FINAL

DEFINITION OF HISTORIC DISTRICTS FOR PICATINNY ARSENAL, MORRIS COUNTY, NEW JERSEY

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Prepared for:
U.S. Army Corps of Engineers
New York District
26 Federal Plaza
New York, New York 10278-0090

Contract # DACW51-95-D-0024

September 1999

Contract No. DACW51-95-D-0024
Work Order No. 19

U.S. Army Corps
of Engineers
New York District

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Management Summary

Project Name: Definition of Historic Districts for Picatinny Arsenal, Morris County, New Jersey.

Project Location and Environmental Setting: Picatinny Arsenal is located on a 6,500-acre (2,600-hectare) site in the Township of Rockaway, Morris County, New Jersey. The arsenal is located within the Green Pond Brook valley and is flanked by the uplands to the west and east. Rocky outcrops, steep slopes and stony soils are characteristic of the region.

Purpose: The U.S. Army Corps of Engineers, New York District, contracted Panamerican Consultants, Inc. in June 1997 to complete an evaluation of historic structures at Picatinny Arsenal, New Jersey. The goal of this contract was two-fold. The first part of the contract was to reevaluate 500 structures which were previously judged eligible for the National Register of Historic Places (NRHP). The second was to identify those structures eligible for nomination to the NRHP either individually or as part of a historic district. This report presents the conclusions of the identification of those structures eligible for the NRHP nomination.

Methods: PCI reevaluated 500 historic structures on Picatinny Arsenal and the former Lake Denmark Navy Depot which were previously judged eligible for the National Register of Historic Places by WCH/Boston Affiliates (Harrell 1994). The task of reevaluating 500 structures included two methodological strategies: in-field inspection and research evaluation. The 500 structures were visually inspected and their NRHP status evaluated utilizing NRHP criteria and a number of Department of Defense (DOD) architectural reports concerning the NRHP status of a number of types of military structures present within that system. For a more complete discussion of the reevaluation of Picatinny's historic structures, please see *Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey* (Nolte and Steinback 1999).

When the structures had been initially evaluated (Harrell 1994), it was believed that all of Picatinny Arsenal formed a single historic district. The New Jersey Historic Preservation Office (HPO) ruled that the entire installation does not have sufficient integrity to form a single district; instead three smaller areas were determined to be eligible as districts and two structures were determined to be individually eligible (Guzzo 1999).

The first district, the Administrative and Research District, combines two early historically-related arsenal activities which are further united by one architectural style. During World War II many important advances in new products or simplified methods of production were made at Picatinny Arsenal in its newly constructed labs, testing facilities and administrative buildings. The importance of Picatinny's research and development activities grew giving more emphasis to this R&D function which it would retain after the war. In one year the job training methods, research projects and improved work

developments originating at Picatinny and passed along to other plants, saved the U.S. more than $3,000,000.

The Administrative and Research District consists of 23 contributing structures and one non-contributing building which are eligible for the NRHP under Criteria A and C as determined by the New Jersey HPO (Guzzo 1999).

The second district is the 600 Ordnance Testing Area. This area has been carefully documented by a 1983 Historic American Engineering Record (HAER) report (Thurber and Norman 1983) and consistently highlighted in previous architectural reports as being significant.

The complete planning of this area in 1928 was carried out by the Engineering Department of the Arsenal with the assistance of the Quartermaster and outside contractors (*Plant Design* ca. 1945). World War II blueprints show that structure designs were created by The War Plans Division, Ordnance Department, Picatinny Arsenal (Picatinny Arsenal, DPW n.d.c.). Certainly numerous structures were specifically designed for explicit purposes in the 600 Area and would seem to be one-of-a-kind buildings. A survey of the facilities at the old line Army arsenals at Edgewood (Aberdeen) Arsenal, Maryland, Rock Island Arsenal, Illinois, and Watervliet Arsenal, New York, reveal no grouping of testing-related structures like those on Picatinny.

The 600 Ordnance Testing Area District, made up of 26 contributing structures and three non-contributing structures, is eligible for the NRHP under Criteria A and C, as determined by New Jersey HPO (Guzzo 1999).

The third district is Test Area E, Naval Air Rocket Test Station (NARTS), Lake Denmark Depot District created in 1948. The earliest work at NARTS was devoted primarily to liquid propulsion, but eventually encompassed a wide range of activities including evaluation of rocket engines and rocket systems, development of methods for analyzing rocket propellents, and the collaboration with private industry on a wide range of experiments and safety manuals. All these functions were part of the NARTS mission as assigned by the Chief of Naval Operations: "to test, evaluate and conduct studies pertaining to rocket engines, their components and propellants" (U.S. NARTS ca. 1959)

The test facilities at NARTS were generally grouped into six test areas, two used especially by and for NARTS projects and the others leased to Reaction Motors, Inc. (RMI). NARTS used Test Areas "D" and "E" and sometimes "G". Test Area E was considered the "elite" among the many facilities at NARTS (U.S. NARTS ca. 1959). It was here that the Navy fired liquid propellant rocket engines with a thrust up to 350,000 lbs. from one of the largest static test stands on the East coast. When the area first went into operation it was used for the testing of the X-15 power plant under a use-agreement contract with RMI.

The Test Area E district, which has two structures, is eligible for the NRHP under Criteria A and D, as determined by the New Jersey HPO (Guzzo 1999).

In addition two buildings (3250, Navy Hill Commander's Quarters, and 3316, Fire House/Stable) were determined to be individually eligible for the NRHP under Criteria A and C by the New Jersey HPO (Guzzo 1999).

Conclusions: Of the 500 structures resurveyed, PCI judged 443 to be ineligible for the NRHP when reevaluated against new criteria (see Nolte and Steinback 1999 for a detailed discussion of these structures), and the New Jersey HPO concurred this recommendation. Of the remaining 57 structures, 51 were determined as eligible for listing to the NRHP as contributing structures to three historic districts, two (Buildings 3250 and 3316) were determined individually eligible under Criteria A and C, and four were judged to be non-contributing to a district by the New Jersey HPO (Guzzo 1999).

Location of file copies of report: Copies of this report are on file at the U.S. Army Corps of Engineers, New York District, New York, New York; the U.S. Army, Division of Engineering and Housing, Picatinny Arsenal, New Jersey; and the New Jersey Historic Preservation Office, Trenton.

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Acknowledgments

Panamerican Consultants, Inc. (PCI) wishes to thank a number of individuals at Picatinny Arsenal who assisted us in completing this report. We thank Dr. Patrick Owens, Command Historian at Picatinny Arsenal, for the numerous books, articles, photographs, maps and time he gave us. We also acknowledge the invaluable assistance lent us by the Department of Public Works, Picatinny Arsenal, especially by Mr. Jack Lyons, Real Property Specialist, who went that extra mile in providing us access to structures as well as excellent research materials. We thank Mr. Vinod Kapoor, Chief of Master Planning and Programs Office, Mr. Ronald Bailey, Engineering Technician and Mr. Timothy Miller, Chief of Environmental and Natural Resources Division, all of Picatinny Arsenal.

We especially thank Ms. Roselle Henn, New York Army Corps of Engineers, for her assistance throughout all phases of the project, and Mr. Dan Saunders of the New Jersey State Historic Preservation Office, Trenton, New Jersey. We also acknowledge the invaluable assistance of Mr. Steve Lawson, Public Relations, Thiokol Corporation, Ogden, Utah.* Assistance was also provided by Ms. Judith M. Matteson, Curator, Fort Jackson Museum, Fort Jackson, South Carolina; Mr. Ben King, Command Historian, Ft. Eustis, Virginia; Dr. Kier Stirling, Mr. Roger Goode and Mr. David Blick, Aberdeen Proving Grounds, Maryland; Dr. William F. "Jack" Atwater, Ordnance Historian; Mr. Tom Snyder, Command Historian, Rock Island Arsenal, Illinois; and Mr. David A. Alberg, Curator, College Park Aviation Museum, College Park, Maryland.

For PCI, Ms. Kelly Nolte, Architectural Historian, researched the historic structures of Picatinny Arsenal, and served as the Principal Investigator and principal author of this report. Ms. Nolte and Mr. Michael V. Taylor, who served as Research Assistant and Photographer, conducted the field work. Dr. Michael A. Cinquino served as Project Director and Technical Advisor. Mr. Mark Steinback served as Project Historian. Ms. Suzanne Vizzini provided clerical assistance. Mr. Martin Lewars prepared the graphics. Mr. Carl W. Thiel edited the report.

* In 1998 the Thiokol Corporation changed its name to Cordent Technologies, with Thiokol Propulsion as a subsidiary division, and moved its corporate offices to Salt Lake City, UT.

1.0 Introduction

The U.S. Army Corps of Engineers, New York District, contracted Panamerican Consultants, Inc. in June 1997 to complete an evaluation of historic structures at Picatinny Arsenal, New Jersey. Picatinny Arsenal, a 6,500-acre (2,600-ha) United States Army installation, is located in the Townships of Rockaway and Jefferson, Morris County, NJ (Figure 1), contained within the current facility is the former Lake Denmark Naval Depot.

The goal of this project was two-fold. The first was to re-assess 500 structures which were previously judged potentially eligible for the National Register of Historic Places (NRHP). The second was to identify those structures eligible for nomination in the NRHP either individually or as part of a historic district.

As an agency of the federal government, the Army has certain responsibilities for protecting and preserving the cultural resources on lands it controls or uses. In compliance with federal regulations, Picatinny Arsenal is currently developing an Integrated Cultural Resource Management Plan which will enable the installation to adequately manage its cultural resources (Cinquino et al. 1998). The identification of those structures eligible and ineligible for listing to the NRHP is an integral part of the development of that plan. This report presents the conclusions of the identification of those structures eligible for the NRHP nomination.

Reevaluation of the 500 structures included in-field assessment and archival research. The 500 structures identified by Harrell (1994) were visually inspected and their NRHP status evaluated utilizing the standard National Park System (NPS) criteria for inclusion in the NRHP. A number of U.S. Army and Department of Defense (DOD) architectural reports concerning the NRHP status of several types of military structures within that system were also consulted.

The 500 structures assessed were constructed primarily between World War I and World War II and include both Navy and Army buildings since Lake Denmark was originally a Navy depot. There were, however, a number of pre-World War I buildings, most of them utilized for storage since both facilities were originally designated as depots. Two of the structures are from the Cold War years and are associated with the Navy rocket program, specifically development of the X-15. Many of the buildings are directly related to the production, testing and storage of various ordnance and ordnance-related materials. A smaller number of administration and quarters buildings were also included.

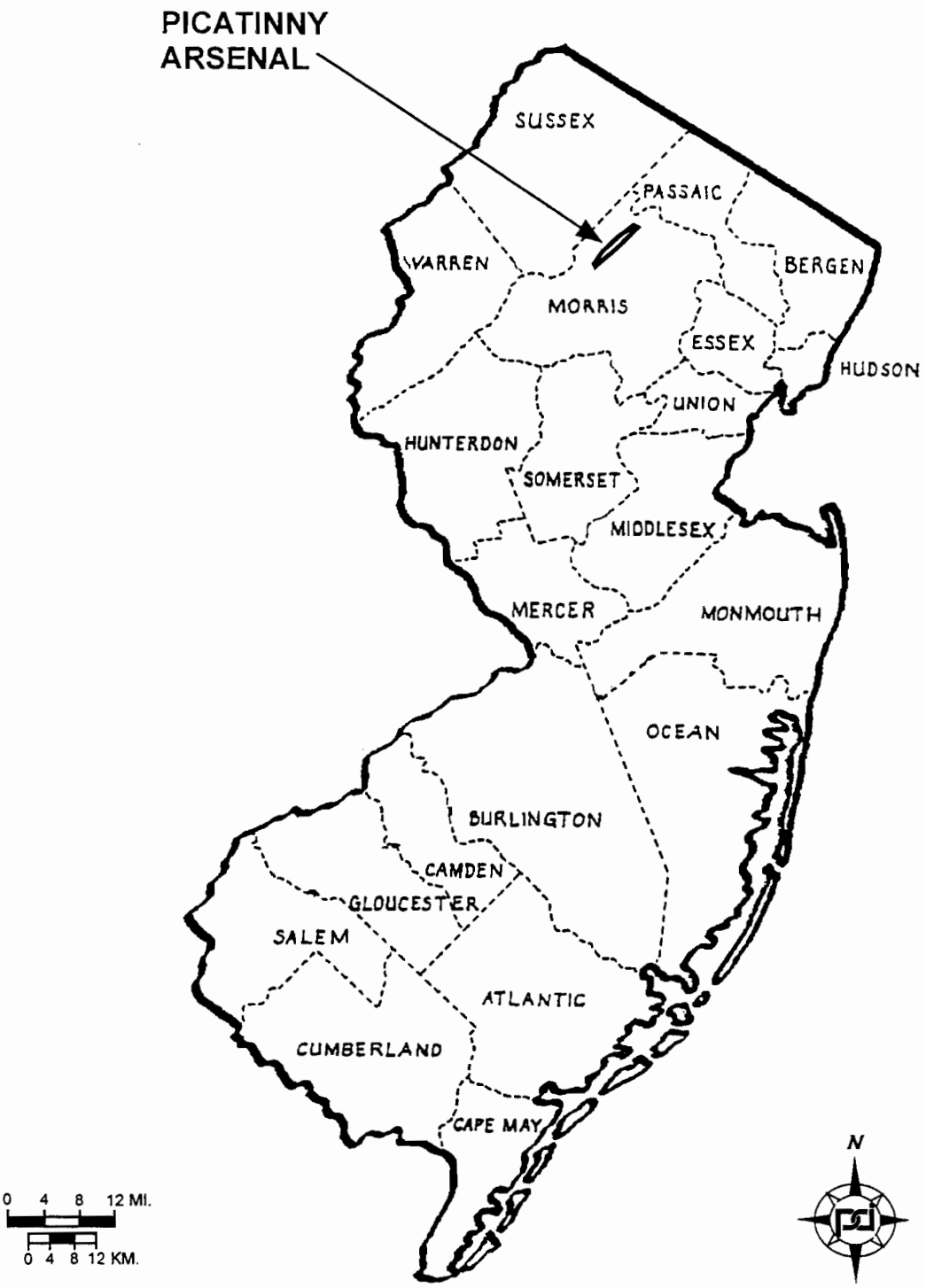

Figure 1. Location of Picatinny Arsenal, Morris County, New Jersey *(Chesler 1982)*.

IN- FIELD EVALUATION

Between June 5 and June 13, 1997, Ms. Kelly Nolte, PCI Architectural Historian, and Mr. Michael V. Taylor conducted the field assessment at Picatinny Arsenal, NJ. During this time, 500 structures were visually inspected and their NRHP status evaluated using numerous Army and DOD architectural reports discussing the NRHP status of types of military structures found within that system as well as the standard NPS criteria for NRHP inclusion.

Pertinent blueprints located in the Department of Public Works at Picatinny Arsenal were reviewed for information regarding construction dates, architects/builders involved, and the evolution of various pieces of the arsenal's infrastructure such as the railroad network and other transportation systems. Also during this time, the Command Historian, Dr. Patrick Owens, was consulted on Picatinny Arsenal's history. In August 1997, eight hours were spent at the New Jersey State Historic Preservation Office (New Jersey HPO) reviewing all information on the facility.

Before the survey team entered the field, an initial planning phase was completed which identified the structures to be surveyed. The basic resource used in the planning stage was the WCH/Boston Affiliates Report (Harrell 1994). This report not only identified the historic structures on the arsenal, but also provided the survey team with construction dates, photographs and good architectural descriptions.

The identified structures were then located by numerical sequence on Picatinny maps within clusters relating to historical function and accessibility. Field efforts concentrated upon visually inspecting all the structures located in these obvious road net and historical oriented clusters. The field crew was accompanied by a Picatinny representative into those areas, called "enclosures," that were not open to the public. After all the buildings in each identified area had been surveyed, the survey team then moved to the next area to be surveyed.

CRITERIA USED FOR EVALUATION

During the architectural survey at Picatinny Arsenal, all buildings were judged against a standardized set of criteria as identified in the National Register guidelines. The NRHP is the official list of the country's cultural resources, and provides a standard by which federal, state, and local agencies can rank significant historic resources.

The application of these standards at Picatinny Arsenal serves two purposes. First, the NRHP criteria are generally used standards in the practice of historic architectural surveys and planning work thereby providing a uniform and unbiased model upon which to evaluate historic structures. Second, Picatinny Arsenal is required under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and Army

Regulation AR 200-4, to consider the effect of planning changes on properties that are eligible for inclusion on the National Register.

Potentially significant historic properties include districts, structures, objects, or sites which are at least 50 years of age or older and which meet at least one of the National Register Criteria. To be eligible for inclusion in the NRHP, a historic property must possess "the quality of significance in American History, architecture, archaeology, engineering, and culture [that] is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of type, period, or method of construction, or that represent the work of a master, or possess high artistic value, or that represent a significant and distinguishable entity whose components lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history" (U.S. Department of the Interior 1995).

The NRHP recognizes five classifications of significant properties: *buildings*, principally a shelter for any form of human activity; *structures*, functional constructions made for purposes other than creating human shelter; *objects*, constructions that are small in scale, relatively simple and primarily artistic; *sites*, location of a significant event where the site itself possesses value regardless of the value of any existing structure; and *districts*, a significant linkage of sites, buildings, structures or objects united historically or aesthetically by a plan or physical development (U.S. Department of the Interior 1995).

A district derives its importance from being a unified entity, even though it may include a wide variety of resources. "The identity of a district results from the interrelationship of its resources, which can convey a visual sense of the overall historic environment or an arrangement of historically or functionally related properties" (U.S. Department of the Interior 1995). A district must be important for historical, architectural, engineering or cultural values. The individual components of a district may lack significance provided the group as a whole has significance. Most of the components making up a district must add to the district's character and must possess integrity, as must the district itself.

"Integrity is the ability of a property to convey its significance" (U.S. Department of the Interior 1995). To be placed on the NRHP a property must be shown to have significance under the NRHP criteria and it must have integrity. Integrity is determined by looking at the seven elements that create it. They are: location, design, setting, materials, workmanship, feeling and association. To retain integrity, a property must possess several of these aspects. Although determining integrity tends to be a subjective judgment, this is tempered by an understanding of the property's physical features and how they relate to its significance (U.S. Department of the Interior 1995).

Under previous guidance over the past ten years, the structures on Picatinny Arsenal appear to have been evaluated with the idea that the facility would form one large historic district, as can be found at various Army installations, such as Watervliet Arsenal, Albany County, New York. Many structures, however, including most of the production lines and much of the landscape at Picatinny, have changed significantly over the years. Most of the changes have compromised the integrity necessary for a district's inclusion on the NRHP, and it is PCI's recommendation, based on this lack of integrity, that the entire arsenal is not eligible as a single district. Nevertheless, three smaller districts, an administrative and research area, the 600 Ordnance Testing Area, and Test Area E, do qualify as NRHP districts (Guzzo 1999).

These three districts include 55 structures, four of them non-contributing, and cover a time span from the earliest years of the arsenal to the Navy rocket experiments of the 1950s. For more information about those structures considered ineligible by PCI please see *Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey* (Nolte and Steinback 1999). The majority of the structures reviewed, however, are not eligible for nomination to the NRHP.

One of the districts considered eligible for the NRHP is a property that is less than 50 years old, Test Area E, Naval Air Rocket Test Station (NARTS), on the former Lake Denmark Navy Depot. NRHP criteria generally excludes properties that are less than 50 years old unless they are "of exceptional importance" (U.S. Department of the Interior 1995). This "exceptional importance" may be applied to the extraordinary importance of an event or to an entire category of resources so fragile that survivors of that age are unusual. This does not mean, however, that the property must be of national significance. It is a measure of that property's importance within the appropriate historic context (U.S. Department of the Interior 1995).

Fifty years is not an arbitrary period; it was created as a filter to ensure that enough time had elapsed to allow proper evaluation of the property in a historic context. The fifty-year criterion does not automatically block a property for NRHP nomination. Approximately three percent of the properties on the NRHP were listed before they became 50 years old with missiles and nuclear facilities, from a military perspective, having received the greatest amount of attention (Department of Defense, Legacy Commission 1994). Non-military properties that have achieved significance before the 50-year criterion include: Gateway Arch, St. Louis, Missouri; the Oscar Hammerstein Farm, Doylestown, Pennsylvania; the Coral Court Motel, Marlborough, Missouri; and The New Jersey City Medical Center, Jersey City, New Jersey.

In November 1989, with the dismantling of the Berlin Wall, the Cold War (1946-1989) ended. The new geopolitical situation led the DOD to rethink its global commitments, to downsize and to reallocate resources (Department of Defense, Legacy Commission 1994). The DOD decided that it was important to preserve artifacts, documents, properties, and sites that constituted a significant and invaluable record of the Cold War. The DOD Legacy

Resource Management Program, now defunct, was created to address cultural resource concerns and was assigned nine separate task areas. Among them was the responsibility to "inventory, protect, and conserve [DOD's] physical and literary property and relics" associated with the origins and development of the Cold War at home and abroad (Department of Defense, Legacy Commission 1994).

Tracing Cold War history and the importance of associated properties is often difficult. Because of its duration, the Cold War saw a large number of industrial contractors working for the DOD. Many of these contractors were acting as independent agents contracting with the government well after important research and testing had been completed. This limited federal control over documents and objects and the lack of awareness within the private industrial community restricts the flow of information about the military's Cold War assets (Department of Defense, Legacy Commission 1994).

Test Area E is a typical Cold War problem. Although the Lake Denmark Rocket area was ostensibly under Navy control, Reaction Motors and later Thiokol Chemical Corporation leased the area from its inception until well after the Army assumed command, and undertook a number of different projects. The Navy command responsible for this area did not keep records of all activities, only those related to weaponry that were actually used by that service. This site was the test home of XLR-99, the most important rocket engine of the late 1950s. It seems clear that Test Area E was at the center of a vital research and testing activity that would later serve as the basis for the space shuttle, but the actual specifics of these activities are spread across military, National Aeronautics and Space Administration (NASA) and private corporation records.

DOCUMENTARY RESEARCH

The research portion of this investigation used numerous DOD/Army/Navy documents relating to various, specific building types, their incidences within the greater military community, and their role in military or architectural history. A number of architectural, archaeological and historical writings on Picatinny were also used.

Past architectural studies on Picatinny had divided the structures into their use areas—interrelated individual buildings and structures constructed to accomplish a specific mission—a standard practice, and one advocated in current literature on historic structures of the Army Material Command (AMC), Picatinny Arsenal's current command (Cannan et al. 1996). It is particularly important to look at industrial buildings, one of the most common building types at Picatinny, in their proper use settings. Many of the component structures of an industrial process are not significant in and of themselves, but become vital in the larger industrial context. As a result, if the most important structures on a line are missing, then the smaller structures become unimportant due to loss of integrity. This is also true of such industrial settings as mining operations (Noble and Spude 1992).

Examining structures only in their use categories is insufficient. For instance, isolated structures lack context, and conversely, without careful research may assume false attributes. Buildings were regularly constructed in areas in which they are not connected by use for any number of reasons including space, fiscal constraints or command structure. Further, buildings in a military industrial line may be magazines, storage and ordnance-related buildings, administrative and personnel offices, or other building types commonly found throughout the installation. While these common building types may gain a greater meaning in the industrial setting, not all such common buildings are of equal importance on a military installation. Examining only the use context is misleading. The larger concept of that specific building type, both historically and architecturally, must also be inspected.

The Department of Defense and the various military services have endeavored to give historical context to a wide range of building types as well as providing historical context and architectural evaluations for these buildings. In some cases, the DOD in conjunction with the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers has organized all materials necessary for the final steps in the mitigation of particular types of structures. Other reports have provided guidance on the historical and architectural significance of various types of buildings (Garner 1993; Grandine and Cannan 1995; Grashof 1986; Kriv n.d.; and Walsh 1995). Many of these reports are less than five years old and are generally difficult to obtain. They are, however, vital in determining the actual NRHP status of certain building types.

Another factor to consider in judging the eligibility of military buildings is the types of materials used. During most of the construction history of the various military branches, the services have distinguished two and some times three types of structures: permanent, temporary and the difficult-to-define "semi-permanent." What generally makes a building temporary or permanent is the type of building material used. The distinction between construction techniques is vital to understanding a building's potential NRHP status.

Since immediate use context alone was not sufficient to determine the eligibility of some structures, the Picatinny buildings were placed in individual categories by family type—e.g., storehouses, quarters, laboratories—and also by use of materials. Further research was then conducted on each of Picatinny's buildings taking into consideration the larger contexts of family types and materials.

In determining the status of a significant number of Picatinny's structures, two publications were influential: *World War II Temporary Buildings: A Brief History of the Architecture and Planning of Cantonments and Training Stations in the United States* by John Garner (1993) and *Support and Utility Structures and Facilities (1917-1946) Overview, Inventory and Treatment Plan* by Katherine Grandine and Deborah Cannan (1995). Since both of these monographs were important, an overview of each is presented.

World War II Temporary Buildings (Garner 1993). A significant number of structures reviewed for this report have already been mitigated and reported in a DOD

publication that was produced in 1993 as a result of the *Military Construction Authorization Bill of 1983.* This legislation requires the demolition of World War II-era temporary buildings on DOD installations. In 1986, DOD entered into a Memorandum of Agreement with the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers to document World War II temporary buildings on U.S. military bases in preparation for implementing the construction bill. This report serves as partial fulfillment of the requirements of the NHPA, Section 106.

In his monograph, Garner (1993): 1) describes the principal types of temporary structures built during mobilization for World War II (1939-1946); 2) documents the approximate numbers and location of surviving World War II temporary structures; and 3) provides a historical context to support the assessment of this architecture's historical significance. The report presents a wide range of buildings from Quonset Huts to barracks to air hangars.

A "temporary" building during this time period can be described as being constructed with a wooden frame with any number of wall coverings. It was estimated that a temporary building would have a life of five years. While this is the guiding principle, a number of temporary structures were built using light steel frame construction. To further complicate matters, General Brehon Somervell, Chief of Ordnance (Picatinny was an ordnance facility during the war), announced in January 1941 that all future ammunition plants would be designed as temporary installations (Cannan et al. 1996). Pressure was placed on all ordnance facilities to construct only temporary buildings. Therefore, whole industrial lines at older ordnance facilities, including Picatinny, were built as temporary structures.

Support and Utility Structures and Facilities (Grandine and Cannan 1995). In compliance with the NHPA of 1966, as amended, DOD continues to provide consistent and comprehensive information on a large segment of real property that is potentially eligible for the National Register. To meet this obligation a study was completed on mundane structures, and support and utility buildings constructed between 1917 and 1946 at U.S. military installations.

In the report, *Support and Utility Structures and Facilities (1917-1946) Overview, Inventory and Treatment Plan*, Grandine and Cannan (1995) developed a mechanism for classification, evaluation and treatment of support and utility buildings. This report provides 1) an overview of the construction and historical associations of support and utility facilities; 2) a classification system for these structures; 3) a partial inventory of the frequency and distribution of 35,077 current support and utility structures; 4) a methodology for evaluating the significance of these facilities; and 5) recommended treatment plans for these properties.

The structures in Grandine and Cannan's (1995) monograph can be grouped into the following categories: general storage, ordnance storage, fuel storage, water supply systems, sewage disposal systems, power and heating systems and refuse disposal.

There are, of course, a number of sub-types within each of these categories and these were covered within the larger context.

Other important reports used to determine NRHP eligibility included: *A Study of United States Army Family Housing Standardized Plans, 1866-1940,* vols. 1-6 (Grashof 1986); *World War II and the U.S. Army Mobilization Program* (Kriv n.d.); and *World War II Ordnance Department's Government-Owned Contractor-Operated (GOCO) Industrial Facilities: Ravenna Ordnance Plant Historic Investigation* (Walsh 1995).

Aside from the various DOD/Army/Navy reports a significant number of Picatinny Arsenal architectural studies have been performed and these reports aided in identifying important structures and significant industrial and research use areas. At least seven significant architectural studies (Ashby et al. 1984; Fitch and Glover 1990; Harrell 1993, 1994; Thurber ca. 1983; Thurber and Norman 1983; and U.S. Department of the Army n.d.) have been completed on Picatinny Arsenal in the past 14 years, three having been performed in the past five years.

A Historic American Building Survey and Historic American Engineering Report (HABS/HAER), Level IV, was completed on more than 800 structures that were 50 years old or older. (Many have since been demolished due to excessive contamination.) This survey (Ashby et al. 1984) and the resulting report (Thurber ca. 1983) was part of a pilot project undertaken by the U.S. Army Material Development and Readiness Command (DARCOM) and the National Park Service (NPS) which inventoried structures at five installations: Watertown Arsenal, Massachusetts; Aberdeen Proving Ground, Maryland; Savannah Army Depot, Georgia; Kansas Army Ammunition Plant, Kansas; and Picatinny Arsenal, New Jersey. This pilot project led to similar studies for all 72 AMC installations nationally.

The HABS report grouped 310 properties into three Army Categories, a system no longer utilized, which identified the preservation level required for historic Army properties. The Department of the Army ranked historic buildings according to their degree of significance (U.S. Army Regulation 420-40 [1984] and TM 5-801-1). The categories by degree of significance are:

Category I. Historic properties of **great significance** which contribute to the national cultural heritage of that installation and its environs, which should be preserved if at all possible. All Category I historic properties not currently listed on or nominated to the National Register of Historic Places are assumed eligible for nomination regardless of age and should be nominated if they are not. These properties should be documented at Level I in accordance with the Historic American Buildings Survey.

Category II. Historic properties of **importance** which contribute significantly to the cultural heritage or visual continuity (harmony) and interest of the installation and its environs, and which should be preserved if possible. Category II properties should be

treated as if they were on the National Register and nominated if they are not. These properties should be documented at Level II in accordance with the Historic American Buildings Survey.

