This plan included eleven storage magazines, a stable, foreman's quarters, an office, an engine house, a store, a shop and other sites planned for future buildings. The first shipment of powder, 300,000 lbs. of a hexagonal type, was sent to the depot for storage in November 1886 (Dover Era 1885).

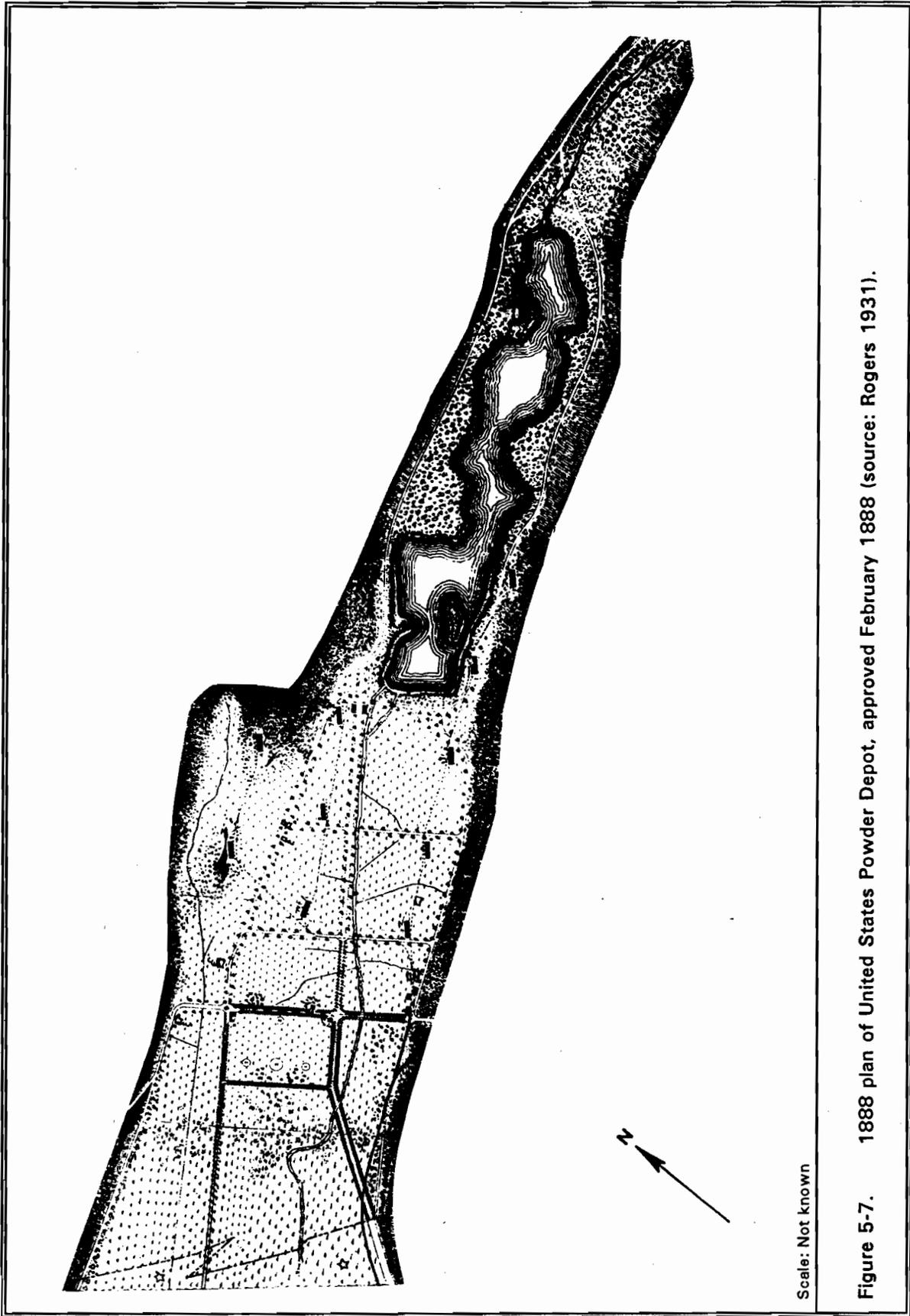
By June 1887, 23.5 miles of track connecting the Army depot with the Delaware Lackawanna and Western Railroad and the Dover and Central Railroad of New Jersey at Wharton had been laid by the Morris County Railroad Company of New Jersey under the terms of a 9-acre right-of-way granted by a 99-year lease (WPD 1931:54). In July 1887,, 70 men were employed at the depot and 900,000 pounds of powder were in storage (The Jerseyman July 29, 1887:3). In 1889, it was announced that 4,500 tons of saltpeter used in the production of black powder were to be stored there (The Jerseyman March 5, 1889:3).

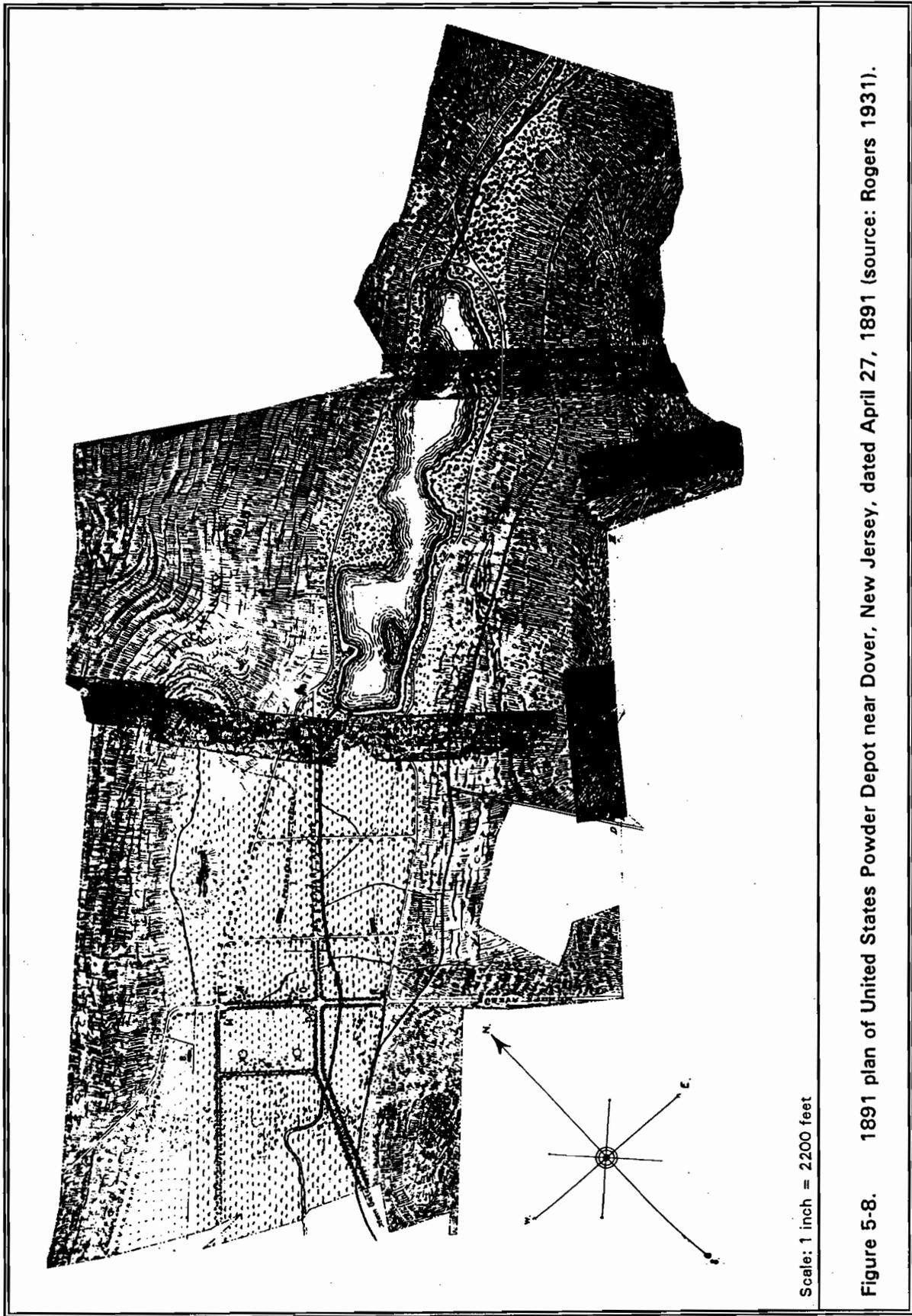
Cannon Gates

The Cannon Gates were installed in October 1885 to provide the new installation with an appropriate main entrance at its southern end (Figure 5-8). The Gates, constructed by the Cornell Iron Works, was patterned from a special design which used heavy cannon mounted on stone foundations to serve as posts for the wrought-iron gates. The gates themselves were decorative wrought-iron, embellished with the insignia of the Ordnance Department.

U.S. Navy Lake Denmark Powder Depot, 1891

In 1890, the Department of the Navy transferred its powder magazine on Ellis Island in New York Harbor to the Treasury Department. This left the Navy without an adequate powder storage facility on the East Coast. By act of Congress, approved April 11, 1890, \$75,000 was appropriated to purchase a new site for a powder depot (USDN 1890:255). The site selected was located at Lake Denmark, New Jersey, and the northern part of the Army's Picatinny Powder Depot (see Figure 5-8). Lake Denmark was chosen for many of the same reasons that attracted the Ordnance Department, and title for 315 acres was formally ceded to the Navy on June 9, 1891. Ground was immediately cleared for construction (USDN 1891:231).





Scale: 1 inch = 2200 feet

Figure 5-8. 1891 plan of United States Powder Depot near Dover, New Jersey, dated April 27, 1891 (source: Rogers 1931).

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The Lake Denmark Powder Depot was the Navy's principle East Coast facility and was intended to be the general storage depot for all powder and high explosives (Ibid:19). The first structures, a magazine for the storage of powder and explosives, a shell house, and three small frame houses for Navy caretaker personnel, were completed in 1892, by a local contractor, J. J. Vreeland, who had also worked for the Army at the site (The Jerseyman April 1, 1894). By 1894, the depot also included three large buildings for the storage of powder and ammunition, two smaller structures for the storage of high explosives and one large building for loading artillery shells.

The early history of Lake Denmark Powder Depot is one of gradual but steady expansion. The Spanish-American War (1898-1899) and the growing needs of the Navy contributed to the development of the facility. Two additional tracts of land were acquired in 1902 - a parcel of 78.58 acres by purchase and a second tract of 67.5 acres, confiscated by Presidential proclamation (Platt 1976:229).

Early Projectile Loading 1897-1906

Although the Picatinny Powder Depot was primarily originally intended for black powder storage, several small-scale loading operations were begun in the late nineteenth and early twentieth centuries. The assembly of powder charges for cannon began in 1897. This process involved the manufacture of silk cartridge bags to contain the powder charge and the filling of charges for separately loaded ammunition. As a result, buildings for the storage of loaded projectiles and explosives were required. By 1902, six magazines for the storage of sodium nitrate and filled projectiles had been constructed.

A temporary plant for loading armor-piercing projectiles with Maximite, including a boiler house and a loading house, was constructed in 1903. Several thousand projectiles were manually filled and compressed before Explosive "D" completely supplanted Maximite. The shells which had been loaded with Maximite were unloaded in 1906-7 (Muhlenberg 1912:9). A plant for loading shells with Explosive "D" was completed in 1904 and continued in operation until 1906 when a policy of loading projectiles in the field was instituted (Ibid:54).

The expansion of operations at Picatinny Arsenal required construction of new service buildings and laboratories. By 1906, a water powered wheel and dynamo house was constructed at the southwestern corner of Lake Picatinny; a metal working shop was built; and a building in which to assemble fixed ammunition was constructed. However, plans for this activity were abandoned and the building was converted to a chemical laboratory and later to a high explosives plant. By 1906, there were 105 buildings at Picatinny Arsenal.

Early Production Phase, World War I, Picatinny Arsenal (1906-1918)

Smokeless Powder Plant

Congress passed the fortification bill on June 25, 1906 authorizing \$165,000 to build and equip a major powder manufacturing site for the Army. The Chief of Ordnance recommended the New Jersey site to the Secretary of War. In 1907, this location was chosen as the first Army-owned smokeless powder (Muhlenberg 1912:10). In October 1907, the installation's name was officially changed to "Picatinny Arsenal".

Major Dunn, the inventor of Explosive "D", was detailed to supervise building the powder factory on May 14, 1907. Dunn prepared the plans, but left shortly thereafter for a position with the American Railway Association. Work on the powder factory began in April, 1907 under Major Horney, who was given command of the post on June 10, 1907 (WPD 1931:57). The buildings were

completed in eight months and the manufacture of cannon powder begun in January 1908. The plant had an initial production capacity of 3,000 pounds of powder daily. This facility differed from other powder factories in the United States because it employed the Thompson displacement process in the nitration of cotton (Van Gelder and Schlatter 1927:837-838). This process was later replaced by the Dupont Centrifugal Wringer Process.

In 1908, equipment for the manufacture of powder for small arms of .30 caliber was installed. The original capacity of this plant was 250 to 300 pounds of small arms powder per day (WPD 1931:72-74).

Plant Expansion

In 1909, Picatinny became solely responsible for the assembly of fixed ammunition above .50 caliber. On March 4, 1909, Congress approved \$175,000 for the expansion of its powder factory. Production capacity increased to 9,000 pounds of smokeless powder daily (WPD 1931:55).

In 1911, Congress authorized the expenditure of \$20,000 for the construction of a plant to manufacture Explosive "D", an explosive used as a bursting charge in armor-piercing projectiles. This plant was in operation by 1913 with a daily production capacity of 1,000 pounds. It remained operational until 1918, when the factory was dismantled (Muhlenberg 1912:11; Platt 1976:225).

In November 1911, an Officer's Training School was established to provide instruction in the chemistry of explosives and ballistics. Training was in the ammunition manufacturing process and War Department methods (Platt 1976:225). By 1913, employment at Picatinny stood at 200. In 1914 124 buildings were located on the site.

World War I

The entry of America into World War I, signaled a need for additional storage capability for powder and other ordnance materials. Fifty-four new storage buildings, a new powder house, a locomotive round house, garages, and more office space were constructed. More roads were planned and new railroad right-of-ways were established. During the war the Arsenal hired 2,600 workers to meet war time production needs. Approximately 20% of the employees were women.

The post's most significant role during World War I was not the manufacture or loading of projectiles, since private firms (Dupont, Hercules, Aetna, and Atlas Powder) received contracts from the Army to produce the bulk of explosives. Rather, Picatinny Arsenal served as a liaison between the Army and private industry. The work accomplished during World War I established Picatinny Arsenal as an important research installation, and helped insure it a significant post-war role.

Interwar Era (1918-1940)

Early Experimental Phase, 1918-1926

After the Armistice in November 1918, production of powder was halted and the arsenal served as a field depot for one year for the storage of surplus powder. Employment declined from 2,600 to 1,300; by 1919-20 it dropped further to between 600 and 1,000. Activities soon accelerated, however, as a plant for manufacturing pyrotechnic flares and signals was established and a small experimental plant for artillery ammunition was begun.

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The Ordnance Department decree on December 28, 1920 that Picatinny Arsenal would be a complete ammunition arsenal initiated major developments that would sustain the post between the wars and establish Picatinny Arsenal as the major center of explosives research and development. An intensive building and renovation program was launched, and all the Army's research on fuzes was transferred to the site. Nine buildings were constructed for drying, grinding and sieving explosives such as dicyandiamid, quaridine nitrate and pentaerythrite. Storage tanks for raw materials and a control laboratory were also constructed (Harris 1926:43).

Plants were established for loading TNT and Amatol into bombs and shells and to load fuzes and assemble complete rounds. Fifty buildings, including the powder factory, were renovated for new experimental work. To support these expanded facilities, the physical plant was modernized to include new steam, electric and sewage lines, and the power house was refitted with new boilers and generators. By 1922, Picatinny Arsenal contained 485 buildings (Figure 5-9).

Explosion at Lake Denmark Powder Depot, July 10, 1926

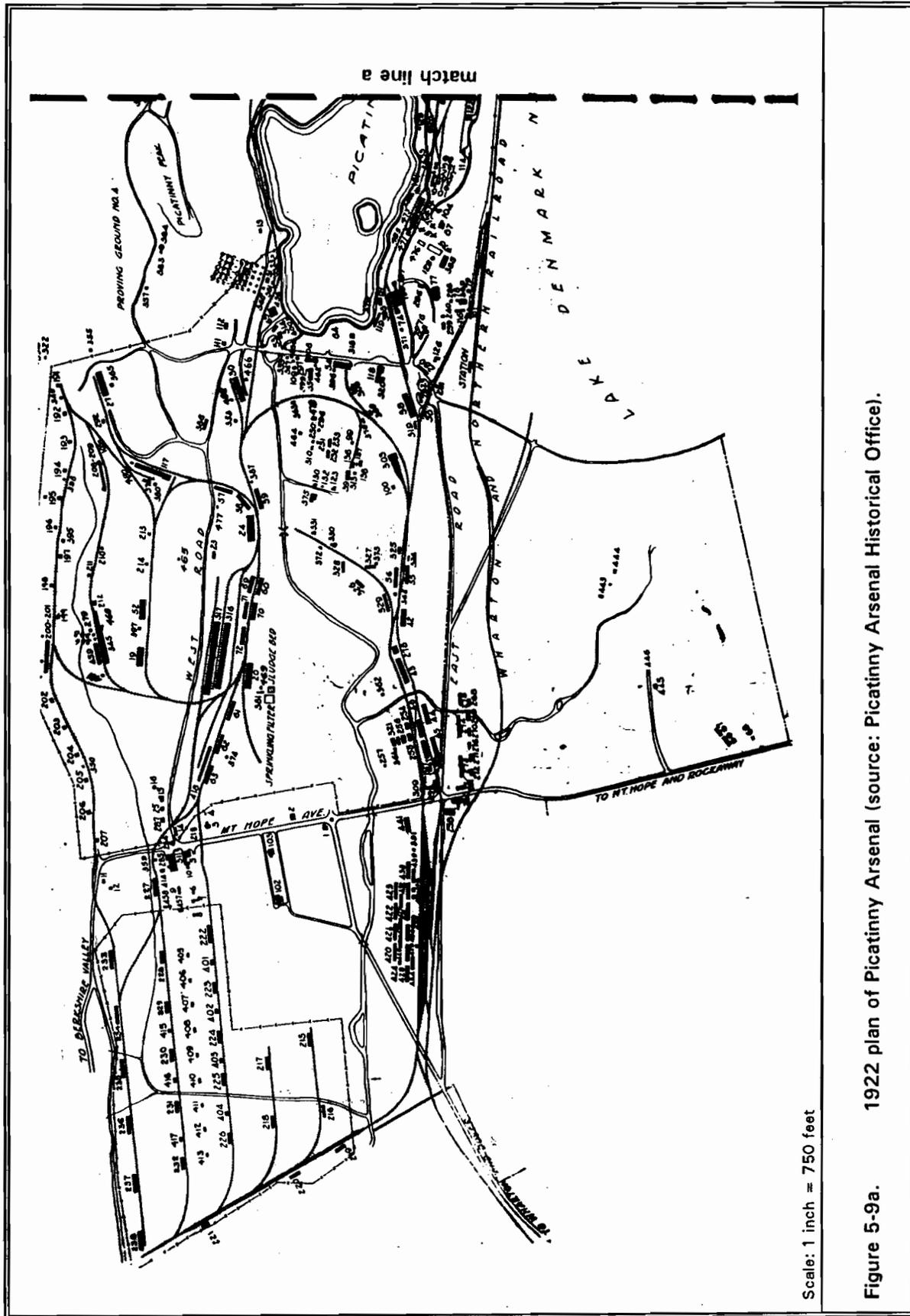
After World War I, the Navy was burdened with excessive amounts of unused ammunition and faced the difficult problem of storing these vast reserves of high explosives, smokeless powder, and inert materials. A great number of magazines were constructed at Lake Denmark during 1917-1918 to increase the capacity of East Coast storage depots. However, this effort was inadequate as all the East Coast storage facilities were quickly filled to capacity (USDN 1947:323-325).

Around 5:15 on the afternoon of Saturday, July 10, 1926, a severe electrical storm hit the Dover area and lightning struck the southwest end of the Naval Powder Depot. Attempts to contain the resulting fire proved futile. At 5:20, a tremendous explosion outside temporary Magazine No. 8 caused considerable damage to it and other magazines in the vicinity, thus exposing their contents to flame and shrapnel. As a result, fires spread rapidly and a series of sympathetic explosions occurred throughout the area. At about 5:25, the contents of Storehouse No. 9, 150 feet distant from Storehouse No. 8, exploded (WPD 1931:72-74).

Temporary Storehouses No. 8 and 9 were of typical storehouse construction: one-story, hollow clay tile and brick buildings with steel roof trusses. Roofs were wood with tar sheeting. Both buildings were equipped with lightning rods. Temporary Storehouse No. 9 held 1,600,000 lbs. of TNT stored in boxes. Storehouse No. 8 contained an estimated 670,000 lbs. of various types of explosives from depth charges to bomb fuzes. A third explosion at Shell Storehouse No. 22, which contained 180,000 lbs. of loaded artillery shells and fuzes. Fortunately, 2,500,000 lbs. of Explosive "D" stored in Storehouse No. 11 (500 feet from the blast area) burned rather than detonated thus avoiding another major explosion (WPD 1931:72-74).

The detonations triggered tremendous shock waves and caused a series of destruction reverberations. Everything within a 3,000 foot radius of the blasts was destroyed. Beyond 3,000 feet, many buildings in the Naval depot were seriously damaged (WPD 1931:74). The explosion also did considerable damage to buildings at Picatinny Arsenal because of its location in the valley directly below the Navy's depot. This included many buildings associated with the Nitrocellulose Smokeless Powder Plant.

The 1926 Explosion at Lake Denmark demonstrated the hazards of storing concentrated amounts of explosive materials. At the time of the explosion, both Storehouses No. 8 and No. 9 were dangerously overloaded and in violation of the laws of New Jersey relating to the manufacture, keeping, storage, transportation, and sale of explosives (USDN 1927:270-271).



Scale: 1 inch = 750 feet

Figure 5-9a. 1922 plan of Picatinny Arsenal (source: Picatinny Arsenal Historical Office).

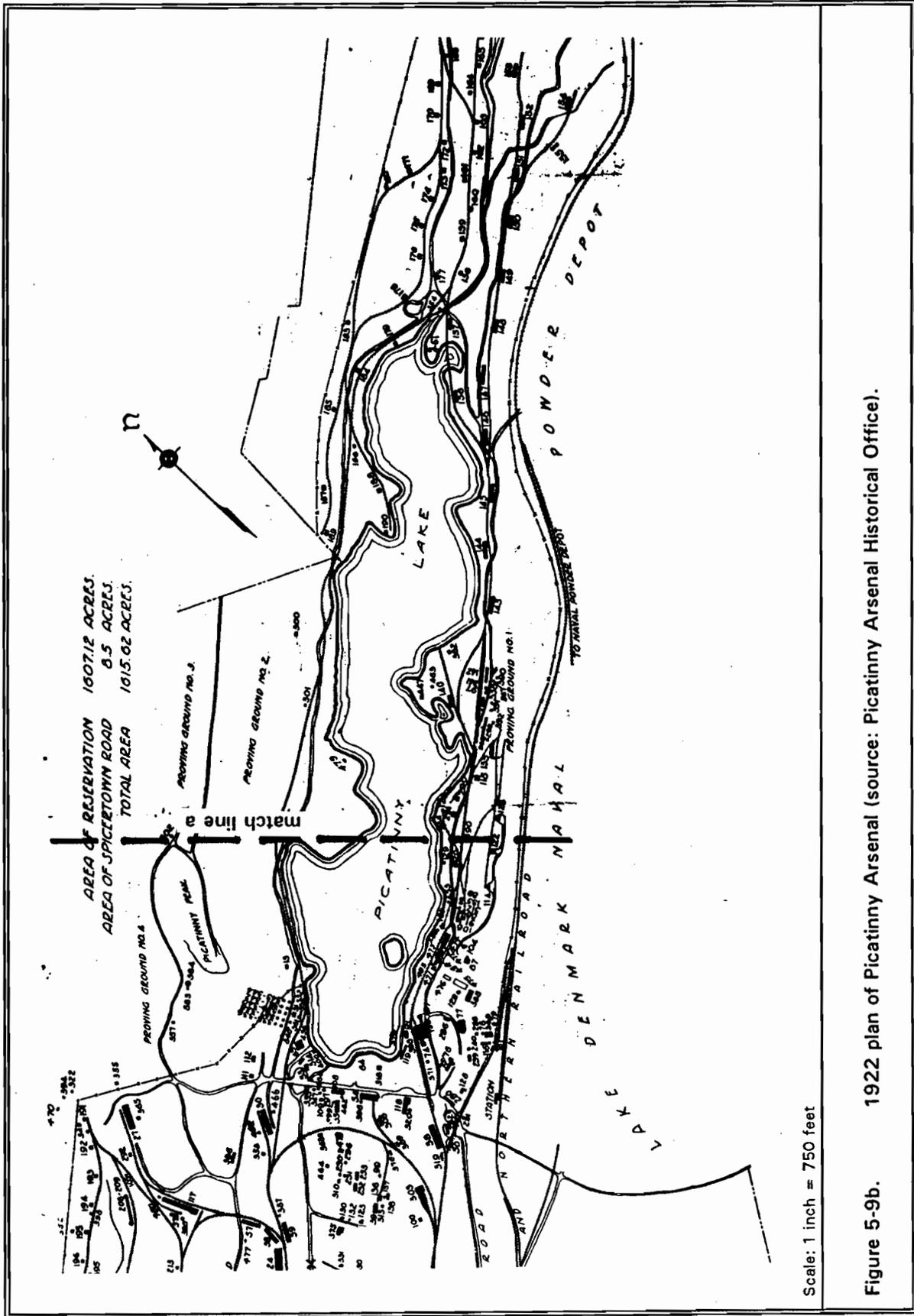


Figure 5-9b. 1922 plan of Picatinny Arsenal (source: Picatinny Arsenal Historical Office).

Aftermath of the 1926 Explosion

Two weeks were required before all fires were extinguished, and it was safe to begin the task of cleaning up debris, salvaging materials and filing damage reports at Lake Denmark and Picatinny Arsenal. In the area of the original detonation, great quantities of twisted steel girders, steel shrapnel, and brick fragments were widely strewn. Three distinct craters, on the sites of the three storehouses, marked the location of the original explosions. Unexploded shells and shell fragments, some as far as 3/4 mile from the site of Shell Storehouse No. 22 posed great problems for cleanup crews (WPD 1931:89-90).

300,000 tons of loaded and fuzed projectiles damaged by the explosion were transferred by rail to a Navy installation at Iona Island in the Hudson River and then dumped at sea. Some damaged fuzes and primers were burned on site. Salvaged materials included 7,809 tons of metal, which was sold for \$191,910 (USDN 1928:321). Other explosive materials were bulldozed into craters and covered over (as a result, two sites in the Navy Hill area remain quarantined today).

Court of Inquiry

The Court of Inquiry, appointed by the Navy and headed by Rear Admiral Coontz, recognized the problem of inadequate ammunition storage facilities on the East Coast. The court's most urgent finding was for the segregation of high explosive storage facilities. In effect, the court's recommendation's led to a general revision of ammunition storage practices and three recommendations were made to the Secretary of the Navy:

- 1) The amount of high explosive material stored in any given facility should be limited to 143,000 pounds per magazine.
- 2) High explosive magazines should be constructed with a minimum allowable distance of 500 feet between buildings.
- 3) New design standards should be developed for the construction of storage buildings.

The Court of Inquiry also recommended that combustible materials, materials with low resistance to explosion, and materials with a tendency to fragment into hazardous missiles be eliminated from the construction of ammunition storage buildings (USDN 1926:30).

The Court of Inquiry further recommended that after salvage and repairs were completed at Lake Denmark, funds should be appropriated to construct six new storage magazines to be used only for storing inert material, propellant powder, and projectiles. Storage of live ammunition of Lake Denmark would no longer be permitted (USDN 1926:270-71).

Following the explosion of July 10, 1926, the Chief of Ordnance appointed a board of Army officers to investigate the incident and to make recommendations on the further of Picatinny Arsenal. The commission, headed by Col. Tschappat, advised that Picatinny Arsenal be reconstructed and expanded to consolidate the Army's holdings in northern New Jersey.

In reviewing the damage caused by the 1926 Explosion, three major factors were found which affected the extent of damage inflicted upon a buildings:

- 1) The distance from the explosion.

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- 2) The structural strength of a building.
- 3) The extent to which a building was screened or protected from the direct impact of the blast.

Reconstruction Phase, 1926-37

Prior to 1926, the expansion of Picatinny Arsenal had been gradual in order to meet the changing demands and functions of the Army. The 1926 Explosion provided an opportunity to redesign the installation to meet the Army's new specific and particular requirements.

In December 1927, Congress approved plans for rehabilitating Picatinny Arsenal and appropriated \$2.3 million. Lt. Col. J.K. Crain, Ordnance Department, was appointed to direct its reconstruction. Essentially, the "new" Arsenal was divided into three distinct functional zones (Rogers 1931:93):

- 1) An area for the production of powder and explosives.
- 2) An area for testing powders and explosives.
- 3) An area for non-explosives manufacturing, including all research and administrative facilities.

A fourth area, the explosives storage area (900 area), remained essentially unchanged. However, several recommendations concerning safety procedures were adopted and many new sand-filled wood bunkers were constructed. The amount of ammunition stored at Picatinny Arsenal was reduced and, to insure the safety of surrounding areas, Congress appropriated funds for the purchase of additional lands.

The reconstruction effort focused largely on the powder and explosives manufacturing area. The Nitrocellulose Smokeless Powder Plant (the 500 area) was built on its original site, with greater distances between buildings. A Complete Rounds/Melt-Loading Plant (800 area) was established along the west shore of Lake Picatinny. This was constructed as a major loading-line, designed to incorporate various loading procedures into one distinct production component.

Four major loading and assembly buildings were constructed, connected by covered walkways to facilitate the production process. The Complete Rounds/Melt-Loading Plant represented a major development in production conception and greatly enhanced Picatinny Arsenal's production capability. A new Bag-Loading Plant (400 area) was established along the south shore of Lake Picatinny. Three major buildings which replaced the outmoded facilities were constructed specifically for this production process.

A new testing area (600 area), established on the plateau west of Picatinny Peak, consisted of structures specifically designed as testing facilities and marked advances in technological and scientific developments.

A small High Explosives Plant (1000 area) for the production of tetryl was constructed in an isolated area on the eastern ridge of Picatinny Peak. The new plant followed construction guidelines established by New Jersey State law and replaced the old Tetryl Plant.

A new administrative building (Building 151) and a new chemistry laboratory complex (Building 162) were the major construction projects executed in the non-explosives manufacturing area. These two projects formed the nucleus of a new administrative district. The emphasis placed on

administrative functions, and especially on research facilities, reflected a shift in the focus of the arsenal. A third important area in this division was a new engineering complex including a new metal shop (Building 31) and wood-working shop (Rogers 1931:94). The main metal shop manufactured all metal components and ammunition prototypes for research and development needs at the Arsenal (Ordnance Bomb 1937:55; Research & Engineering 1955). The Arsenal golf course was also constructed during this period (1926).

The reconstruction and expansion of Picatinny Arsenal established the installation as the Army's major ammunition facility. It also became the Army's development, research, and manufacturing center for all types of ammunition, except for small arms and machine guns.

The rehabilitation of Picatinny Arsenal was essentially completed by 1931 as the new production plants and research facilities were all operable (Figure 5-10). During the 1930s, additional maintenance and repair work was completed as part of the Works Project Administration (WPA). Nine hundred WPA workers were employed in 1937 to make renovations and improvements. By 1940, there were 567 buildings at Picatinny Arsenal. There were 342,000 square feet of storage space; the value of items stored was \$37.5 million and the facility itself was valued at close to \$10 million. Picatinny Arsenal, having suffered tremendously from the explosion of July 10, 1926, had been completely revived.

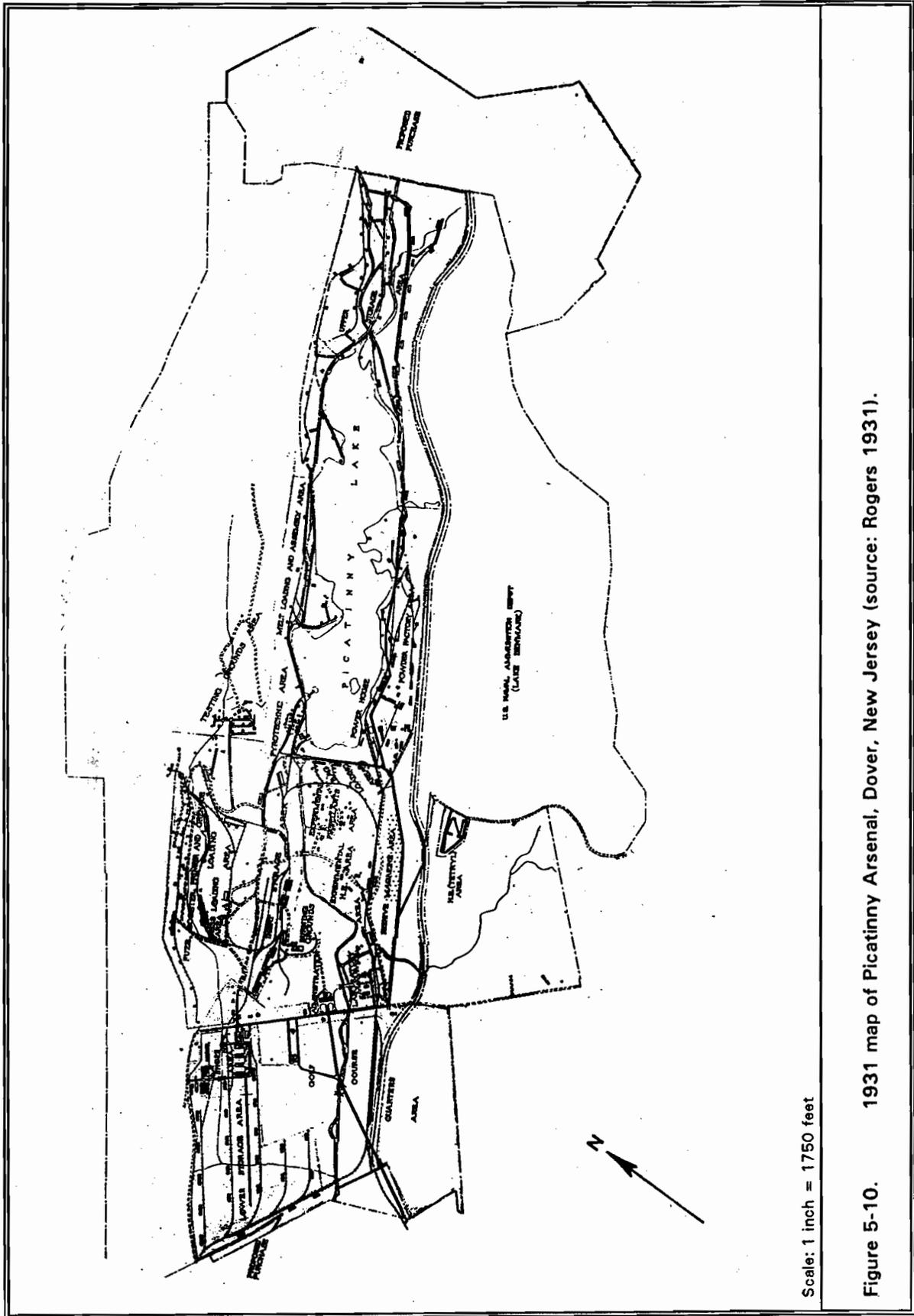
Production Activities

The mission of Picatinny Arsenal, just prior to America's involvement in World War II, was to provide the Army with a munitions manufacturing center which included experimental and production plants for various propellants and high explosives. In 1940, the installation was producing the following materials at either experimental or peace-time production levels:

- 1) Smokeless Powder
- 2) High Explosives
- 3) Fuzes and Primers
- 4) Assembled Rounds of Artillery Ammunition
- 5) Bombs and Grenades
- 6) Pyrotechnics (Airplane Flares/Military Signals)

Picatinny Arsenal was an important explosives and ammunition research center. Though work was interrupted briefly by the 1926 Explosion, the Arsenal's research/development facilities served both the Army and private industry during the period between the wars. From 1918-1940, Picatinny Arsenal was responsible for the standardization of new designs for base- and point-detonating artillery fuzes, and for the development of nose and tail bomb fuzes.

Picatinny Arsenal was also instrumental in redesigning and improving artillery primers, trench mortars, and rounds of chemical and tracer ammunition. New high explosive compounds, propellant compositions, fuze powders, primer mixtures and pyrotechnic compositions were developed by the Research and Chemical Branch. An important aspect of Picatinny Arsenal's mission was the development of up-to-date designs for munitions, and in the event of a national emergency, to provide private industry with production plans and training.



Scale: 1 inch = 1750 feet

Figure 5-10. 1931 map of Picatinny Arsenal, Dover, New Jersey (source: Rogers 1931).

World War II (1940 - 1945)

Mission

On December 8, 1941, the United States was at war and private industry faced a major challenge to meet the demands of mass production. Of necessity, Picatinny Arsenal assumed an important role in:

- 1) Ammunition Manufacture/Production
- 2) Ammunition and Explosives Research
- 3) Civilian and Military Personnel Training

At the outbreak of the Second World War, Picatinny Arsenal was responsible for producing most of the ammunition for American troops as well as much of the ammunition for our European Allies. It was the only major plant in the United States capable of full-scale production for any ammunition larger than small arms, and it was responsible for loading and assembling large caliber ammunition, artillery projectiles and bombs. Picatinny Arsenal remained the nation's only major munitions producer until the fall of 1942 when private industry was capable of accepting the burden (Anon 1944:41).

Expansion

To meet these responsibilities, Picatinny Arsenal experienced another era of rapid expansion. Pilot plant and experimental projects were converted to production operations. Production lines were operated at full-scale and then expanded in order to cope with increasing needs. The facility operated 24 hours a day, 7 days a week; the work force grew from 1,800 to 18,000 workers. By 1942, the production at Picatinny Arsenal had expanded far beyond the Army's expectation (Table 5-3). To meet personnel needs, the Army established temporary worker's housing outside Dover. A portion of the employees lived in this housing, while many commuted from areas as far away as Newark and New York City.

Table 5-4. WORLD WAR II PRODUCTION FIGURES, PICATINNY ARSENAL

YEAR	PRODUCTION/RATE
1938	2,000 boosters/8 hr day
1942	72,000 boosters/24 hr day
1938	600 artillery fuzes/8 hr day
1942	173,000 artillery fuzes/24 hr day
1938	10,000 primers/8 hr day
1942	90,000 primers/24 hr day

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1942	40,000 37 mm complete rounds/24 hr day
	30,000 60 mm complete rounds/24 hr day
	12,000 75 mm complete rounds/24 hr day
	7,500 81 mm complete rounds/24 hr day

(Source: Inventory of Federal Archives in the States, The Survey of Federal Archives 1940).

Technical Division

The Technical Division, established in March 1925, was responsible for all research and development work during World War II. Many important advances were realized during the war which developed new products or methods of simplified production. Perhaps the most significant of these was development of an improved method for manufacturing Teteryl, a highly explosive material used as a booster charge in bombs and artillery shells. The new procedure, which discontinued the dimethylaniline process in favor of the dinitromonomethylaniline process, proved less hazardous and less expensive (Larned 1943).

Improvement in the production and composition of nitrocellulose powder was accomplished by the Propellants Sub-Section of the Technical Division. The first development was the discovery that wood-pulp could be substituted for cellulose-based powders. This was extremely important because of the scarcity of cotton (Ibid). The Propellants Sub-Section was also responsible for studies of powder ignition and for standardizing testing procedures (Anon. 1948:17-20).

Ammunition

The Mechanical Branch of the Technical Division was responsible for the design and development of ammunition. At the outbreak of World War II, the branch was responsible for the development of all artillery fuzes, boosters and grenades. During the war, a variety of special components were designed to meet the requirements of different warfare tactics. Special bomb fuzes were designed, one for above ground detonation and another for long delay (1 to 2 144 hour) detonation. Pyrotechnic devices, flares and signals were designed or improved. All these devices were developed and tested at Picatinny Arsenal before undergoing further testing or combat action (Ibid:41-48).

Explosives

The Chemical Engineering Section of the Technical Division was responsible for developing and evaluating new explosives and improving the performance of standard military explosives. Its most significant accomplishment was the invention of Haleite. Named for Dr. G. C. Hale, Chief of the Chemical Branch, this explosive was developed in co-operation with DuPont. A small production plant was established in the old Teteryl area (Ibid:15-16).

Training

The third significant function of Picatinny Arsenal was the establishment of training programs to impart knowledge of explosives and powder production to military and civilian personnel. The Ordnance School trained 300 reserve officers and 4,000 key ordnance personnel for special ordnance assignments. The men were later stationed among the 23 ordnance districts, to aid in establishing and maintaining ordnance facilities.