Category III. Historic properties of **value** which contribute to the cultural heritage or visual harmony and interest of the installation and its environs, and which should be preserved if possible. These structures should receive routine maintenance and should be protected from modification. If properties are unoccupied, they should, as a minimum, be maintained in stable condition and prevented from deteriorating. They should be documented at Level III of the Historic American Buildings Survey.

Category IV. Any property that has been inventoried but does not qualify in one of the above categories at this time. These properties remain, however, in the Inventory and in the historic preservation file in order to facilitate subsequent review and possible re-evaluation of their historic significance.

As a result of the HABS report, in 1983 a HAER was completed on Picatinny which more fully documented the historically significant structures related to various industrial processes at the facility (Thurber and Norman 1983). This documentation focused on five areas: 200 Area, Shell Component Loading; 400 Area, Gun Bag Loading; 500 Area, Powder Factory and Power House; 600 Area, Ordnance Test Area; and the 800 Area, Complete Rounds/Melt Loading. The HAER report produced a number of excellent as-built drawings, schematics for various industrial processes, and intricate maps of the five areas.

Further, a draft Multiple Resource National Register Nomination for six Historic Districts at Picatinny Arsenal was prepared. The six districts were: the 200 Area, Shell Components Loading; the 400 Area, Gun Bag Loading; the 500 Area, the Powder Factory and Power House; the 600 Area, Ordnance Test Area; the 800 Area, Complete Rounds/Melt; and the Picatinny Multiple Resources Area, a large area primarily of administrative structures that runs roughly down Farley Avenue including the Cannon Gates. The six districts were cited as being eligible under Criteria A, B, C and D. The draft nomination was never finalized or submitted for consideration to the National Park Service.

These three reports seem to have been the basis for all succeeding architectural studies completed at Picatinny Arsenal.

In 1990 a Prehistoric and Historic Reconnaissance Survey of Picatinny (Fitch and Glover 1990) was published in *Army Materials Technology Laboratory Closure with Transfers to Detroit Arsenal, Michigan, Picatinny Arsenal, New Jersey and Fort Belvoir, Virginia* (Department of the Army 1990). This report, which used the past HABS/HAER reports as a basis for architectural evaluation, agreed with and passed on the 1983 HABS report conclusions related to structures and their Army categories.

At Picatinny Arsenal, only seven properties were listed as Category I, the highest and most significant level, and it was believed that two of those seven had already been demolished by the time the Fitch and Glover report (1990) was completed. Today, only three of those buildings remain: 604D, Drop Tower; 607 and 621, both Fragmentation Tub Buildings. The Drop Tower and the two Fragmentation Tub structures are located in the Testing Area (600 Area).

In 1993, WCH Industries and Boston Affiliates, Inc. prepared an *Annotated Catalogue of Building Drawings and Evaluation of Architectural Features* for 51 structures on the installation (Harrell 1993). The structures surveyed included quarters, labs, industrial facilities, warehouses, support and utilities structures and one building from the now defunct Navy rocket program. Detailed accounts of the blueprints surveyed appear for each of the structures. No architects' names are mentioned and the source of creation of the blueprint is not listed. This report recommended that all of the historic structures on Picatinny be surveyed so that future catalogs could include all components of an industrial line and so that patterns of construction and modernization could be defined.

WCH Industries and Boston Affiliates, Inc. prepared such a report in 1994 (Harrell 1994). Five hundred and twenty-seven structures, which were 50 years of age or older, were chosen from the HABS/HAER studies and then surveyed in some detail including an evaluation as to each structure's NRHP status. A massive amount of information was gathered to complete this report including fairly detailed architectural descriptions. The opinion of WCH and Boston Affiliates was that 500 buildings were eligible as contributing elements to a single historic district. At this point it seems clear that the six smaller districts, which occupy most of the installation, were simply folded into one large district making most of the arsenal's early structures eligible for the NRHP as contributing to a single district. This report did not place Picatinny Arsenal's structures within a larger U.S. military architectural and historical context. In the Army's opinion there was not enough information to support the nomination of 500 structures. Therefore, PCI was asked to reevaluate the 500 structures previously judged eligible.

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2.0 Historic Period Overview

Outlining the history of Picatinny Arsenal and the surrounding area, this section summarizes material presented in more detail in Trigger (1978), Klein et al. (1986), Rogers (1931), Fitch and Glover (1990) and Rutsch et al. (1986).

Regional Overview. Although the French, employing Florentine navigator Giovanni da Verrazano, explored the Atlantic coast of North America in 1524, the Dutch were the first Europeans to penetrate the streams and forests of what would become New Jersey. The Dutch claim to the region rested on the 1609 voyage of Henry Hudson, an English mariner in the service of the Dutch East India Company. Seeking a shorter route to the Spice Islands and India, Hudson with his ship the *Halve Maen* reconnoitered the coast of what would become New Jersey and the river that now bears his name. During his reconnaissance, Hudson and his crew exchanged goods with Native Americans in Sandy Hook Bay, but not without incident—one sailor was killed and two others were wounded when Native Americans attacked Hudson's ship. Subsequent voyages by Dutch captains established outposts in this portion of North America to advance the commercial interests of the United Provinces of the Netherlands, and included the expedition of Cornelis Jacobsen May, who sailed around the southern tip of present day New Jersey (Cape May) and explored Delaware Bay in 1614. In 1621 the Estates General of the United Provinces organized the Dutch West India Company and granted the company a monopoly to trade along the shores of the Americas for 24 years. The center of Dutch operations in North America was New Netherland, a thin band of sparsely settled territory stretched along the Hudson or North River which connected New Amsterdam at the lower tip of Manhattan Island with the frontier outposts of Fort Orange, the present city of Albany, New York, and Schenectady. From their base in New Netherland, the Dutch prosecuted the prized beaver pelt trade, competing with the English in the Connecticut River valley and the Swedes in the Delaware River valley. While the Dutch claimed both regions, only the Delaware valley would actively feel their influence (Brasser 1978:79-82; Goddard 1978:220; Bureau of Electronic Publishing, Inc. 1995: New Jersey File; Ellis et al. 1967:18-23; Burke 1991:1-18).

Loosely linked in political confederacy, subgroups of Algonquian Delaware or Lenni Lenape Indians inhabited the area that would become New Jersey at the time of the arrival of the Europeans. Neither linguistically nor culturally homogeneous, these subgroups spoke "dialects of two closely related Eastern Algonquian languages, Munsee and Unami" (Goddard 1978:213; Williams and Kardas 1982:185-187). Affirmed by the 1758 Treaty at Easton (Pennsylvania), the traditional dividing line between these subcultures was the Raritan River. The native groups north of the Raritan River, including those of the New Jersey Highlands and the lower Hudson River valley spoke Munsee dialects, while the native groups south of the Raritan, including the Delaware River valley and Eastern Pennsylvania, spoke Unami dialects. Although occupying the mountainous region of northern New Jersey-southern New York, the Minisink Delaware maintained an extensive network of trails through the mountains in order to reach the rich shellfish areas along the Atlantic Ocean (Goddard 1978:213-216, 222; Williams and Kardas 1982:186, 189-190; Kraft and Mounier 1982:139-141; Pitney 1914:2-3).

Disagreement exists among researchers concerning the derivation of the word "Picatinny." Some scholars allege that members of the Pequot tribe, displaced from their Connecticut homes by European intrusion during the late seventeenth century, settled for a time in the Highlands with subsequent intermixing between Pequot and indigenous Delaware groups (Salwen 1978:173; Kraft 1986). As a result, "[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)" (Fitch and Glover 1990:B-143). Other researchers disagree. Asserting a strict Delaware origin, one historian speculates that the word may mean either "(Body of) Water by the Hill" or "Village by the (Body of) Water," since in the language of the Delaware "Peek/Pic" means "body of water" and "Atn/Atin" means "Hill" or "Uteney/Utenay" means "Village" (Perry 1993). A third researcher suggests that the word is a "Lenape-Pequote" hybrid, meaning "'the smaller end face of the endless hill' or 'peak with broken rocks and cliffs'" (Myers 1984:7). However, all of these investigators concur that the word "picatinny" is of Native American origin.

Unlike most American colonies, the relationship between the first Europeans in New Jersey and the local Native Americans was relatively peaceful. While tensions between the Dutch and the Delaware increased during the middle decades of the seventeenth century as the Dutch population slowly grew and as competition for European trade goods exacerbated rivalries among the different Delaware groups, these conflicts tended to erupt in violence and bloodshed only along the lower Hudson River valley (Fitch and Glover 1990:B/141-143; Goddard 1978:213-216, 221). However, since both Colonial settlers and the Delaware utilized similar subsistence strategies—farming the flats along rivers and fishing in those rivers—both groups tended to regard similar areas highly for the establishment of their settlements. Therefore, as the population of European settlers increased and spread throughout the colony, especially after 1664, the Delaware were forced to move west, ultimately out of New Jersey entirely. The Delaware for the most part sold the land to the Europeans, and then migrated to some other place. At conferences held at Easton, Pennsylvania, and Crosswicks, New Jersey, in 1758, the Delaware relinquished their claims to all lands in New Jersey. However, those Native Americans who wanted to remain were assigned to a reservation on Edgepillock Creek (later, Indian Mills). Eventually, the remaining Delaware left the area, resettling in either Pennsylvania, Wisconsin or Indiana (Cinquino et al. 1996: 2/19, 49-52; Goddard 1978:222; Williams and Kardas 1982:186, 189-190; Kraft and Mounier 1982:139-141).

Although establishing several small short-lived communities in the 1620s and 1630s, including Hoboken, Pavonia (on Staten Island) and on Burlington Island in the Delaware River, and more permanent settlements in the 1640s along the Hudson valley, the Dutch population of New Netherland rose only to a meager 1,200 by 1647 (Burke 1991:2). The paucity of Dutch inhabitants and the presence of a few hundred Swedish settlers along the Delaware River contributed to the problems of the company's governors in New Amsterdam. Wouter Van Twiller (governor from 1633-1638) placed a garrison on the Delaware River to safeguard the beaver trade and protect the land from Swedish and English interlopers. In 1637 the New Sweden Company established a settlement on the Delaware River in the hope of turning a profit, but the Dutch refused to recognize the

legitimacy of the outpost. Problems with Colonial neighbors, recognized or not, also troubled notable New Netherland governor Pieter Stuyvesant (1647-1664). After New Englanders successfully established trading posts and settlements on eastern Long Island and in the Connecticut River valley, Stuyvesant feared that they would replicate this success in the Delaware valley. However, Dutch governors failed to move against the Swedes' Delaware River settlement until 1651 when the Dutch invaded the region and erected Fort Casimir. Three years later the Swedes demolished the fort, and Stuyvesant responded by sending an armada of seven ships and 650 soldiers up the Delaware, whereupon the Swedish governor surrendered. The English would not be so easily dispatched (Ellis et al. 1967:20-28; Bureau of Electronic Publishing, Inc. 1995: New Jersey File; Fitch and Glover 1990: B/141-143).

Notwithstanding the founding of their first permanent settlement in what would become New Jersey at Bergen (later, Jersey City) in 1660, Dutch proprietorship over New Netherland was abruptly terminated four years later, when forces loyal to James, Duke of York and Albany, captured the colony during the Second Anglo-Dutch War. New Netherland was renamed New York and the duke was given control over all land west of the Connecticut River and east of the Delaware River. Later, as a gift to two courtiers who had served King Charles II during the English Civil War and his subsequent exile in France, James (who was Charles' brother) awarded the land lying between the Hudson and the Delaware Rivers to John, Lord Berkeley, and Sir George Carteret. In the 1665 patent to the new proprietors, the colony was named Nova Caesaria in honor of Carteret's birthplace, the Isle of Jersey in the English Channel. Jersey is a corruption of Caesaria: "Jer" is a contraction of Caesar, while "ey" represents island—Caesar's Island—therefore, Nova Caesaria becomes New Jersey (Wacker 1982:199; Kim 1978:8-9; Divine et al. 1995:51-53; Halsey 1882:8-9; Bureau of Electronic Publishing, Inc. 1995: New Jersey File; Ellis et al. 1967:25-28; Pomfret 1964:8).

Prior to this time the areas nominally under Dutch control were practically undisturbed by European occupation. Upon Philip Carteret's arrival in 1665 to become the first governor of New Jersey, he found "a cluster of four cabins waiting for him" at the site of what would become the capital, Perth Amboy (Kim 1978:5). Six years later the region's primitive state of settlement had only slightly improved.

> An observer of the New Jersey scene commented in 1671 that there were several villages on the ocean side near the entrance of the Raritan River, but that there was not even one for about a sixty-mile [96.6-kilometer] stretch between the entrance to the Raritan and the Delaware Bay [Kim 1978:5].

Prior to the arrival of Philip Carteret, English Military Governor Richard Nicolls had allowed migrants from New England to take up farms west of the Hudson River, in what would become Essex, Union and Middlesex Counties. In exchange for the privileges of establishing an assembly and a headright system, the migrants had agreed to pay a small annual quitrent to the Duke of York. The proprietors, Berkeley and Carteret, recruited colonists on similar terms, except they assumed they would be receiving the rent money. The duke's impulsive gift had caused so much confusion that it was unclear who owned

what in New Jersey (Wacker 1982:199; Kim 1978:8; Pomfret 1964:8-10; Divine et al. 1995:51-53; Halsey 1882:8-9; Bureau of Electronic Publishing, Inc. 1995: New Jersey File).

Berkeley soon grew tired of the venture, and, in 1674, sold his share to a group of surprisingly quarrelsome Quakers. This sale resulted in the division of the colony into two separate governments, known as East Jersey and West Jersey. Carteret and his heirs tried unsuccessfully to turn a profit in East Jersey, while the West Jersey Quakers went bankrupt. In 1702, the Crown reunited the two Jerseys into a single royal colony, but, while recognizing New Jersey as an independent colony distinct from New York, forced the two colonies to share a Colonial governor from 1702 until 1738. In 1700 the population of New Jersey stood at approximately 14,000. Its residents lived on scattered, often isolated farmsteads; with villages of more than a few hundred people rare. The New Jersey Legislature considered the northwestern portion of the colony, including the study area, uninhabited in 1707 (Pomfret 1964:21; Wacker 1982:200-209; Divine et al. 1995:53; Bureau of Electronic Publishing, Inc. 1995: New Jersey File; Manning 1982:43-46, 49-53; Halsey 1882:17-18).

Local Overview. The rugged, hilly terrain of northwestern New Jersey, with its concomitant stony soil and steeply sloping topography, did not readily attract settlers who wanted to cultivate crops for their livelihood. While those agricultural activities that were conducted in the mountains probably provided generally unfavorable results for those early resident colonists, the Highland ridges were well-suited to support mining and related industrial endeavors, particularly iron working. Beginning in the early eighteenth century, the initial settlement of the Highlands, including the project area, was associated with the iron industry. Near the close of the seventeenth century, as Colonial ironmasters depleted the poorer grade ores of the coastal plains, they were forced to look to the mountains of the northwest for new sites for their iron mining and production industries (Rogers 1931:2-3; Klein et al. 1986:2-8; Fitch and Glover 1990:B/145-146). Mining is reputed to have occurred at both Mount Hope mine (adjacent to the study area) and Dickerson mine (west of the study area) as early as 1710, making these sites the oldest iron mining operations in both New Jersey and the thirteen colonies (Rutsch and van Voorst 1991:13). By 1737, the northern portion of Hunterdon County (which at that time consisted of the present counties of Morris, Warren and Sussex) had an approximate population of 1,750 whites and 70 slaves (Pitney 1914:4).

The preconditions to support the Colonial iron industry were well-satisfied by environmental conditions in the Highlands, particularly in the Green Pond Brook valley area, the future site of Picatinny Arsenal. "The Highland ridges were rich in magnetite ore and limestone; streams provided the water power sources for furnaces and forges; and the heavy timber cover could be converted to charcoal for fuel" (Fitch and Glover 1990:B/145-146; Halsey 1882:40; Klein et al. 1986:2-8; Rutsch c.1995:6-8, 13-18; Wacker 1982:210). Moreover, since the need for charcoal was constant and substantial, early furnaces and forges in the Green Pond Brook valley were situated on extensive tracts of land. In 1772, Jacob Ford's Mount Hope tract measured 6,271 acres (2,508 hectares) (with exceptions), while his Denmark Tract measured 6,231.21 acres (2,493 ha) (Rutsch c.1995:6-7; Pitney 1914:159; Halsey 1882:41, 53, 334-335; Pope 1945:69-74; Cinquino et al. 1996:61-62).

The Colonial iron industry in the study area involved several stages of production: ore procurement or mining; the separation of iron from slag through smelting, where the iron was processed into pigs or cast into molds; and the making of wrought iron bars or marketable products in forges. More frequently, these three stages occurred as distinct units and at separate locations, although these processes could be managed under a common owner (Pope 1945:69; Rutsch et al.1986:22).

Highlands iron working communities included not only industrial structures, such as furnaces, forges, bloomaries, coal houses and charcoal kilns, but ancillary residential and commercial structures, as well. Tradition and the difficulties of transportation demanded that ironworkers live in close proximity to their place of work, especially in the northern wilderness. Often isolated from established towns and roads these settlements became self-contained communities, suggestive of company towns more firmly established during the post-Civil War years. Ironworkers leased houses from the forge or mine owner, were given credit at a company store or paid in scrip. Settlements associated with the operation of a blast furnace have been referred to as "iron plantations." Furthermore, other commercial enterprises, like taverns, stores and mills (both grist and saw), were established near the workers' houses and the ironworks. Later, in order for bar iron and other finished iron goods to get to their eastern markets major roads would be sited in close proximity to the ironworks and other major regional trade routes (Pope 1945:75; Fitch and Glover 1990:B/145-146; Halsey 1882:40; Klein et al. 1986:2/8-9; Rutsch and van Voorst 1991:13; Dulles and Dubofsky 1984:Chapter 1; Rutsch c.1995:12-13; Cinquino et al. 1996:2/58-62). Moreover, WES argues that,

> Unlike other regions of British controlled North America, the New Jersey Highlands were an industrial frontier of the British Empire, fully integrated within the trans-Atlantic economy [due to the region's importance as an iron manufacturer]. The site's economic system, transportation network, and settlement pattern were all developed within an industrial, not an agricultural, framework. Roads were constructed to bring iron ore and charcoal to forge sites. Settlements were located at waterpower sites and consisted primarily of industrial structures and housing for workers [1995:70].

During the mid-eighteenth century three forges were established either near or within what would become the Picatinny Arsenal reservation. These ironworks were:

- Mount Pleasant Forge, founded in 1748 and subsequently known as Lower Forge;
- Picatinny Forge, founded in 1749 and called Middle Forge after 1772; and
- Burnt Meadow or Denmark Forge, founded in 1750 and known as Upper Forge.

Although there is little agreement about the structures that may have existed at these forges (Klein et al. 1986:2-10; Fitch and Glover 1990:B-150; Rutsch c.1995:10-19), Halsey suggests that these sites were "bloomary forges," where charcoal, ore and limestone were shoveled into a furnace to create a "bloom" or semi-molten mass of metal and slag. While still hot, this mass was hammered to remove the slag and produce wrought iron (Halsey 1882:48-56; WES 1995:71). Rutsch et al. adds: "A forge is always a place where iron is

heated and then worked with a hammer" which produces wrought iron by extruding its slag (1986:41).

An important element to the successful operation of these establishments was that the necessary raw materials—iron ore, limestone and charcoal—could be found nearby. The Mount Hope and Hibernia mines were located in the hills just east of these forges, while previous research has uncovered at least two limestone extraction pits within the arsenal and several charcoal kilns adjacent to the arsenal (WES 1995:68-71; Rogers 1931:7; Fitch and Glover 1990:B-150; Sandy and Rutsch 1992:69; Rutsch et al. 1986:184-186; Cinquino et al. 1996:2-65).

The early agriculturalists of the Colonial-era Highlands consisted of Dutch, English, Scotch-Irish, German and Swiss homesteaders, whose valley settlements have been characterized as comprising a pattern of dispersed rural residences and functional outbuildings (barns, sheds, and smokehouses) utilizing a subsistence economy of animal grazing and limited crop production (Fitch and Glover 1990:B-145; Manning 1982:44, 56; Wacker 1982:211). For industrial activities, the type of work associated with iron extraction and production industries attracted German and Irish Roman Catholics to the region, groups not common "to the Mid-Atlantic region during the Colonial period" (Klein et al. 1986:2-9; Wacker 1982:210-211). These endeavors also utilized slaves in the performance of the heavy, labor intensive work of Colonial furnace operations (Pope 1945:69).

European penetration of the area that would become Morris County occurred from both the east and the south. The first actual settlement by Europeans probably occurred in the northeastern portion of the future Morris County, near what is now Pompton Plains. In June 1695, Dutch speculator Arent Schuyler and his associates purchased from the Indians "all the territory lying between the Passaic [River] on the south and the Pompton [River] on the north, and between the foot of the hills on the east and [those] on the west" (Halsey 1882:19). Moreover, the proprietors of West Jersey began to divide their large land tracts among themselves beginning around 1710:

> William Penn, John Reading, William Biddle, John Kays and others took up tracts of at least 1,200 acres [480 ha) in West Jersey as far east as Morristown, but not further north than Budd's Lake and Dover or Rockaway valley. The country north of these places seeming to these early speculators too forbidding and unpromising for their purposes [Halsey 1882:19, 40].

Despite tract ownership by connected speculators, mines were reputed to have been worked in what would become Morris County as early as 1685, and in 1719 a mine was discovered that was alleged to have been worked by early Dutch squatters (Halsey 1882:15, 18-19; Pitney 1914:3).

Dating to 1710 and reputed to be the oldest mine in the United States, Mount Hope mine was purchased by ironmaster Jacob Ford in 1750, and later acquired by ironmaster John Jacob Faesch in 1772 (Halsey 1882:53; Fitch and Glover 1990:B-146; Acroterion 1986/87:1, Form #1435-035). In 1714, John Reading, one of the proprietors, began to exploit a tract embracing Dickerson mine for its minerals. He sold this tract to Joseph

Kirkbride two years later. The first iron forge at what would become Dover was erected in 1722 by John Jackson. The alleged site was still referred to as Jackson's Brook as late as 1882. Jackson purchased 527 acres (211 ha) of land from Joseph Latham, which included considerable property to the west of Dover. The financially unsuccessful forge and associated farm were divided and sold to Josiah Beman and Hartshorne Fitz Randolph, respectively, in 1757 (Halsey 1882:39-40, 314; Rogers 1931:4).

The iron industry would expand into the Green Pond Brook valley when Jonathan Osbourne (various spellings) established one of the earliest forges in New Jersey in 1749 at the southern end of what is now Picatinny Lake. Within the boundaries of what is now Picatinny Arsenal, Osbourne's ironworks was called Picatinny Forge, but later became known as Middle Forge. Osbourne may have used ores from the nearby Mount Hope mine (Klein et al. 1986:2-10; Rogers 1931:7; Halsey 1882:41). Establishing his forge at the foot of Picatinny Peak near Green Pond Brook, Osbourne created Picatinny Lake by damming the brook for his forge. Machinery and other implements from Middle Forge are on display at the arsenal museum (Rogers 1931:6; Myers 1984:7; WES 1995:71). The following year (1750), Colonel Jacob Ford, Sr., owner of Mount Hope mine, established a forge at Mount Pleasant. Since this forge was south of Osbourne's forge it was sometimes referred to as the Lower Forge. South of the project area, the Mount Pleasant Forge site is reputed to be in the vicinity of a "Gulf" gas station near the intersection of Route 15 and Route 80 (WES 1995:70; Rutsch c.1995:12). Also in 1750, Ford, a leader in the Colonial iron working industry in New Jersey, constructed a dam on Burnt Meadow Brook, creating Lake Denmark in the process, in order to erect another forge. Subsequently located near the southern end of Lake Denmark, this forge is referred to as the Upper Forge, or, later, as John Harriman's Iron Works or Burnt Meadow Forge (Fitch and Glover 1990:B-146; WES 1995:71; Klein et al. 1986:2-9). Jacob Ford, Jr., who would continue the family business of owning numerous iron operations in the Green Pond Brook valley, reacquired Middle Forge in 1772 (Fitch and Glover 1990:B-146; Rogers 1931:6-7; Halsey 1882:41; Cinquino et al. 1996:2/61-63).

Playing a leading financial role in the development of the northern New Jersey iron industry, the London Company (sometimes referred to as the American Iron Company) dispatched John Jacob Faesch and Peter Hasenclever to the colonies in 1764 to create three "iron plantations" (furnace and forge) in the resource rich New Jersey Highlands—at Charlotteburg (overseen by Faesch), Ringwood and Long Pond (Klein et al. 1986:2-10; Rutsch and van Voorst 1991:13; Fitch and Glover 1990:B-146). After a falling out with company management, Faesch, a Swiss, left the London Company and began to dominate the valley's iron industry. Southeast of the future arsenal near the village of Dover, he established the Mount Hope Furnace in 1772. Also in 1772 Faesch purchased a large tract of land in the Green Pond Brook valley from East Jersey Board of Proprietors. This 5,192.2-acre (2,077 ha) tract included 2,079.33 acres (932 ha) of "mountainous woodland" north of the road to Middle Forge (Mount Hope Road). Of the remaining property, much of the land south of the future Mount Hope Road had been stripped of timber. Moreover, numerous parcels were excluded from Faesch's control since they had been previously occupied (Without exemptions, the total lot size would have equaled 6,271 acres [2,508 ha].) (Rutsch et al. 1986:46). After demolishing two standing mills (a grist and a hemp mill)

to construct the Mount Hope furnace on the best location for water power, Faesch increased his holdings by renting contiguous properties from Jacob Ford, Jr. (Rutsch et al 1986:46-48; Fitch and Glover 1990:B-146, B-150). He purchased Middle Forge from the Ford heirs in 1778 as well as over 1,900 acres (760 ha) of forested land adjacent to his forges. Faesch, like the Fords, Sr. and Jr., before him, acquired other forges in the Green Pond Brook valley as well as the Mount Hope mine. Moreover, he operated his forges, including Middle Forge, in conjunction with Mount Hope mine until his death in 1799 (Fitch and Glover 1990:B-150; Rutsch et al. 1986:49; Klein et al. 1986:2-10; Rogers 1931:7; Halsey 1882:41, 53).

Faesch's various iron works played an important role in the American War for Independence by providing the Continental Army with iron matériel, such as "cannon, shot, bar iron, shovels, axes and other iron implements" (Myers 1984:7). George Washington visited the ironworks at Mount Hope, and approved the transfer of a number of Hessian prisoners to Faesch in order to work at the facilities (Myers 1984:7; Fitch and Glover 1990:B-150; Rogers 1931:5; Rutsch et al. 1986:48; Klein et al. 1986:2/9-10; Rutsch c.1995:21). Within the arsenal's boundaries, the Walton Family Cemetery (known alternatively as the Walton Burial Ground or the Hessian Cemetery) lies near Picatinny's Mount Hope gate and is reputed to contain graves of several of the Hessian prisoners. Since most of the graves in the cemetery are marked with field stones, following early custom, the Hessian connection is extrapolated from prisoner work at the local forge and those Hessians who remained in the area after the war's conclusion. Additional reports allege that three other Revolutionary War veterans, besides Peter Doland, are buried there, as well as a possible Civil War veteran, whose grave is unknown (Historical Office n.d.:Item 19; Rutsch et al. 1986:41, 55; Rogers 1931:7-8).

Known as the Denmark Tract (the location of the subsequent mid-1850s L. Bruden sawmill), Jacob Ford, Jr.'s tract contained 6,231.21 acres (2,493 ha) and was located west of Mount Hope and east of Green Pond Mountain (or right in the middle of the Green Pond Brook valley). Sources report that the property was "returned to Courtland Skinner and John Johnson" on 21 June 1774 (Halsey 1882:334; Rogers 1931:5), although Skinner and Johnson appear to have purchased this tract for Jacob Ford, Jr. (Sandy and Rutsch 1992:43). The substantial tract included Mount Pleasant, Washington Forge, the Spicer properties, Middle Forge and Denmark lands, and remained in the Ford family until 1806, when it was purchased by Benjamin Holloway who rebuilt the abandoned forge. The historical records are unclear regarding the relationship between Ford's Denmark Tract and Faesch's Tract, which, upon initial review, seem either to overlap or to be contiguous.

In any event, properties within the Denmark Tract changed hands often during the next seventy-five years. In 1818 Holloway sold the property to George Stickel, who, in turn, sold it to John Hardy in 1829. Twelve years later, in 1841, Hardy sold the Denmark Forge property, which contained almost 2,658 acres (1,063 ha), for $7,000 to John Eddy with several exceptions. Ernest Fielder acquired the Denmark Forge complex in 1858 from Edward R. Biddle, who owned Mount Hope at the same time (Sandy and Rutsch 1992:46-51; Halsey 1882:45, 334).

Upon Faesch's death in 1799, his sons, John Jacob Faesch, Jr., and Richard B. Faesch, inherited the extensive Faesch iron holdings. After several years of unprofitabilty and his brother's death, Richard B. sold the properties to Moses Phillips in 1809. Phillips sent his sons, Henry Wisner Phillips and Lewis Phillips, to the Highlands to manage his properties. While the Phillips siblings purchased additional properties in the area, they operated old Middle Forge under the name of Aetna Forge until 1839, when the forge was purchased by Jacob Righter. The property was owned by George E. Righter, Jacob's son, from 1853 until the U.S. Government purchased it in 1879. The forge's fire had been long extinguished by that time (Fitch and Glover 1990:B-150, B-154; Rogers 1931:5-6: Rutsch et al. 1986:59).

The area Picatinny Arsenal now occupies was initially part of Burlington County, when counties were first created for West Jersey in 1694. Later, about the same time that the Rockaway area began to be settled (c.1714), the area was reclassified as part of Hunterdon County. Finally in 1739, the area was included in Morris County, named in honor of Lewis Morris, then Colonial governor of New Jersey (the first governor after New Jersey's political separation from New York). During the initial municipal division of the county in 1740, the project area was included within the boundaries of Pequannock Township, which had been informally organized in 1720 within Hunterdon County. Created in 1844, the present Township of Rockaway was hewn from the Townships of Pequannock and Hanover. The southern portion of Rockaway was removed in 1913 to form the Town of Denville (Halsey 1882:20; Pitney 1914:5-6, 158; Rutsch and van Voorst 1991:11-12; Fitch and Glover 1990:B-145).

The nascent system of trails and paths active prior to the Revolutionary War connected the various valley forges and furnaces with regional mines, and facilitated communication with Morristown. In use by the mid-1750s, Mount Hope Road connected Middle Forge with David Beman's White Meadow Forge (east of the project area). Snake Hill Road was also active at this time linking the mines of Hibernia with Denmark or Upper Forge. Another pre-Revolutionary War road connected the Mount Hope mining complex to Snake Hill Road near Denmark. As iron working industries in the Green Pond Brook valley became more extensive, the network of roadways developed in turn, linking the prominent forges. By the beginning of the nineteenth century, the Mount Hope-Denmark Road was an important north-south artery, while the east-west route connected Middle Forge and Mount Hope. Communication and trade with communities south of the project area was facilitated by a road along the Green Pond Mountains between Middle Forge and Dover (Rutsch et al. 1986:41; Fitch and Glover 1990:B-151; Rogers 1931:7-8).

After the Highlands was organized into counties and townships developers sought to link the area with the rest of New Jersey. Opening in 1801, the Morris Turnpike connected Elizabethtown to Morristown, allowing for increased access and trade to the sparsely populated uplands (Halsey 1882:66). The Union Turnpike (now Route 15 and the present road between Spicertown and the arsenal) connected Morristown to Sparta, Sussex County, through Dover and Mount Pleasant and was the first turnpike established in the vicinity of the project area (c. 1805) (Fitch and Glover 1990:B-151; Rogers 1931:7; Halsey

1882:66). Further, the Mount Hope and Longwood Turnpike (after 1815) traversed part of the arsenal before going over Green Pond Mountain to Longwood valley (Rogers 1931:7).

As one might expect, nineteenth century settlement within the area that would become Picatinny Arsenal occurred along the nascent road system and in the vicinity of two forge locations. While most of the population of the valley was situated south and east of future arsenal property at such villages as Rockaway, Hibernia, and Dover, a small settlement emerged called Denmark to serve the iron community near that lake, and groups of structures clustered near Picatinny Lake (then known as Lake Clifford) as well as the Mount Hope mining complex. Several farmsteads were also scattered throughout the level areas of the Green Pond Brook valley (Fitch and Glover 1990:B-151, B-154; Rutsch et al. 1986:30, 32). The population of the Township of Rockaway vacillated with the swings in the economic health of the iron industry. After the township was established in 1844, the population rose steadily until the area was purchased by the United States government in the early 1880s, rising from 3,139 to 6,445 between 1850 and 1879. In 1882, the population reached its nineteenth century zenith of 7,366 (Fitch and Glover 1990:B-151, B-154).

Despite a depletion of forest timber (and subsequently charcoal), which began in the 1820s and contributed to the volatility of early nineteenth century iron markets, Middle and Upper Forges continued to operate until the 1850s. Other factors reflecting the general volatility of the industry included the frequent ownership changes detailed above and a continuous pattern of forge shut-downs and start-ups (Klein et al. 1986:2-10). On the other hand, providing new blood to the region's sclerotic economy, the Morris Canal was built between 1825 and 1831. Passing just south of the project area through Rockaway and Dover, the canal connected Jersey City on the Hudson River to Phillipsburg on the Delaware River by 1865. Constructed to carry cheap coal from Pennsylvania to the industrial centers developing along the coast, the canal also provided coal to fuel the iron forges and furnaces of the Highlands, replacing the depleted timber supply. While anthracite coal traveled east, ore from the New Jersey Highlands was shipped westward in great quantities to newer furnaces constructed in Pennsylvania near the Delaware River (Klein et al. 1986:2-11; Rutsch et al. 1986:65-66; Halsey 1882:68-69; Fitch and Glover 1990:B/150-151).

Another important economic development supporting the continued growth of the iron industry was the development and proliferation of railroads during the middle decades of the nineteenth century. The Morris and Essex Railroad (incorporated in 1835 to connect Morristown with Newark and Elizabethtown) effectively replaced the Morris Canal by 1865 as the chief method of freight shipment. Spurs from the main route went to Rockaway and Dover by 1848 (Halsey 1882:69-70; Rutsch et al. 1986:75; Acroterion 1986/87:Form #1435-035).

> In 1866, the Mount Hope Mineral Railroad was chartered with authorization to build a line from the mines [at Mount Hope] to Port Oram [now the Borough of Wharton] which included connections with the Morris & Essex Railroad [later Delaware, Lackawana & Western Railroad]

and Morris Canal. This route allowed access to other important mines . . . and by 1867 to Hibernia [Acroterion 1986/87 Form #1435-035; see also Rutsch et al. 1986:75; Halsey 1882:358].

By 1873, the mines of the Mount Hope Mining Company were excavating over 100 tons of iron ore annually (Rutsch et al. 1986:78). However, the Panic of 1873 and subsequent depression of the mid-1870s nearly killed all mining activities for the rest of the decade (Rutsch et al. 1986:79).

Other railroad lines in the vicinity of the project area included: an 1874 line from Charlotteburg south to the Green Pond Iron Mining Company's Copperas Mine, which went bankrupt a year later (Klein et al. 1986:2-11; Fitch and Glover 1990:B-155); the Wharton and Northern Railroad which traversed the arsenal in the 1880s (Rutsch c.1995:28-30); and a line constructed by the Morris County Railroad Company in 1887 through Picatinny Arsenal, which connected the Delaware, Lackawanna & Western Railroad and the Central Railroad of New Jersey at Wharton with the Erie Railroad at Green Pond Junction (Rogers 1931:53-54).

With the discovery of iron ore in the Mesabi Range in Minnesota and cheaper Lake Superior shipping, the Highlands iron industry was doomed. Even during the industry's most productive years, other economic endeavors began to emerge in the Green Pond Brook valley. Historic maps increasingly reveal farmsteads in the region after the Civil War, although the settlement pattern throughout the valley remained dispersed along existing roadways and clustered at the southern ends of Picatinny Lake and Lake Denmark (Rutsch c.1995:26-27; Fitch and Glover 1990:B-151, B/154-155; Acroterion 1986/87:4; Sandy and Rutsch 1992:34-37). As transportation networks improved access to iron industrial sites beginning in the 1830s, the salubrious environment of the Highlands began to become attractive as a setting for summer resorts and vacation get-aways. Klein et al. note that in 1844 a contemporary account of the Green Pond area included bucolic descriptions of a resort "abounding in fish, and surrounded by wild, romantic scenery" (1986:2-11). Rutsch adds, "The forge ponds made excellent swimming ponds, and soon the stops on the rail line were used by patrons of summer boarding houses, hotels and cottage communities" (c.1995:30). Moreover, by 1876 the Denmark Land and Improvement Company had purchased land around Green Pond and was building roads to develop the residential potential of that area. By the middle of the 1880s, those plans had been abandoned (Sandy and Rutsch 1992:45-46; Halsey 1882:358-359; Rogers 1931:8; Acroterion 1986/87:4-6; Cinquino et al. 1996:2/64-66).

By the start of the twentieth century, only 20 iron mines in the Highlands were in operation, including the Mount Hope Mine, which had passed to the control of the Empire Steel & Iron Company. The decline of the iron industry continued through the twentieth century, and resulted in a continual ebbing of the region's population over the next forty years (Fitch and Glover 1990:B-155; Sandy and Rutsch 1992:37). By 1882 the Denmark Forge was no longer in operation and was followed into inactivity five years later by the Denmark Mine (Sandy and Rutsch 1992:53). The U.S. Army founded Picatinny Powder Depot in 1880 and provided a major shift in the area's economy and land use. The southeastern portion of Lake Denmark was later occupied by the U.S. Navy, which maintained a munitions depot there as well as a detachment of Marines. As the profitability

of the iron industry declined after 1880, the population of the region declined in tandem, to a low of 2,423 in 1940 (Fitch and Glover 1990:B-155; Rutsch et al. 1986:27-29, 35). While the Highlands lakes continued to be popular as resorts and vacation spots, the area around Picatinny Arsenal became attractive to suburban development with improvements in the automobile and the region's transportation infrastructure. Population surged following World War II with the construction of Interstate Routes 80 and 287, the development of suburban residential communities and ancillary commercial construction. The population of Rockaway Township rose from 4,418 in 1950 to nearly 20,000 by 1980 (Fitch and Glover 1990:B-155; Rutsch c.1995:30-31).

Picatinny Arsenal. Established on 6 September 1880 as the Dover Powder Depot by Special Orders No. 189 under the command of Major Francis H. Parker of the Ordnance Department, Picatinny Arsenal's initial purpose was the storage of "powder, projectiles, and explosives, both for reserve supply and for issue; also for the preparation and issue of these stores" (Rogers 1931:53). A Board of Ordnance Department Officers chose the Green Pond Brook valley near Dover as the location of the depot based on several criteria: the site had to be a sparsely populated region near New York City, capable of storing a large amount of powder, and, accessible by train (Acroterion 1986/87:3-4; Fitch and Glover 1990:B-160; Rogers 1931:10). Once the site was selected on 28 February 1880, the Ordnance Board began purchasing land in the valley, which included both wooded hillsides and level valleys. Between 1880 and 1881 the government acquired 1,866.12 acres (746 ha) from various owners for a total of $62,750, or about $34 per acre. Table 1 depicts the initial land purchases in the Green Pond Brook valley for the creation of Picatinny Arsenal. After Major Parker requested that the installation's name be changed, the new depot became Picatinny Powder Depot on 10 September 1880 with construction beginning six days later (Fitch and Glover 1990:B-160; Rogers 1931:10-11).

Table 1. Initial Land Purchases for Picatinny Arsenal (Source: Rogers 1931)

Property Owner	Amount of Purchase (in acres)(in ha)	Amount Paid	Date
George E. Righter (Middle Forge)	1,195.8 (478.3)	$35,874.00	26 June 1880
Uel H. Wiggins & wife	167.32 (66.9)	$ 8,500.00	17 July 1880
Edward C. Fielder et al. (Denmark)	304.2 (121.7)	$ 9,126.00	30 July 1880
Henry and Michael Doland	11.0 (4.4)	$ 750.00	20 August 1880
John E. Kindred	187.8 (75)	$ 8,500.00	5 March 1881
Lewis H. Spicer & wife	8.5 (3.4)	$ 200.00	12 May 1881
Morris County RR	9.3 (3.7)	$ 1.00	1 February 1887

Note: 315 acres (126 ha) transferred by depot to Navy Department on June 9, 1891.

Between 1880 and 1890, construction activities focused on the erection of storage magazines, officer's quarters, and service facilities. The first powder storage magazine was completed in 1881 with the storage capacity of 10,000 pounds (4,500 kilograms) of black powder. With four powder magazines completed by November 1886, the depot received its first shipment of powder (300,000 pounds [135,000 kg]) for storage later that month (Klein et al. 1986:2-12; Fitch and Glover 1990:B-164). To facilitate access to the installation and the general shipment of freight, the Morris County Railroad began building a rail line through the depot in 1886. By 1887, 23½ miles (37 km) of track traversed the powder depot and connected it to the Delaware, Lackawanna and Western Railroad and the Dover Central Railroad of New Jersey at Wharton. A privately owned line called the Northern and Wharton Railroad also ran through the arsenal and maintained five associated stations. By then, 70 men were employed at Picatinny and 900,000 pounds (405,000 kg) of powder were stored at the facility. From 1893 until 1907, the facility was known as the United States Powder Depot (Klein et al. 1986:2-12; Fitch and Glover 1990:B/164-166; Rogers 1931:53-54, 71; Rutsch c.1995:28, 30).

In June 1891, 315 acres (126 ha) of Picatinny Powder Depot land near Lake Denmark were ceded to the Navy for the establishment of a Navy powder depot. (This area is now part of Picatinny Arsenal.) After vacating its powder magazine on Ellis Island in New York harbor, the Navy utilized the Lake Denmark facility as its primary depot on the east coast. Storing powder, ammunition, high explosives and artillery shells, the Lake Denmark Powder Depot was enlarged when the Navy acquired over 146 additional acres (58 ha) in two purchases in 1902. By 1892 a shell house, a storage magazine and three residential structures were complete (Rogers 1931:29-31; Klein et al. 1986:2/12-13; Fitch and Glover 1990:B/166-168; Harrell 1994:6).

Historical development within Picatinny Arsenal has been concentrated in the areas south and east of Picatinny Lake, which included most of the areas initially purchased by the federal government in 1880-1881 (Rogers 1931:58-61, 77; Harrell 1994). Construction phases at the arsenal dovetail with the installation's manufacturing activities and changes in the arsenal's mission over time (WES 1995:73). The initial phase of development covers the Depot/Storage period from 1880 until 1907, when powder storage and increasing involvement in the assembly of cannon charges were the facility's primary mission. In 1897, workers at the depot assembled powder charges which included manufacturing and filling the storage bags. Between 1902 and 1906 armor-piercing shells were assembled at the depot. This process involved filling projectiles with explosives, such as Maximite and Explosive "D" (Rogers 1931:54; Fitch and Glover 1990:B-168; Harrell 1994:6; Klein et al. 1986:2-13).

A major change in the installation's mission occurred in 1907 with the construction of the first Army-owned smokeless powder factory. This activity resulted in the redesignation of the depot as Picatinny Arsenal, and marks the beginning of the arsenal's important manufacturing phase, which continued until the early years of World War II (Rogers 1931:54-55; Klein et al. 1986:2-13; Fitch and Glover 1990:B/168-169). Manufacturing

increased gradually in the years before World War I as Congress approved continual expansion of the arsenal's production facilities. Picatinny Arsenal maintained sole responsibility for the assembly of fixed ammunition over .50 caliber by 1909. By 1913 the arsenal was operating a plant for the manufacture of Explosive "D," which was used in armor piercing projectiles. An Officer's Training School was established in late 1911 to provide training in chemistry, explosives and ballistics, as well as ammunition manufacturing processes (Rogers 1931:55-56; Klein et al. 1986:2-13; Fitch and Glover 1990:B-169). With the entry of the United States into World War I Picatinny Arsenal saw a rapid development of its physical plant both around Picatinny Lake and Lake Denmark to meet the exigencies of preparing for war and to accentuate its storage capabilities. During this time the development of the arsenal as a research and administrative installation also began as the arsenal provided technical assistance to the private sector producing explosives for the war effort. During the 1920s, munitions experimentation and training had replaced powder production as the arsenal's mission, foreshadowing the later expansion of the facility into a complete ammunition arsenal (Rogers 1931:54-55; Fitch and Glover 1990:B-170; Harrell 1994:7).

While the Ordnance Department was transforming Picatinny Arsenal into a center for explosives research and development through an intensive renovation and construction program, the Navy was constructing additional powder storage magazines at its Lake Denmark installation. On Saturday afternoon, 10 July 1926, lightning struck the 461-acre (184-ha) Lake Denmark Powder Depot, causing a series of fires and explosions throughout the southwest end of the depot. These explosions killed 19 people, including eleven Marines fighting the fires, and sent shock waves throughout the Green Pond Brook valley, destroying everything within a 3,000 foot (915 m) radius of the epicenter. Outside this 3,000 foot (915 m) radius many structures were severely damaged both within the Navy depot and the adjacent Picatinny Arsenal and among the nearby non-military residences (Rogers 1931:Chapter IX; Fitch and Glover 1990:B/171-174; Klein et al. 1986:2/13-14).

Once the fires were extinguished, the Navy appointed a Court of Inquiry to investigate the incident which led to changes in safety and ammunition storage procedures and standards. Since Picatinny Arsenal stored material similar to that stored by the Navy at Lake Denmark and had been damaged by the explosions, a board of Army officers also investigated the incident. This commission recommended that Picatinny Arsenal not only be reconstructed but enlarged for the purpose of consolidating the Army's ordnance activities in northern New Jersey. Devised with the safe handling of explosives as a top priority, plans for rebuilding Picatinny Arsenal called for the division of the arsenal into zones based on the function or activity occurring in that zone (Klein et al. 1986:2-14; Rogers 1931:94-96; Fitch and Glover 1990:B/174-176). These functional zones were:

1) powder and explosives production and handling;
2) powder and explosives storage;
3) powder and explosives testing; and,
4) non-hazardous manufacturing, and offices for administration and research (Rogers 1931:94).

Between 1927 and 1937 both the Navy Powder Depot and Picatinny Arsenal were completely rebuilt. With rehabilitation nearly complete in 1931, Picatinny became not only the major ammunition arsenal of the U.S. Army but was an important center of ammunition research, development and manufacturing. At the onset of the Second World War, Picatinny Arsenal contained 567 buildings and produced smokeless powder, high explosives, primers and fuses, assembled artillery rounds, bombs, grenades, and pyrotechnics (flares and signals) (Fitch and Glover 1990:B/177-180; Harrell 1994). While expanding production capabilities to meet the munitions requirements of fighting a two-front war, Picatinny continued to conduct research on tetryl manufacturing and nitrocellulose powder. The arsenal also provided explosives and powder production training to both civilian and military personnel. During the war Lake Denmark Powder Depot continued to operate as the Navy's propellant and projectile storage area (Fitch and Glover 1990:B/179-183). Several sources suggest that the 340 Area of the Lake Denmark Depot was built to house prisoners-of-war, but no evidence has been located to document whether POWs were ever held there (Fitch and Glover 1990:B-183; Shankle, personal communication 1995).

The post-war years were marked by both the Cold War and hot wars in Asia and the Middle East. During this period, Picatinny Arsenal continued as a center for research and development for new weapons systems and advances in the production process. Innovations in production processes had occurred consistently at the arsenal over its history and included the development of the explosive Haleite and advances in artillery fuses, grenades and pyrotechnics during World War II. These types of innovations increased after the war and included the development of photoflash cartridges and bombs, the study of plastics and adhesives in the packaging of ammunition, the research on warheads for the Nike nuclear missile and other missile programs, and the production of a tank-piercing rocket for the 3.5-in bazooka and an atomic shell for the 250mm gun (Fitch and Glover 1990:B/182-184).

In 1948, the Lake Denmark depot became home to the Navy's east coast rocket engine test center. The facility was called the Naval Aeronautical Rocket Laboratory, but was renamed the Naval Air Rocket Test Station (NARTS) in April 1950. The NARTS was established for the testing and evaluating of "rocket engines, components and propellants, and training service personnel in handling, servicing and operating rocket engines" (Department of the Navy 1999b). The Navy subcontracted with private industry to accomplish these goals. Founded in 1941, Reaction Motors, Inc. (absorbed by the Thiokol Corporation in 1958) was one of these companies and their work led to the development of both the XLR-II and the XLR-99 engine. Tested at Lake Denmark, the XLR-99 liquid rocket engine was the first large, throttle-able, restartable liquid propellant rocket engine. The XLR-99 was used for the X-15, the experimental hypersonic aircraft, and a preliminary design for the Space Shuttle called for its use (Historical Office 1984:23; Harrell 1994:8; Department of the Navy 1999a, 1999b, 1999c; Thiokol Propulsion 1999; Jenkins 1996:9-11, 40-41). "The X-15 program contributed significantly to the U.S. manned space program in general, and was the only existing database on winged manned reentry vehicles

available when the development of the Space Shuttle was begun in the 1970s" (Jenkins 1996:11). Decommissioned by the Navy, the Lake Denmark installation reverted to Picatinny Arsenal in August 1960.

By 1977 most production of weapons and ammunition had ceased at Picatinny Arsenal and its activities focused on research and development. Today, over 1,000 buildings are spread out over the arsenal's nearly 6,500 acres (2,600 ha), making Picatinny Arsenal "the largest Army installation devoted solely to research and development" (STV/Lyon Associates, Inc. 1994:1.2.2; Cinquino et al. 1996:2/66-67).

MILITARY ARCHITECTURE

The military services have always had a need for structures related to the efficient functioning of a standing army and naval force. The construction of basic administration buildings, stables, repair facilities, docks, barracks and small manufacturing concerns were vital for a successful defense. The architectural style of these structures mirrored those of the greater civilian community. A survey of military bases today shows a wide range of architectural styles reflective of changing times. As the services grew in size and number, the need for standardized building plans became apparent. Standardized plans for all types of construction would ensure that the military was building from adequate plans, with the appropriate materials at a price that the general tax paying public might find palatable as well as one that would not bankrupt the services.

Warfare in the twentieth century presented the services with new and special problems. The global nature of WWI illustrated the need to be able to sustain a lengthy world-wide war in which the creation and movement of supplies played the most significant role. Having many well-trained troops was not enough, these troops had to have supplies—food, basic shelter and most importantly, weapons and ammunition. Since the military itself could not create the necessary numbers of supplies involved in such a war, it formed alliances with the industrial community to assist in meeting the needs. World War II proved to be the ultimate test of that alliance calling on the industrial community to create new and specialized weaponry and ammunition in buildings especially designed for the military many on military installations.

During World War II, War Department propaganda posters declared that "Industrial Lines are Battle Lines!" At facilities like Picatinny Arsenal, the industrial battle lines operated twenty-four hours a day, every day for the duration of the war. Many military installations were created only to produce supplies and rarely ever saw a soldier. This creation of a military industrial complex highlighted a new phase in the development of military architecture and one that would forever mark the face of growth at Picatinny.

During the 1930s, the Army had created a set of standardized plans, called the 700 Series, for a number of typical structures that it would be required to build during the event of war. Based in part on the inadequate 600 Series of WW I, the new blueprints for

structures as varied as barracks, chapels, warehouses, and movie theaters incorporated the more modern requirements of an Army such as indoor toilets, heating, and a concern for the sheer numbers of solders using any type of facility. The industrial end of military building was not as fully addressed since in the past any industrial needs had been met by private contractors. When it became clear that private contractors alone could not produce the materiel necessary for running a global prolonged war, the Army began to consider construction of industrial government owned facilities to be operated by the private sector. This was considered a fortuitous marriage since the military could not keep specialized scientists and engineers on staff the way the private industry could. However, by using private industry as a contractor at a government facility, the military could make use of the firm's expertise and workers.

Contemporary American industrial architecture and international trends in design all influenced the construction of military industrial buildings. Steel and reinforced concrete were used as building materials in industrial architecture and contemporary innovative designs. These new materials were cost effective, resistant to sway, and capable of supporting heavy loads. New structural support systems replaced massive load-bearing masonry walls that had been a part of industrial architecture since the nineteenth century. New technology made possible the uninterrupted clear spans associated with modern industrial buildings (Cannan et al. 1996).

During the Protective Mobilization in 1939, private industry and the military came together to design prototypical industrial structures for very specialized materiel production. Picatinney Arsenal and Edgewood Arsenal became testing grounds for new industrial buildings and processes related to chemicals and ordnance. These two arsenal's experiences combined with the building plans from the private sector were the basis of military industrial building design.

Also during the Protective Mobilization period, it was believed that industrial facilities would be of permanent construction much like private sector factories. Permanent in this case refers to buildings that have a 25-year life span. Functional design was the top priority for industrial facilities thereby determining the basic architectural and engineering design. Levin Campbell, Chief of Ordnance from 1941 to 1942, declared that "the object of building plants [was] to produce munitions required to win the war" (Kriv n.d). These industrial buildings were exceptionally plain utilizing the pioneering work of Albert Kahn, the great industrial facilities architect, as spring board for the understanding of how buildings best shelter industrial processes.

Unlike the private sector, the military was always concerned with the cost of building materials. Although the early military industrial buildings were permanent, they used a number of lesser priced building materials such as construction tile. Construction tiles were essentially hollow brick tiles, approximately 8 inches wide, that took the place of bricks. Their tensile strength allowed them to be used in self supporting walls and they were virtually maintenance free. Larger industrial buildings were constructed with steel frames using other types of traditional building materials.

By 1941, however, enormous cost overruns and the shortage of strategic materials led to a decision to make as many structures as possible temporary. Temporary buildings were to have a five-year lifespan. At first, only amenities were cut and changed, but eventually whole industrial complexes were constructed of wood, asbestos paneling, and with little or no steel frames. This change from permanent to temporary had a great affect on all installations.

Today on most U.S. military installations, a variety of World War II temporary structures are extant and Picatinny is no exception. Garner (1993) lists 36 army bases as having 100 or more units of temporary World War II buildings and some bases such as Fort Chafee, Fort Bragg, Fort Lewis, Fort McCoy, and Fort Polk have more than 1,000 units. Structures are as diverse as barracks, sewage treatment plants, industrial process buildings, ball fields and tennis courts, and the inevitable general and ordnance warehouses.

As World War II moved into its first and second years, military industrial complexes were forced by decree and the general lack of special types of building materials, such as steel, to construct temporary buildings for miscellaneous industrial processes. Such volatile compounds as TNT which were originally produced in buildings made of substantial steel beams were frequently manufactured in structures of almost flimsy construction. Even old line production facilities, like Picatinny, had to make do with temporary, light frame buildings. A number of these can still be found in the former production areas.

Typically, individual buildings in a military production complex were linked by covered walkways or monorails for transporting materials. Walkways were often used as work sites. In order to make this work in an essentially open space more comfortable and therefore more productive, Cel-O-Glas, a type of flexible, opaque plastic enmeshed in a screen was used to cover the walks. This very inexpensive material can still be seen on a number of Picatinny's extant covered walks in the 1600 "Little Picatinny" Area.

The branches of a particular service also affected the types of structures built. The Ordnance Department, the Chemical Warfare Department, and the Signal Corps each had different building regulations which were influenced by War Department architectural decisions at different times and in various ways. Although all construction projects during World War II eventually fell under the purview of the Army Corps of Engineers, at the beginning of the war several disparate departments guided the build-up.

Today, 500 World War II structures are extant on Picatinny making this the largest number of buildings from a particular time period on the facility. Of these 500, almost all are exclusively related to the production and storage of materiel. Although Picatinny gradually became an installation almost exclusively related to research and design of ordnance, its significant number of World War II industrial structures attests to its role in the creation of the military industrial complex.

3.0 Evaluation Results

Although this report evaluates only those structures eligible for the NRHP, the initial assessment of this study identified 443 buildings that were not eligible (Nolte and Steinback 1999). Of the remaining 57 structures, 55 are eligible as contributing or non-contributing elements to one of three historic districts (Figures 2, 3 and 4), and two (Buildings 3250 and 3316) are individually eligible. This portion of the report will review these districts (listed in Table 2). For a complete listing of all structures reviewed, please see Nolte and Steinback 1999, Table 2.

3.1 ADMINISTRATION AND RESEARCH DISTRICT

Structures that are included in the Administrative and Research District (Figure 5) are listed below by historical name and current building number.