To accelerate the transfer of ammunition production from the Army to the private sector, 530 engineers, chemists and executives from various industries studied ammunition and explosives production at Picatinny Arsenal (Larned 1943). An apprentice school to train 100 Tool, Die, and Gagemaker students simultaneously was also established (Anon. 1944:35). Picatinny Arsenal's training program benefits were reflected in its excellent safety record. From 1940-1943, the facility's accident rate declined from 25.7 to 4.04 accidents per million man hours (Anon. 1944:48).

The Arsenal's record proved that adequate safeguards and proper training could minimize hazards without jeopardizing the production output of an explosives manufacturing plant and demonstrated that the concept of "safety" in the explosives industry was possible.

Achievements Recognition

World War II represents the zenith of Picatinny Arsenal's production development. The achievements of Picatinny Arsenal were recognized on September 20, 1942 when the Army-Navy "E" Award was bestowed upon Picatinny Arsenal for excellence in the production of ordnance. A second "E" Award was bestowed in August 1943, in further recognition of the Arsenal's important role in the nation's military effort (Larned 1943). The technological advances of World War II created great opportunities for research, and Picatinny Arsenal continued to develop new and more effective munitions during the post-World War II period.

Lake Denmark Powder Depot

The significance of the Navy's Lake Denmark Powder Depot in World War II is minor compared to Picatinny Arsenal. Though virtually destroyed by the 1926 explosion, Lake Denmark had since been used chiefly as a storage area for propellants and loaded projectiles. During World War II, the Navy's installation continued to operate in this capacity while it expanded in size. The Marine Corps barracks and a storage area (330 area), comprising a total of 24 structures, were completed in 1939. A number of ordnance facilities were built during the war, most notably a heavy ordnance storehouse (Building 3050) completed in March 1942.

In 1943-44, a new barracks area was constructed to provide housing for enlisted men preparing to go overseas. Although no official documentation has been identified, it is alleged that this area (340 area) was built as a prisoner of war camp during the last years of the war. The area was constructed as a self-sufficient entity surrounded by a high security fence and served by its own powerhouse. Evidence of guard towers still remain, but it is not believed that any war prisoners were ever held here.

Post World War II to Present (1945-1989)

Cold War

Following World War II, the Cold War forced a continued posture of military readiness. Picatinny Arsenal was ideally suited to contribute to the national defense because it combined laboratory,

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production, and testing facilities at one installation. Research and Development study areas included pyrotechnics, plastics, packaging, explosives, rockets and missile warheads. Picatinny Arsenal had long been involved in the field of pyrotechnics and continued in this capacity. It was responsible for all military pyrotechnic devices for the Army and the Air Force. Post-war activities in this field included the research, design, and development of photoflash cartridges for tracking the missiles, photoflash bombs, flares, signals, smokes, tracers, spotting charges, and simulated charges (Anon. 1961).

The Arsenal also continued its research in the packaging of ammunition, including the study of plastics and adhesives. The installation was equipped to measure the mechanical properties of plastics and adhesives and to mold experimental quantities of development items. Testing facilities included equipment that could simulate different climatic conditions and handling hazards (Anon. 1961). A Naval Air Rocket Test Station (NARTS) was established at the former Lake Denmark Powder Depot in the early 1950s to research and test liquid and solid rocket fuels.

Korean Conflict

Activity at Picatinny Arsenal increased once again with the outbreak of the Korean conflict in 1950. North Korean use of the Russian-made T-34 Medium Tank posed a serious threat to American forces until a new 3.5 inch bazooka capable of penetrating the tank's thick armor was developed. The rocket for this weapon was manufactured at Picatinny Arsenal on a pilot plant basis and was soon put into full-scale production (Harris 1953:14).

Research and Development work also continued throughout the Korean conflict. In 1952, researchers at Picatinny developed an atomic shell capable of being fired from a 250mm gun (Anon. 1961:72).

Research

Picatinny Arsenal's research in plastics gained importance as this type of explosive came to be more widely used in ammunition during the late 1950s and early 1960s. Research included high-speed photographic studies of the detonation of explosives and studies of the effects of nuclear radiation on explosives. These studies applied to nuclear and special weapons as well as to conventional munitions.

During the 1960s, there began development work on warhead sections for the Nike system - a family of ground-to-air, anti-missile missiles. Picatinny Arsenal was also responsible for the development of warheads for other Army missiles such as the Hawk, Corporal, Honest John, Littlejohn, Lacrosse, Redstone, Pershing, Sergeant, SAM-D, Lance and Safeguard (Anon. 1961; Bergaust 1966:42).

Vietnam Conflict

During the Vietnam conflict, Picatinny Arsenal was responsible for the production of bomb fuzes, mortar shells, tank mines and other ammunition, until private industry could go into full-scale production. Picatinny was also responsible for the development of many sophisticated weapons systems (Star Ledger April 24, 1979). Limited new construction has occurred within the past 20 years. A large new headquarters building was constructed in 1982.

CHAPTER VI

EVALUATION OF CULTURAL RESOURCES AT PICATINNY ARSENAL

Disturbance Evaluation

[This section describes ground disturbances to the natural topography of Picatinny Arsenal. It has been extracted and updated from previously evaluated information (Klein et al. 1986).]

Both historic and modern period land use of the area encompassed within Picatinny Arsenal has resulted in alterations to the natural topography (Table 6-1). As previously noted, the area surrounding Picatinny Arsenal was characterized by dispersed small farms and residences in the valley during the early historic period. By the mid-eighteenth century iron working settlements developed at Middle Forge and Upper Forge situated within the Arsenal valley. This type of historic land use continued until 1880 when the United States Army began purchasing large parcels south of Picatinny Lake.

Alterations to the natural topography of the valley would have been limited to tree clearing and plowing associated with agricultural activities during the early historic period. Some earth-moving activities also resulted from the construction of farmstead structures. The most important alteration resulted from the creation of the iron industry at Middle Forge and Upper Forge (Table 6-1). Both forge complexes are responsible for the damming of Burnt Meadows Brook and Green Pond Brook, which resulted in the flooding of large lowland areas in the valley. Lake Denmark covers 194 acres, while Picatinny Lake encompasses 108 acres. Small-scale ground disturbances related to the iron industry occurred during the construction of the forges themselves, factories, residential housing, and associated mining/quarrying activities from the mid-eighteenth to the mid-nineteenth century.

Following the 1880 purchase of the land south of Picatinny Lake, the nature of military land use in the valley and along the surrounding ridges has determined the types and extent of ground disturbances. The Arsenal presently encompasses approximately 6500 acres, and activities are conducted in over 1500 buildings and structures as well as along 89 miles of roads and 28 miles of railroads.

During the recent visual field inspection of the Arsenal, several large areas within the Arsenal were not visited due to restricted access. The disturbance evaluation in presented in this chapter is subsequently largely extracted from previously collected information. More detailed descriptions of specific areas of military-related ground disturbances are presented in Section 3.2 of the Archaeological Overview (Klein et al. 1986).

Nearly two thirds of Picatinny Arsenal have been the object of some degree of construction, development, landscaping, and other earth-moving operations associated with the facility's mission (Figure 6-1 a,b,c). These activities began almost immediately following the 1880 purchase. As previously noted, one of the most important transformations to the natural topography was the creation of an artificial drainage system throughout the southern most portion of the valley area of the Arsenal. This area has since been underlain with a tile drain and culvert system as well as the sanitary landfill and burning ground near Green Pond Brook. Picatinny Lake was also enlarged to its present size and shape as a result of Arsenal-related improvement activities in the 1880s.

Construction activities conducted between 1880 and 1906 associated with the erection of buildings and structures designated as Dover Powder Depot and later "Picatinny Powder Depot" began the major earth-moving disturbances in the Green Pond Brook Valley. The construction of the railroad

Table 6-1. Summary of Historic and Modern Ground Disturbances at Picatinny Arsenal.

DESCRIPTION	YEAR CONDUCTED	REFERENCE
Erection of Middle Forge and associated structures	1749 to 1868	Rogers 1931; Lightfoot and Geil 1853
Erection of Upper Forge and associated structures	1749 to 1868	Rogers 1931; Lightfoot and Geil 1853; Hopkins 1867; Beers 1868
Two limestone quarries for Mt. Hope Furnace	18th century	Rogers 1931
Erection of Dover Powder Depot Structures and related features	1880 to 1890	Anon. 1882-1884; Anon. 1885; Anon. 1891; Rogers 1931
- Powder Magazine		
- Storage Magazines		
- Officers' Quarters		
- Stables		
- Service Buildings		
- Limestone Quarries		
- Route 7 of the Morris County Railroad		
- Underground drainage and culvert system		
- New dam/spillway of Picatinny Lake		
Erection of Navy's Lake Denmark Powder Depot	1891 to 1902	Anon. 1891; Rogers 1931
- Storage Magazine		
- Shell house		
- Three small frame houses		
- Six powder and munitions storage buildings		
New constructions at Picatinny Powder Depot	1897 to 1906	Anon. 1902 (revised to 1906); Anon. 1904; Rogers 1931
- Six Magazines		
- Storage Buildings		
- Industrial Buildings		
- Five Railroad Station structures		
- Sanitary landfill/burning grounds		

DESCRIPTION	YEAR CONDUCTED	REFERENCE
Pre-World War I constructions and improvements <ul style="list-style-type: none"> - Smokeless Powder Plant including several buildings (post-WWI dismantling) - Fifty-four new storage buildings - New powder house - Locomotive Road house - Garages and new office space - Associated underground utilities, parking areas, and roadways - Landscaping activities 	1907 to 1918	Anon. 1904 (revised to 1914)
Building and Renovation Program at Picatinny Arsenal <ul style="list-style-type: none"> - Nine new industrial buildings - Storage tanks and a control laboratory - Renovations to fifty buildings - Physical Plant renovated with above and below ground steam, electric, and sewage lines - 3 hole Golf Course on parade grounds 	1920 to 1925	Rogers 1931
Explosion at Lake Denmark Powder Depot <ul style="list-style-type: none"> - Destruction of Powder Depot - Destruction of temporary storehouses - Damage to all of Navy buildings - Damage to many Picatinny Arsenal buildings - 3 craters on the sites of three storehouses 	1926	Rogers 1931; Anon. 1934
Reconstruction of Naval Depot and Picatinny Arsenal <ul style="list-style-type: none"> - Two craters filled with explosive materials - Reconstruction in the powders and explosives manufacturing area (500 area) 	1927 to 1931	Rogers 1931; Anon. 1934; Anon. 1944



DESCRIPTION	YEAR CONDUCTED	REFERENCE
- Complete Pounds/Melt-Loading Plant (800 area) along west shore of Picatinny Lake		
- New Bog-Loading Plant along south shore of Picatinny Lake (400 area)		
- New ammunitions testing area on the plateau west of Picatinny Peak (600 area)		
- Small high explosives plant on eastern ridge of Picatinny Peak (1000 area)		
- Explosives Storage Area (900 area)		
- New administrative building (151) and New chemistry laboratory (162)		
Maintenance and Repair completed under WPA	1930s	Anon. 1934; Anon. 1938; WPA 1938
- New dam/spillway at Picatinny Lake		
- Renovated underground tile drainage and culvert system and landscaping		
- Expansion of Golf Course to 9 holes		
- Drainage, filling, and replanting of Landing Field		
- Marine Corps Barracks and Storage Area (330 area) in Naval Depot		
- New and improved roads and bridge crossing, and underground utilities		
World War II Construction and Improvements	1943 to 1944	Anon. 1944; Anon. 1948
- New barracks area (3400 area)		
- Ordnance facilities		
- Munitions testing and training areas		
Modern Period Constructions and Improvements	1950 to present	Harris 1953; Anon. 1961
- Naval Air Rocket Test Station at former Lake Denmark Powder Depot 		
- New administrative and research/development facilities		
- Ongoing landscaping and grounds maintenance around all buildings		

DESCRIPTION	YEAR CONDUCTED	REFERENCE
- Associated underground utilities, parking areas, and road improvements		
- Eighteen hole golf course		
- Munitions testing and training areas		

embankment and track which served as a transportation link for the depot to the Morris County Line also constituted a major late nineteenth century land modification.

By 1906 the total number of buildings at the Arsenal was 105, and these were situated mainly in the nearly level valley south of Picatinny Lake. Aside from extensive drainageways and culverts, other ground disturbances at this time include associated underground utilities, roadways, and parking areas. Some structures had also been erected near Lake Denmark which had been selected as the Navy's Powder depot in 1890. In 1902, the size of this base was expanded to 102 acres, and earth-moving activities included the construction of new storage magazines.

From 1907 to 1908 major earth-moving disturbances at the Arsenal were related to its new mission as a smokeless powder factory. Numerous industrial and administrative facilities were constructed, as well as associated roadways, parking areas, landscaping, and underground utilities. During World War I the need for greater storage capacity resulted in the erection of new buildings, roads, and additional railroad right-of-ways. A major building and renovation program from 1920 to 1925 at Picatinny Arsenal resulted in numerous ground disturbance areas associated with new industrial and administrative buildings. Underground steam, electric, and sewer lines were also laid throughout the Arsenal. A three-hole golf course was designed on the parade grounds with associated landscape features (Milio et al. 1987).

The 1926 explosions at the Lake Denmark Powder Depot resulted in major ground disturbances to the area of Picatinny Arsenal. The impact of the blast not only destroyed all buildings, structures, and features within 3000 feet of the Depot, but also created structural damage to the surrounding buildings on the Arsenal and in nearby towns. The remains of three explosion craters appear on an 1934 map of the U.S. Naval Ammunition Depot at Lake Denmark as well as the foundation outlines of destroyed buildings (Anon. 1934).

Major reconstructions and expansions of the Arsenal occurred between 1927 and 1931. This included the filling in of two craters with explosive materials from the Naval Depot. The majority of the heavy earth-moving activities associated with building (400, 500, 800, 900, 1000) and testing (600) areas occurred during this period. During the 1930s additional work was conducted under the Works Project Administration (WPA). This included the construction of the numerous artificial bodies of water as well as the new Picatinny Lake dam and spillway. The area surrounding Bear Creek near the present landing field was also drained via the construction of 400 feet of conduit piping, covered with fill, and replanted (Anon. 1938).

The original underground drainage (irrigation and culvert system) in the southern portion of the Arsenal valley was improved with tile piping, and the golf course area was expanded to nine holes. Other ground disturbance activities included the construction of additional storage, administrative, and housing facilities (330 area). New and improved roads and bridge crossings as well as underground utilities also caused substantial ground disturbances throughout the Arsenal.

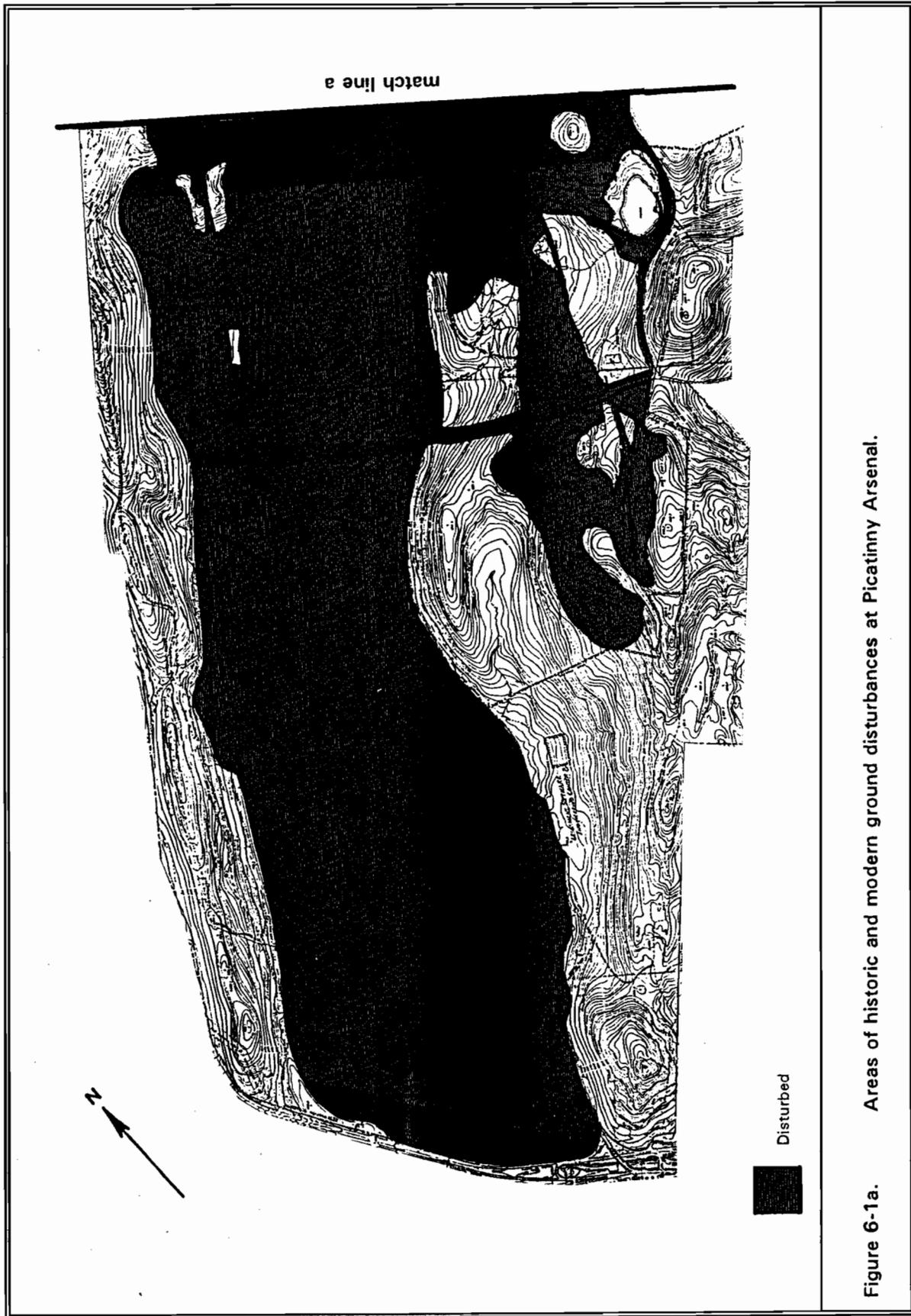


Figure 6-1a. Areas of historic and modern ground disturbances at Picatinny Arsenal.

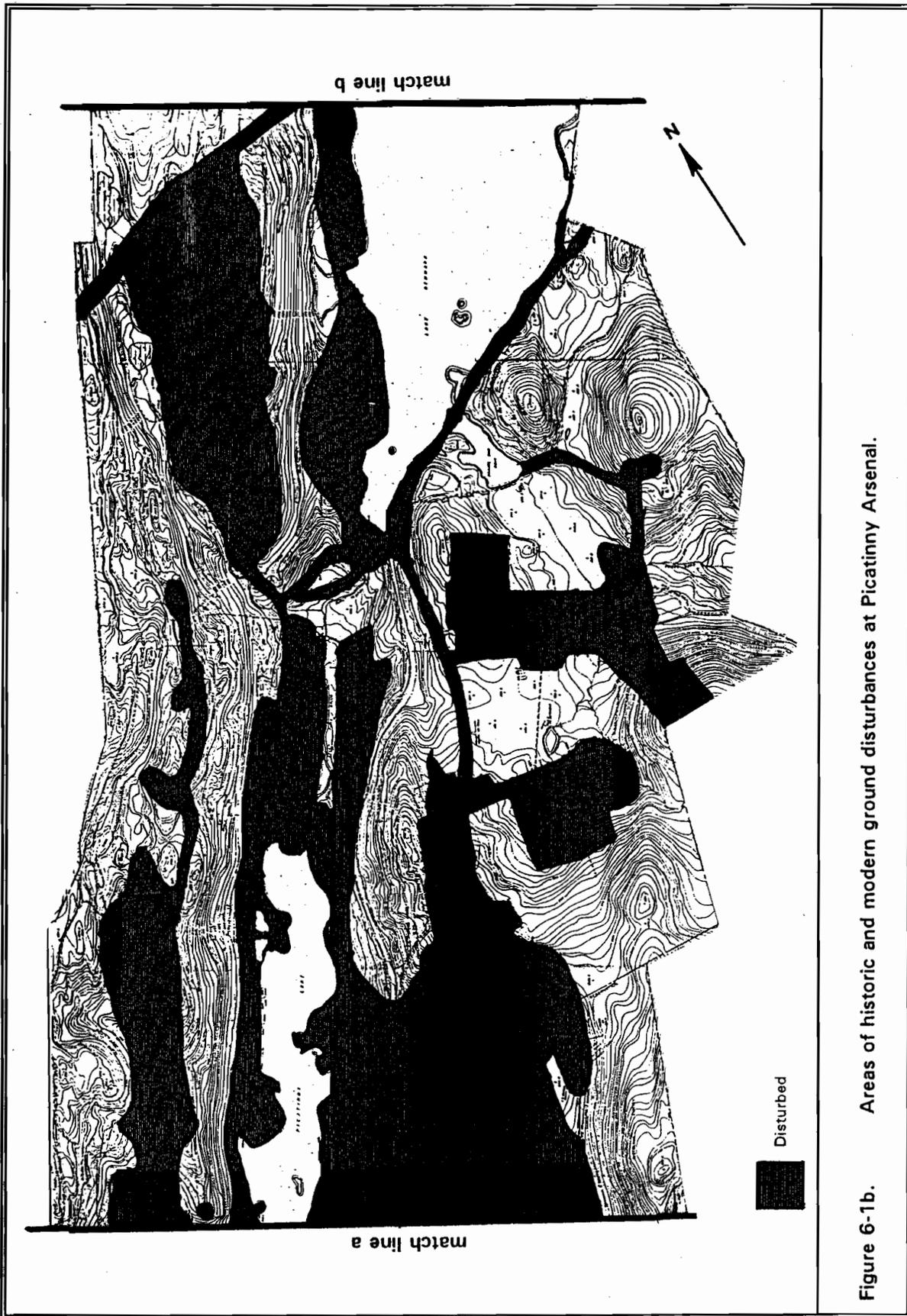
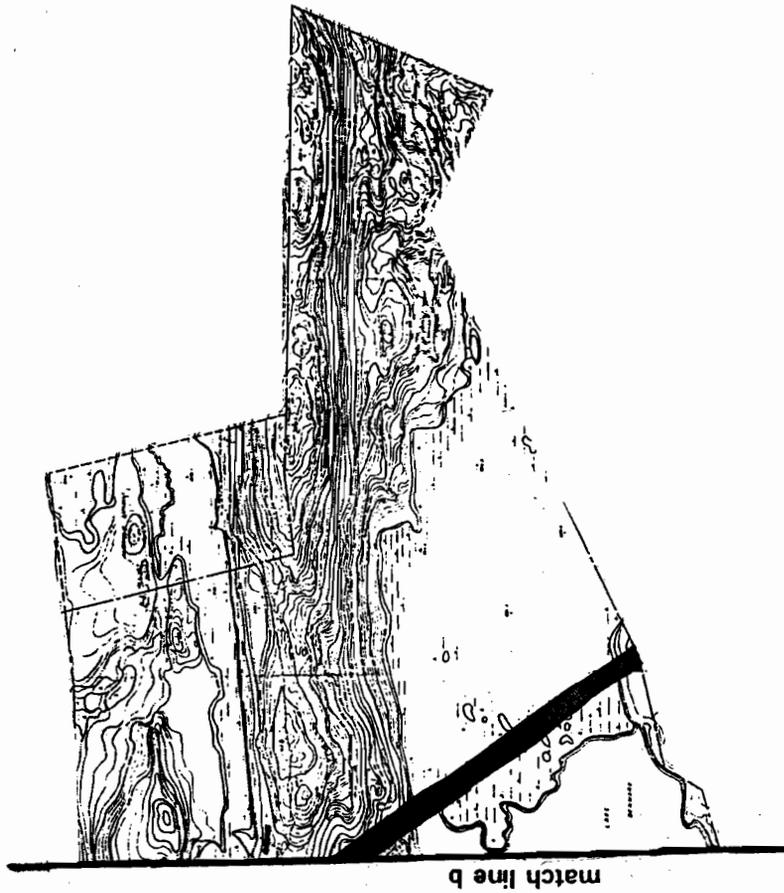


Figure 6-1b. Areas of historic and modern ground disturbances at Picatinny Arsenal.



Disturbed

Figure 6-1c. Areas of historic and modern ground disturbances at Picatinny Arsenal.

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Ground disturbance activities during World War II were limited to the construction of a new barracks area (3400 area) as well as some new ordnance facilities in the existing administration area. The World War I munitions training and testing zones were also expanded along the west and east ridges during this period. Modern period constructions and improvements to the natural and artificial andscape have continued at the Arsenal from the 1950s to the present. These include new administrative and research/development facilities as well as on-going landscaping and grounds maintenance. The munitions testing and training areas situated along the west ridge continue to be altered by explosive detonations.

Sections of the Arsenal believed to contain somewhat minor ground disturbances are situated along the ridges and terraces to the west and east sides of the largely developed Arsenal valley. These sections have remained largely undeveloped due to their use as troop training areas and ammunition testing zones. Previous disturbance evaluations of these areas suggest that earth-moving activities are probably minimal, except where ammunition testing has resulted in crater-like features as well as an undetermined degree of contamination. Hence, a disturbance evaluation of these restricted areas can only be extrapolated from the extent of intact second-growth vegetation and ground cover visible from the valley area.

Prehistoric Archaeological Resource Base

Known Prehistoric Archaeological Sites

The only known prehistoric archaeological resources within Picatinny Arsenal are those identified during research conducted for the Archaeological Overview. Contacts with Arsenal personnel revealed that several prehistoric artifacts had been collected during farming and construction activities within the Arsenal boundaries. These surface finds have not been reported to the Office of New Jersey Heritage (ONJH) nor the New Jersey State Museum.

Details of these artifact finds are included in the comments section of the Archaeological Overview draft report no. 14 (Klein et al. 1986). Prehistoric artifacts were reportedly collected from a residential garden situated at the back of a dwelling house on Parker Road in 1944. This location in the southern portion of the Arsenal valley is presently occupied by athletic fields. The collection of artifacts from the garden reportedly included a pitted hammerstone and a large Jasper preform. The whereabouts of these artifacts is unknown. An undetermined number of black (possibly chert) projectile points were also reportedly recovered in the fields near Mt. Hope gate on the Whitam Farm circa 1890 to 1900. The farm complex was destroyed in the 1926 powder depot explosion. Other find spots include reports of "arrowheads" found near Building 975, and one projectile point recovered in the vicinity of the old personnel building.

The approximate locations of these four artifact collection areas are shown in Figure 6-2a and 6-2b. Although the existence of these prehistoric cultural resources relies entirely upon second-hand informant documentation, the presence of prehistoric activity within Picatinny Arsenal cannot be discounted.

Potential Prehistoric Archaeological Sites

Background research on the distribution and typology of known prehistoric sites in the Highlands region revealed that this section of New Jersey has not been systematically studied by professional archaeologists. The few prehistoric sites recorded for the Morris County area were collected and identified by avocational archaeologists during the early twentieth century. No information other than

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location and general temporal affiliations are known for these prehistoric sites. Recent archaeological investigations did identify a prehistoric rockshelter (28-MR-220) in the immediate vicinity of Picatinny Arsenal. Low density scatters of chipping debris were also identified along the transmission line near the Arsenal property. These artifactual remains were not designated sites, but attest to the presence of prehistoric groups in the Green Pond River valley.

Although a low frequency of prehistoric occupations have been reported in the Highlands region in general, this is attributed more to an absence of systematic survey work than actual site potential (Chesler, ed. 1982). The wide distribution and documentation of a range of site types and occupations in the nearby Upper Delaware River Valley to the west and Passaic River basin to the east indicate that the Highlands region was most likely included within regional networks of settlement and subsistence systems. The numerous secondary tributary streams and associated lakes and marshes would have provided an attractive environmental setting for natural food resources. The streams and lakes would also have served as local transportation routes between the upper Delaware Valley core area of settlement and coastal estuarine core settlement areas.

The Highlands regions could have functioned as a peripheral-corridor area between the known core areas of prehistoric settlement. The mountain and lakes topography may have been utilized as areas of seasonal resource exploitation throughout the prehistoric period. Archaeological evidence of prehistoric activity at the Arsenal would most likely include rockshelters on the surrounding ridges, and small temporary campsites in the valley section near former wetland areas and natural stream drainages. The valley site locations would most likely have been situated on slightly elevated, moderate to well-drained terraces adjacent to the natural freshwater sources.

The principal restraint to prehistoric archaeological resource potential is the disturbance of natural soils that would have contained the prehistoric depositions. Although the valley portion and large sections of the surrounding ridges have been generally identified as containing moderate to severe ground disturbances, some areas of relatively intact soils may exist. Consequently, the lands encompassed within Picatinny Arsenal have been stratified in terms of low, moderate, or high potential for the recovery of prehistoric cultural remains (Figure 6-3 a,b,c).

Areas of relatively intact sandy soils on nearly level ground in proximity to natural freshwater sources have been assigned a high archaeological sensitivity for prehistoric resources. The presence of reported prehistoric materials at several locations within the Arsenal reinforces the high sensitivity ranking. Moderate sensitivity areas have been assigned in portions of the Arsenal valley and ridges that have been assessed as containing only minimal ground disturbances. These areas also possess favorable environmental features such as moderately well-drained soils and gently sloping land surfaces.

Areas of low sensitivity include all previously identified ground disturbances listed in Table 6-1. Previous disturbances are generally defined as the clearing, stripping, and/or grading/earth-moving of land surfaces in preparation for the erection and/or demolition of buildings, structures, and related features. These activities would have either destroyed or deeply buried prehistoric depositions. Other areas ranked as possessing a low likelihood for recovering prehistoric cultural materials include all water sources (creeks, streams, ponds, wetlands), artificial and natural, where poorly drained soils and/or standing water are present. However, the possibility of submerged prehistoric sites within the artificial bodies of water, including Picatinny Lake and Lake Denmark as well as the reservoirs and basins, cannot be discounted. Some small areas of slightly elevated, sandy soils containing prehistoric deposits may have been inundated by the creation and expansion of these artificial water sources.

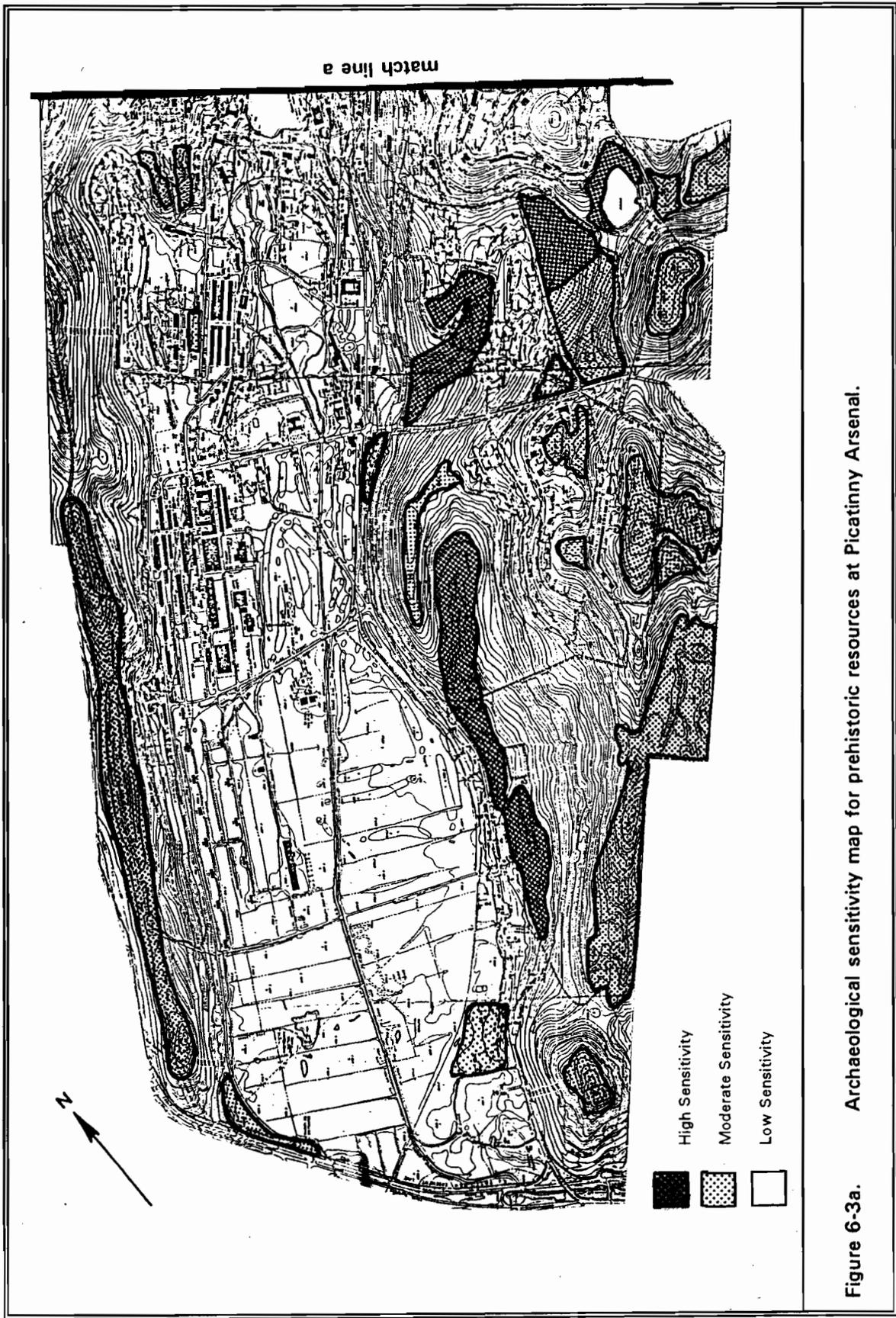


Figure 6-3a. Archaeological sensitivity map for prehistoric resources at Picatinny Arsenal.

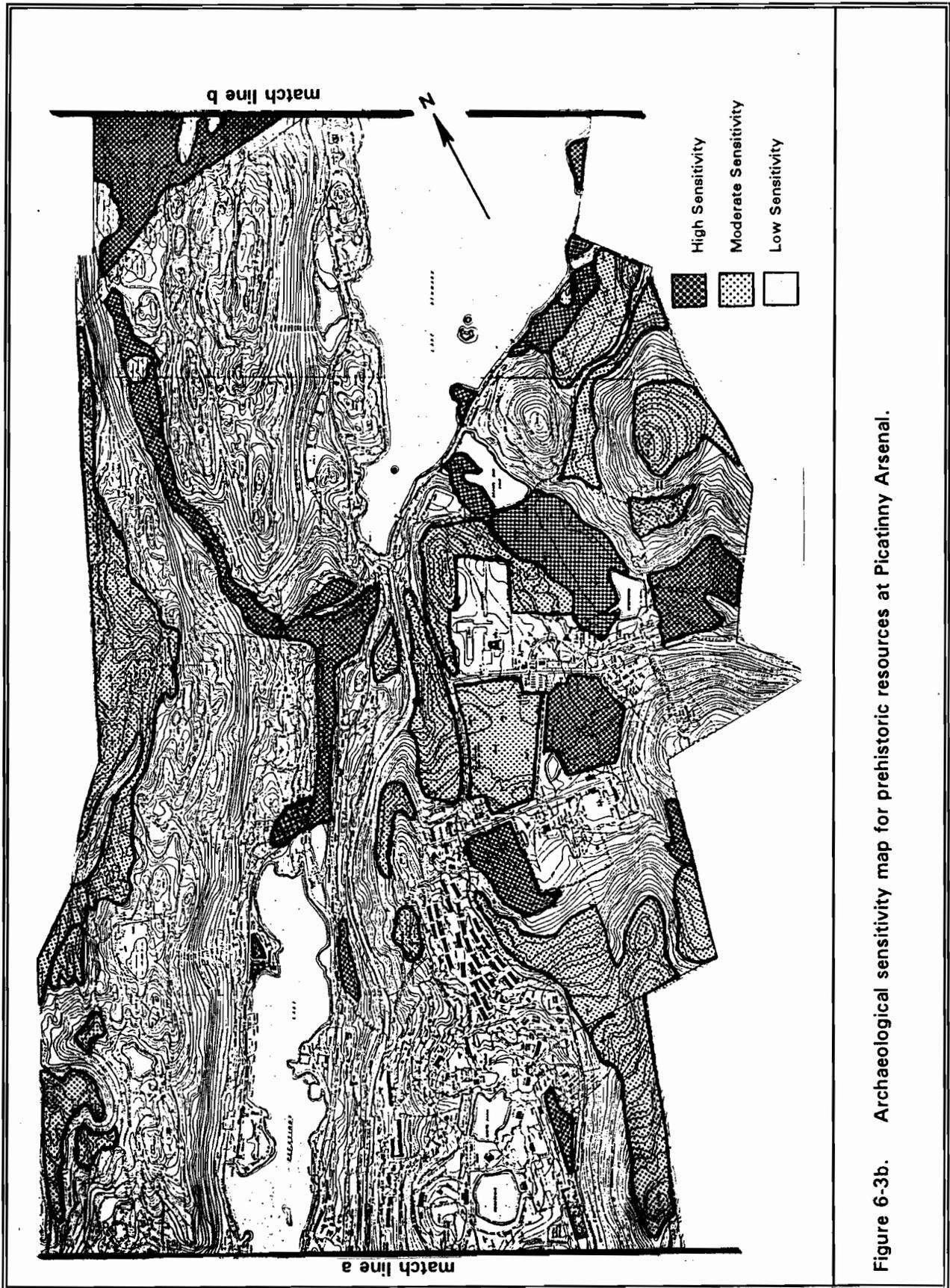


Figure 6-3b. Archaeological sensitivity map for prehistoric resources at Picatinny Arsenal.

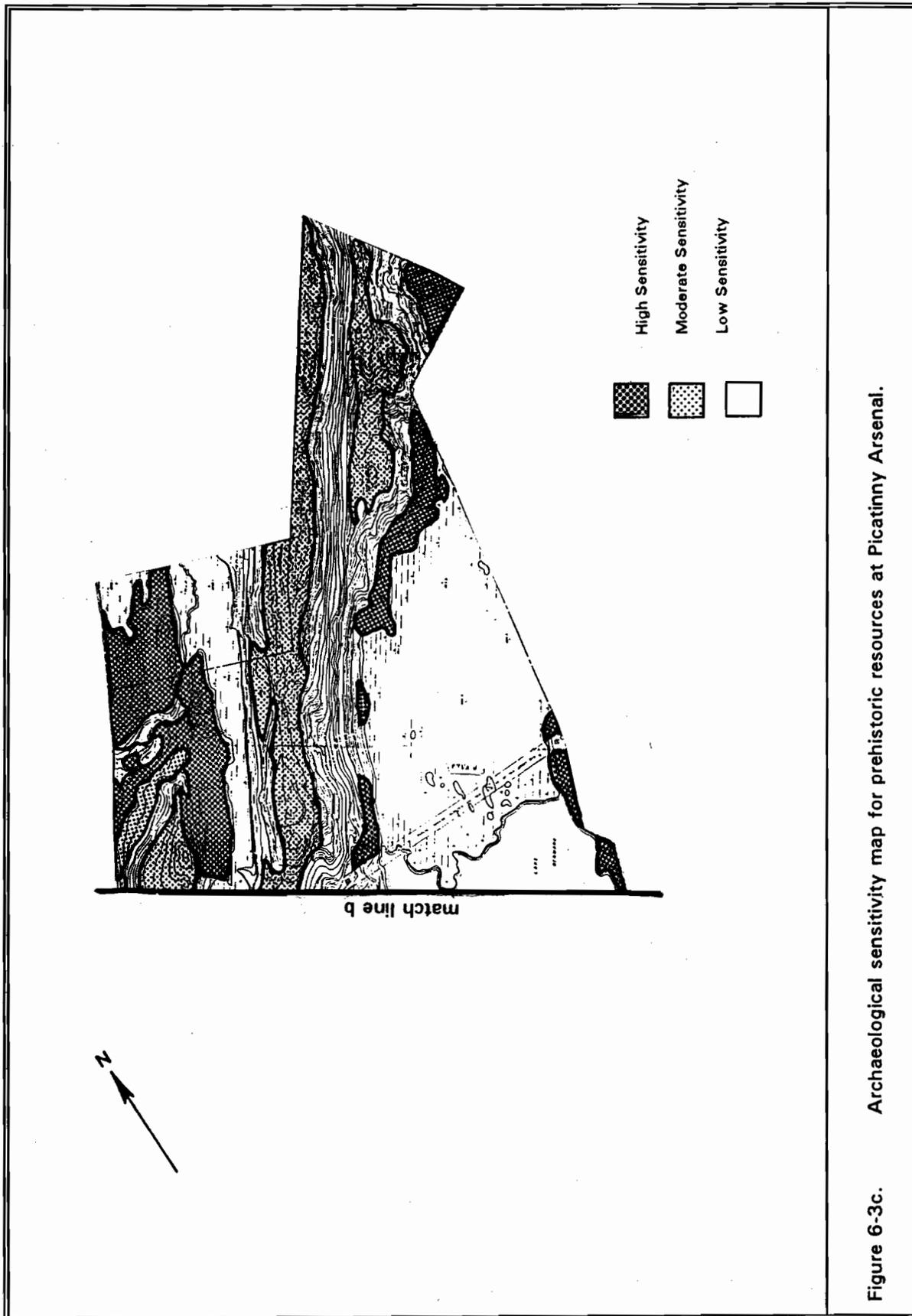


Figure 6-3c. Archaeological sensitivity map for prehistoric resources at Picatinny Arsenal.