111	Root Storage / Greenhouse (1909)
112	Commanding General's Quarters (1909)
113	Family Housing, General (1909)
114	Commanding Officer's Quarters (1884)
114a	Garage (1937)
115	Guardhouse / Fire Engine House / School / Officers Quarters (1884)
115a	Garage (1943)
119	Officers Quarters / Fill Plant / Hospital (1887)
151	Post Headquarters (1929; 1941)
154	Solvent Lab (1943), scheduled for demolition due to contamination
162	Physics / Chemistry Lab (1930-42)
163	High Explosives Research Lab (1930)
164	Chemistry / Stability Lab (1930)
164b	World War II Pay Station, non-contributing
166	Test Conditioning Chamber (1930) - this building is currently derelict and rumored to be the site of a radiological accident.
167	High Explosives Preparation and Test Lab (1930)
168	Ammunition and Explosives Magazine (1930)
171	Administrative Building (1949)
172	Ordnance Administration Building (1942)
173	Guard House / Transformer Station (1942)
174	Service Magazine (1942)
176	Lab Equipment / Sampling of Ammunition (1944)
183	Steam Flow Meter House (1945)
197	Lab and Testing (1930)

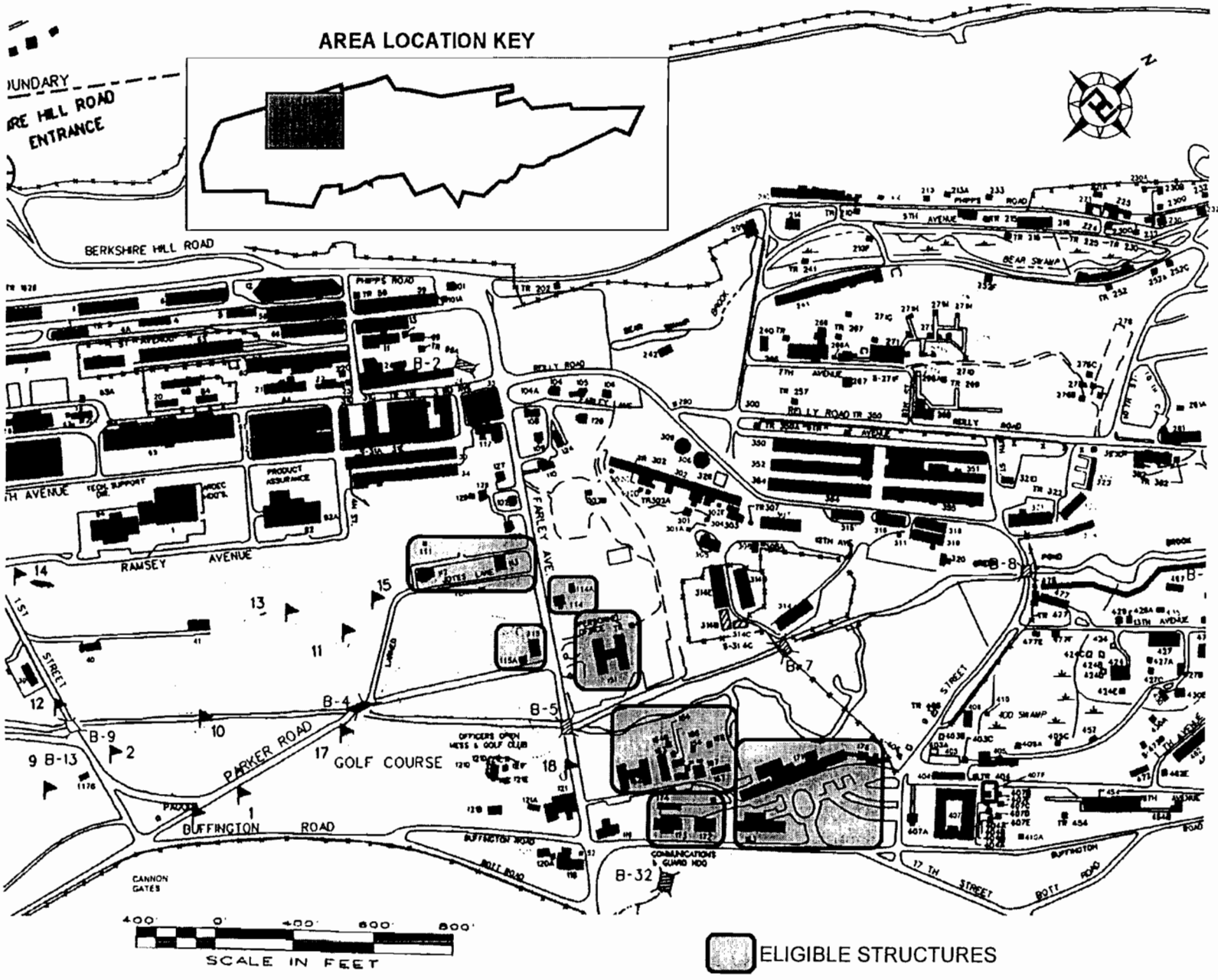


Figure 2. Location of eligible structures within the Administration and Research District of Picatinny Arsenal, Morris County, New Jersey *(ARDEC 1995.)*

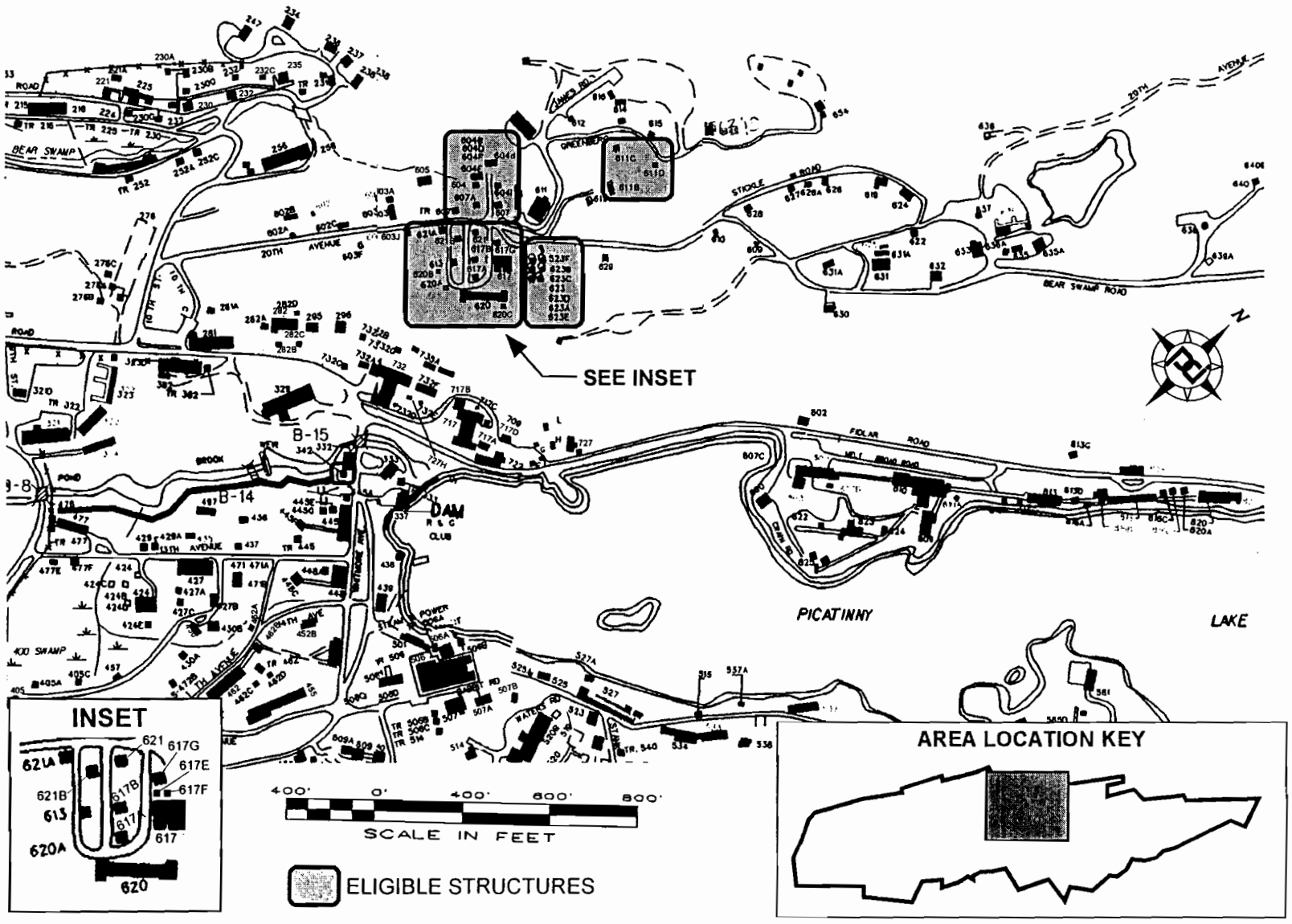


Figure 3. Location of eligible structures within the 600 Ordnance Test Area District of Picatinny Arsenal, Morris County, New Jersey *(ARDEC 1995).*

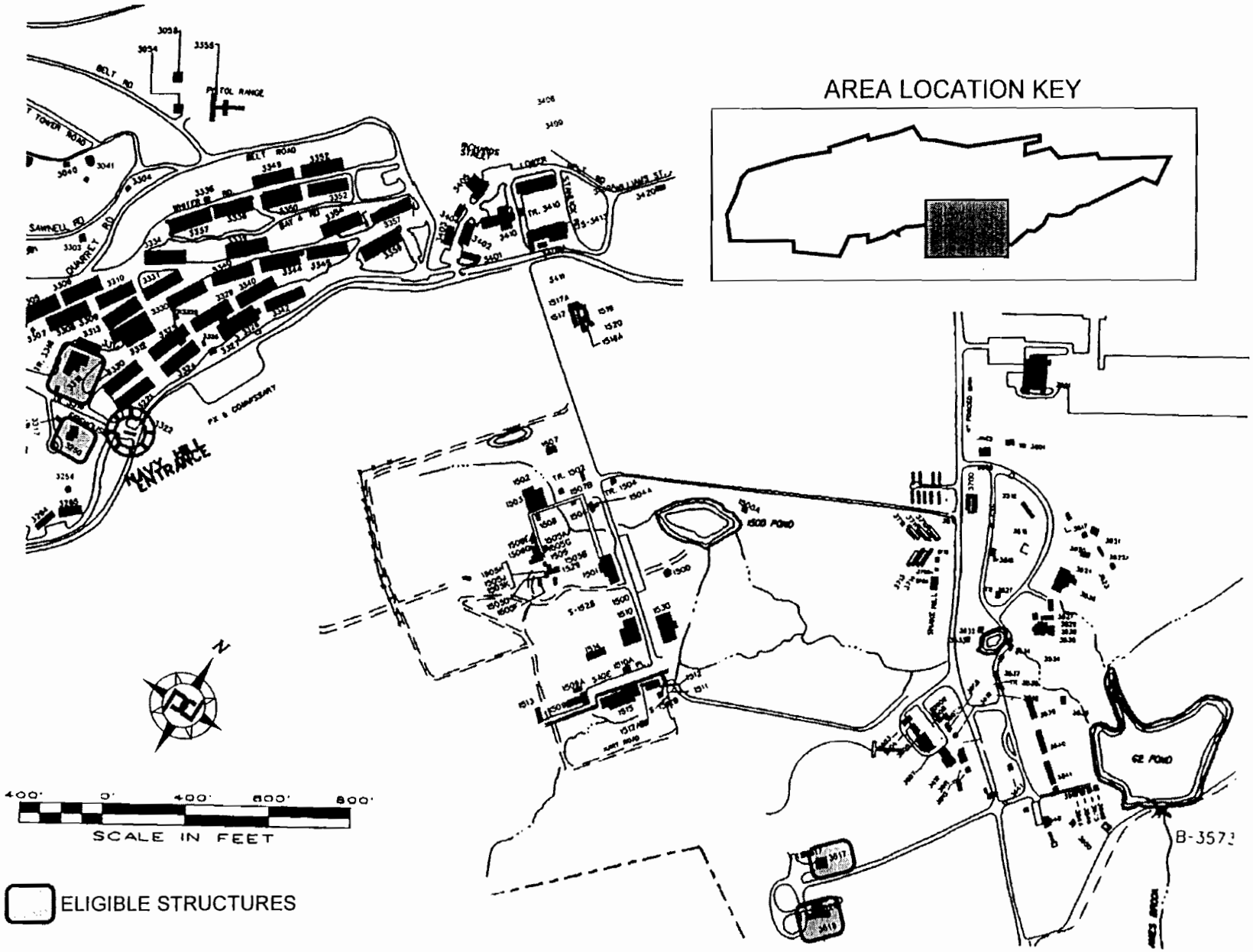


Figure 4. Location of individually eligible structures (3250, 3316) and Test Area E (NARTS) District (3617, 3618) within Picatinny Arsenal, Morris County, New Jersey *(ARDEC 1995).*

Table 2. Index of NRHP Eligible Structures, Picatinny Arsenal

Bldg #	Date Built	Historic Name	Present Name	Fig. This rept.	pg # this rept.	BA[1] pg #	Mitigation/Report of final disposition[2]	Other Surveys	Former Army Category	N R Eligibility	Comments
111	1909	Root Storage / Greenhouse	Storage / Greenhouse	2	53	E-59	Criteria A & D	HABS	none	yes, district	
112	1909	Commanding General's Quarters	Family Housing General	2	53	E-60	Criteria A & D	HABS, Drawings Catalog	none	yes, district	
113	1909	Family Housing General	Family Housing General	2	56	E-61	Criteria A & D	HABS, Drawings Catalog	none	yes, district	
114	1884	Administrative / Headquarters Commanding Officer's Quarters	Family Housing Colonel	2	56	E-62	Criteria A & D	HABS, Drawings Catalog	none	yes, district	
114A	1937	Garage	Garage	2	61	E-64		HABS	none	yes, district	
115	1884	Guardhouse / Fire Engine House / School / Officers' Quarters	Quarters (Col.)	2	61	E-65	Criteria A & D	HABS	none	yes district	
115A	1943	Garage	Garage	2	62	E-66		HABS	none	yes, district	
119	1887	Officers Quarters / Fill Plant / Hospital	Quarters (LC MJ)	2	63	E-72	Criteria A & D	HABS	none	yes, district	
151	1929-41	Post Headquarters Building	Administrative Building / General Purpose Administration	2	63	E-78	Criteria A & D	HABS, Closure Report	3	yes, district	and Jacobus, Chicago, 1928 construction drawing by the Office of Quarter Master
154	1943	Solvent / Chemistry Laboratory	Chemistry Laboratory	2	65	E-80	slated for demolition in mitigation process	HABS	none	within a district, but already in mitigation	
162	1930-42	Physics / Chemistry Laboratory	Applied Instrument Building	2	65	E-82	Criteria A & D, possibly C	HABS, Closure Report	3	yes, district	construction drawing by the Service Office of the Quarter master General
163	1930	High Explosives Research Laboratory	Signal Photo Laboratory	2	67	E-84	Criteria A & D, possibly C	HABS, Closure Report	3	yes, district	
164	1930	Chemistry / Stability Laboratory	General Purpose Laboratory	2	67	E-85	Criteria A & D, possibly C	HABS, Closure Report	3	yes, district	
164B	ca. 1943	World War II Pay Station	General Purpose Laboratory	2	71	E-86		HABS	none	non-contributing to district	
166	1930	Test Conditioning Chamber	General Purpose Laboratory	2	71	E-88	Criteria A & D, possibly C	HABS	none	yes, district	construction drawings by War Plans Div., Ordnance Dept., this structure is derelict and rumored to the site of a radioactive spill
167	1930	High Explosives Preparation and Test Laboratory	Chemistry Laboratory	2	74	E-167	Criteria A & D, possibly C	HABS, Closure Report	3	yes, district	
168	1930	Ammunition and Explosives Magazine	General Purpose Laboratory	2	75	E-168	Criteria A & D	HABS, Closure Report	3	yes, district	
171	1940	Administration Building	Administration	2	75		Criteria A & D	HABS	none	yes, district	construction drawing by War Plans Div., Ordnance Dept.
172	1942	Ordnance Administration Building	Engineering Administration Building	2	79	E-92	Criteria A & D	HABS	none	yes, district	Francisco and Jacobus, Chicago, architects
173	1942	Guard House / Transformer Station	Police Station and Communication Center	2	79	E-93	Criteria A & D	HABS	none	yes, district	Francisco and Jacobus, Chicago, architects
174	1942	Service Magazine	Administration	2	79	E-94		HABS	none	yes, district	
176	1944	Laboratory Equipment / Sampling of Ammunition	Administration	2	82	E-95	Criteria A & D	HABS, Closure Report	3	yes, district	

Table 2. Index of NRHP Eligible Structures, Picatinny Arsenal

Bldg #	Date Built	Historic Name	Present Name	Fig. This rept.	pg # this rept.	BA[1] pg #	Mitigation/Report of final disposition[2]	Other Surveys	Former Army Category	N R Eligibility	Comments
183	1945-63	Steam Flow Meter House	Non Metal Materials Facility / Administration Building R & D	2	82	E-96	Criteria A & D	HABS, Closure Report	3	yes, district	1963 2-story addition by Lawrence Picone & Assoc., Metuchen, NJ
197	1930	Laboratory and Test Building	General Purpose Laboratory	2		E-88	Criterion A	HABS, Closure Report	none	yes, district	
604	1928	Environmental Testing	Ordnance Facility	3	95	E-238		HABS	none	yes, district	
604A	1928	Control House	Ordnance Facility	3	95	E-240		HABS	none	yes, district	
604B	1931	Detonating Chamber	Ordnance Facility ("Detonating Chamber")	3	97	E-241		HABS, Closure Report	2	yes, district	
604C	1928	Sectioning	Ordnance Facility ("Sectioning / Teardown Facility")	3	99	E-242		HABS, Closure Report	2	yes, district	
604D	1928	Drop Tower ("Drop Tower")	Ordnance Facility	3	99	E-243		HABS, Closure Report	1	yes, district	
604E	1942	Wind Tunnel	Ordnance Facility	3	99	E-244		HABS, Closure report	2	yes, district	
604F	1928	Bull Pen	Ordnance Facility ("Bull Pen / Rifling Chamber")	3	101	E-245		HABS, Closure report	2	yes, district	
604I	un-known	unknown	unknown	3	101					non-contributing to district	
607	1940	Fragmentation Tub Building	Ordnance Facility ("Fragmentation Tub Building")	3	102	E-247		Drawings Catalog, HABS, Closure report	1	yes, district	
607A	1938	Testing Facility	Ordnance Facility ("Testing Facility")	3	104	E-249		HABS, Closure Report	2	yes, district	
611	1965	Gun emplacement		3	104					non-contributing	
611A	1965	Armor plate-butt		3	104					non-contributing	
611B	1929	Gas Gun Test Tunnel	Ordnance Facility	3	104	E-251		HABS, Closure Report	2	yes, district	
613	1928	Mortar Powder Building / Ballistic Mortar Testing	Ordnance Facility	3	107	E-255		HABS, Closure report	2	yes, district	
617	1928	Fragment Cleaning, Reconstruction and Photography Building	Administration Building / Research and Development	3	107	E-256		HABS, Closure Report	2	yes, district	
617A	1928	High Explosives Magazine	High Explosives Magazine	3	107	E-257		HABS	none	yes, district	
617B	1928	Magazine	General Storehouse	3	108	E-258		HABS	none	yes, district	
617E	1928	Flammable Material Storage Magazine	Flammable Material Storage Magazine	3	108	E-259		HABS	none	yes, district	
617F	1928	Magazine	Fuze and Detonator Magazine	3	108	E-258		HABS, Closure report	2	yes, district	
617G	1938	Gun and Powder Shed	Ordnance Facility	3	108	E-260		HABS	none	yes, district	
620	1928	Test Range	Test Tunnel / Offices	3	109	E-261		HABS, Closure Report	2	yes, district	
620B	1921	Test Range / Tower	Ordnance Facility ("Test Range / Tower")	3	110	E-263		HABS, Closure report	2	yes, district	
621	1941	Fragmentation Tub Building	Ordnance Facility (Fragmentation Tub Building")	3	110	E-247		Drawings Catalog, HABS, Closure Report	1	yes, district	
621B	1914	Shipping and Receiving Building	Ordnance Facility	3	110	E-266		HABS	none	yes, district	
623A	1929-42	Elevated Water Tank	Elevated Water Tank	3	110	E-267		HABS	none	yes, district	

Table 2. Index of NRHP Eligible Structures, Picatinny Arsenal

Bldg #	Date Built	Historic Name	Present Name	Fig. This rept.	pg # this rept.	BA[1] pg #	Mitigation/Report of final disposition[2]	Other Surveys	Former Army Category	N R Eligibility	Comments
623B	1929-42	Elevated Water Tank	Elevated Water Tank	3	110	E-267		HABS	none	yes, district	
623C	1929-42	Elevated Water Tank	Elevated Water Tank	3	110	E-267		HABS	none	yes, district	
623D	1929-42	Elevated Water Tank	Elevated Water Tank	3	110	E-267		HABS	none	yes, district	
623E	1929-42	Elevated Water Tank	Elevated Water Tank	3	110	E-267		HABS	none	yes, district	
3250	1890	Navy Hill Colonel's Quarters	Family Housing (Gen. and Col.)	4	83	E-439		HABS, Drawings Catalog	none	yes	Individually eligible; Guzzo 1999
3316	1903	Stable	Fire Station	4	88	E-446	Criteria A & C	HABS, Drawings Catalog, Closure Report	2	yes	Individually eligible; Guzzo 1999
3617	1953	Control House Facility	Propellant Systems	4	118	E-458	Criteria A & D	HABS, Closure Report	3	yes, district	Area E, Rocket Firing, F. Grad & Sons, Architects and Engineers
3618	1953	Test Cell 1-E (Test Stand)	Propellant Systems Facility	4	123	E-458	Criteria A & D	HABS, Drawings Catalog	none	yes, district	Area E, Rocket Firing, F. Grad & Sons, Architects and Engineers

[1] Boston Affiliates report (Harrell 1994)

[2] National Register eligibility in this document

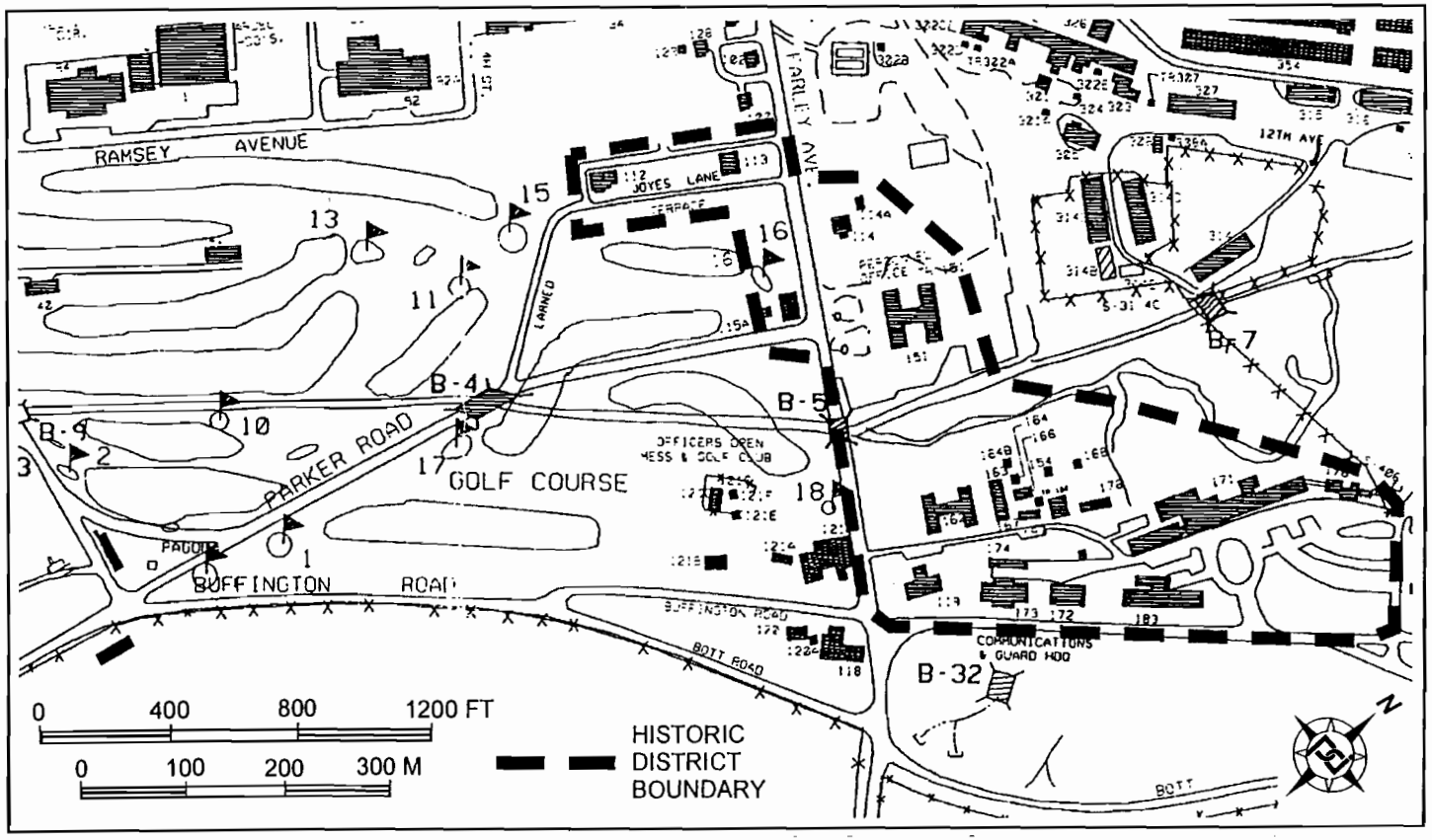


Figure 5. Administrative and Research District. Picatinny Arsenal, Morris County, New Jersey *(ARDEC 1995).*

Figure 6. Quarters 115, one of the earliest administrative structures on Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

The first building erected on the U.S. Army Powder Depot, Dover, NJ, was appropriately enough a black powder magazine that was completed in 1881 costing $51,700.00 (Rogers 1931). The foundation was built of stone quarried on the grounds, called "Green Pond conglomerate," the walls of brick and the roof of galvanized iron. The Green Pond conglomerate proved hard to work so a new search was begun for other types of rock in the area. Several granite outcrops were known to be on the post grounds and one of these yielded a stone that proved easier to cut and work (Rogers 1931). The granite discovered was actually a conglomeration of granite-type rocks known as pudding stone. The use of pudding stone for foundations, quoining and for actual walls would become an architectural hallmark for Picatinny Arsenal as well as for Lake Denmark Navy Depot. Other magazines soon followed.

Unlike the later construction of many military installations, Picatinny's administrative area seemed to grow as an afterthought, rather than a planned unit. One of the earliest administrative structures, a brick guard house (now Quarters 115, Figure 6) was built in 1885 at the intersection of Mt. Hope Road (now Farley Avenue) and Mt. Pleasant Avenue (now Parker Road), facing Mt. Hope Road. Stables (now #117) had been built in 1882 as well as a two-story wood frame quarters, no longer standing, for the Superintendent, all facing Mt. Hope Road.

By 1888, old Building #2, now no longer standing, was built as "the office" (Rogers 1931). Mt. Hope Road (also depicted on some maps as Mt. Hope Avenue) had become the administrative center of the Powder Depot. By 1885, a heavy new gate, the Cannon Gates, marked the primary entrance onto the Arsenal, down Mt. Hope Road. A 1904 map clearly shows the beginning of the growth of that administrative area (Figure 7).

After the 1926 explosion, Picatinny Arsenal was in a position to reconstruct itself, not only architecturally but also philosophically and technologically. The restoration established the arsenal as the U.S. Army's major ammunition facility. This involved not only the manufacture of armaments but, most importantly, the research and development of all types of ammunition, except small arms and machine guns (Thurber and Norman 1983).

The primary reconstruction effort focused on the powder and explosives manufacturing area. A new Nitrocellulose Smokeless Powder Plant (500 Area) (Figure 8) was built on the original site; the Complete Rounds/Melt Loading Plant (800 Area) (Figure 9) was created; a High Explosives Plant (1000 Area) was constructed and the new testing area (600 Area) was established on a plateau west of Picatinny Peak (Thurber and Norman 1983). A new administrative building (#151) and a chemical laboratory complex (Figure 10) were also constructed. The creation of these administrative and research facilities reflected the shift in the focus of the arsenal to research and development (Thurber and Norman 1983).

Just prior to World War II, Picatinny's mission was to provide the Army with a munitions manufacturing center that included experimental and production plants for a range of propellents and explosives. Picatinny Arsenal was an important explosives and ammunition research center. The Lake Denmark explosion was merely an interruption in Picatinny's role of preserving armament knowledge. The Arsenal's facilities continued to serve both the Army and private industry during the inter-war years. By the time of the U.S. entry into World War II, the arsenal was producing smokeless powder; high explosives; fuzes and primers; assembled rounds of artillery ammunition; bombs and grenades; and pyrotechnics (airplane flares and signal smokes) all at experimental or peace-time levels (Thurber ca. 1983).

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. The arsenal was also instrumental in improving and redesigning artillery primers, trench mortars and rounds of chemical and tracer ammunition. Fuze powders, primer mixtures, pyrotechnic compositions, propellent compositions, and new high explosives were developed by the Research and Chemical Branch. Picatinny's mission also called for the development of new munitions designs utilizing the latest technology and in the event of a national emergency, to provide private industry with production plans and testing.

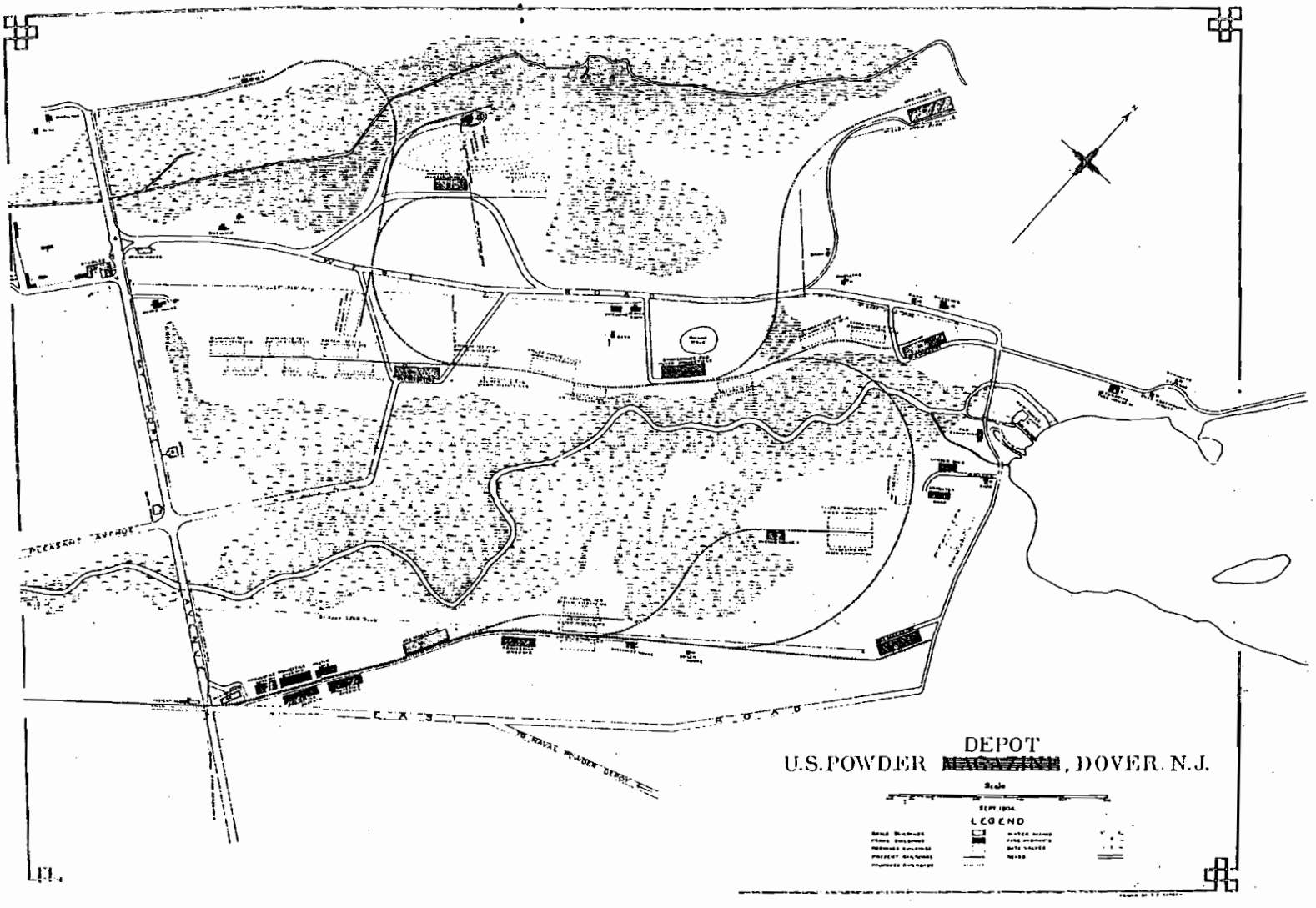


Figure 7. U.S. Powder Depot, Dover, N.J., drawn by E. E. Storch, September 1904. Picatinny Arsenal, Morris County, New Jersey *(Picatinny Arsenal DPW, n.d.).*

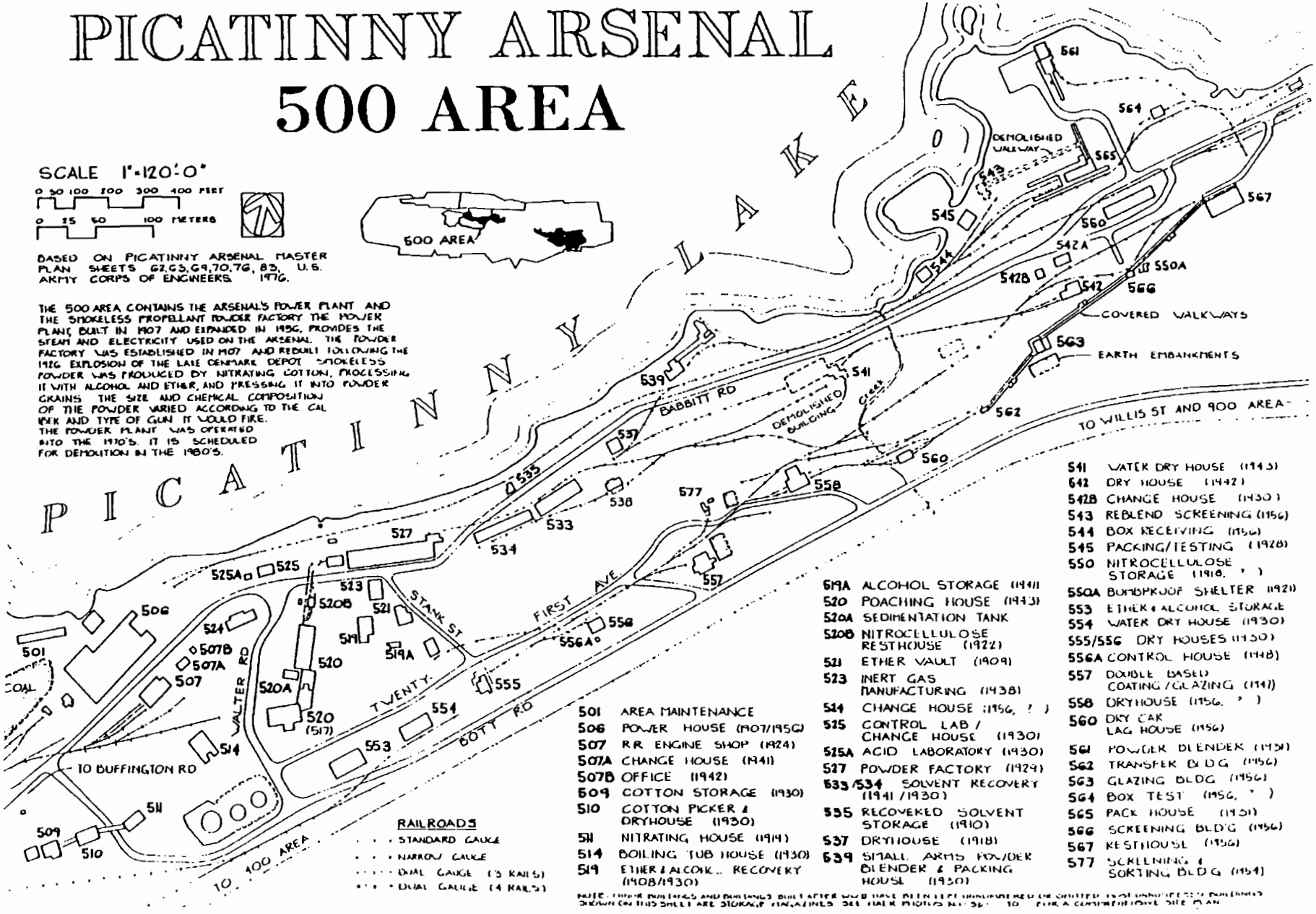


Figure 8. Picatinny Arsenal: 500 Area, 1907-1956. Picatinny Arsenal, Morris County, New Jersey *(Thurber and Norman 1983).*

PICATINNY ARSENAL - 800 AREA

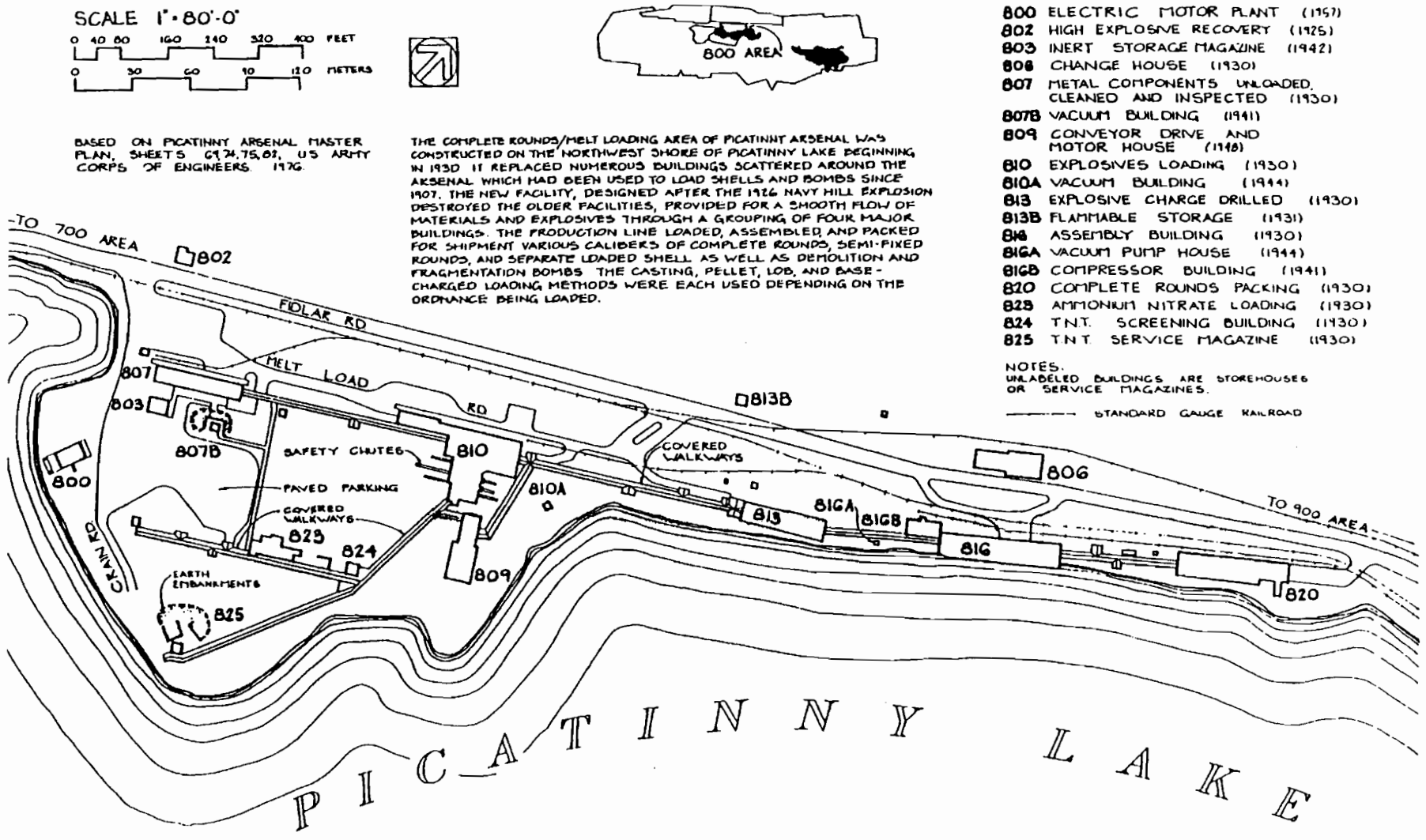


Figure 9. Picatinny Arsenal: 800 Area, 1930-1957. Picatinny Arsenal, Morris County, New Jersey *(Thurber and Norman 1983).*

Figure 10. Buildings 165 and 167, Research Area, "Chemistry Row." Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

During World War II many important advances in new products or simplified methods of production were made at Picatinny in its newly constructed labs and testing facilities. The importance of Picatinny's research and development activities grew, giving more emphasis to this R&D function which it would retain after the war. In one year the job training methods, research projects and improved work developments, originating at Picatinny and passed along to other plants, saved the U.S. more than $3 million. This accomplishment was recognized by Lt. General Brehon Somervell, Chief of the Army Service Forces, and Maj. General L.H. Campbell, Chief of Ordnance, in correspondence with Picatinny's commanding officer (Kaye 1987).

The Technical Division created in 1925 was responsible for all research and development work during World War II. The most significant development was an improved method of manufacturing Tetryl, an explosive, usually mixed with TNT that was used as a booster charge in bombs and artillery shells (Thurber ca. 1983). The new procedure proved less hazardous and less expensive.

The Propellents Sub-Section of the Technical Division discovered that wood-pulp could be substituted for cellulose-based powders. This discovery was of vital importance since cotton was scarce during World War II. The improvement in the production and composition of nitrocellulose powder proved to be significant in helping the war effort. This section was also responsible for studies of powder ignition and for the standardization of all Army ammunition testing procedures (Thurber ca. 1983).

There was a demand for flashless, non-hygroscopic cannon powders. The military had long had a problem with the chemical compositions of powders that absorbed moisture which in turn changed the ballistics and chemical properties of that powder. If flashless and smokeless qualities could be added to the non-hygroscopic qualities the advantages would be inestimable. Researchers at Picatinny and DuPont eventually developed non-hygroscopic flashless powders or FNH. DuPont developed M1 powder; Picatinny developed M3. These two powders were tested at the arsenal, both for composition and for specific weapons (Thurber ca. 1983). The creation of a complete line of FNH powders was one of the most useful accomplishments of the Ordnance Department before 1940 (Green et al. 1990).

The Mechanical Branch of the Technical Division was responsible for the development and design of ammunition. At the beginning of World War II, this included artillery fuzes, boosters and grenades. During the war a number of special components were designed and tested at Picatinny. This included two types of bomb fuzes, above-ground and long delay fuzes. In 1943, the introduction of skip-bombing, an airplane maneuver performed at low altitudes, created a need for bombs that could be dropped from as low as 25 feet but would not detonate until the plane was well away from the scene. The solution was the development of a long delay fuze (Kaye 1978). The Mechanical Branch also created pyrotechnic devices such as flares and signals (Thurber ca. 1983). The heavy fog conditions encountered in Europe created a pressing need for a flare with the illuminative power of 800,000 candles, capable of penetrating fog or smoke, and that would burn for five minutes without generating much smoke of its own. Such a flare was created by Picatinny's pyrotechnics engineers. During the Battle of the Bulge alone (winter 1944-1945) these flares were credited with saving more than one hundred Allied bombers from crashing (Kaye 1978).

Special bombs for special jobs were also created by the Mechanical Branch. One of the most important bombs developed for a particular need were created to blow up the Ploesti oil fields in Romania, a vital source of oil for Hitler's forces. The bombs created by Picatinny for this mission obliterated the Ploesti installations (Kaye 1978).

The Chemical Engineering Section of the Technical Division was responsible for developing and evaluating new explosives and improving the performance of regularly used, standard military explosives. Its most significant accomplishment was the invention of Haleite named for Dr. George C. Hale, chief chemist at Picatinny.

The development of new and more powerful explosives that were dependable and could be safely handled was of vital importance. At the beginning of the war, the Allies had only a few special explosives with a higher brisance (shattering effect) than TNT. The two most important were cyclotrimethylene-trinitramine, which the Americans called cyclonite and the British called RDX, "Research Department explosive," and pentaerythritol tetranite or PENTN. RDX and PENTN were too sensitive to be used in a pure state in a shell, therefore, the compounds were mixed with a variety of compositions to stabilize them. Since the 1920s the chemists at Picatinny had been working on a compound with the brisance of RDX without its sensitivity to impact and friction. The research on this

explosive, spearheaded primarily by Dr. Hale, led to the discovery of ethylenedinitramine, or EDNA, later named Haleite. Haleite was the first entirely American high explosive (Green et al. 1990).

Unfortunately, one component of Haleite, thylene urea, was expensive to manufacture, but through the combined efforts of DuPont and the National Defense Research Committee (NDRC) that obstacle was removed. In 1943 Haleite was ready to be adopted for testing purposes. This new explosive could be press-loaded into small shells without a desensitizing agent and its derivative, ednatol, could be melt-loaded into large shells. Manufacturing problems, however, prevented Haleite from being used in combat (Green et al. 1990).

Delays in the creation of Haleite did not prevent Picatinny's chemists from further explosives development. The analysis of foreign explosives proved useful. For instance, examination of Soviet high explosives led to the creation of PTX-2, Picatinny Ternary Explosive, a combination of 28% PENTN, 43.2% RDX and 28.8% TNT. Preliminary firings at Picatinny revealed that it could be adapted to a shaped-change ammunition, though by the end of the war, PTX-2 was still in the testing stage (Green et al. 1990).

No new explosive compositions conducive to shell loading or available in quantity were developed during World War II. While disheartening, this failure led the War Department to conclude that further study on the fundamental properties of all high explosives was essential to effective development in the future (Green et al. 1990). This need to complete basic research on explosives and their uses insured Picatinny's continuing role in the Army's research and design program.

Fortunately at the beginning of the war, Picatinny was equipped with almost new laboratory space which had been constructed after the 1926 explosion. A series of new labs, special storage spaces, and offices facilitated World War II research efforts. During the war, buildings all over the arsenal were expanded and new construction went on continuously. At a press visit in 1941, Picatinny's commanding officer, Col. W.E. Larned, told reporters: "We don't need new buildings. We need ammunition. We can make tents if necessary." True to his word, workers reporting to a new components building found it water-proofed by a number of large tarpaulins (Kaye 1978). The work of the Arsenal went on with or without buildings.

When Picatinny built its new research labs and office spaces, they were located in an area which extends roughly up Parker Road and Farley Avenue that had come to be identified with administrative activities (see Figure 2). The new Administration Building (#153) was "ideally located at the junction of Parker Road and Farley Avenue fronting the main entrance to the Arsenal..." (*Plant Design* ca. 1942). The actual layout of the building was in a T shape and was designed to permit the addition of other **T** shapes should the need arise. The architectural style chosen was Colonial Revival to "symbolize the early historical background of the Arsenal" (*Plant Design* ca. 1942). The research center was located just east of the Administration Building and the main structures in the area "follow[ed] the architecture and style which was adopted for the Administration Building"

(*Plant Design* ca. 1942). The new buildings were created to be as technologically up-to-date as possible since "It was realized when new plans for the new Picatinny were underway that research work would gradually become the main activity of the Arsenal and that the Area should be as complete as available funds would permit" (*Plant Design* ca. 1942). Further, "the buildings should be located and designed to permit expansion as well as economical use during peace times" (*Plant Design* ca. 1942). Over the years the research area buildings have come to be known as "Chemistry Row."

Colonial Revival, which refers to an entire rebirth of interest in early English and Dutch architecture on the Atlantic seaboard, was popular from about 1880 until 1955 (McAlester 1984:321 and 324). It can be persuasively argued that this style is still viable especially in some portions of the Southeastern United States. Generally, Colonial Revival sought a return to the pure forms of classical architecture as codified by the Italian Renaissance. The true aim of classical architecture has always been to achieve a demonstrable harmony of parts. This harmony is achieved by proportion, by dividing the building into mathematical ratios. These simple ratios are repeated throughout the building thereby achieving the desired harmony (Summerson 1983:8). However, Colonial Revival is more a mixing and blending of Adam and Georgian styles with strong influences from Post Medieval English and Dutch Colonial than it is the true achievement of harmony (McAlester 1984:324).

The Colonial Revival style was introduced in 1893 at the World's Columbian Exposition in Chicago. This celebration of Columbus's discovery of the New World was highlighted by a new architectural style that was in complete contradiction to the exuberant Victorian styles with which most people were familiar. These enormous but architecturally restrained structures featured a smorgasbord of classical elements all painted in gleaming white which proved to be an immediate sensation and the Exposition was dubbed the "White City." This first public introduction of Colonial Revival was an unqualified success.

As the country grew more settled with westward expansion the growth of municipalities prompted a need for public buildings. By the late nineteenth century, the demands for court houses, post offices and custom houses had reached staggering proportions. In 1898, the Office of the Supervising Architect, a Treasury Department office responsible for designing, building and funding all federal structures, was occupied by James Knox Taylor, a former partner of the renowned architect Cass Gilbert. During Taylor's tenure, 1898-1915, he was able to establish Colonial Revival as the federal style. In fifteen years his office built an amazing 1,126 structures, a ninefold increase in public buildings. Taylor transformed the federal image across the country to Colonial Revival thereby setting in the public's mind the idea that all public buildings should be Colonial Revival (Lowry 1985:77-81).

Colonial Revival was one of the most popular building styles throughout the country, certainly it was the most popular domestic style (McAlester 1984:324). Sears and Roebuck, Aladdin and Loizeau Lumber Co., Plainfield and Elizabeth New Jersey, offered several types of pre-cut Colonial Revival homes. The market was flooded by pattern books and blueprint companies selling Colonial Revival styles.

As the movement expanded and matured, the decorative elements of the style became less common and the allusion to form and classical elements became more common. In part this was an economical solution to building a structure while at the same time acknowledging one's patriotism (Schwartz 1983:150-151). Ironically, the harmony of proportions, not just the decorative elements, became important, harkening back to the movement's original intent.

The military service's structures were influenced by the prevailing architectural climate. The Colonial Revival style met its requirements for creating permanent, low-cost and low-maintenance buildings. This style lent itself to brick exteriors with stone or plaster decoration that required no painting and little upkeep. Further, a building's size was not an impediment since its proportions and decorations could be scaled appropriately and any additions could be worked into those proportions. Finally the style itself had been accepted as representative of the Federal government thereby lending a structure a certain authority. While the planners at Picatinny Arsenal had chosen the style to match its historical past, they also chose a style already embraced and accepted by the military.

3.1.1 Structures of the Administrative and Research District

The following is an architectural description and known history of each structure in the Administrative and Research District.

Building 111, Root Storage / Greenhouse. As described by Harrell (1994):

> Building 111 is a small, one-story building, with a concrete foundation, masonry bearing walls, and an overhanging, gable roof with composition shingles [(Ashby et al 1982)]. Constructed in 1909, Building 111 served as a root house for the Commanding General's House, and had formerly been a root cellar. In 1938, the building was rehabilitated by the WPA. The building retains original siting, massing, and construction and has an enclosed wooden entry on the south side (Harrell 1994:E-59).

Building 112, Commanding General's Quarters. As described by Harrell (1994):

> Constructed from locally-quarried pudding stone, this Colonial Revival residence has a central four square plan with adjacent, gable-fronted side ell [(Ashby et al. 1982; Harrell 1993)]. The house was built in 1909 and has served continuously since 1911 as the Commanding General's Quarters [(Figure 11)]. The first occupant was Major O.C. Horney. Building 112 is intact with limited alterations. It has a two-story front portico; rough-finished puddingstone facade with dressed puddingstone window surrounds; hipped, dormered central roof with flared ends; flared gables on side ell; enclosed front and rear porches and bay windows (side and rear elevations); and a glass-enclosed conservatory" [(Figure 12)]. Both exterior and interior are richly embellished with decorative architectural elements. The original floor plan remains, except for alterations to kitchens, bathrooms and enclosed porch [(Figure 13)] (Harrell 1994:E-60).

Figure 11. Building 112, Commanding General's Quarters. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

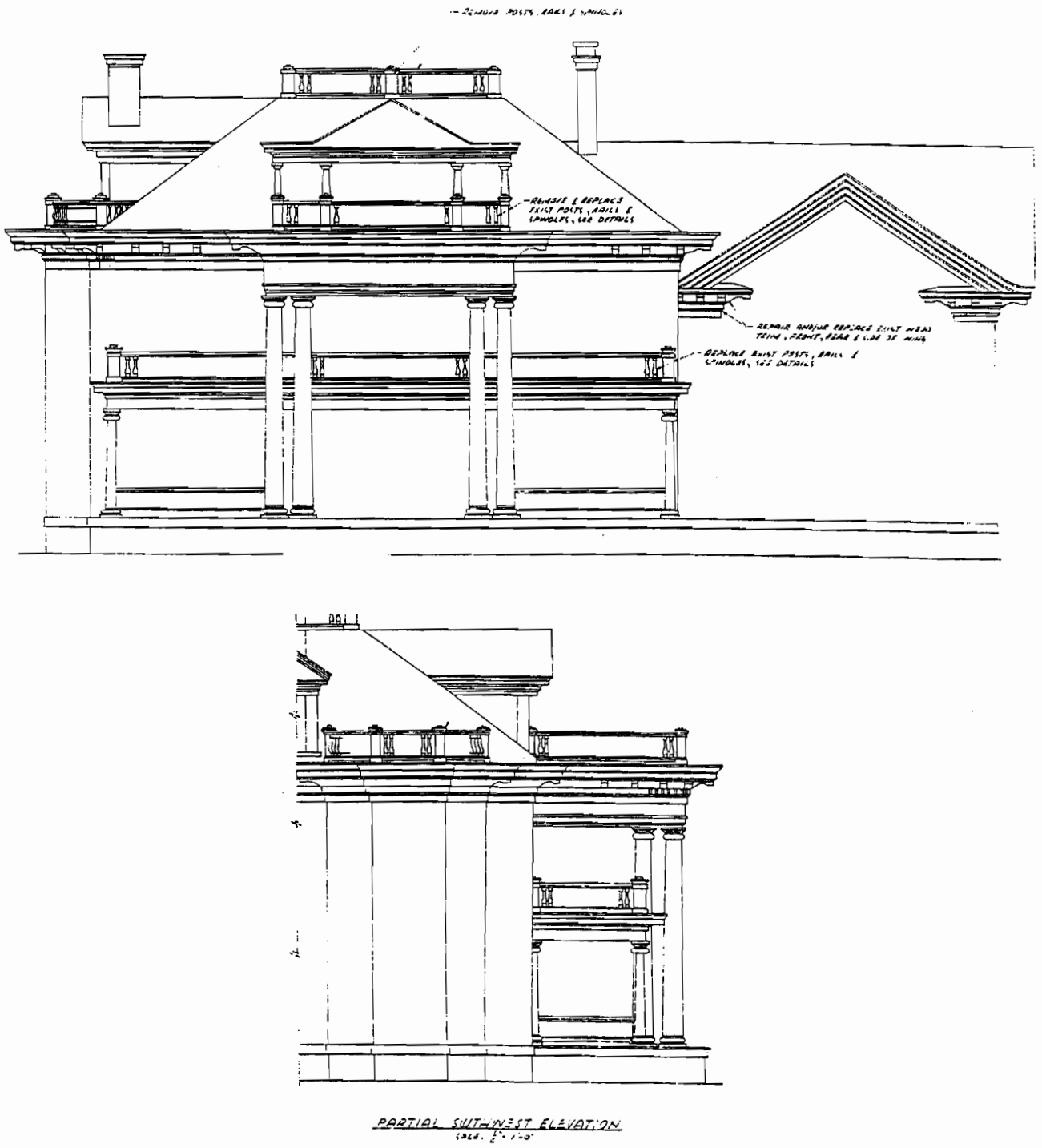


Figure 12. Building 112, Commanding General's Quarters, Blueprint # DP-148745, details from *Building No. 112, Commanding Officer's Quarters, Rehabilitation of Railings and Trim*, May 5, 1978. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

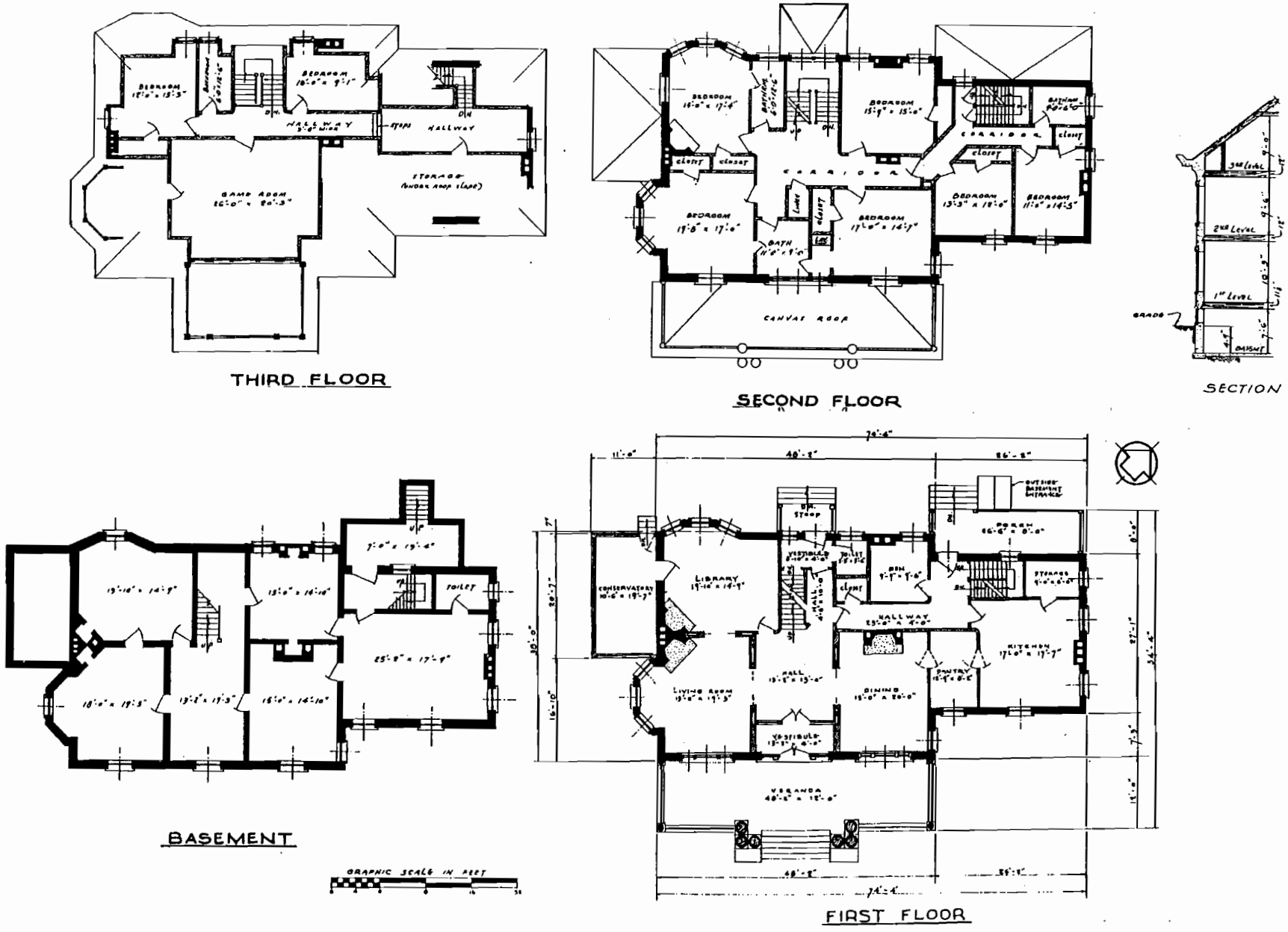


Figure 13. Building 112, Commanding General's Quarters, Blueprint # SK-54731, *Floor Plan, Qtrs. 112,* n.d. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

Figure 14. Building 113, Family Housing, General. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

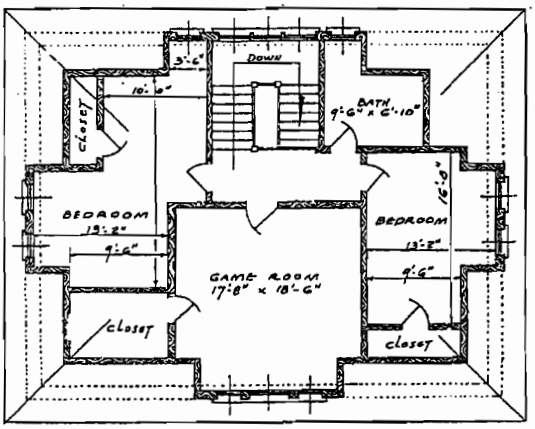
Building 113, Family Housing, General. As described by Harrell (1994):

Building 113 is a Colonial Revival structure built of locally quarried puddingstone, with a shingled roof [(Ashby et al. 1982, Harrell 1993)]. Originally constructed in 1909 as an Assistant Officer's residence, the house has for many years been used as the General's residence [(Figure 14)].

Significant Features. Building 113 remains intact with limited alterations. The exterior walls are of coursed puddingstone; the shingled hipped roof has flat roofed dormers with central pediment (front and rear elevations), pedimented dormers (north and south elevations). Windows are double hung, and there is an oval window at the head of the maid's stairway. It has an enclosed front porch, balustrade second floor balcony, and conservatory. It has its original floor plan, except for alterations to the bathroom (Figure 15) (Harrell 1994:E-61).