Information Gaps

In order to adequately evaluate the potential for the survival of intact prehistoric depositions within those portions of the Arsenal ranked as having moderate and high archaeological sensitivity, specific disturbance information is required. The previous disturbance evaluations (low, moderate, or heavy disturbance) presented in the Archaeological Overview are based primarily on consideration of assigned contemporary land use activities and/or the horizontal extent of contemporary building construction (Klein et al. 1986).

Further background research would include an assessment of all potentially useful data which is catalogued at the Arsenal. These would include an examination of blue print drawings for former and extant buildings, structures, and related features. Information concerning grading descriptions, soil borings, and contour features would also be useful in evaluating the horizontal and vertical extent of ground disturbance.

An assessment of the degree of previous ground disturbance to the areas possessing prehistoric site potential could be completed through preliminary archaeological subsurface testing. The subsurface testing would be designed to identify a sample of the existing soil stratigraphy to determine the extent, if any, of ground disturbances. This field investigation would be critical to an evaluation of the physical integrity of any potential prehistoric resources.

Historic Archaeological Resource Base

Known Historic Archaeological Sites

Seven historic archaeological resource locations have been identified at Picatinny Arsenal (Table 6-2). The locations of the Middle Forge Complex and the Upper Forge Complex are well-documented on historic maps. Actual remains of these two forges, which reportedly functioned from 1749 and 1750 until at least 1868, were documented within the Arsenal at the time of military purchase in 1880. These remains have been referenced in a variety of secondary source historical summaries compiled by Arsenal personnel (Robert Ronschein, personal communication).

Table 6-2. Known Historic Archaeological Resources at Picatinny Arsenal.

Site No.	Description	Affiliation	Reference
A	Middle Forge Complex	1749 to 1870s	Erskine 1777; Hills 1781; Gordon 1828; Lightfoot and Geil 1853; Hopkins 1867; Beers 1868
B	Upper Forge Complex	1750 to 1870s	Erskine 1777; Hills 1781; Gordon 1828; Lightfoot and Geil 1853; Hopkins 1867; Beers 1868

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C	Kitchell Homestead (2 dwellings, 3 support structures)	Late Eighteenth/ Nineteenth Century	Hopkins 1867; Beers 1868; Robinson 1887; Rutsch et al. 1986
D	Blakely Homestead (1 dwelling, 2 outbuildings)	Nineteenth/Early Twentieth Century	Lightfoot and Geil 1853; Hopkins 1867; Beers 1868; Rutsch et al. 1986
E	Palmer Homestead (1 dwelling, 3 support buildings)	Nineteenth/Early Twentieth Century	Lightfoot and Geil 1853; Hopkins 1867; Rutsch et al. 1986
F	Palmer/Elliot Homestead (1 dwelling, 2 outbuildings)	Nineteenth/Early Twentieth Century	Lightfoot and Geil 1853; Hopkins 1867
G	Walton Family Graveyard (Hessian Cemetery?)	Eighteenth? and Twentieth Century	Munsell 1982; Milio et al. 1987

The Middle Forge (Site A), along with its ancillary structures, was situated at the southern end of Picatinny Lake near the location of extant Building 333. The Upper Forge (Site B), along with its ancillary structures, was located at the southern end of Lake Denmark (Anon. 1885). Arsenal-related buildings and features presently cover these two historic site locations (Figure 6-4a,b).

A recent cultural resources survey conducted for the hydroelectric facility and transmission lines in Rockaway township located and identified the remains of several historic homestead sites. Four of these homesteads are situated within the limits of Picatinny Arsenal (see Figure 6-4a,b).

The Kitchell Homestead (Site C) is located on the north and south sides of Lake Denmark Road in the extreme northeast corner of the Arsenal to the east side of Lake Denmark. The homestead site consists of the foundation wall remains (native cut stones and mortar) of two dwelling houses. The remains of three support structures are also included within the site location. These include a probable root cellar, a stone-lined spring, and the stone-lined opening of a possible well shaft. Collapsed field stone walls surround these structural remains to either side of Lake Denmark Road. Limited subsurface testing in the site area recovered a low density of late eighteenth and nineteenth century domestic and structural materials (Rutsch et al. 1986). The homestead structures appear on historic maps dating from the second-half of the nineteenth century.

The foundation remains of three homestead dwellings and associated support structures along Snake Hill Road were also identified within the Arsenal during the 1986 cultural resources survey. The Blakely homestead (Site D) is situated to the south side of Snake Hill Road near the central eastern limit of the Arsenal. The foundation remains of a dwelling house and two outbuildings (possible stables) as well as a pattern of collapsed field stone walls, are included within this site location.

The Palmer Homestead (Site E) is identified as the dwelling house remains located to the immediate west of Site D on the south side of Snake Hill Road. Three support structures including a spring house, privy, and root cellar were also identified within the homestead stone wall enclosure.

The Palmer/Elliot homestead (Site F) lies across from these two site locations to the north side of Snake Hill Road. The foundation wall and cellar hole of a single dwelling surrounded by several field

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stone walls was identified at this location. Historic maps dating from the latter nineteenth century indicate the existence of two outbuildings associated with the dwelling house. Limited subsurface testing conducted within all three site locations recovered historic cultural materials dating from the nineteenth and early twentieth centuries (Rutsch et al. 1986). All three homesteads appear on the nineteenth century maps.

The archaeological remains of these three homestead sites have been designated as forming the Snake Hill Road Historic Homestead site area (Rutsch et al. 1986). The foundation remains of the dwelling houses and outbuildings (possible stables) and support structures (spring houses, privies, and root cellars) within a pattern of fieldstone walls suggests that barn and yard enclosures separated the site properties. Field lines and farm paths/lanes are also expected to exist in the general site area.

The final known historic resource is the Walton Family Cemetery, dating from the nineteenth century. It was most likely associated with the Walton Farmstead that covered a large parcel of land to the north side of Mount Hope Road. This former farmstead parcel is included within the present Arsenal limits. Although the earliest reference to this farmstead dates from the mid-nineteenth century (Lightfoot and Geil 1953), local oral tradition maintains that the cemetery was in existence at the time of the Revolutionary War (Munsell 1882).

The cemetery is believed to include the graves of some Hessian soldiers captured at the Battle of Trenton and conscripted to work in the Mount Hope Ironworks. This cemetery occupies approximately three acres, and is marked on master plan general site maps of Picatinny Arsenal, within a restricted area north of Farley Avenue (Milio et al. 1987). The Commanding Officer did not permit a visual inspection of the cemetery location during the reconnaissance survey. It may include as few as ten burials or as many as sixty-five graves (Robert Ronsheim, personal communication). The cemetery is inactive, and is completely enclosed by a fence.

Potential Historic Archaeological Sites

The Archaeological Overview identified eighty-five potential historic archaeological sites within the Arsenal from historic maps and secondary source summaries (Klein et al. 1986). An updating and revision of this information, completed as part of the reconnaissance survey, has reduced this number of potential historic sites to sixty-nine (Table 6-3) (Figure 6-5a,b,c). This is due in part to the recent field identification of four of the previously unrecorded site locations (Rutsch et al. 1986). Nine of the previously potentially identifiable sites were also eliminated due to their locations outside the Arsenal boundaries.

The following description has been largely extracted from Section 4.2.1 of the Archaeological Overview (Klein et al. 1986), except for the revised information.

The potential historic archaeological resources include residential, commercial, institutional, and industrial sites that formerly comprised the northwestern portion of Rockaway Township. Forty-eight homestead or farmstead dwellings and their associated support structures have been identified within Picatinny Arsenal from historic maps. The majority of these potential sites date from at least the mid-nineteenth century. These farmsteads and homesteads reflect the general settlement pattern of the dispersed rural farming community. Numerous other support structures such as wells, privies, orchards, gardens, and small outbuildings may also be found within each site location. Mid-nineteenth century maps indicate that homesteads and farmsteads were small and separated from one another by wooded tracts. Farm fields and cleared meadowlands joined by a network of cart paths also characterize the area.

Table 6-3. Potential Historic Archaeological Resources at Picatinny Arsenal.

SITE NO.	DESCRIPTION	OCCUPANT	REFERENCE
1	Sandstone Quarry	None	Robinson 1887
2	Homestead/Farmstead (1 dwelling)	W.E. Wiggins	Lightfoot and Geil 1853; Hopkins 1867
		W. Murdock	Beers 1868
		W. Wiggins	Robinson 1887
3	Dwelling	W.E. Wiggins	Lightfoot and Geil 1853; Hopkins 1867
		W. Murdock	Beers 1868
		W. Wiggins	Robinson 1887
4	Dwelling	Albert Davison	Robinson 1887
5	Dwelling	Albert Davison	Robinson 1887
6	Route 7 of Morris County Railroad	N/A	Robinson 1887
7	Dwelling	Wm. Whitehead	Lightfoot and Geil 1853; Hopkins 1867
		Wm. Whitehead	Beers 1868
8	Dwelling	Whittaycock	Lightfoot and Geil 1853; Hopkins 1867
9	Homestead/Farmstead (1 dwelling, 3 outbuildings)	J. Kindred	Lightfoot and Geil 1853; Hopkins 1867; Beers 1868; Robinson 1887
10	Dwelling	J. Spice	Robinson 1887
11	Homestead/Farmstead	J. Spice	Hopkins 1867; Beers 1868; Robinson 1887
12	Dwelling	None	Robinson 1887
13	Dwelling	None	Robinson 1887
14	Dwelling	L. Spice estate	Robinson 1887
15	Dwelling	L. Spice estate	Robinson 1887
16	Dwelling	L. Spice estate	Robinson 1887
17	Dwelling	Mrs. E. Nichols	Robinson 1887
18	Dwelling	H. Ford estate	Lightfoot and Geil 1853
19	Farmstead Structure	Mrs. Mills	Lightfoot and Geil 1853; Hopkins 1867
		Miss Doland	Beers 1868

SITE NO.	DESCRIPTION	OCCUPANT	REFERENCE
		R. Whiteham	Robinson 1887
20	Farm Structure	Walton	Lightfoot and Geil 1853
		P. Agan	Beers 1868
21	Homestead/Farmstead (3 structures)	S. F. Righter	Lightfoot and Geil 1853; Hopkins 1867
		W.H. Wiggins	Beers 1868
	Headquarters Structures	Arsenal	Robinson 1887
22	Homestead/Farmstead (1 dwelling, 1 outbuilding)	None	Hopkins 1867
		W. Fredericks	Beers 1868
		J. Buckley	Robinson 1887
23	Dwelling	J. Brown	Robinson 1887
24	Dwelling	M. Crow	Robinson 1887
25	Dwelling	J. Buckley	Robinson 1887
26	Dwelling	None	Hopkins 1867
		A. Walton	Beers 1868
27	Homestead/Farmstead (1 dwelling, 1 outbuilding)	S.F. Righter	Lightfoot and Geil 1853; Hopkins 1867
		George A. Righter	Beers 1868
28	Dwelling	None	Hopkins 1867
		None	Beers 1868
29	Homestead/Farmstead (1 dwelling, 1 outbuilding)	S.F. Righter	Lightfoot and Geil 1853; Hopkins 1867
		George A. Righter	Beers 1868
30	Dwelling	S.F. Righter	Lightfoot and Geil 1853; Hopkins 1867
		George A. Righter	Beers 1868
31	Farmstead ? (2 dwellings)	S.F. Righter	Lightfoot and Geil 1853; Hopkins 1867
32	Dwelling	George A. Righter	Hopkins 1867; Beers 1868
33	Dwelling ?	None	Hopkins 1867
34	Dwelling	None	Lightfoot and Geil 1853; Hopkins 1867

SITE NO.	DESCRIPTION	OCCUPANT	REFERENCE
35	Schoolhouse	N/A	Lightfoot and Geil 1853; Hopkins 1867; Beers 1868; Robinson 1887
36	Homestead/Farmstead (2 dwellings, 4 outbuildings)	M. Doland	Lightfoot and Geil 1853; Hopkins 1867; Beers 1868; Robinson 1887
37	Dwelling	C. Tebo	Lightfoot and Geil 1853
38	Quarry Site	N/A	No map -- ca. 1890
39	Dwelling	A. Stickle	Robinson 1887
40	Schoolhouse	N/A	Lightfoot and Geil 1853; Hopkins 1867
41	Farmstead (4 structures)	G.W. Blakely	Lightfoot and Geil 1853; Hopkins 1867
	Mining House (1 structure)	Elliot Co.	Beers 1868; Robinson 1887
42	Homestead/Farmstead (1 dwelling, 1 outbuildings)	None	Hopkins 1867
43	Dwelling	None	Hopkins 1867
44	Dwelling	None	Hopkins 1867
		Mrs. H. Barrens	Beers 1868
		J. Barnes	Robinson 1887
45	Mine	None	Hopkins 1867
	Denmark Mine	None	Beers 1868
46	Homestead/Farmstead (1 dwelling, 1 outbuilding)	E.R. Biddle	Lightfoot and Geil 1853; Hopkins 1867
		E. Feedler	Beers 1868; Robinson 1887
47	Dwelling	S.B. Marsh	Lightfoot and Geil 1853
48	Dwelling	E.R. Biddle	Lightfoot and Geil 1853; Hopkins 1867
		E. Feedler	Beers 1868
		None	Robinson 1887
49	Lake Denmark Hotel	None	Wharton and Northern Railroad 1906
50	Saw Mill	None	Lightfoot and Geil 1853
51	Dwelling	None	Lightfoot and Geil 1853

SITE NO.	DESCRIPTION	OCCUPANT	REFERENCE
		None	Hopkins 1867
		None	Beers 1868
		E. Merrit	Robinson 1887
52	Dwelling	E.R. Biddle	Lightfoot and Geil 1853; Hopkins 1867
53	Saw Mill	L. Bender	Lightfoot and Geil 1853
		None	Hopkins 1867
54	Mines	Winter and Pardee	Robinson 1887
55	Dwelling	None	Robinson 1887
56	Dwelling	None	Robinson 1887
57	Dwelling	Thomas Lynch	Robinson 1887
58	Mill	None	Gordon 1828
59	Mill	None	Gordon 1828
60	18th century Limestone Quarry for Mt. Hope Furnace [location approximate]	None	Rogers 1931
61	18th century Limestone Quarry for Mt. Hope Furnace [location approximate]	None	Rogers 1931
62	19th century forge	Samuel Merrit	Munsell 1882
63	18th century Mt. Pleasant forge [location approximate]	None	Munsell 1882; Boyce 1931
64	Mt. Hope Baptist Church and Cemetery	None	Munsell 1882
65	Mt. Pleasant Station (ca. 1900)	Arsenal	Lowenthal 1981
66	Picatinny Station (ca. 1900)	Arsenal	Lowenthal 1981
67	Factory Station (ca. 1900)	Arsenal	Lowenthal 1981
68	Navy Dept. Station (ca. 1900)	Arsenal	Lowenthal 1981
69	Lake Denmark Station (ca. 1900)	Arsenal	Lowenthal 1981

Institutional structures that would have served the rural community include two schools and the Mt. Hope Baptist Church and cemetery. The Lake Denmark Hotel reflects the use of the Lake Denmark area in the last quarter of the nineteenth century as a summer resort prior to military occupation.

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Local industries operating during the eighteenth and nineteenth centuries in the Green Pond valley also constitute a potential historic archaeological resource category. The eighteenth century Mt. Pleasant Forge Complex is possibly situated at the extreme southeast corner of the Arsenal property. A nineteenth century forge, operated by Samuel Merrit, is also believed to be located near the north end of Lake Picatinny (Munsell 1882). Several mines and quarries associated with the forge operations have been identified along the west and east ridges surrounding the Arsenal valley. These include one nineteenth century sandstone quarry at the extreme southwest corner of the Arsenal, two eighteenth century limestone quarries associated with the Mt. Hope Furnace along the central portion of the west ridge, and one unidentified late nineteenth century quarry site situated at the base of the west ridge between Picatinny Lake and Lake Denmark.

A group of nineteenth century mines appears on historic maps in the extreme northwest corner of the Arsenal. The Denmark Mine is potentially located in proximity to the location of the Upper Forge at the southern extremity of Lake Denmark. Other small-scale industrial sites include two saw mills and two unidentified mills. These structures may have associated tail and head races that would be located along their water sources.

The remaining potential historic archaeological resources are presumably Arsenal-related structures. No description of these sites other than location is presented in the Archaeological Overview (Klein et al. 1986). These include Route 7 of the Morris County Railroad which passes from the southern limit of the Arsenal through Arsenal valley to Lake Denmark. A section of this late nineteenth century railroad bed was identified along the northeast side of Lake Denmark during a recent cultural resources survey (Rutsch et al. 1986). The five stations, dating from the turn-of-the-century, are located along the railroad line that passes through the Arsenal property.

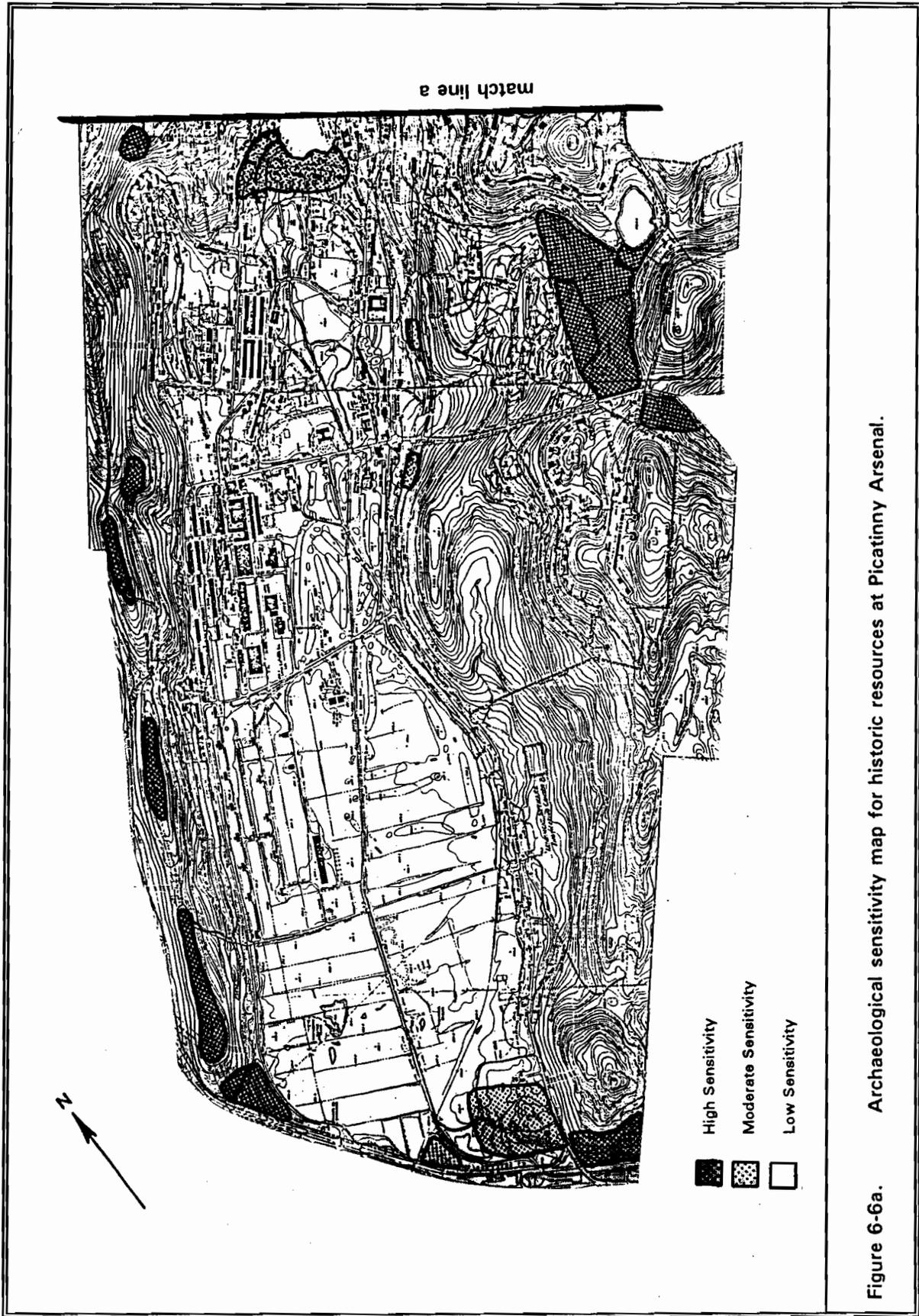
The locations of the potential historic archaeological resources have been ranked as possessing low, moderate, or high sensitivity for survival, depending on the degree of previous ground disturbances (Figure 6-6a,b,c). Some of the potential resources may pre-date their late eighteenth and nineteenth century appearances on historic maps. Background research has determined that the general vicinity of Picatinny Arsenal was settled during the second-half of the seventeenth century. Early historic period (1660 to 1750) archaeological resources not documented on historic maps may also be situated along cart path and stream edges within the Arsenal property.