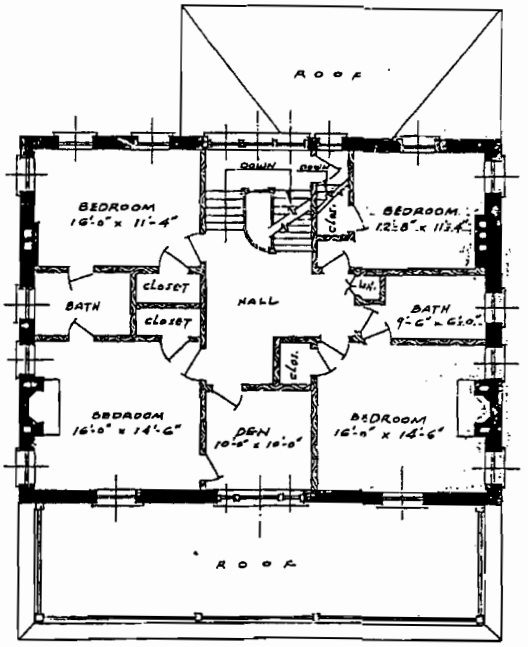
Building 114, Commanding Officers Quarters. As described by Harrell (1994):

This residence is a two-story brick building [(Ashby et al. 1982; Harrell 1993)]. Constructed in 1884 to serve as the Arsenal's administrative headquarters, this building was converted to officer's quarters in 1912 [(Figure 16)]. The Commanding Officer lived here in 1937-38 while Building 112 was being renovated. In 1938-39 a sunroom was added and the interior refurbished (Harrell 1994:E-61).



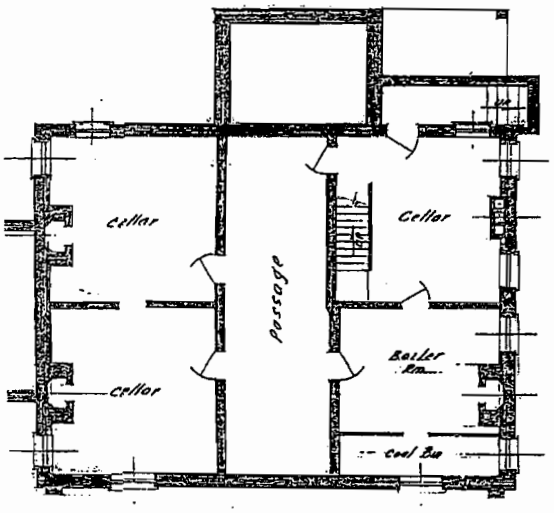
THIRD FLOOR

CEILING HEIGHT - 8'-8"



SECOND FLOOR

CEILING HEIGHT - 9'-5"



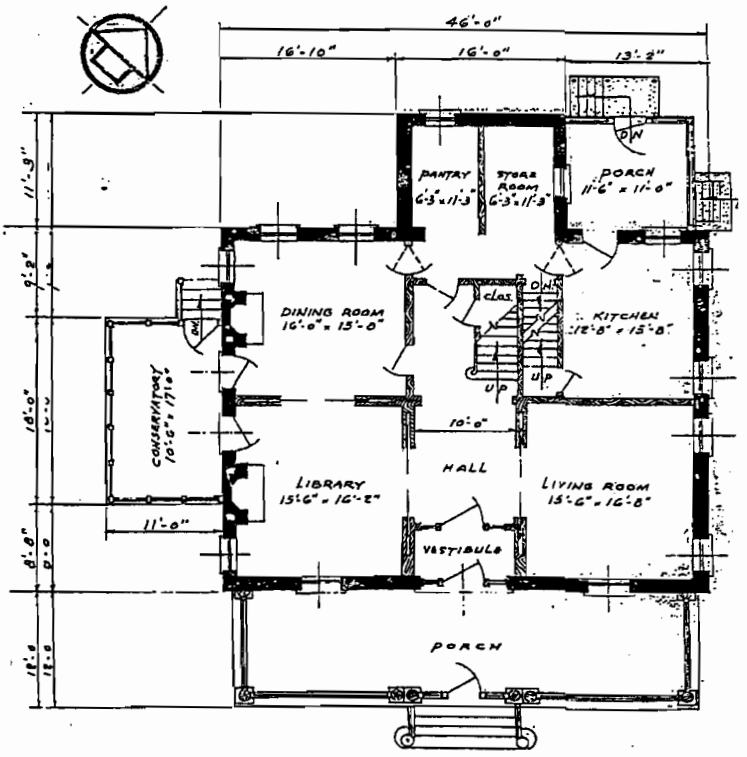


Figure 15. Building 113, Family Housing, General, Blueprint # SK-54732, *Quarters No. 113*, drawn by C. Cecarelli, n.d. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

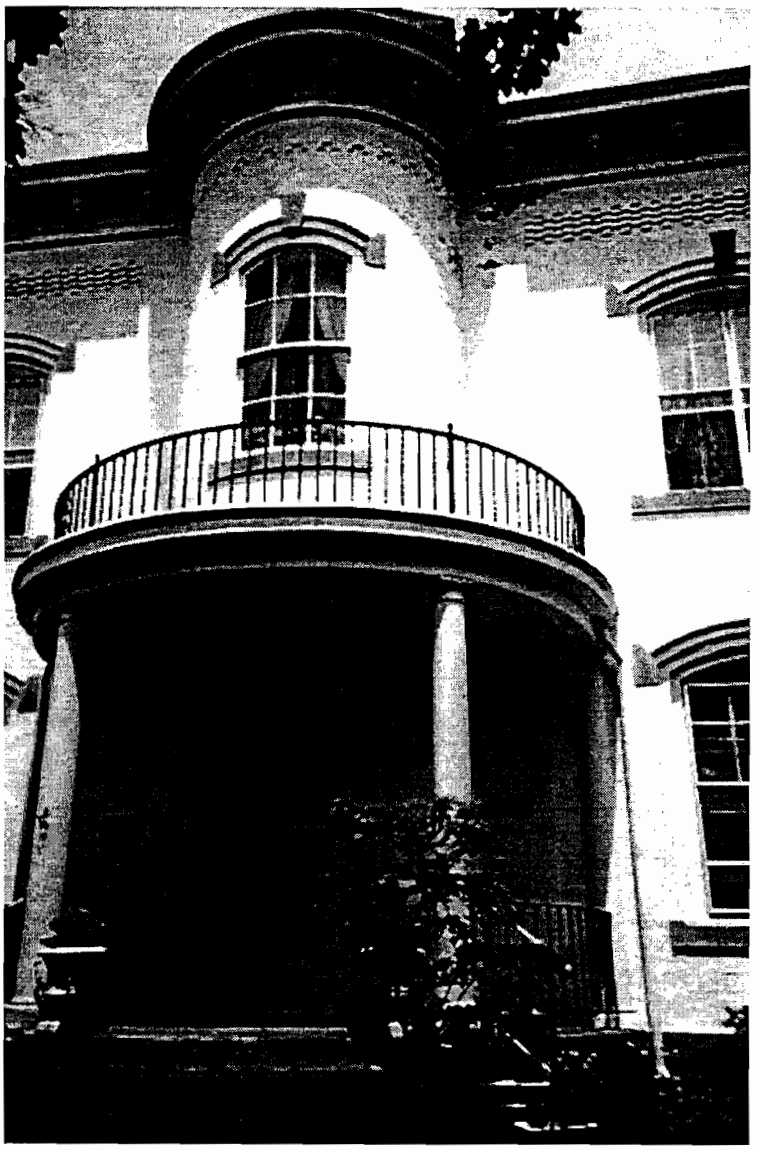


Figure 16. Building 114, Commanding Officer's Quarters. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Figure 17. Building 114, Commanding Officer's Quarters, detailing decorative elements. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Significant Features. Building 114 is intact with limited alterations. Its eclectic architectural style combines Second Empire decorative elements and proportions with Colonial Revival hipped and dormered roof and central projecting bow [(Figure 17)]. Each facade is divided into three bays by the articulation of brick pilasters and recessed, corbeled panels. Remaining from the original structure are the steel frame structure with brick bearing walls; puddingstone foundation; shingled roof; segmented arch windows; decorative brickwork (recessed window surrounds and brick corbeling); and curved, central projecting bay with front porch; segmented arch transom and side lights frame front entrance. The structure's 1913 interior layout is intact with finishes and woodwork dating from 1938 [(Figure 18)] (Harrell 1994:E-62).

Building 114 was originally created as the post's office building, in effect, post headquarters. During its 1938 WPA renovation, a wooden porch which extended along the front facade was removed, the back porch was replaced, a chimney was removed, and an east wing sun porch was added (History Office, Picatinny Arsenal n.d).

When constructed in 1884, the structure was valued at $20,000, and by 1939, it was valued at $52,458 as a result of significant alterations completed by the WPA (History Office, Picatinny Arsenal n.d.).

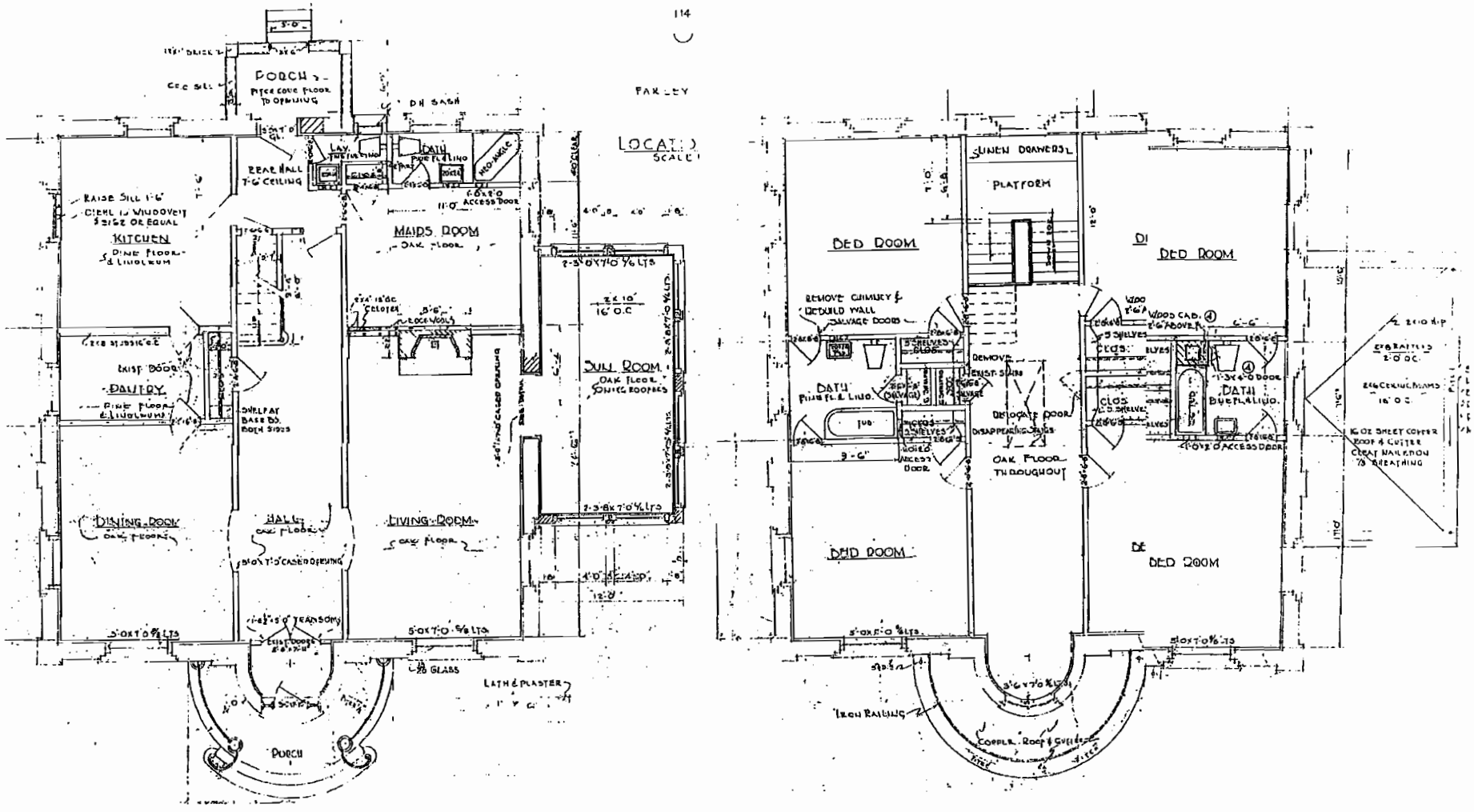


Figure 18. Building 114, Commanding Officer's Quarters, details from *Alterations to Qtrs. 114, 1st and 2nd Floor Plans Construction*, Nov. 7, 1938, War Plans Division, Ordnance Department. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

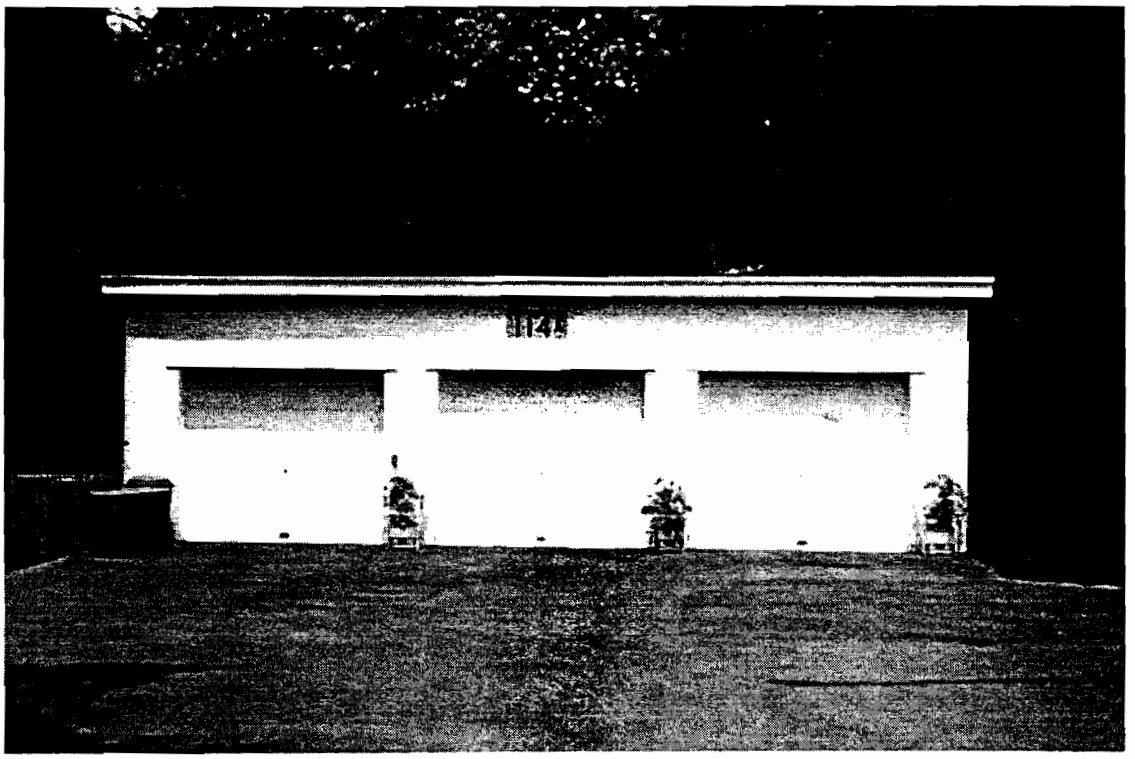


Figure 19. Building 114A, Garage, Commanding Officer's Quarters. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Building 114A, Garage. As described by Harrell (1994):

> Building 114A is a one-story, three-door garage. It sits on a concrete foundation and has a galvanized iron on wood roof (Ashby et al. 1982). Building 114A is the garage for Quarters 114. . .built in 1937 in connection with the other improvements to Building 114 [(Figure 19)].
>
> *Significant Features.* Building 114A retains original siting, massing, and construction (Harrell 1994:E-64).

Building 115, Guardhouse/Fire Engine House/School/Officer's Quarters. As described by Harrell (1994):

> Building 115 is a two-and-one-half-story, rectangular, pitch roof brick building which occupies a corner lot on Farley Avenue (Ashby et al. 1982). Building 115 was built in 1884 as a guard house/fire engine house, but could not be used for the fire engine until 1891 [(see Figure 3)]. It was used as a schoolhouse during World War I. The building was damaged in the 1926 explosion, and was gutted and most of the third floor removed. In the early 1930s, it was rebuilt above the second story, and has since been used for Officer's Quarters.

Figure 20. Building 115A, Garage, Officer's Quarters. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Significant Features. Building 115 retains original siting, massing, and most of its original construction (below the third floor level). Additions and alterations dating from the 1930s are believed to include: small hip roof addition added on the east end; floor plan changed (adapted for residential use); new Colonial Revival front doorway added on north side; new dormer window added in attic; roof reframed and entire new third floor added; steel framing and concrete chimney support added in basement (Harrell 1994: E-65).

Building 115A, Garage. As described by Harrell (1994):

Building 115A is a one-story, rectangular, gable roof, two-car garage situated near Quarters 115 [(Ashby et al. 1982)]. Building 115A was built in 1943 as a garage and is still used as such [(Figure 20)].

Significant Features. Building 115A retains original siting, massing, and most of its original construction. It has a number of Colonial Revival style features including a hipped roof (light gray asphalt shingles); common bond brick construction (header courses every sixth course); 6/6 double hung windows. The building has wood sills, and wood lintels, and two new aluminum roll-up garage doors on the east side (Harrell 1994:E-66).

Building 119, Officers Quarters/Fill Plant/Hospital. As described by Harrell (1994):

Building 119 is a large two and one half-story T-plan building built with brick bearing walls upon a stone foundation. The building has a pitched roof, clad with gray asphalt shingles, and is painted white [(Ashby et al. 1982)]. Building 119 was built as a shell filling house. It was converted to a hospital for the 1918 influenza epidemic. Although damaged in the 1926 explosion, it was used for temporary offices until the completion of building 151 in 1930. It then became enlisted quarters and a furniture storehouse until the 1930s WPA renovation for multi-family quarters. It is currently used for military housing.

Significant Features. Building 119 retains original siting, massing, and construction, including brick exterior walls and six-over-six wood sash windows. A number of minor changes appear to have been introduced ca. 1940, including new concrete stair platforms, new concrete watertable and new garage doors at the rear (Harrell 1994: E-72).

When first constructed as a Shell Filling Plant in 1887, Building 119 cost $9,760 (History Office, Picatinny Arsenal n.d.).

Building 151, Post Headquarters. As described by Harrell (1994):

Building 151 is a large two-story-plus-basement, red brick, hip roofed H-plan building [(Ashby et al. 1982)]. The front (south) "I" portion of Building 151 was built in 1929 as the major Administration Building at Picatinny Arsenal [(Figure 21)]. Two linear additions were built to the north in 1941, by Francisco and Jacobus, Architects and Engineers, NY and Chicago, giving the building its present H-plan configuration. The building is still used for administrative and office use.

Significant Features. Building 151 retains original siting, massing, and most of its original construction. Important Colonial Revival architectural features include Flemish bond patterning in the brickwork, limestone quoining at the corners, a formal plan with symmetrical composition, central pavilion at the front entrance, front portico, Colonial Revival style lanterns (front and back), "PICATINNY ARSENAL" sign in Roman block letters, ornamented Classical pediment in the front pavilion, hipped roof, six-over-six windows [(Figure 22)]. The 1941 additions were sympathetic to the original in design and style, and set a precedent allowing for further expansion in the future. The building has recently had some alteration of original roof profile, and insertion of replacement windows with filler panels and snap-in mullions (Harrell 1994:E-78).

Building 154, Solvent Lab. As described by Harrell (1994):

Building 154 is a one-story, pitch roofed building built with a concrete foundation, load-bearing hollow clay tile walls, steel sash windows, and a corrugated asbestos roof [(Ashby et al. 1982)]. Building 154 was built in 1943 as a combination Solvent Vault /Chemistry Laboratory. It was vacant at the time of inspection.

Figure 21. Building 151, Post Headquarters. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Figure 22. Building 151, Post Headquarters, front portico detail. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Figure 23. Building 162, Physics/Chemistry Lab. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Significant Features. Building 154 retains original siting, massing, and most of its original construction. The building is square in plan, and is divided beneath the ridge by a partition which creates two rooms, each equipped with work counters, and accessible by one door. There is a lightning pole near the building (Harrell 1994:E-80).

This building is currently scheduled for demolition due to contamination.

Building 162, Physics/Chemistry Lab. As described by Harrell (1994):

Building 162 is a large H-shaped building with one, two and three story sections [(Figure 23)]. It is in Georgian style, with a concrete foundation, brick walls and hipped roofs [(Ashby et al. 1982)]. Building 162 was built in 1930 and the link and rear additions apparently date from 1942 [(Figure 24)]. It was renovated in 1980.

Significant Features. Building 162 is mostly intact, except for some features changed in the 1980 rehabilitation. The building has a concrete foundation, brick walls with brick quoins and cast stone entrance surrounds, string courses, keystones, cornices and pediment. The sills are cast concrete, the flat arches brick. The many chimneys are brick with a cast stone capping (Figure 25). The stairs at the four side entrances are granite with iron railings, with lantern lights hanging in front of some of the entrance doors. The entrance screen at the main entrance appears to be glazed cast iron.

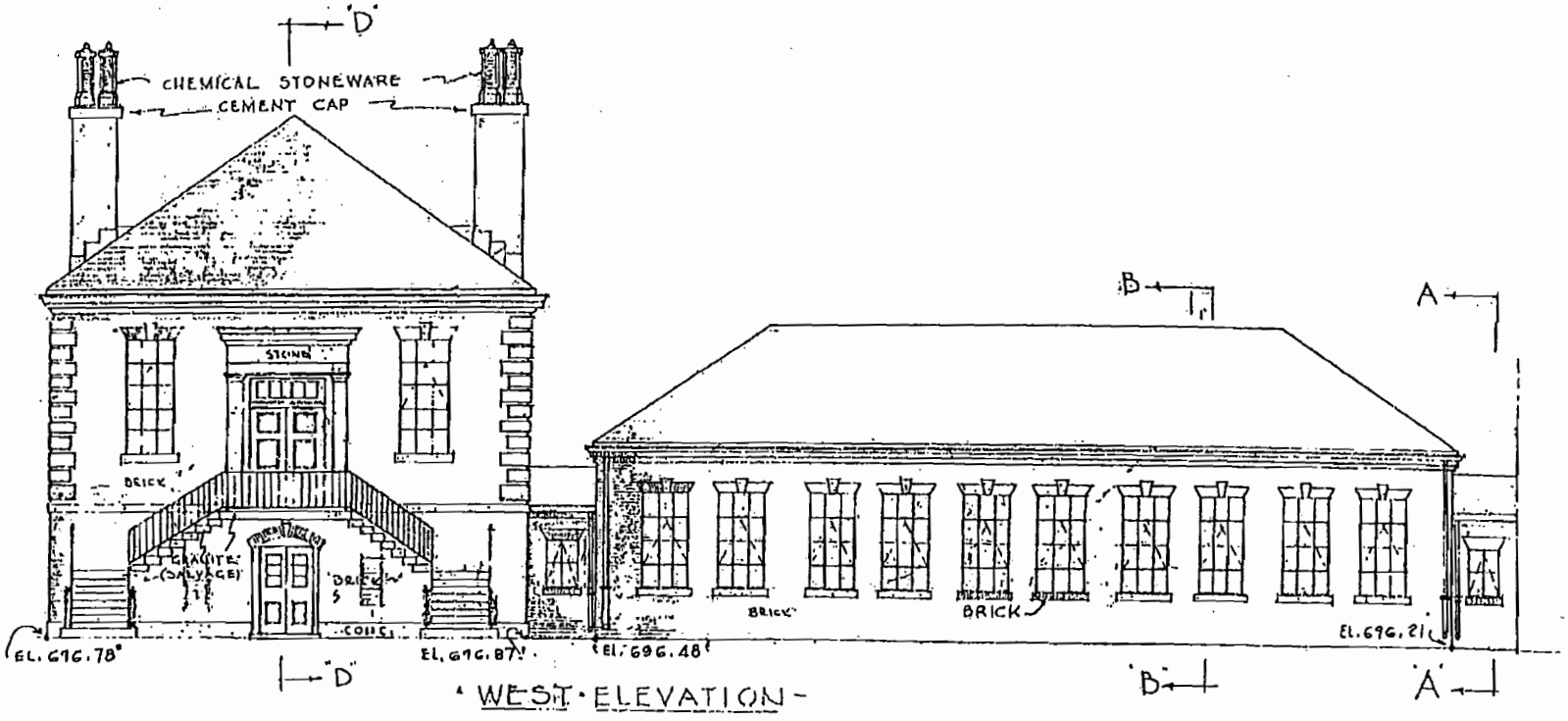


Figure 24. Building 162, Physics/Chemistry Lab, Blueprint # DP-27973, detail from *Extension to Bldg. 162 and connecting Bldg. between 162 and 162N, Elevations and Sections*, April 4, 1940, War Plans Division, Ordnance Department. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

Replacements include asphalt shingles to the roof (originally slate), metal windows (probably double hung wood, originally), anodized aluminum entrance doors, concrete stairs at the main entrance, and a two-story metal addition on the front left-hand side (Harrell 1994:E-82).

Building 162 occupies a prominent position on Farley Avenue in the Administration/ Laboratories Area. Its Georgian style, carried consistently throughout all sides of the H-shaped structure, and landscaped lawn with large trees, adds to the dignified public appearance of Farley Avenue.

Building 163, High Explosives Research Lab. As described by Harrell (1994):

Building 163 is a two-story, hip roofed brick building with stone trim and details (Ashby et al. 1982). Building 163 was built in 1930 as a Chemistry Laboratory building, and is currently used as a Photographic Laboratory [(Figure 26)].

Significant Features. Building 163 retains original siting, massing, and construction. Significant Colonial Revival style architectural features include the formal, symmetrical composition, Flemish bond brick exterior, hipped roof, six-over- windows, double exterior granite stairways, fine wrought iron railings, stone keystones and other details. The roof is supported by cross-braced triangular steel trusses. Building 163 has HVAC fan units supported on railroad ties near the southwest corner, and some "temporary" sheds were added between the steps on the west facade ca. 1974-75 (Harrell 1994:E-84).

This building is virtually identical with the north portion of Building 162 which stands parallel and close by on the south. Both are important structures in the historic "Chemistry Row" area of Picatinny Arsenal.

Building 164, Chemistry/Stability Lab. As described by Harrell (1994):

Building 164 is a one-story, hip-roofed brick building with stone trim and details (Ashby et al. 1982). Building 164 was built in 1930 as a Stability Laboratory building, and is currently used as a General Purpose Laboratory [(Figure 27)].

Significant Features. Building 164 retains original siting, massing, and construction. Significant Colonial Revival style architectural features include the formal, symmetrical composition, hipped roof, Flemish bond brick exterior, brick quoins at the corners, copper gutters, six-over-six windows, splayed lintels, formal Colonial Revival style front door surround, and stairs with wrought iron Colonial Revival style railings. A lightning pole stands north of the building. The building has galvanized steel exhaust vents on the roof and asphalt shingles (Harrell 1994:E-85).

Building 164B, World War II Pay Station. Building 164B is non-contributing to the district.