Information Gaps

The extant data base concerning known and potential historic archaeological resources for Picatinny Arsenal is based on a synthesis of previous evaluated information (Klein et al. 1986) and on updating/revisions conducted as part of this reconnaissance survey. Overall, the information concerning historic resource potential has allowed an evaluation of the likelihood for encountering historic sites within the Arsenal. General descriptions and distributions of these potential historic resources have been provided.

Gaps in the documentary research include specific information concerning construction and demolition dates of the historic structures identified from maps as well as chain of ownership and function. This information could be obtained from property deeds, probate inventories, and oral traditions. These documentary sources could also be used to determine the likelihood for locating associated features (wells, privies, outbuildings, etc.) as well as early historic and other archaeological resources not presently documented.

The degree of prior ground disturbances (horizontal and vertical extent) at the Arsenal also needs to be further refined. This could be conducted through additional documentary research related to



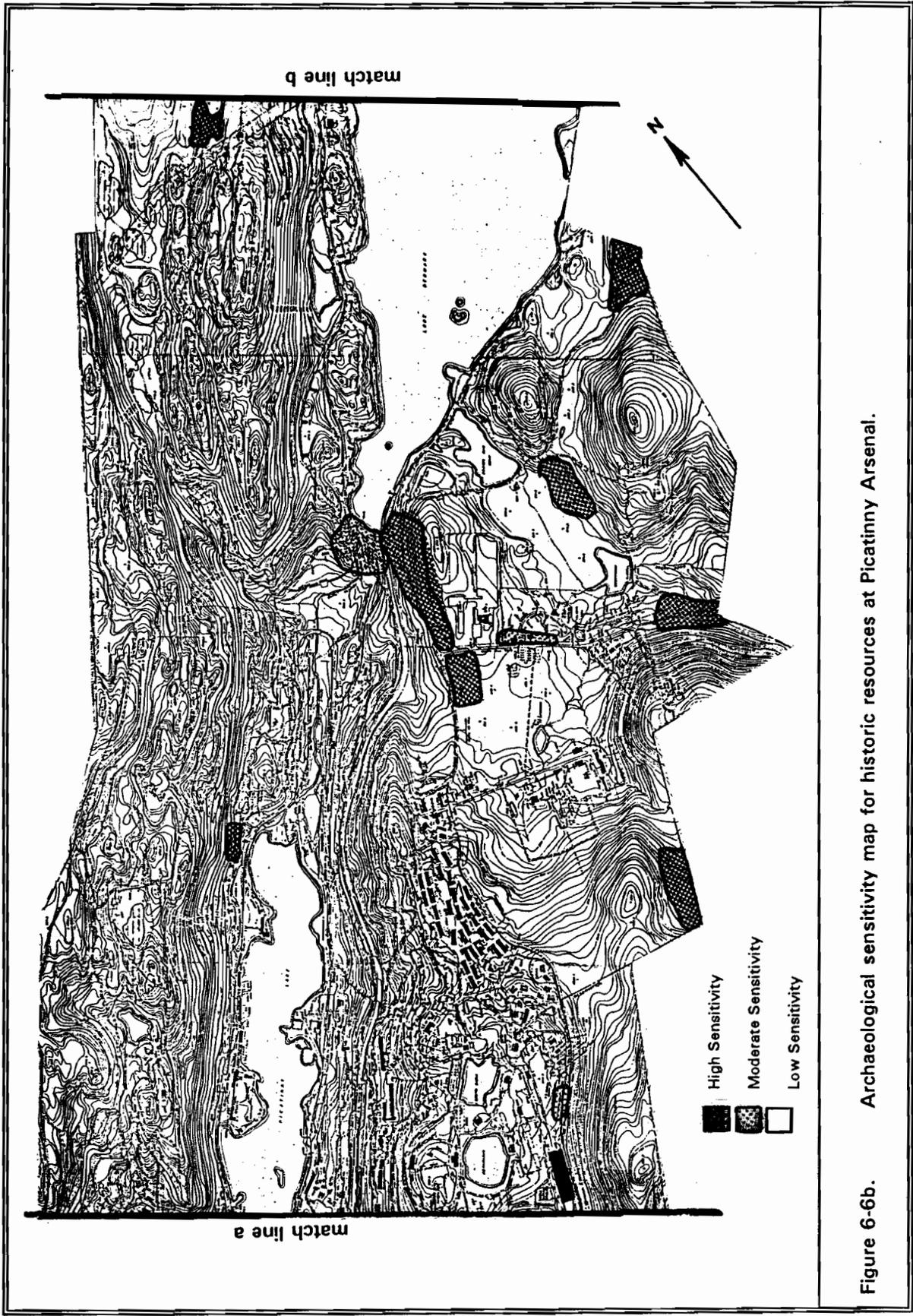


Figure 6-6b. Archaeological sensitivity map for historic resources at Picatinny Arsenal.

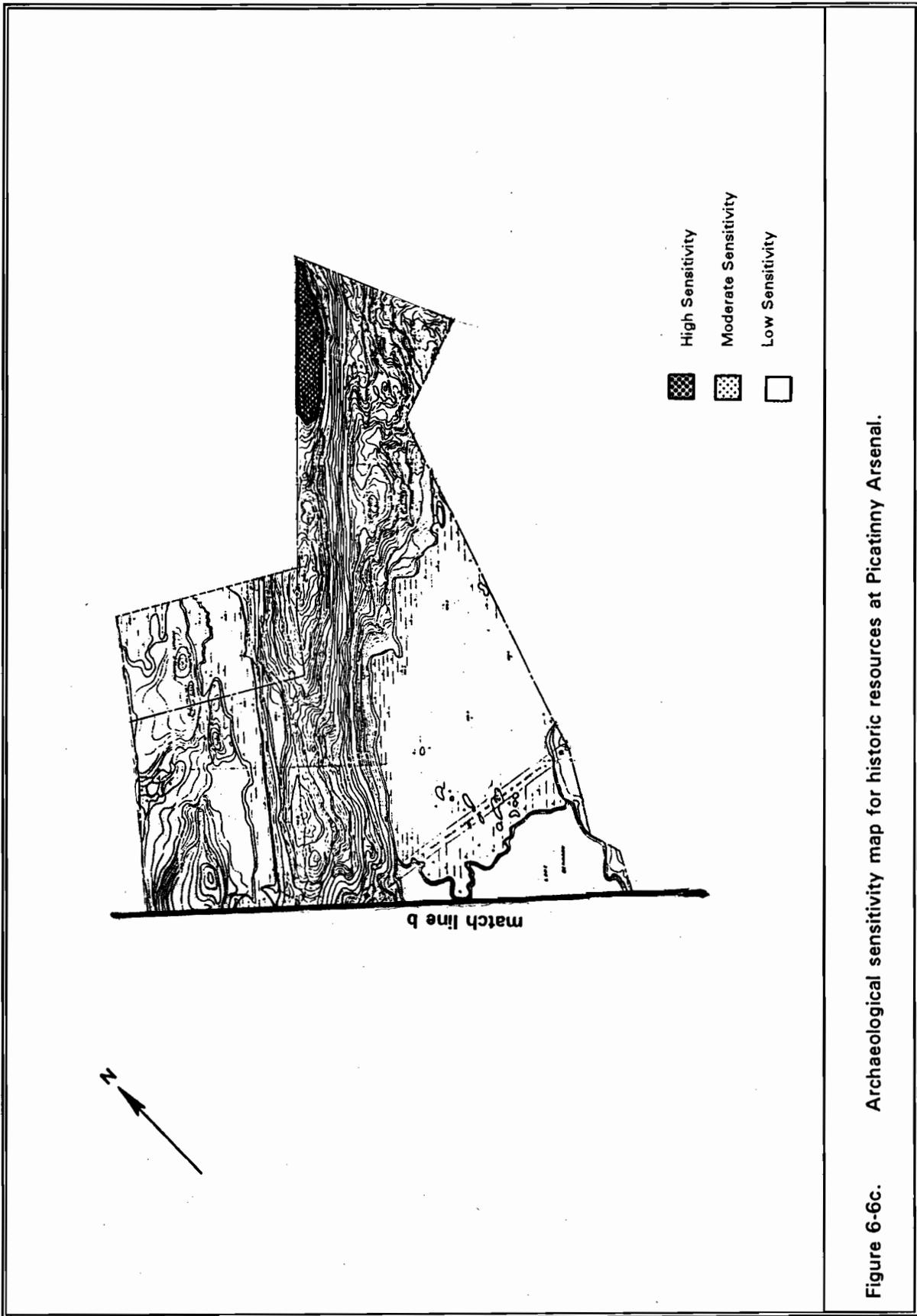


Figure 6-6c. Archaeological sensitivity map for historic resources at Picatinny Arsenal.

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specific buildings (earth-moving specifications, soil borings, etc.) and through preliminary archaeological subsurface testing. This is an important consideration that is directly related to the physical integrity and subsequent potential significance of the resources.

Historic Buildings/Structures, and Related Features Resource Base

Previously Evaluated Buildings

National Register Properties

A draft Picatinny Arsenal Multiple Resources Area National Register of Historic Places (NRHP) Nomination Form has been prepared and submitted to the United States Army and to the Office of New Jersey Heritage, Trenton, New Jersey. The Multiple Resources Area (MRA) coincides with the current boundaries of Picatinny Arsenal. It includes six districts and three individual properties constructed before 1945 and significant in the areas of military history, industry, and the history of Picatinny Arsenal from 1880 to the early 1940s. A summary of the NRHP evaluation criteria appears in Table 6-4. The proposed districts are listed below, and approximate boundaries are shown in Figure 6-7a,b. No information was obtained regarding the three individual buildings cited in the draft nomination.

Picatinny MRA Districts

- Picatinny Complete Rounds/Melt Loading Historic District (800 Area; approximately 17 acres; 4 major buildings)
- Picatinny Shell Components Loading Historic District (200 Area; approximately 70 acres; approximately 75 structures)
- Picatinny Test Area Historic District (400 Area; approximately 15 acres; 20 buildings)
- Picatinny Powder Factory and Power House Historic District (500 Area; approximately 65 acres; approximately 60 structures)
- Original Picatinny Historic District (Approximately 170 acres)

No buildings at Picatinny Arsenal are currently listed in the NRHP or the State Register.

Category I, II and III Properties

An evaluation of the Picatinny Arsenal buildings within U.S. Army Historic Property Evaluation Categories was conducted by the National Park Service for the U.S. Army in 1985 (HABS/HAER 1985). The designations assigned during that study are included in Table 6-5. A summary of category criteria appears in Table 6-4. For treatment of category designated properties, refer to Army Technical Manual 5-801-1, Section 7.

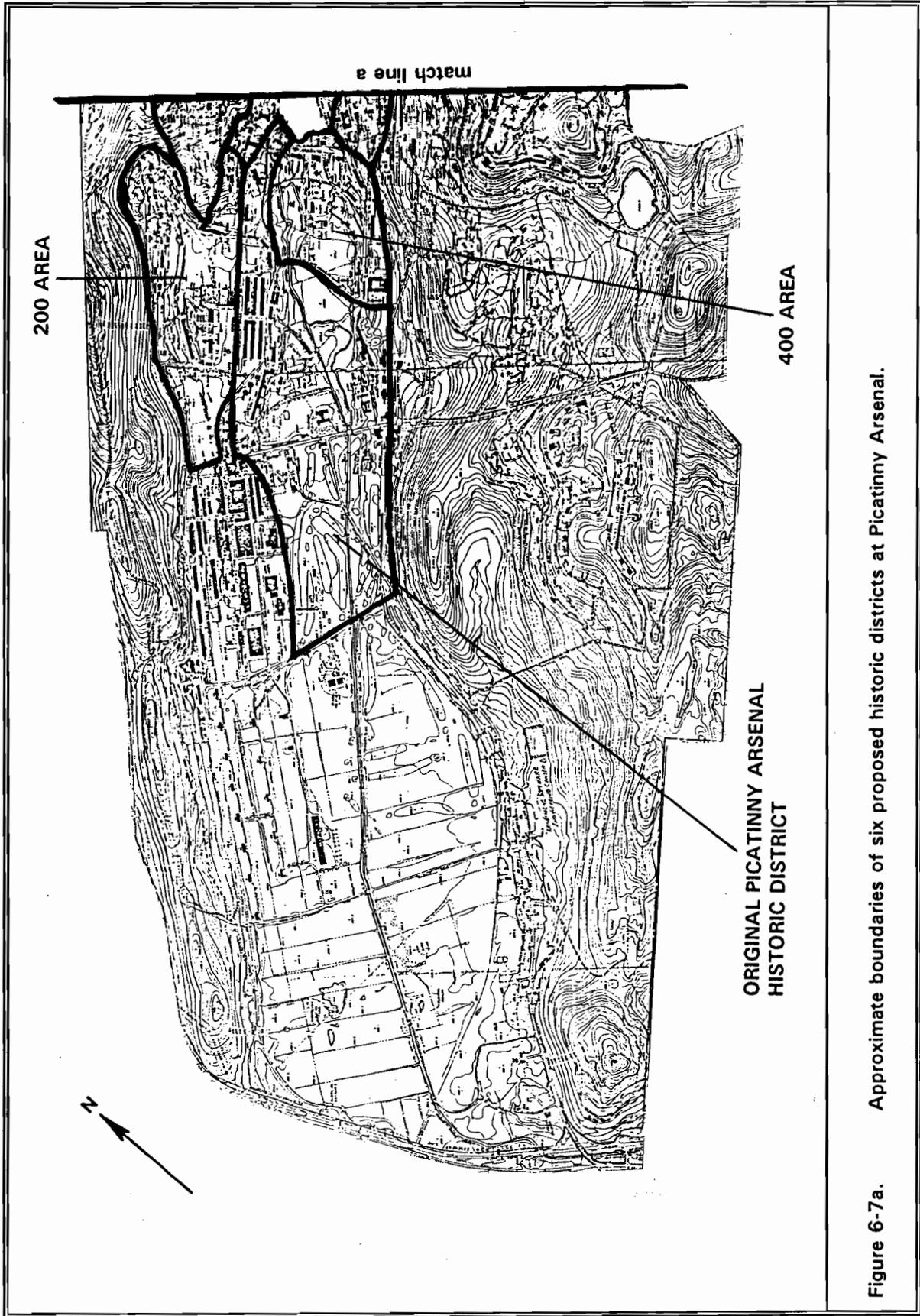


Figure 6-7a. Approximate boundaries of six proposed historic districts at Picatinny Arsenal.

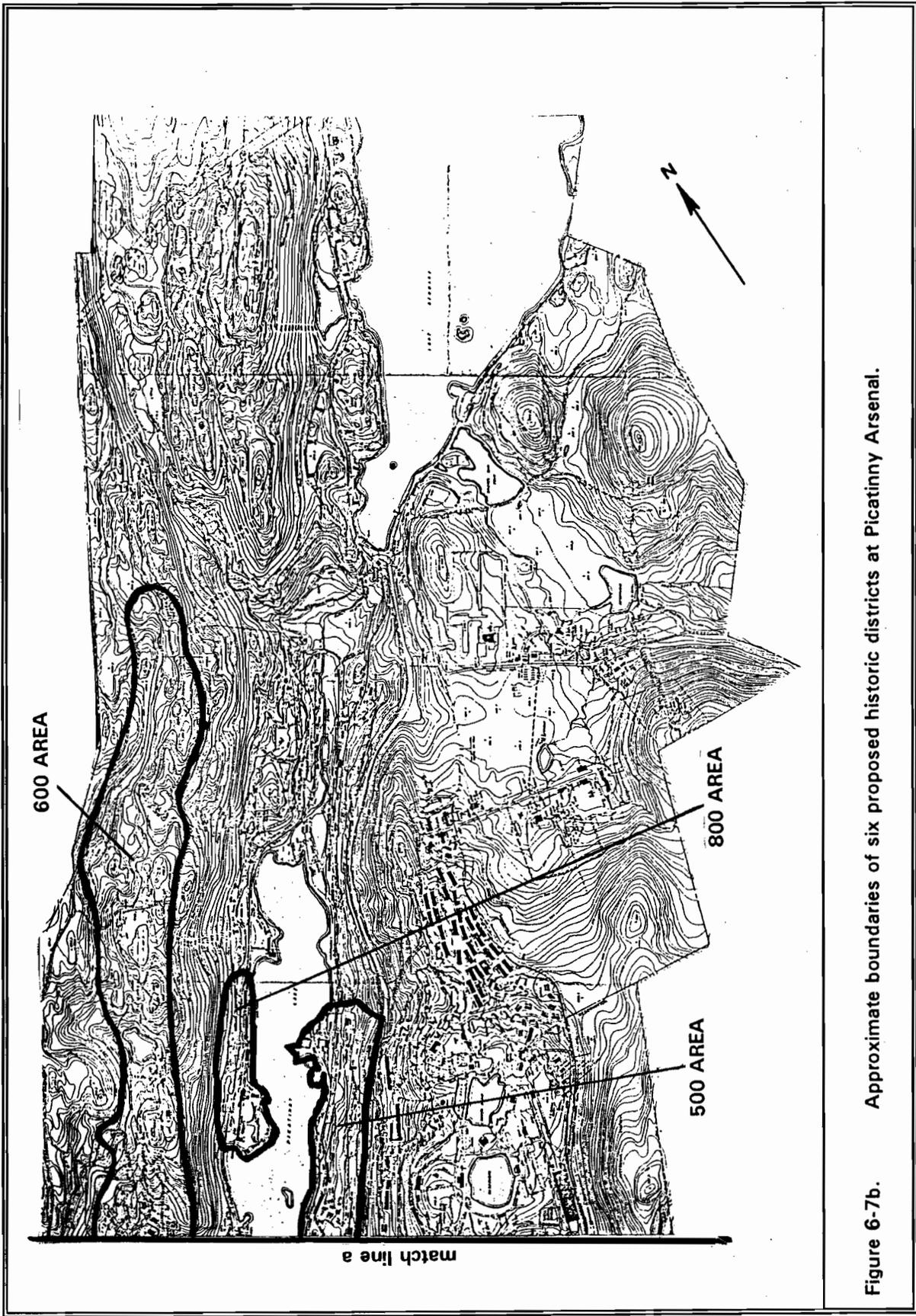


Figure 6-7b. Approximate boundaries of six proposed historic districts at Picatinny Arsenal.

Table 6-4: Summary of National Register of Historic Places and U.S. Army Historic Property Evaluation Criteria.

National Register	
Properties are at least 50 years old, possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:	
A.	Are associated with events that have made a significant contribution to the broad patterns of our history;
B.	Are associated with the lives of persons significant in the nation's past;
C.	Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction;
D.	Have yielded, or may be likely to yield, information important in pre-history or history.
U.S. Army	
Category I	Properties of major importance.
Category II	Properties of importance.
Category III	Properties of minor importance.
Category IV	Properties of little or no importance at this
Category V	Properties detrimental to the significance of adjacent historic properties.

Table 6-5. Category I, II, and III Buildings, Picatinny Arsenal, Arranged by Area.