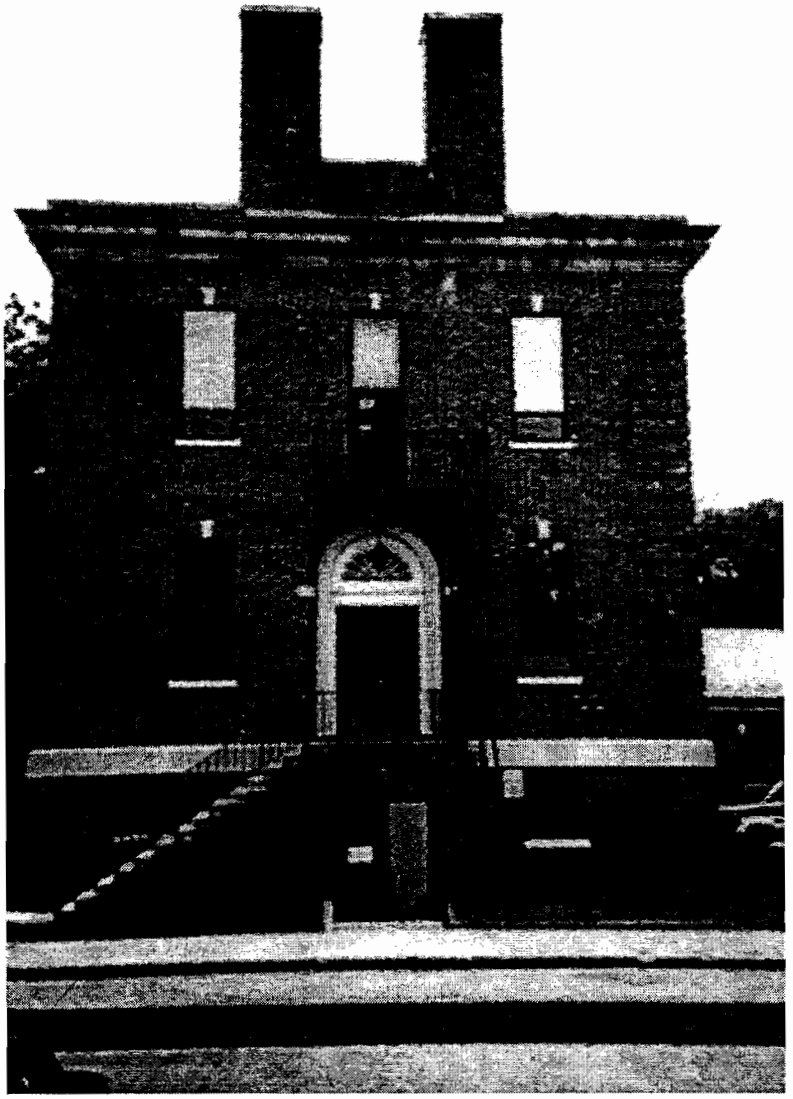


Figure 25. Building 162, Physics/Chemistry Lab, detail of brick chimneys. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Figure 26. Building 163, High Explosives Research Lab. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

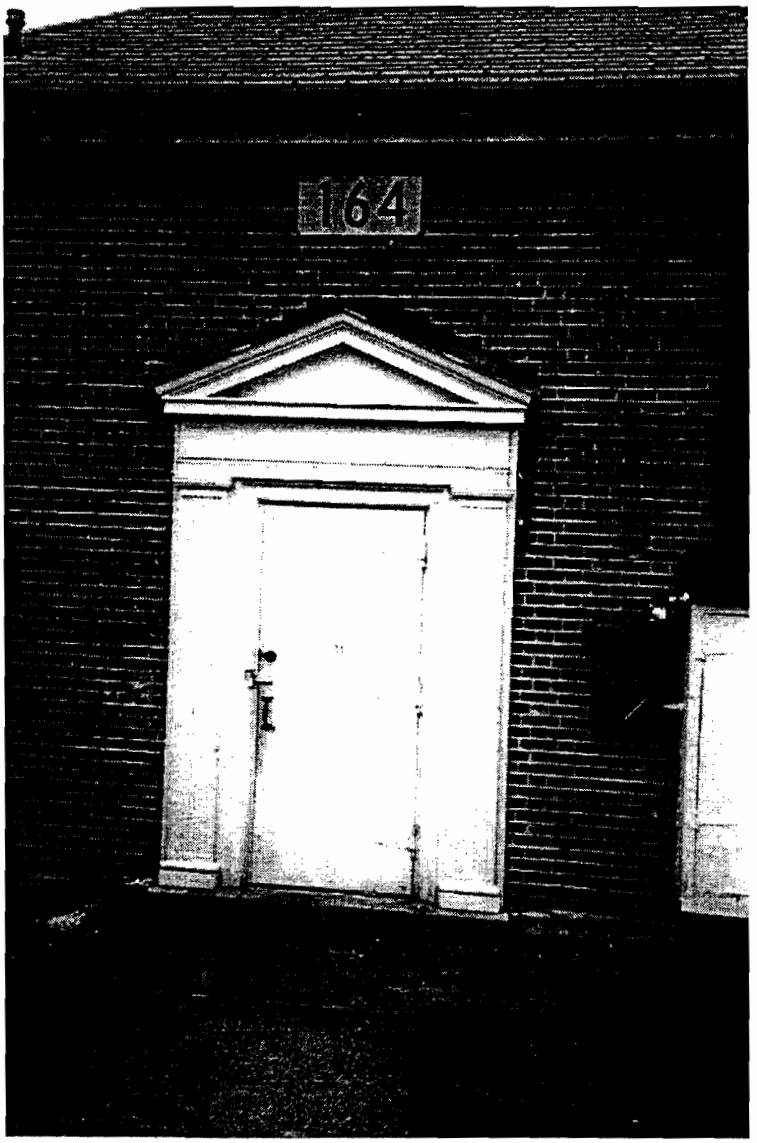


Figure 27. Building 164, Chemistry/Stability Lab. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

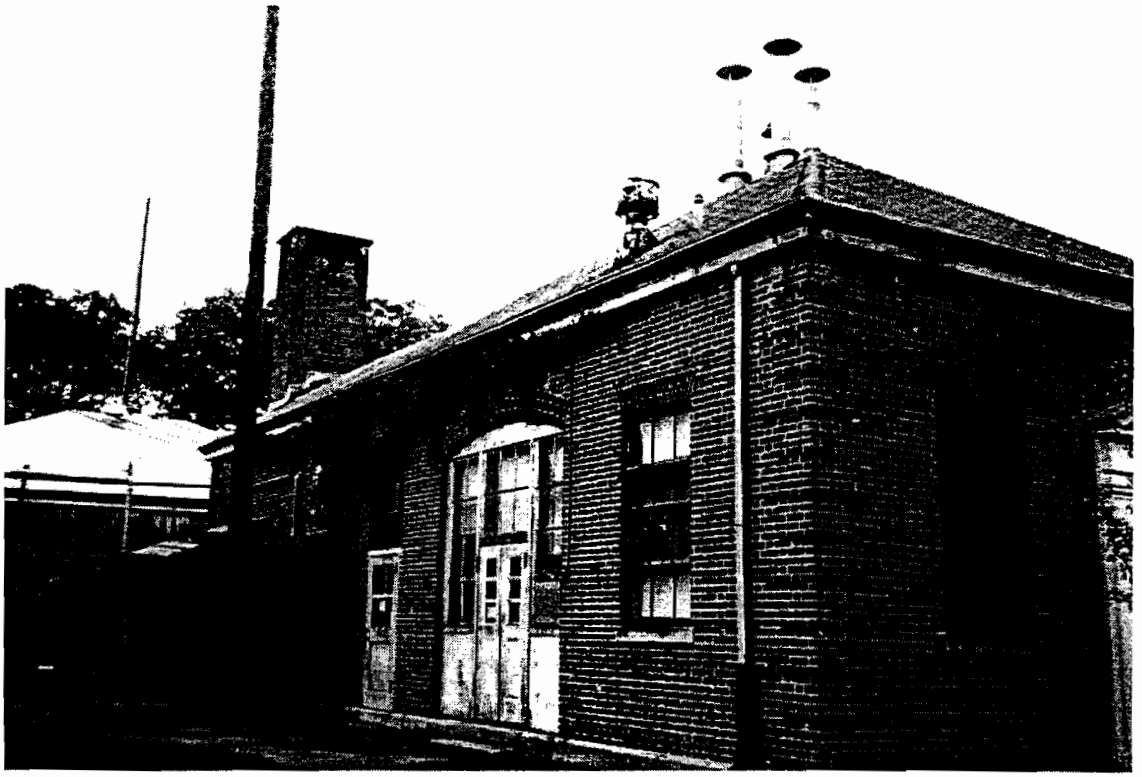


Figure 28. Building 166, Test Conditioning Chamber. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Buildings 166 and 197, Test Conditioning Chambers. As described by Harrell (1994):

> Buildings 166 and 197 are one-story, hip roofed, brick buildings which have asphalt shingle roofing, and concrete foundations [(Ashby et al. 1982)]. Buildings 166 and 197 were built in 1930 as Test Chambers or Accelerated Aging Chambers and are still used for this original purpose [(Figure 28)].
>
> *Significant Features.* Buildings 166 and 197 retain original siting, massing, construction, and some original interior equipment and furnishings. These buildings have many exterior elements (roof style, brick bond, door and window trim, etc.) which are nicely proportioned and representative of the early 20th century Colonial Revival (and Georgian Revival) architectural styles [(Figure 29)]. Doorways in the end walls of each building lead to a U-shaped corridor that surrounds a group of four test chambers. Each test chamber is a square room that contains a circular set of shelves surrounding a central electric resistance heating element [(Figure 30)]. Samples of explosive powders are stored in glass bottles in the shelves, and response to time and temperature variations are recorded (Harrell 1994:E-88).

Buildings 166 and 197 retain their original exterior features and interior plans. Interior elements such as the Test Chamber remain intact and in use (Building 166). These are examples of rare building types and equipment found at Picatinny Arsenal. Building 166 is currently derelict and believed to be the site of a radiological accident.

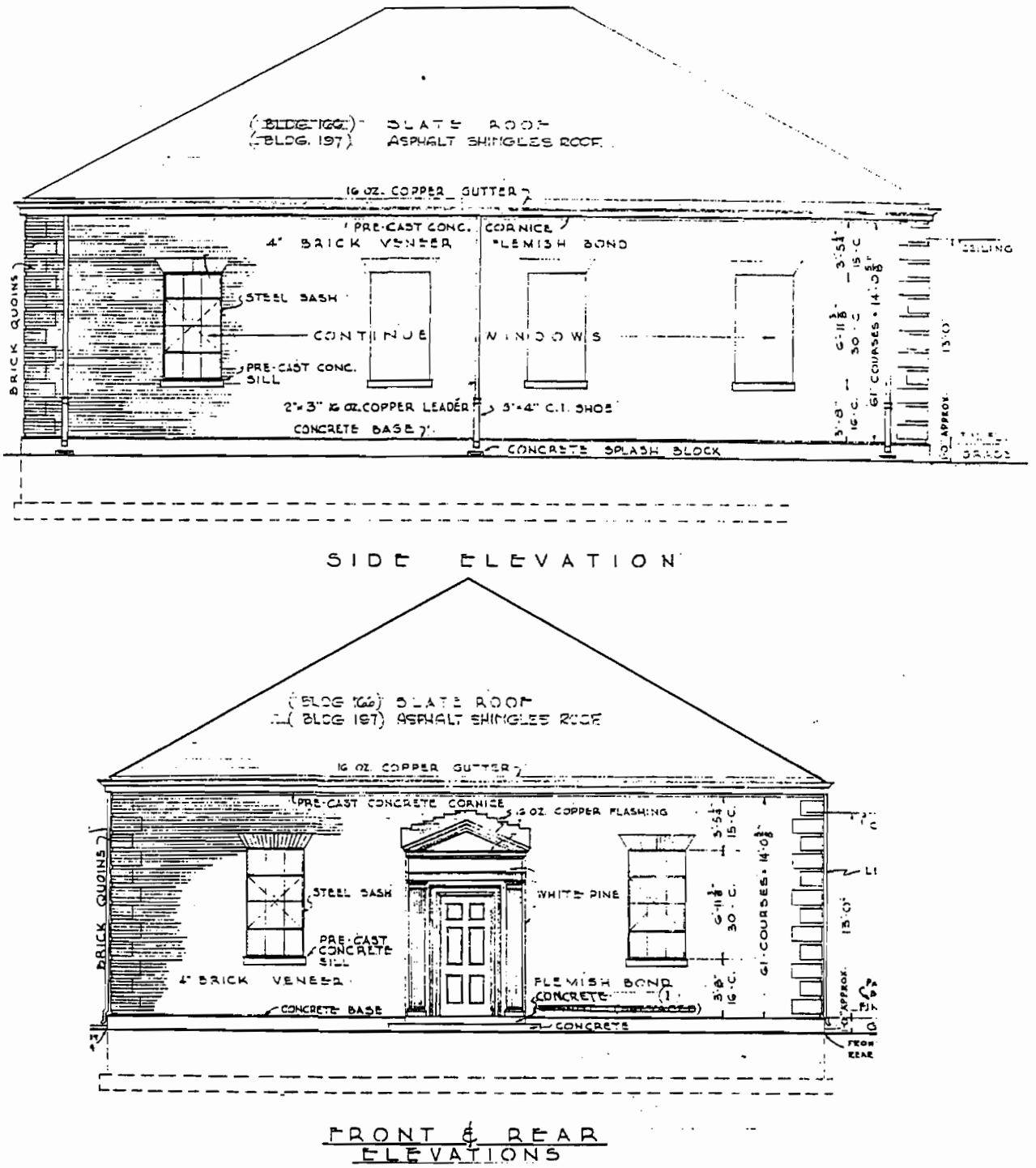


Figure 29. Building 166, Test Conditioning Chamber, Blueprint # DP-29054, detail of exterior from *Buildings No. 166 & 197, High Temperature Surveillance Magazine, Floor Plans and Elevations*, March 15, 1941, War Plans Division, Ordnance Department. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

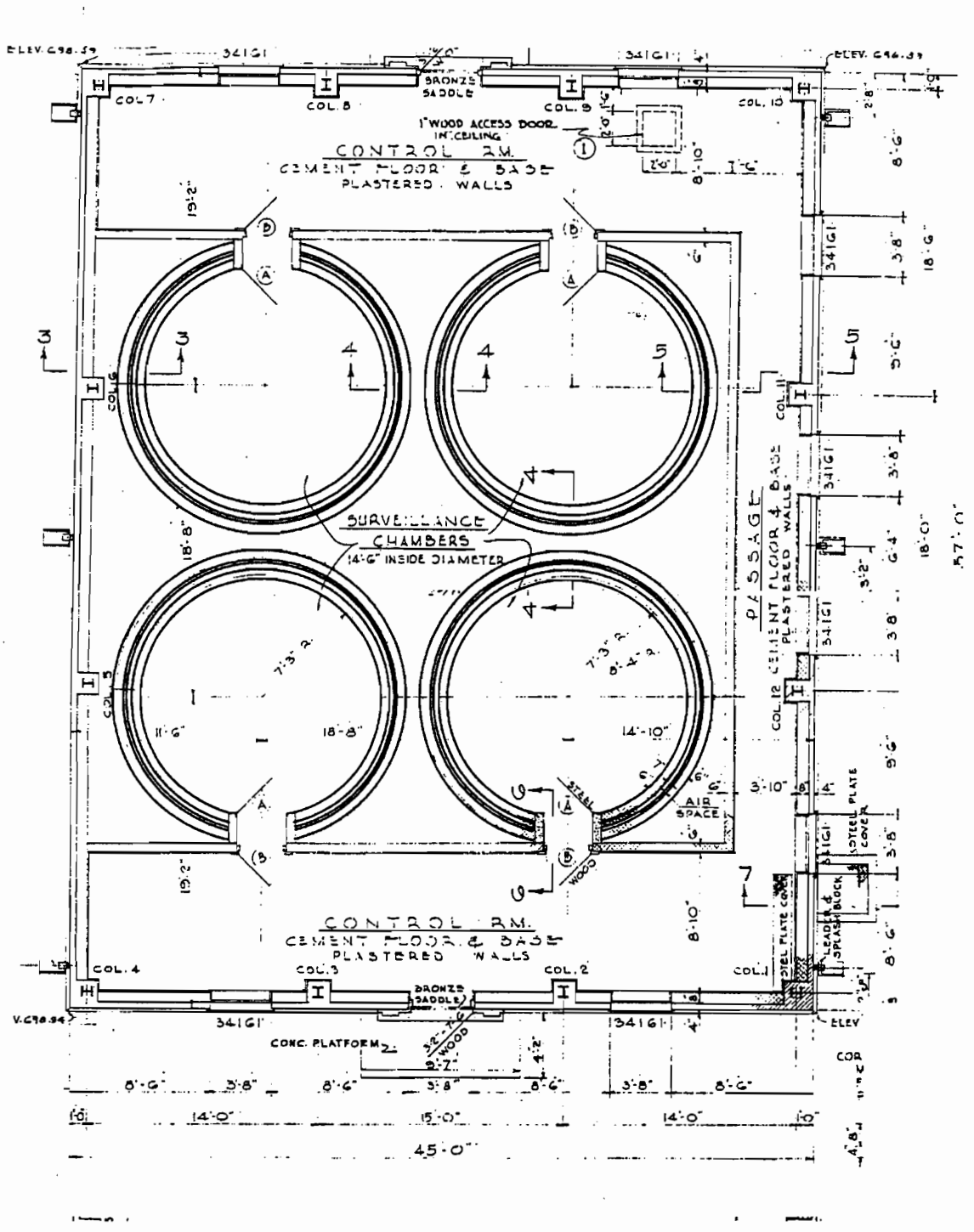


Figure 30. Building 166, Test Conditioning Chamber, Blueprint # DP-29054 detail of floor plan from *Buildings No. 166 & 197, High Temperature Surveillance Magazine, Floor Plans and Elevations,* March 15, 1941, War Plans Division, Ordnance Department. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

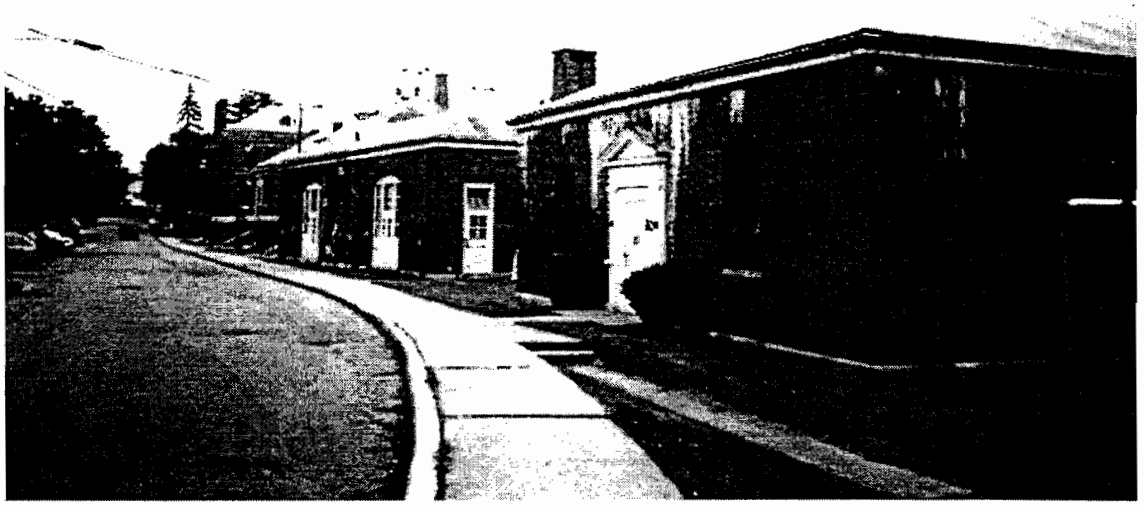


Figure 31. Building 167, High Explosives Preparation and Test Lab. Picatinny Arsenal, Morris County, NJ. *(Nolte 1997)*

Building 167, High Explosives Preparation and Test Lab. As described by Harrell (1994):

> Building 167 is a one-story, hip roofed, brick building with asphalt shingle roofing, and concrete foundations [(Ashby et al. 1982)]. Building 167 was built in 1930 as a High Explosives Preparation and Test Laboratory [(Figure 31)]. It was expanded by a large addition on the north side in 1945.
>
> *Significant Features.* Building 167 retains original siting, massing, and construction. The building has many exterior elements (roof style, brick bond, door and window trim, etc.) which are nicely proportioned and representative of the early twentieth century Colonial Revival (and Georgian Revival) architectural styles. The original 1930 portion of the building (covered by a ridged hip roof) was expanded in 1945. The addition on the north side has a flat hip roof (Harrell 1994:E-90).

Building 168, Ammunition and Explosives Magazine. As described by Harrell (1994):

> Building 168 is a one-story, pitch roofed, concrete and hollow clay tile building with corrugated asbestos-covered metal roofing, and concrete foundations [(Ashby et al. 1982)]. Building 168 was built in 1930 as an Ammunition and Explosives Magazine.

Significant Features. Building 168 retains original siting, massing, and construction. It contains five small storage chambers, which are separated into two areas by a concrete blast-resistant divider wall. The building has five metal vents on the roof, concrete loading docks on each end (north and south) and is separated from other buildings to the north and east by a V-shaped barricade constructed of vertical telephone poles, and vertical board siding, attached by wood framing (Harrell 1994:E-91).

Building 171, Administrative Building. Building 171 is an extremely large, long two-story brick structure that presents a relatively flat facade broken in the center by a front pedimented two-story tetra style porch supported by Doric columns (Figure 32). The long line of the roof is broken by a hexagonal cupola that sports a weather vane (Figure 33). The window feature concrete sills and pediments and are surrounded by decorative shutters. While seemingly odd up close, at a distance, the shutters actually help to breakup the visual space on this extremely long structure. The building is now approached off Buffington Road through an oval driveway system.

The date of construction of this building is uncertain. The HABS inventory (Ashby et al. 1982) cites the construction date as 1948 and Harrell (1994) does not even discuss the structure, presumably because it fell outside the age criterion. A blueprint detailing the structure's front door shows that this building was in existence by June 18, 1940 (DPW, Blueprint # DP 28243) (Figure 34). Clearly, it is the same structure now standing because the door details illustrated in the blueprint can be seen on the present building (Figure 35). The only missing component is the Ordnance Department's "flaming bomb" symbol centered in the door's broken pediment.

A walking tour prepared for the arsenal provides a small bit of information on this structure. Building 171 was built over the site of the original #2 Magazine. At the time of the 1926 explosion, the magazine was being used as a bag loading plant. The explosion caused significant damage, and after repairs were made it was used as a chemical lab and a main technical building until 1931. It subsequently became a storehouse and later an experimental plant before it became an administrative building (History Office, Picatinny Arsenal n.d.).

Whenever its construction date, it was clearly designed or re-designed as a part of the Colonial Revival Administrative and Research district. Today it anchors the northern end of the district and serves as a focal point off Buffington Road at 9th Street.

Building 172, Ordnance Administration Building. As described by Harrell (1994):

> Building 172 is a two-story building and basement, with a concrete foundation, structural steel frame encased in concrete, brick walls, and a hipped roof [(Ashby et al. 1982)]. Building 172 was built in 1942 by Francisco and Jacobus, Architects and Engineers, NY and Chicago as an ordnance administration building, and it continues to be used for administrative purposes [(Figure 36)].

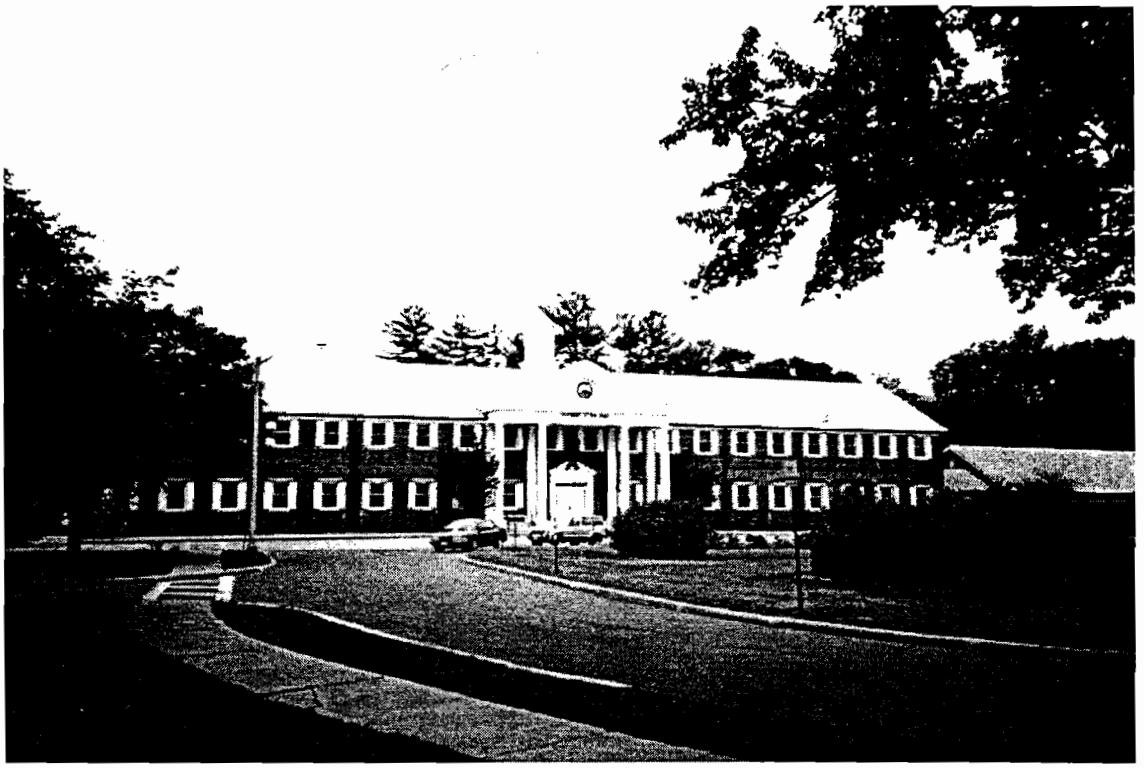


Figure 32. Building 171, Administrative Building. Picatinny Arsenal, Morris County, NJ. *(Nolte 1997)*

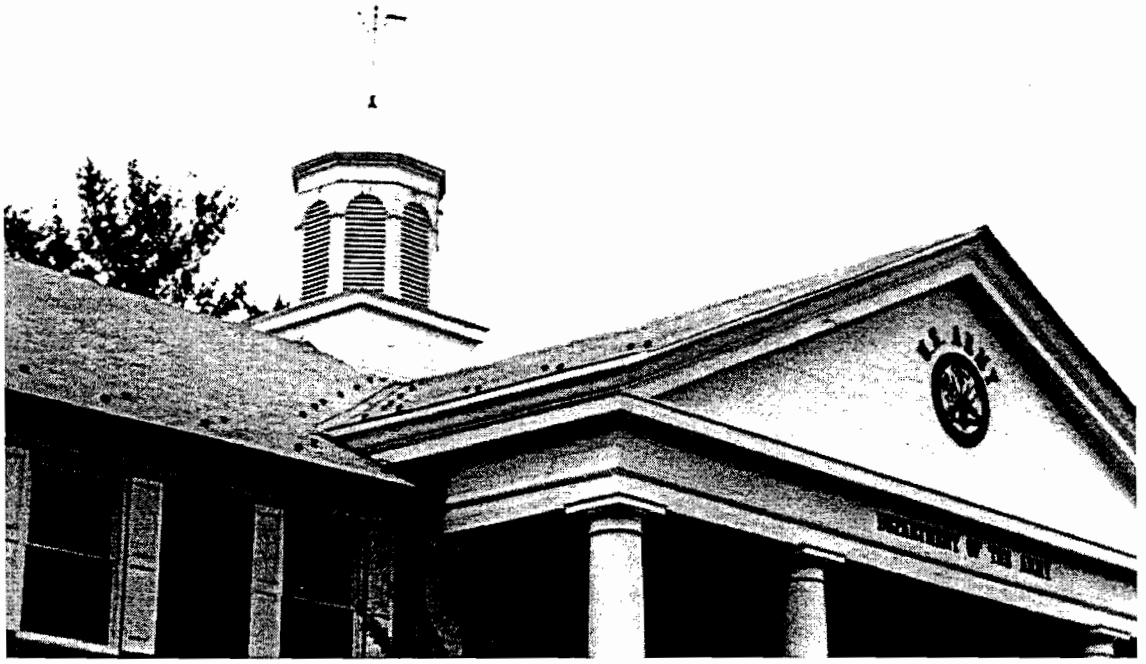
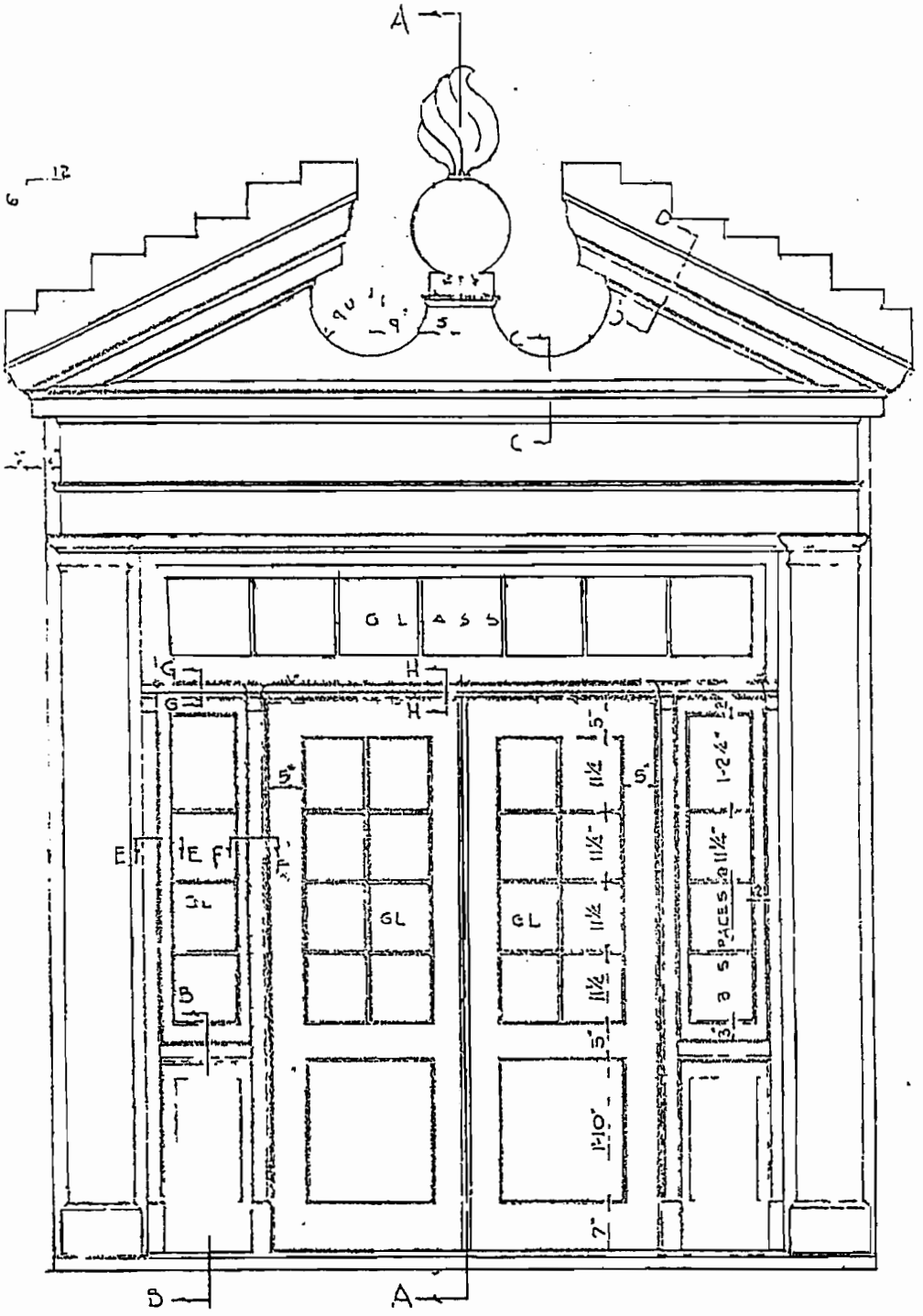


Figure 33. Building 171, Administrative Building, cupola detail. Picatinny Arsenal, Morris County, NJ. *(Nolte 1997)*



ELEVATION

Figure 34. Building 171, Administrative Building, Blueprint # DP-28243, detail from *Building No. 171, Entrance Doorway Details*, June 18, 1940, War Plans Division, Ordnance Department. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

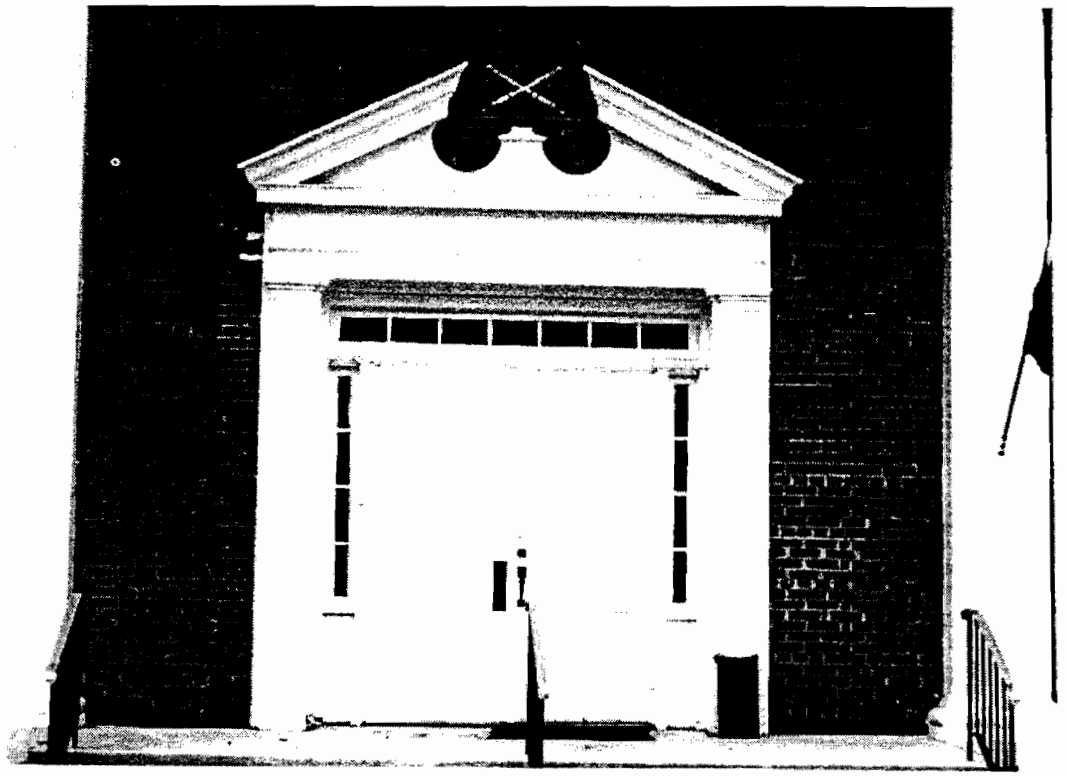


Figure 35. Building 171, Administrative Building, door detail. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Figure 36. Building 172, Ordnance Administration Building. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Significant Features. Building 172 is mostly intact. The building has a concrete foundation, a structural steel frame encased in concrete forming piers and beams, with brick spandrels and panels, and metal windows with cast stone sills. The hipped roof is covered with asphalt shingles, and there are two copper-clad dormer vents front and back. The front entrance stairs are concrete, with iron railings and standard lamps topped with eagles [(Figure 37)]. Modifications to the original building include aluminum entrance doors, anodized aluminum windows, metal gutters and downspouts, and a metal entrance canopy at the basement entrance. The interior has been renovated [(Figure 38)] (Harrell 1994:E-92).