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
BUILDINGS 1-99		
Category III Properties		
2	Museum (Storage)	1918
3	Administration General Purpose	1918
4	Electrical Equipment Facility	1918
5	Operations General Purpose	1918
17	Flammable Materials Storehouse	1918
18	Laboratory General Purpose (Flammable Materials Storehouse)	1918
	Electrical Equipment (Flammable Materials Storehouse)	1918
20	Administration Building, Research and Development (Flammable Materials Storehouse)	1918
21	General Instrumentation Building (Flammable Materials Storehouse)	1918
22	Precision Machine Shop	1918
30	General Purpose Warehouse (Storehouse)	1918
33	Motor Repair Shop	1933
36	General Purpose Warehouse	1918
39	Facility Engineering Maintenance Shop (Storage)	1918
40	General Purpose Warehouse	1918
41	General Purpose Warehouse	1918
45	General Purpose Warehouse	1918
Subtotal (II)		17
BUILDINGS 100-149		
Category II Properties		
110	BCQ Military, Male (Superintendent's House)	1882
112	Family Housing, Gen.	1909
113	Family Housing, Gen.	1909

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
114	Family Housing, Col. (Commanding Officer's Quarters)	1884
---	Cannon Gates	1885
Subtotal (II)		5
Category III Properties		
105	Family Housing, Lt. Col., Major (Officer's Quarter's)	1880
106	Family Housing, Col. (Officer's Quarter's)	1899
108	Family Housing, Lt. Col., Major (Officer's Quarter's)	1884/1936
115	Family Housing, Col. (Officer's Quarter's/School/Firehouse)	1884
117	Family Housing, Lt. Col., Major (Stables/Transient/Officer's Quarters)	1889/1937
119	Family Housing, Lt. Col., Major (Officer's Quarters/Fill Plant/Hospital)	1887/1936
120	Civilian Personnel Building (Enlisted Men's Quarters)	1918
Subtotal (III)		12
BUILDINGS 150-199		
Category III Properties		
151	Post Headquarters Building (former)	1929
162	Applied Instruction Building (Physics/Chemical Laboratory)	1942
163	Signal Photo Laboratory (High Explosives Research Laboratory)	1930
164	Laboratory, General Purpose (Chemical Stability Laboratory)	1930
164	Laboratory, General Purpose (Test Conditioning Chamber)	1930
167	Chemistry Laboratory (High Explosives Prep. & Test Laboratory)	1930
168	Laboratory, General Purpose (Test Conditioning Chamber/Experimental Prop. Sur. Magazine)	1930

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
171	Administration, Research and Development (Foundation of Original Magazine No. 20)	1948
176	Administration, General Purpose (Plastics Laboratory)	1944
178	Physics Laboratory (Service Magazine)	1938
183	Other (Metals Test Laboratory/Steam Flow Meter House)	1945
197	Laboratory, General Purpose (Laboratory and Test Building)	1942
Subtotal (III)		12
200 AREA BUILDINGS		
Category II Properties		
213	Ordnance Facility (Fuze Testing & Loading)	1916
230	Ordnance Facility (Primer & Detonator Loading)	1918
232	Ordnance Facility (Detonator Loading)	1918
235	Ordnance Facility (Mercury Fulminate Mixing)	1918
252	Operating (Press Loading)	1918
256	Ordnance Facility (No. 6 Powder Magazine/Booster & Fuse Loading Bldg.)	1889
266	Laboratory General Purpose (Original Magazine for HE "A" Pump & Change House)	1903
276	Major Caliber Projectile Loading (Original No. 6 Powder Magazine, Melt Loading)	1902
Subtotal (II)		8
Category III Properties		
221	Ordnance Facility (Cast High Explosives Fill Plant)	1941
230-G	General Storehouse (Air-Conditioning)	1944
232-C	Air-Conditioning Plant	1943
241	Operating (Demilling & Disassembly)	1942

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
241-E	Storage	1918
252-C	Magazine (Ammonium Picrate Screening)	1920
267	Ordnance Facility	1941
268	Operating (Primary Explosives)	1941
269	Operating (Artillery Primer Loading)	1941
271	Ordnance Facility (Original Magazine for HE "B" Fuze Assembly Plant)	1905
271-C	Ready Magazine	1921
271-D	Ordnance Facility (Air-Compressor House)	1920
271-H	Major Caliber Projectile Loading (Operating)	1942
271-I	Ordnance Facility (Primer Mixture Mixture Preparing Room)	1941
271-J	Ordnance Facility (Dry House)	1941
271-K	Ordnance Facility (Fan House)	1941
271-L	Ordnance Facility (Lead Azide Powder Dry House)	1941
271-O	General Purpose Magazine	1918
271-P	General Purpose Magazine	1918
276-D	General Storehouse	1920
281	Ordnance Facility (Pelleting/Office/Change House/Tool Room)	1941
295	Major Caliber Projectile Loading (Lead Azide and Primer Mixture)	1941
296	Other (Pelleting for Pyroteching Explosives)	1941
Subtotal (III)		23
300 AREA BUILDINGS		
Category II Properties		
315	Post Engineering Maintenance (Original Storehouse for Sodium Nitrate)	1907/8
316	Metallurgy Laboratory (Foundry/Original Storehouse for Sodium Nitrate)	1907/8

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
318	Metallurgy Laboratory (Records Holding Office/Original Storehouse for Sodium Nitrate)	1907
321	Ordnance Facility (Original Storehouse for Fuzed Projectile "O")	1902
322	Metallurgy Laboratory (Foundry/87 mm Loading Plant/Original Storehouse for Sodium Nitrate)	1906
323	Laboratory, General Purpose (Original Storehouse for Sodium Nitrate)	1906-8
Subtotal (11)		6
Category III Properties		
302	Facility Engineering Maintenance Shop (Site of Original Magazine for Sodium Nitrate)	1905
305	Facility Engineering Storehouse (Post Engineering Maintenance)	1880
307	Facility Engineering Maintenance (Original Powder Magazine)	1880
319	Administration, General Purpose (Original Storehouse for Sodium Nitrate)	1906
324	General Storehouse (Original Storehouse for Sodium Nitrate)	1905
326	Facility Engineering Maintenance Shop (Shell Sandblasting)	1918
329	Propellant System Facility (Loading Plant/Original Storehouse for Sodium Nitrate)	1918
333	Human Engineering (Power House)	1902
350	Laboratory, General Purpose (Storage)	1938
351	Physics Laboratory/Engineering Administration Building (Storage)	1938
319	Physics Laboratory/General Purpose Laboratory (Storage)	1938
354	Engineering Administration Building (Engineering Research and Development/Storage)	1940
355	Administration Building Research and Development (Engineering Research and Development/Storage)	1940
Subtotal (III)		13

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
400 AREA BUILDINGS		
Category I Properties		
445	Physic Laboratory (Bag Loading)	1930
452	Vacant (Bag Loading - Igniters)	1942
454	Ordnance Facility (Bag Charge Filling O Horwitzer Charges)	1930
Subtotal (I)		3
Category II Properties		
403	Woodworking, Packaging & Testing Lab (Storehouse for S. Nitrate)	1906
404	Thermo Chemical Lab (Storehouse for S. Nitrate)	1906
405	Laboratory-General Purpose (Chemistry Laboratory)	1920
408	General Purpose (Nitrating Building)	1920
448	Ordnance Facility (Howitzer & Aliquot Bag Loading)	1930
462	Chemistry Lab (Tracer Loading Building)	1942
477	Ordnance Facility (Non-Gaseous Projectile Loading)	1945
Subtotal (II)		7
Category III Properties		
408-D	Dry House	1920
424	Ordnance Facility (Combustible Cartridge Case Factory/Nitration Building)	1904
424-C	High Explosives Magazine (Nitro Separation)	1941
424-D	High Explosives Magazine	1924
424-E	Mix House	1943
427	Experimental Propellants Plant	1938
427-B	Dry House	1939
427-C	General Storehouse	1921

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
430	Propellant Systems Facility (Laboratory-Propulsion System)	1922
435	Ordnance Facility (Pulverizing)	1918
437	General Purpose Magazine	1918
445-A	Igloo Storage	1918
445-D	Inert Storage	1930
445-E	Other (Storage)	1930
455	Engineering Admin. Bldg. (Cloth Storage, Dyeing, Cutting & Sewing/Original Magazine)	1930
456	Engineer Adm. Bldg. (Field Office)	1930
427	Ordnance Facility (Blender & Mixer)	1941
Subtotal (III)		17
500 AREA BUILDINGS		
Category I Properties		
520	(?) Demolished <input type="checkbox"/> (Poaching House) <input type="checkbox"/>	1943
527	Vacant (Powder Factory)	1929
539	Vacant (Small Arms Powder Blender)	
561	(?) Demolished <input type="checkbox"/> (Cannon Powder Blender)	1931
Subtotal (I)		4
Now (1989)		2
Category II Properties		
511	Propellant Plant (Nitrating House)	1918
514	Laboratory Gen. Purpose (Boiling Tub House)	1930
519	Ordnance Facility (Ether & Alcohol Recovery House)	1908

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
533	Ordnance Facility (Solvent Recovery)	1941
534	Ordnance Facility (Solvent Recovery)	1930
538	General Storage (Graphiting & Sorting House)	1930
541	Propellant Plant (Water Dry House)	1943
545	Propellant Plant (Packer & Box Testing House)	1928
553	Flammable Material Storehouse (Ether & Alcohol & Mixed Solvent Tanks-11)	1942
554	Propellant Plant (Rework Powder Grinding House, Pulverizing, Water Dry House)	1930
555	Ordnance Facility (Continuous Dry House)	1930
565	Pack House	1931
Subtotal (II)		12
Category III Properties		
506	Electric Power Plant	1907/1956
507	RR Engineering Shop (Locomotive House/Round House)	1929
509	Inert Storage (Cotton Storage Building)	1930
510	General Storehouse (Cotton Picker & Dry House)	1930
519-A	Storage Shed (Ether & Alcohol Storage Tanks (3))	1941
520-B	Propellant Plant (Rest House)	1922
521	Propellant Plant (Ether Vault)	1909
523	Ordnance Facility (Solvent Recovery)	1938
525	Electrical Equipment (Office & Charge House)	1930
525-A	Chemical Laboratory (Acid Laboratory)	1930

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
535	Propellant Plant (Recovered Solvent Storage)	1910
537	General Storage (Dry House)	1918
542	Propellant Plant (Dry House)	1942
542-B	Other (Change House)	1930
550	General Storehouse	1918
550-A	Air Raid Shelter	1921
556	Propellant Plant (Small Arms Powder Dry House)	1930
556-B	Propellant Plant (Fan House, Control Room)	1944
561-A	Propellant Plant (Fireproof Shelter)	1931
Subtotal (III)		19
600 AREA BUILDINGS		
Category I Properties		
602	Ordnance Facility (Powder Blender)	1935
604-D	Ordnance Facility (Drop Tower)	1928
607	Ordnance Facility (Fragmentation)	1941
621	Ordnance Facility (Fragmentation)	1942
Subtotal (II)		4
Category II Properties		
603	Ordnance Facility (Dry House)	1941
603	Ordnance Facility (Environmental Testing)	1928
604-B	Ordnance Facility (Detonating Chamber)	1931
604-C	Ordnance Facility (Sectioning)	1928

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
604-E	Ordnance Facility (Wind Tunnel)	1942
604-F	Ordnance Facility (Bull Pen)	1928
605	Ordnance Facility (Screening Building)	1924
607-A	Ordnance Facility (Control Room)	1938
611-B	Ordnance Facility (Gas Gun Test Tunnel)	1929
613	Ordnance Facility (Dry House)	1928
617	Administration-R&D (Office)	1928
617-F	Magazine-Fuze & Detonator	1928
620	Ordnance Facility (Test Range)	1928
620-B	Ordnance Facility (Test Range)	1928
620-C	Ordnance Facility (Test Range)	1943
634	Ordnance Facility (Slug Butt)	1930
636-A	Flammable Material Storehouse	1930
Subtotal (III)		17
700 AREA BUILDINGS		
Category III Properties		
717-A	Ordnance Facility (Major Caliber Projectile Loading Plant)	1939
717-D	Chemistry Laboratory (Magazine)	1928
722	Physics Laboratory (Office & Testing Laboratory)	1920
732	Ordnance Facility (Pyrotechnic Pelleting/Receiving, Packing & Shipping)	1938
735	Ordnance Facility (Pyrotechnic Production Unit)	1943

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
Subtotal (III)		5
800 AREA BUILDINGS		
Category II Properties		
807	Ordnance Facility (Receiving, Cleaning, Inspection)	1930
810	Ordnance Facility (Loading & Cooling Plant)	1930/1945
813	Ordnance Facility (Drilling & Assembly Plant)	1930/1945
816	Ordnance Facility (Assembly)	1930
820	Ordnance Facility (Packing & Shipping)	1930
824	Ordnance Facility (TNT Screening)	1930
Subtotal (II)		6
Category III Properties		
802	General Storehouse (High Explosives Recovery)	1925
806	Other (Bombproof Shelter & Charge House)	1930
810-A	Vacuum Pump (Wash-Out Recovery)	1944
816-B	Ordnance Facility (Magazine/Compressor House)	1941
823	General Purpose Magazine (Ammonium Nitrate Service)	1930
Subtotal (III)		5
900 AREA BUILDINGS		
Category III Properties		
904	General Purpose Magazine	1918
905	"	1927
906	"	1918
907	"	"

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
908	"	"
909	"	"
911	"	"
914	"	"
915	"	"
916	"	"
917	"	"
918	"	"
919	"	"
920	"	"
921	"	"
922	"	"
926	"	1922
928	"	1918
929	"	"
930	"	"
931	"	"
932	"	"
933	"	"
936	"	"
937	"	"
938	"	"
939	"	"
940	"	"
941	"	"
942	"	"
943	"	"
944	"	"
945	"	"
946	"	"
948	"	"
949	"	"

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
950	"	"
951	"	"
952	"	"
953	"	"
Subtotal (III)		42

1000 AREA BUILDINGS

Category II Properties

1055	Other (Experimental Tetryl Crystallization Plant)	1931
1071	Ordnance Facility (Crystallization Building)	1942
Subtotal (II)		2

Category III Properties

1053	Other (Office & Change House)	1931
1071-G	Ordnance Facility (Dry House)	1941
1094	General Storehouse (Screening & Pulverizing)	1942
Subtotal (III)		3

1200 AREA BUILDINGS

Category III Properties

1217	General Purpose Magazine/Propellant Plant	1944
Subtotal (III)		1

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
1363	Ordnance Facility (Neutralizing)	1945
1363-A	Ordnance Facility (Slum House)	1945

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
950	"	"
951	"	"
952	"	"
953	"	"
Subtotal (III)		42
1000 AREA BUILDINGS		
Category II Properties		
1055	Other (Experimental Tetryl Crystallization Plant)	1931
1071	Ordnance Facility (Crystallization Building)	1942
Subtotal (II)		2
Category III Properties		
1053	Other (Office & Change House)	1931
1071-G	Ordnance Facility (Dry House)	1941
1094	General Storehouse (Screening & Pulverizing)	1942
Subtotal (III)		3
1200 AREA BUILDINGS		
Category III Properties		
1217	General Purpose Magazine/Propellant Plant	1944
Subtotal (III)		1
1300 AREA BUILDINGS		
Category II Properties		
1301	Ordnance Facility (Mortar Powder Building)	1945
Subtotal (II)		1
Category III Properties		
1352	Ordnance Facility (Blending, Nitroglycerine)	1945

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
1363	Ordnance Facility (Neutralizing)	1945
1363-A	Ordnance Facility (Slum House)	1945
1365	Flammable Materials Storehouse (Spent Acid House)	1945
1381	Reservoir	1904
1382	Reservoir	1906
Subtotal (III)		6
1400 AREA BUILDINGS		
Category III Properties		
1418	Ordnance Facility (Storage & Shipping Building)	1942
Subtotal (III)		1
1600 AREA BUILDINGS		
Category III Properties		
1604	Processing, Pyrotechnics Assembly Plant	1942
1609	Physics Laboratory (Machine Shop)	1942
1616	Ordnance Facility (Preparation of Pyrotechnics)	1942
1619	Laboratory-General Purpose (Radiographic Laboratory)	1942
Subtotal (III)		4
LAKE DENMARK POWDER DEPOT AREA		
Category II Properties		
3013	Boiler House, Heating Plant	1905
3250	Family Housing, General, Colonel	1890
3316	Fire Station	1903
3618	Propellant Systems Facility (Test Cell 1-E)	1953
Subtotal (II)		4

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
Category III Properties		
3002	Engineering Administration Building (Storage)	1934
3008	Administration, General Purpose (Engineering Administration/General Instruction Building/Displayed Orientation)	No date
3010	Ordnance Administration Building	1902/1950
3018	Igloo Storage	1918
3022	Physics Laboratory, General Purpose Warehouse, Engineering Administration Building	1928/1981
3028	Chemistry Laboratory (Storage)	1918
3030	Igloo Storage	1918
3032	"	1918
3033	"	"
3035	"	"
3036	"	"
3038	"	"
3039	"	"
3041	"	"
3042	"	"
3045	"	"
3047	"	"
3049	Flammable Materials Storehouse	1918
3050	Enlisted Men's Barracks	1934
3100	Ordnance Facility	1942
3109	Ordnance Facility (Environmental Conditioning)	1943
3119	Family Housing, Lt. Col., Major	1785
3124	Administration, Research and Development	1918
3128	Flammable Materials Storehouse	1929
3137	Flammable Materials Storehouse	1934
3140	Facilities Engineer Storehouse (Magazine)	1934
3155	General Purpose Warehouse (Magazine)	1929

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
3157	Pump House	1898
3159	Administration Building, Research and Development (Laboratory/Storage)	1930
3164	Igloo Storage	1918
3166	General Purpose Warehouse (Storage)	1929
3172	Igloo Storage	1918
3173	Laboratory, General Purpose Applied Instruction Building/Carpenter's Shop	1902
3175	Open Storage Area (Coal Bin)	1901
3176	Precision Machine Shop (Applied Instruction Building/Ordnance Facility/Storage)	1902
3177	Electrical Equipment Facility (Applied Instruction Building/Ordnance Facility/Storage)	1914
3178	Flammable Materials Storehouse (Paint Locker)	1905
3180	Igloo Storage	1918
3203	General Purpose Warehouse	1930
3208	Electrical Equipment Facility (Transmitter Building/General Purpose Warehouse)	1929
3211	General Purpose Warehouse	1929
3221	Chapel (Blacksmith's Shop)	1911
3228	Theater/Open Mess	1932
3234	Igloo Storage	1918
3236	Flammable Materials Storehouse	1930
3239	General Storehouse (Pump House)	1905
3242	General Purpose Warehouse	1919
3252	General Storehouse (Tool House)	1918
3300	Igloo Storage	1918
3303	Igloo Storage	1918
3617	Propellant Systems Facility (Control House)	1953
Subtotal (III)		51

BUILDING #	BUILDING USE (HISTORIC USE)	CONSTRUCTION DATE
TOTAL (I)		7 (5)
TOTAL (II)		55
TOTAL (III)		248

(Sources: HABS/HAER 1985; Building Information Schedule for Picatinny Arsenal, 12/31/88)

It should be noted that these category designations are generally intended to be applicable for five to ten years, at which time properties should be re-evaluated (HABS/HAER 1985:10). The field survey component of the HABS/HAER study occurred in 1982. In the course of this reconnaissance survey, conducted seven years following the original assessment, a number of changes were observed. Due to the large number of buildings at Picatinny Arsenal and time limitations, only general observations were possible. A number of buildings designated in U.S. Army Categories I, II and III have been covered (both roofs and walls) in insulated, vertical grooved, aluminum siding. One example is Building 30, originally a storehouse and now a general purpose warehouse, constructed in 1918. The date of this modification was not available.

Building 30 was designated a Category III building. Another group of buildings in the 300 area (Building 350, 351, 354, and 355) (1938-1940) are sheathed in contemporary wood siding materials. Two buildings in the 500 Area evaluated in 1982 as meeting the stringent Category I requirements do not appear on the most recent Building Information Schedule for Picatinny Arsenal (December 31, 1988) and may have been demolished. They are Building 520, a Poaching House, and Building 561, a Cannon Powder Blender (see Table 6-2).

Historic American Building Survey/Historic American Engineering Record (HABS/HAER)

HABS/HAER Level IV documentation, including an overview report and HABS/HAER data cards, for Picatinny Arsenal buildings is on file at the Prints and Photographs Division, Library of Congress (HABS/HAER NJ-36; Tina Van Dyke, personal communication 1989).

Potentially Significant Buildings, Structures, and Related Features

A total of 310, or 20 percent, of the approximately 1,500 of the buildings and structures at Picatinny Arsenal have previously been evaluated as significant within at least one of several categories.

In the course of review of existing data and evaluation information several observations have been made. A number of buildings predating U.S. military use remain standing within the arsenal. The most interesting of these is a wood-frame house which appears to have been constructed in the late eighteenth or early nineteenth century (Building 3119) located on the Denmark Road near the east boundary. It has interior end chimneys, a central entrance, gable roof, and high fieldstone foundation. The dwelling appears on historic maps of 1853, 1868, and 1887 as "M. Doland" (Figures 5-2, 5-3 and 5-4). Most likely the oldest standing structure within Picatinny Arsenal and now used as quarters, this building illustrates historical civilian land use of the Green Pond River Valley prior to a military presence.

An additional group of approximately one dozen residential structures (1100 Area) are situated in the area known as Spicertown on both sides of Parker Road between the present main gate and the Cannon Gates, the original main entrance to the Arsenal. The buildings are one- and two-story, wood-

EVALUATION OF CULTURAL RESOURCES AT PICATINNY ARSENAL

frame, bungalow-type dwellings constructed in the early twentieth century and now house military personnel. This area at the southern end of the Arsenal was annexed by the Army in 1941.

The previous study of Picatinny Arsenal military development and buildings (HABS/HAER 1985) is generally quite thorough. This reconnaissance survey identified at least one building, however, which was not mentioned and appears to deserve further evaluation. The metal components and shop building (Building 31) is a large, one- and two-story, gable roofed brick building with industrial steel windows. In plan, the building consists of a main wing and four (originally three) projecting wings on the west side separated by open courts. It was originally constructed in 1930; a fourth wing and central second story were added to the south end in 1940-43 (Anon., n.d.; Dr. Owen, personal communication).

Building 31 was erected as the center of a new shops complex during Arsenal reconstruction following the 1926 explosion. The area was considered one of three non-explosive materials handling core complexes, along with the administration and chemical laboratory complexes (Rogers 1931:94). It housed metal working and machine tools for fabrication of all metal components for Arsenal research and development activities and continues to function as a machine shop. The building's design incorporated several features of particular note. It was intended as a design to which additional bays could be added without interruption of activities, as demonstrated by the 1940-43 extension. The bays permitted separation and grouping of additional work, and the additional wall space favored daylighting. Skylights, included in the original construction, proved unsatisfactory and were abandoned within 10 years. Building 31 appears to meet U.S. Army Category III requirements.

Information Gaps

The Picatinny Arsenal facility, its buildings, historical development, and technological contributions have been studied in detail and reported on (HABS/HAER 1985). The historical and engineering significance of the Arsenal is clearly established. In the areas of preservation planning and management decisions much ground has also been covered. Few information gaps were identified for buildings, structures, and related features within the Arsenal. These gaps fall into the following areas:

1. Buildings which reflect premilitary land use on Picatinny Arsenal lands.
2. Up-to-date, building-by-building information concerning modifications made since 1982 which may alter certain significance evaluations.
3. Completion of National Register of Historic Places nomination process for the Picatinny Arsenal Multiple Resources Area.
4. Study of any buildings of potential significance not included in the 1982-1985 HABS/HAER project, specifically Building 31.

CHAPTER VII

SUMMARY

Picatinny Arsenal is situated within the Highlands region of northern New Jersey where only a few prehistoric archaeological sites have been located and identified since the early twentieth century. Recorded site types include small, temporary resource procurement stations and rockshelters. Site occupations range from the Paleolndian to Late Woodland and possibly Contact Periods. Recent professional archaeological studies have evaluated this region as possessing a number of environmental features that would have attracted prehistoric groups of hunter/gatherers. The mountain and lakes topography of the general Arsenal area would have contained seasonally available natural food resources as well as potential source areas for raw lithic materials. Prehistoric populations could have easily exploited both the river valley and ridge-top resources and site locations.

Archaeological Resources

Background research/literature search and a driveover/visual field inspection were used to update and revise the previously evaluated information (Klein et al. 1986) concerning the cultural resource (archaeological) data base and predicted site potential at Picatinny Arsenal.

Four surface collected areas of prehistoric materials have been tentatively identified within the Arsenal property. Although no temporal or cultural affiliation can be assigned to these site locations, their presence attests to the exploitation of the Arsenal area by prehistoric populations. Areas exhibiting only minimal to moderate previous ground disturbances in proximity to freshwater sources have been assigned moderate and high archaeological sensitivity rankings for containing prehistoric depositions. Low sensitivity areas, poorly-drained soils and disturbed sections, have also been delineated across the 6,500 acre Arsenal property.

Seven historic archaeological resources are documented within the Arsenal boundaries. These include the Middle and Upper Forges, four homestead sites, and a family cemetery. The potential historic archaeological resource base has been revised to include sixty-nine site locations. These consist of forty-eight residential sites, three institutional sites, one commercial structure, and twelve industrial sites principally related to the local iron industry. These eighteenth and nineteenth century historic resources formed the northwest portion of Rockaway Township prior to military acquisition of the parcels comprising the present-day Arsenal property.

Six Arsenal-related resources have also been identified from secondary source summaries within the Arsenal boundaries. These include Route 7 of the Morris County railroad line and five railroad-associated station houses. The locations of these potential historic archaeological resources have been assigned low, moderate, or high sensitivities for survival, depending on the degree of previous ground disturbance.

Historic Buildings/Structures and Related Features

Background research and a driveover/visual inspection of the Picatinny Arsenal facility were also used to update and expand existing information concerning the historical development of the military installation, previously evaluated buildings, structures and features, and to collect data on resources not included in earlier studies. The Historic Properties Report (HABS/HAER 1985) and related documentation, including a National Register nomination, were the most important prior studies.

Background research confirmed Picatinny Arsenal's historical and present-day significance within the national context of military munitions storage, production and research and development. The Arsenal lands also have important historical associations with the development of Rockaway Township in the eighteenth/nineteenth centuries. The driveover/visual inspection determined that previous studies were generally comprehensive, but that certain information gaps exist. These gaps include changes to historic buildings since 1982, premilitary buildings, and at least one building apparently overlooked in prior studies.

No properties at Picatinny Arsenal are listed in the State Register and National Register of Historic Places. Seven Category I, 55 Category II, and 248 Category III buildings were previously identified. At least two buildings (Category I) may have been demolished. Documentation at HABS/HAER Level IV exists for categorized buildings (NJ-36) at the Library of Congress.

BIBLIOGRAPHY

References Cited

- Acroterion
1986
/87 Morris County Historic Sites and Survey. Prepared for The Morris County Heritage commission, Morristown, New Jersey.
- Anon.
n.d. Historical Record of Ordnance Buildings and Grounds. Bound volume, on file, Picatinny Arsenal Museum.
- Anon.
1882/
1884 Report of the Chief of Ordnance to the Secretary of War for the Years 1882-1884, Government Printing Office, Washington, DC.
- Anon.
1885 Plan of U.S. Powder Depot, Dover, New Jersey. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.
- Anon.
1891 Plan of U.S. Powder Depot, Dover, New Jersey. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.
- Anon.
1902
(Revised
1906) Map of U.S. Reservation, Picatinny, New Jersey. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.
- Anon.
1904 Map of U.S. Powder Depot, Picatinny, New Jersey. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.
- Anon.
1904 Map of U.S. Powder Depot, Picatinny, New Jersey. On (Revised file at Post Historian's Office, Picatinny Arsenal, 1914)New Jersey.
- Anon.
1920 A Brief History of Picatinny Arsenal. The Summit Herald, April 16, 1920.
- Anon.
1934 Map of U.S. Naval Ammunition Depot, Lake Denmark, New Jersey. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.

- Anon.
1938 Map of U.S. Naval Ammunition Depot, Lake Denmark, New Jersey. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.
- Anon.
1944 Picatinny Arsenal 1880-1944. Vol. 13, No. 3. Houghton Line, New York.
- Anon.
1948 Report of the Technical Division, U.S. Picatinny Arsenal. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.
- Anon.
1958 Geology and Magnetite Deposits of the Dover District, Morris County, New Jersey. Geological Survey Professional Paper 287. Government Printing Office, Washington, D.C.
- Anon.
1955 Research & Engineering Unpublished mimeograph. On file Historical Office, Picatinny Arsenal, Dover, New Jersey.
- Anon.
1961 Research and Engineering. Unpublished mimeograph, Picatinny Arsenal, New Jersey.
- Anon.
1969 Know Your Town, Rockaway Township, New Jersey. League of Woman Voters, Rockaway Township, New Jersey.
- Anon.
1981 This is Morris County, New Jersey. Jersey Central Light and Power Co.
- Anon.
c.1987 Picatinny Arsenal. Draft National Register of Historic Places Nomination. On file, Office of New Jersey Heritage, Trenton, New Jersey.
- Anon.
1988 Building Information Schedule for Picatinny Arsenal. Picatinny Arsenal, New Jersey, December 31, 1988.
- Beers, F.W.
1868 Atlas of Morris County, F.W. Beers, A.D. Ellis and G.G. Soule, New York.
- Berganst, Erik
1966 Rockets of The Armed Forces. G.P. Putnam's Sons, New York.
- Boyer, Charles S.
1931 Early Forges and Furnaces in New Jersey. University of Pennsylvania Press, Philadelphia, Pennsylvania.
- Carpenter, Edmund S.
1950 Five Sites of the Intermediate Period. American Antiquity 15(4): 298-314.

BIBLIOGRAPHY

Chesler, Olga (editor)

- 1982 New Jersey's Archaeological Resources from the Paleolndian Period to the Present: A Review of Research Problems and Survey Priorities, Office of New Jersey Heritage, Trenton, New Jersey.

Corps of Engineers

- 1984 General Site Map, Master Plan, Basic Information Maps, Corps of Engineers, U.S. Army, Office of the District Engineer, New York District, New York. On file, Division of Engineering and Housing, Picatinny Arsenal, NJ.

Cross, Dorothy

- 1956 Archaeology of New Jersey: The Abbott Farm. Volume II. Archaeological Society of New Jersey and New Jersey State Museum, Trenton, New Jersey.

Dover Era

- 1885 Dover Era, Dover, New Jersey.

Erskine, Robert

- 1777 A Map of the States of New York and New Jersey.

Fenneman, N.M.

- 1938 Physiography of Eastern United States. McGraw-Hill, New York.

Gardner, W.

- 1980 The Archaic. Paper Presented at 10th Middle Atlantic Archaeological Conference, Dover, Delaware.

Goddard, Ives

1974. The Delaware Language, Past and Present. In A Delaware Indian Symposium, edited by Herbet C. Kraft, Anthropological Series 4: 103-110, Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania.

Gordon, Thomas

- 1828 A Map of the State of New Jersey. H.S. Tanner, Philadelphia, Pennsylvania.

Green, Constance McLaughlin, Harry C. Thompson, and Peter C. Roots

- 1955 The Ordnance Department: Planning Munitions for War. United States Army in World War II, The Technical Services. Office of the Chief of Military History, U.S. Department of the Army, Washington, DC.

Guter, Robert P.

- 1976 Morris County Master Plan, Historic Preservation Element. Prepared for the Morris County Planning Board, Morristown, New Jersey.

HABS/HAER

- 1985 Historic Properties Report, Picatinny Arsenal, Dover, New Jersey. Prepared by the Historic American Building Survey/Historic American Engineering Record, National Park Service. Prepared for the United States Army Material Development and Readiness Command (DARCOM).

- Harris, J.P. Col.
1953 Picatinny Arsenal. Ordnance Corps, United States Army, Picatinny Arsenal, Dover, New Jersey.
- Hills, John
1781 A Sketch of the Northern Parts of New Jersey.
- Hopkins, G.M.
1867 Map of a Group of Iron Mines in Morris County. Geological Survey of New Jersey, Trenton, New Jersey.
- Huston, James A.
1966 The Sinews of War: Army Logistics 1775-1953. Army Historical Series. Office of the Chief of Military History, United States Army, Washington, DC.
- The Jerseyman
1880-
1926 The Jerseyman, Morristown, New Jersey, 1880-1926.
- Kinsey, W. Fred, III
1975 Faucett and Byram Sites: Chronology and Settlement in the Delaware Valley. Pennsylvania Archaeologist 45 (1-2): 1-103.
- Kinsey, W. Fred, III, et al.
1972 Archaeology in the Upper Delaware Valley. Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania.
- Klein, Joel I., Leonard G. Bianchi, Lorraine E. Williams, and Sydne D. Marshall
1986 An Archaeological Overview and Management Plan for Picatinny Arsenal. Draft Report, No. 14. EnviroSphere Company, Lyndon, New Jersey. Submitted to the National Park Service and U.S. Army Material Development and Readiness Command.
- Kraft, Herbert C.
1970 The Miller Field Site: Warren County, New Jersey: Part I. The Archaic and Transitional Stages. Seton Hall University Press, South Orange, New Jersey.
- Kraft, Herbert C.
1973 The Plenge Site: A PaleoIndian Occupation Site in New Jersey. Archaeology of Eastern North America 1(1): 56-117.
- Kraft, Herbert C.
1975 The Archaeology of the Tocks Island Area. Archaeological Research Center, Seton Hall University, South Orange, New Jersey.
- Kraft, Herbert C.
1976 The Rosenkrans Site, An Adena-Related Mortuary Complex in the Upper Delaware Valley, New Jersey. Archaeology of Eastern North America, 4: 9-49.

BIBLIOGRAPHY

Kraft, Herbert C.

- 1977 PaleoIndians in New Jersey. In *Americans and Their Paleoenvironments in Northeastern North America*, edited by W. Newman and B. Salwen, Annals of the New York Academy of Sciences 228: 264-281.

Kraft, Herbert C.

- 1978a Adena-Hopewell Manifestations on Rosenkrans Site. New Jersey Historical Commission Newsletter 9(3): 6.

Kraft, Herbert C.

- 1978b The Minisink Site: A Re-evaluation of a Late Prehistoric and Early Historic Contact Site in Sussex County, New Jersey. Archaeological Research Center, Seton Hall University, South Orange, New Jersey.

Kraft, Herbert C.

- 1982a The Archaic Period in Northern New Jersey. In *New Jersey's Archaeological Resources from the Paleolndian Period to the Present: A Review of Research Problems and Survey Priorities*, edited by Olga Chesler. Office of New Jersey Heritage, Trenton, New Jersey.

Kraft, Herbert C.

- 1982b The Late Woodland Period in Northern New Jersey. In *New Jersey's Archaeological Resources from the Paleolndian Period to the Present: A Review of Research Problems and Survey Priorities*, edited by Olga Chesler. Office of New Jersey Heritage, Trenton, New Jersey.

Kraft, Herbert C.

- 1986 The Lenape: Archaeology, History, and Ethnography, Newark, New Jersey.

Kummel, Henry B. and Stuart Weller

- 1901 A Geological Map of the Green Pond Mountain Region in Morris and Passaic Counties, Trenton, New Jersey.

Lane, Wharton J.

- 1939 From Indian Trail to Ironhorse: Travel and Transportation In New Jersey 1620-1860, Princeton, New Jersey.

Larned, W.E. Col.

- 1943 Picatinny Arsenal 1879-1943, Development Plant for Bombs, Explosives, Pyrotechnics, and Artillery Ammunition. Picatinny Arsenal, Dover, New Jersey.

Lenik, Edward J.

- 1985 The Archaeology of Wayne, Wayne Township Historical Commission, Wayne, New Jersey.

Lightfoot, J. and Samuel Geil

- 1853 Map of Morris County, New Jersey from Original Surveys. J.B. Shields, Morristown, New Jersey.

Lowenthal, Larry

- 1981 Iron Mine Railroads of Northern New Jersey. The Tri-State Railway Historical Society, Inc. Dover, New Jersey.

Marshall, Sydne B.

- 1982 Aboriginal Settlement in New Jersey During the Paleolndian Cultural Period. In New Jersey's Archaeological Resources from the Paleolndian Period to the Present: A Review of Research Problems and Survey Priorities, edited by Olga Chesler. Office of New Jersey Heritage, Trenton, New Jersey.

Milio, John F., Sally L. Butler and Robert W. Parris

- 1987 United States Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey: Five-Year Natural Resources Management Plan. Land Management & Entomology Unit, Division of Engineering and Housing, Picatinny Arsenal, New Jersey.

Munsell, W.W.

- 1882 History of Morris County, New Jersey. W.W. Munsell & Co., New York.

Muhlenberg, Henry

- 1912 History of Arsenals: Augusta, Benicia, Frankford, New York, Picatinny. Unpublished manuscript.

Picatinny Arsenal Personnel

- 1937 The Ordnance Bomb, Yearbook for Picatinny Arsenal. Picatinny Arsenal, Dover, New Jersey.

Star Ledger

- 1979 Picatinny Provides A Life for Morris Co. Towns. Star Ledger, 24 April 1979., Morristown, New Jersey.

Platt, Charles

- 1976 Dover Dates 1772-1922: A Bicentennial History of Dover, New Jersey. Dover, New Jersey.

Ritchie, William A.

- 1969 The Archaeology of New York State. Revised Edition (1980). The Natural History Press, Garden City, New York.

Robinson, E.

- 1887 Robinson's Atlas of Morris County. E. Robinson, New York.

Rogers, Capt. J.A., Jr.

- 1931 The History of Picatinny Arsenal. Unpublished Manuscript prepared for the War Plans Division, Plant Engineering Department.

Rutsch, Edward S., William Sandy, Richard F. Portar, and Leonard G. Branchi

- 1986 Cultural Resources Investigations of the Proposed Mt. Hope Pumped Storage Hydroelectric Facility and Transmission Lines, Rockaway and Jefferson Townships, Morris County, New Jersey. Historic Conservation and Interpretation, Newton, New Jersey. Prepared for Tippetts-Abbett-McCarthy-Stratton, New York, New York.

Shea, Thomas K.

- 1978 Abandoned Iron Mines of Rockaway Township, Morris County, New Jersey. State of New Jersey, Department of Labor and Industry, Trenton, New Jersey.

BIBLIOGRAPHY

- Skinner, Alanson B. and Max Schrabisch
1913 A Preliminary Report of the Archaeological Survey of the State of New Jersey. New Jersey Geological Survey. Bulletin 9, Trenton, New Jersey.
- Snow, Dean
1980 The Archaeology of New England. Academic Press, New York.
- The Survey of Federal Archives, Division of Professional & Service Projects
1940 Works Progress Administration. (The National Archives, Cooperation Sponsor). Inventory of Federal Archives in the States. Series IV, The Dept. of War, No. 29 New Jersey. The Historical Records Survey Project, Newark, New Jersey.
- Thurber, Pamela, Sandy Norman, Donald C. Jackson and Robie S. Lange
1982 Historic American Engineering Record-Picatinny Arsenal, NJ-36. On file, Prints and Photographs Division, Library of Congress, Washington, DC.
- United States Department of Agriculture
1976 Soil Survey of Morris County, New Jersey, Soil Conservation Service, United States Department of Agriculture.
- U.S. Department of the Navy
Annual Report of the Secretary of the Navy. For the years 1890, 1891, 1892, 1926, 1927, 1928. Government Printing Office, Washington, DC.
- U.S. Ordnance Department
Ordnance Reports, Volume 3. 1860-1889.
- Van Gelder, Arthur Pine and Hugo Schlatter
1927 History of the Explosives Industry in America. Columbia University Press, New York.
- War Plans Division, Plant Engineering Department
1931 The History of Picatinny Arsenal, Vol I. Picatinny Arsenal, New Jersey, Reprint Ed., Facilities Engineering Division, 1976.
- Weigley, Russell F.
1984 History of the United States Army, Enlarged Edition. Indiana University Press. Bloomington, Indiana.
- Wharton and Northern Railroad
1906 Garden Spot of New Jersey. Pamphlet.
- Williams, Lorraine E., Edward S. Rutsch, and Karen A. Flinn
1978 Cultural Resources Sensitivity Analysis of the Passaic River Basin, Report submitted to the U.S. Army Corps of Engineers, New York District, New York.
- Williams, Lorraine E. and Susan Kardas
1982 Contact Between Europeans and the Delaware Indians of New Jersey. In New Jersey's Archaeological Resources from the Paleolndian Period to the Present: A Review of Research Problems and Survey Priorities, edited by Olga Chesler. Office of New Jersey Heritage, Trenton, New Jersey.

Williams, Lorraine E. and Ronald A. Thomas

- 1982 The Early/Middle Woodland Period in New Jersey. In *New Jersey's Archaeological Resources from the Paleolndian Period to the Present: A Review of Research Problems and Survey Priorities*, edited by Olga Chesler. Office of New Jersey Heritage, Trenton, New Jersey.

Works Projects Administration

- 1938 W.P.A., Picatinny Arsenal, September 19, 1935-June 30, 1938. On file at Post Historian's Office, Picatinny Arsenal, New Jersey.

Worton, Stanley N., Wilbur E. Apgar, Daniel Jacobson and Abraham Resnick

- 1964 New Jersey: Past and Present. Hayden Book Company, Inc., New York.

Personal Contacts

Dr. Patrick J. Owens, ARDEC Historian, Picatinny Arsenal, New Jersey.

Robert Ronsheim, ARDEC Museum, Picatinny Arsenal, New Jersey.

Tina Van Dyke, Historic American Buildings Survey/Historic American Engineering Record, National Park Service, Middle Atlantic Regional Office.