Blueprints show that Building 172 once had a very grand entry way featuring double doors topped by a decorative bronze transom window. The doors were flanked by Colonial Revival style lamp posts.

Building 173, Guard House/Transformer Station. As described by Harrell (1994):

Building 173 is a two-story, flat roofed, concrete structure which occupies a central position at Picatinny Arsenal [(Ashby et al. 1982)]. Building 173 was built in 1942 as a transformer station. It was later used as a fire station, before Picatinny Arsenal acquired the Navy property. It currently is used both as a police station (main building) and communications center (concrete block addition on the east side) [(Figure 39)].

Significant Features. Building 173 retains original siting, massing, and construction. The building has a large concrete block addition on the east, three small additions on the west, and a group of new HVAC chillers on the north. Many of the original window openings have been in filled with concrete panels. Many original wood elements (sash and doors) have been replaced with aluminum doors and windows. A drop ceiling has been installed on the interior (Harrell 1994:E-93).

Building 174, Service Magazine. As described by Harrell (1994):

Building 174 is an eleven bay building with a concrete foundation, loadbearing brick and hollow tile construction, covered with metal siding. There are replacement doors and windows and a gable roof [(Ashby et al. 1982)] Building 174 was built in 1942 as a service magazine. It is currently used for administrative offices.

Significant Features. Building 174 retains original siting, massing, and construction. There are wooden eaves with ventilated soffits. One end elevation is gabled; the other is hipped. There is a satellite dish to the northeast (Harrell 1994:E-94).

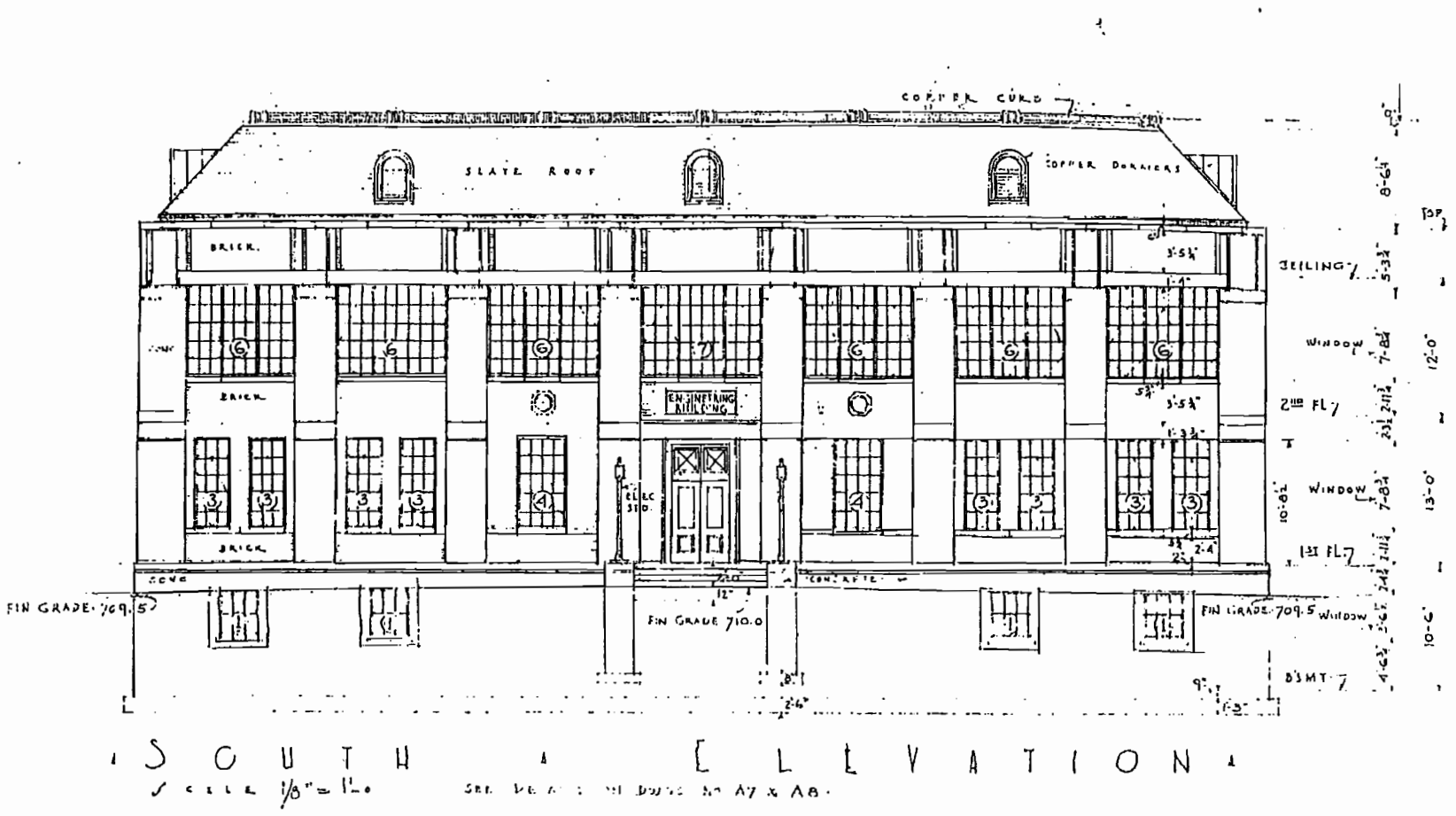


Figure 37. Building 172, Ordnance Administration Building, Blueprint # DP-29615, detail from *Engineering Building, Building No. 172, Elevations and Details*, June 30, 1941, Francisco and Jacobus, Architects and Engineers, New York and Chicago. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

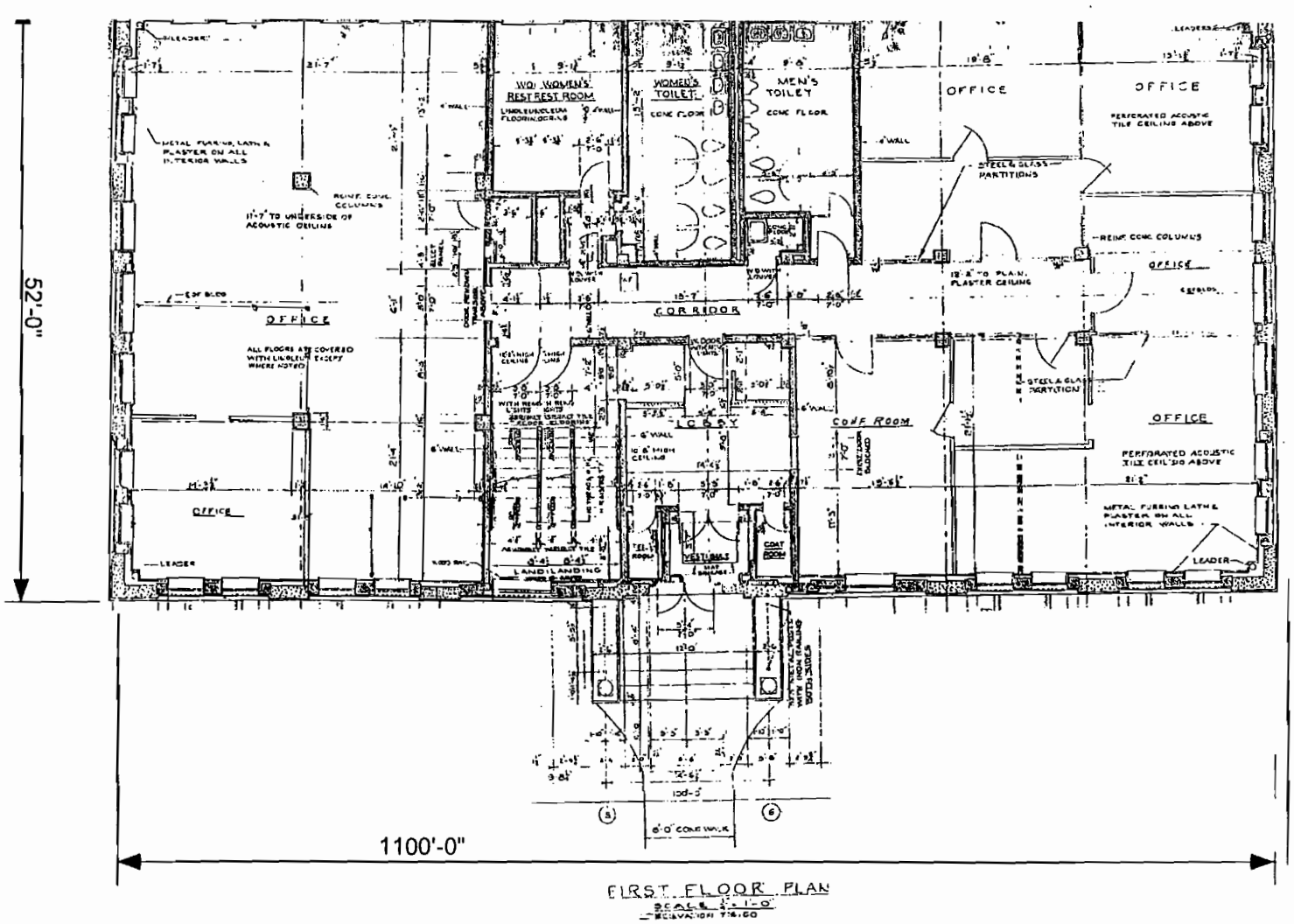


Figure 38. Building 172, Ordnance Administration Building, Blueprint # DP-57492, *U.S. Army Munitions Command Office, First Floor Plan,* June 30, 1941, Francisco and Jacobus, Architects and Engineers, New York and Chicago. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

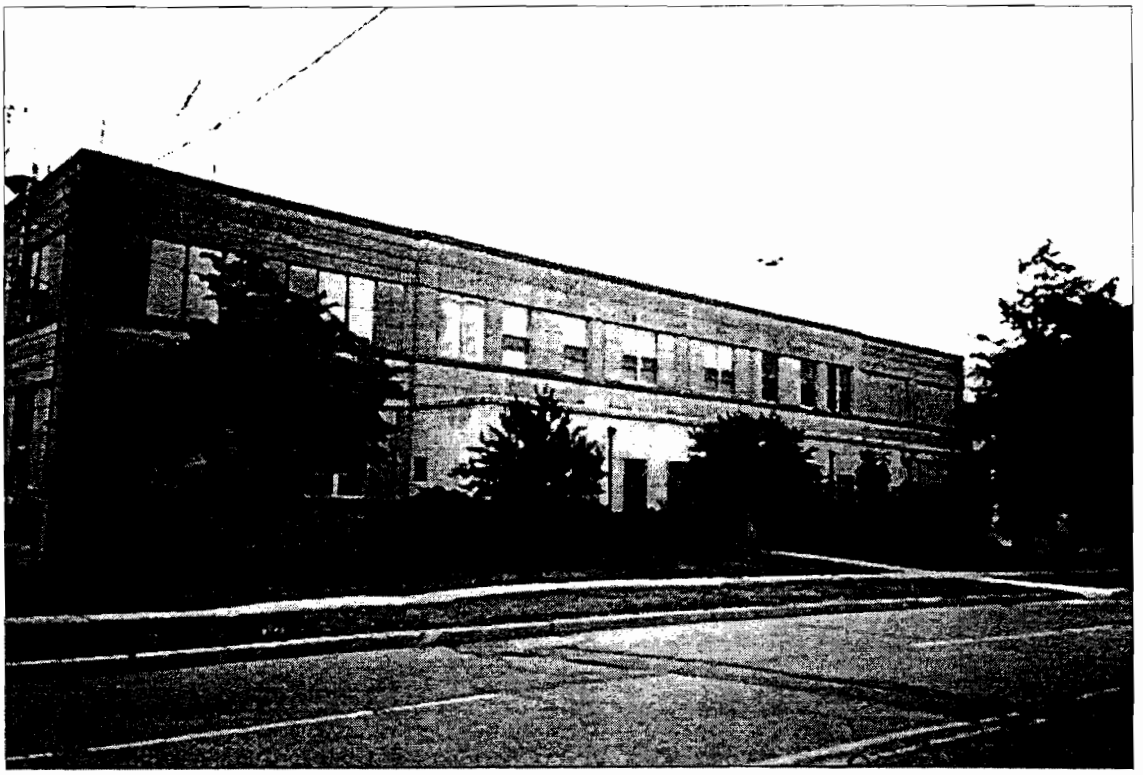


Figure 39. Building 173, Guard and Transformer Station. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Building 176, Lab Equipment/Sampling of Ammunition. As described by Harrell (1994):

> Building 176 is a single story building with nine bays, loadbearing brick walls laid in common bond and concrete block additions with vinyl siding. There are replacement windows, a central doorway and a gabled roof [(Ashby et al. 1982)]. Building 176 was built in 1944 as a laboratory and for sampling of batches of ammunition. In 1959, 1961 and 1962 additions were built. The building is now used for administration.
>
> *Significant Features.* Building 176 retains original siting, massing, and construction. There is no longer a wooden walkway connecting Building 176 to Building 171 (Harrell 1994:E-95).

Building 183, Steam Flow Meter House. As described by Harrell (1994:E-96):

> Building 183 is a combined building of an older one-story section and a newer T-shaped two-story section, both sections with brick walls and gable roof [(Ashby et al. 1982)]. The older section of Building 183 was built in 1945 as the Steam Meter Flow House, with an addition in 1963 (designed by Lawrence Picone and Associates of Metuchen, New Jersey). The building is now used as a materials facility and for administrative purposes.

Significant Features. The older section of Building 183 is in Georgian style, with a concrete foundation, brick walls, six-over-six double hung sash windows, brick sills and soldier course lintels, and a gable roof covered with asphalt shingles. The east facade has two sets of double wood doors with five-light rectangular transoms; the west facade has a central entrance with double wood doors topped with a semicircular fanlight, all set in a pedimented entrance bay. The newer section of the building has brick walls, metal windows with soldier brick lintel and concrete sills, spaced similarly to those on the original building, and gable roof. A metal stairway leads to an upper doorway in the gable end.

3.1.2 Recommendations for Administrative and Research District.

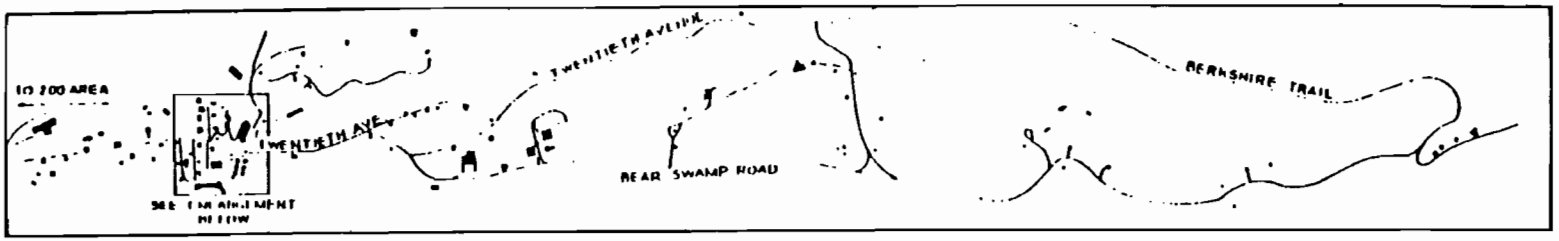
On July 2, 1999 the New Jersey HPO ruled that the Administration and Research District was eligible under Criteria A and C (Guzzo 1999). The district's historic context is: World War I; the inter-war years, World War II mobilization; World War II; and the Cold War.

3.2 600 ORDNANCE TEST AREA DISTRICT

Structures included in the 600 Ordnance Test Area District (Figure 40) are listed by historical name and current building number below.

604	Environmental Testing (1928)
604A	Control House (1928)
604B	Detonating Chamber (1931)
604C	Sectioning Chamber (1928 to 1930)
604D	Drop Tower (1928)
604E	Wind Tunnel (1942)
604F	Bull Pen (1928)
604I	Unknown, non-contributing
607	Fragmentation Tub Building (1941)
607A	Disassembly Building (1938)
611	Gun Emplacement (1965), non-contributing
611A	Armor Plate-Butt (1965), non-contributing
611B	Gas Gun Test Tunnel (1929) or Fuze Test Tunnel
613	Ballistic Mortar Testing (1928)
617	Fragmentation Cleaning, Reconstruction and Photography Building (1928)
617A	Constant Temperature Powder Building (1928)
617B	Smokeless Powder Storage (1948)
617E	Oil and Paint Storage (1928)

PICATINNY ARSENAL - 600 AREA



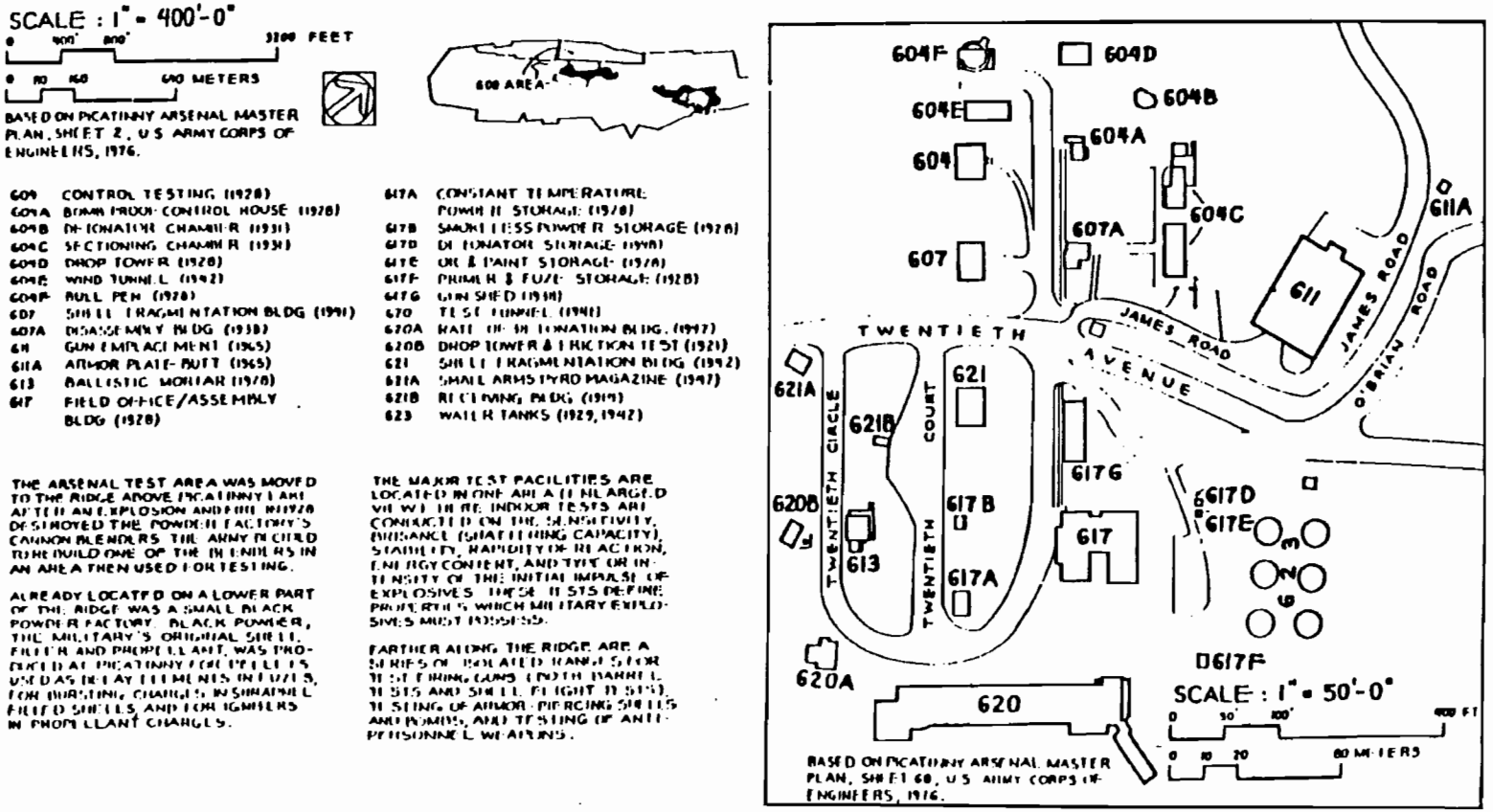


Figure 40. Picatinny Arsenal: 600 Area, 1930-1957 from Picatinny Arsenal, Historic American Engineering Record, NJ-36. Picatinny Arsenal, Morris County, New Jersey *(Thurber and Norman 1983).*

617F Magazine (1928)

617G Gun Shed (1938)

620 Test Tunnel (1941)

620B Drop Tower and Friction Test (1928)

621 Fragmentation Tub Building (1941)

621B Shipping and Receiving (1914)

623A-E Water tanks (1929-42)

Just prior to World War II, Picatinny's mission was to provide the Army with a munitions manufacturing center that included experimental and production plants for a range of propellents and explosives. Picatinny Arsenal was an important explosives and ammunition research center. The Lake Denmark explosion was merely an interruption in Picatinny's role of preserving armament knowledge. The Arsenal's facilities continued to serve both the Army and private industry during the inter-war years. When the U.S. entered the war, Picatinny Arsenal was producing smokeless powder; high explosives; fuzes and primers; assembled rounds of artillery ammunition; bombs and grenades; and pyrotechnics (airplane flares and signal smokes)—all at experimental or peace-time levels (Thurber ca. 1983).

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. The Arsenal was also instrumental in improving and redesigning artillery primers, trench mortars and rounds of chemical and tracer ammunition. Fuze powders, primer mixtures, pyrotechnic compositions, propellent compositions, and new high explosives were developed by the Research and Chemical Branch. Picatinny's mission also called for the development of new munitions designs utilizing the latest technology and, in the event of a national emergency, to provide private industry with production plans and testing.

During World War II many important advances in new products or simplified methods of production were made at Picatinny. Improved methods of manufacturing Tetryl, a high explosive; the discovery that wood pulp could be substituted for cellulose-based (cotton) powders; the development of M1 and M3 flashless powders; and the invention of Haleite, named for Picatinny's Chief of the Chemical Branch, Dr. G.C. Hale, were accomplished at Picatinny. The creation of or changes to various products called for stringent testing and as a result, ammunition testing procedures for the whole Army were standardized at the arsenal.

Aside from the standardization of all Army ammunition testing procedures, Picatinny also conducted a significant number of testing operations. The M1 and M3 flashless, non-hydroscopic cannon powders were tested at the arsenal both for composition and for specific weapons (3-inch and 90mm). Long delay and above-ground bomb fuzes as well as pyrotechnic devices were also tested. At the outbreak of World War II, the arsenal was

responsible for the design and development of artillery fuzes, boosters and grenades, all of which had to be repeatedly tested and fine-tuned. The composition and deterioration rate of powders in explosives was another important part of the testing program. All testing related to the sensitivity, brisance, stability, rapidity of reaction, energy content, and type of intensity of the initial impulse of explosives was conducted in the 600 Testing Area at Picatinny. All of these tests were critical in developing explosives that would best meet the Army's needs.

After the 1926 explosion, Picatinny was in a position to reconstruct itself, not only architecturally but also philosophically and technologically. The recreation of Picatinny Arsenal established it as the Army's major ammunition facility. This involved not only the manufacture of armaments but most importantly, the research and development of most types of ammunition, except small arms and machine guns (Thurber and Norman 1983).

The primary reconstruction effort was focused on the powder and explosives manufacturing area. A new Nitrocellulose Smokeless Powder Plant (500 Area) (see Figure 8) was built on the original site; the Complete Rounds/Melt Loading Plant (800 Area) (see Figure 9) and a High Explosives Plant (1000 Area) were constructed and the new testing area (600 Area) was established on a plateau west of Picatinny Peak (Thurber and Norman 1983). A new administrative building (#151) and a chemical laboratory complex were also built. The creation of these administrative and research facilities reflected the shift in the focus of the arsenal to research and development (Thurber and Norman 1983).

Before the 1926 explosion, ordnance testing was conducted all over the arsenal, usually just outside the building where research was being conducted. Such impromptu testing caused numerous accidents and fires within the production areas. After the 1926 explosion, most of the testing activities were moved to a small peninsula on the south shore of Picatinny Lake. Another fire and explosion in 1928, limited this time to only the 500 Area, destroyed several structures and resulted in the final movement of the testing area to its current location on the ridge above the Lake (Thurber and Norman 1983).

The final removal of the test area to the ridge produced a number of important benefits for the facility. It eliminated all activities but storage from the extreme northern end of the arsenal, thereby freeing the east and west shore of Picatinny Lake from the hazards of test firing across the lake into the mountain. Eliminating the firing hazards meant that all roads around the lake would have uninterrupted service (*Plant Design* ca. 1945).

The administration observed that the new location was "well-suited for practically all activities and tests which are usually assigned to a small proving ground" (*Plant Design* ca. 1945). Here a firing range with gun emplacements, velocity screens and a recovery butt were constructed permitting the testing of pilot lots of smokeless powder for velocity and pressure that would have otherwise been conducted at Aberdeen Proving Ground. Another range, located within a building, for the testing of small arms was also constructed. Other structures provided for the safe explosion of a number of different items (*Plant Design* ca. 1945).

All of the major indoor ordnance test facilities were located in one area immediately off Twentieth Avenue (see Figure 40). Since the creation of the complex in 1928, structures continued to be added until 1965 (Thurber and Norman 1983). Buildings 611 and 611A, a gun emplacement and an armor plate-butt, were built in 1965. These two structures are non-contributing buildings to this district. Buildings 604 through 623 contain the control rooms, testing chambers and other facilities used in the indoor testing of explosives.

The 600 Explosives Test Area structures were specifically designed to withstand shock and blast effects and were built in a variety of shapes and sizes. The structures are utilitarian in extreme; all construction features being dictated by the testing to be conducted within. Building materials include: wood, brick, concrete, galvanized steel, and tile. Framing styles and materials also differed with the structure's testing intent. The area today looks very much as it probably did during the World War II years. Large, well-lit open areas surround oddly configured buildings which stand in stark simplicity. No attempt has ever been made to landscape this almost surreal grouping of buildings which are still used today for ordnance testing.

The planning of this area in 1928 was carried out by the Engineering Department of the arsenal with the assistance of the Quartermaster and outside contractors (*Plant Design* ca. 1945). The Army does not appear to have kept standardized plans for industrial buildings before World War II, relying on private industry to help in the creation of such structures (Cannan et al. 1996). Blueprints for the earliest structures could not be found, although blueprints from the World War II years show that some structure designs were created by The War Plans Division, Ordnance Department, Picatinny Arsenal (Picatinny Arsenal, DPW n.d.c.). Certainly several structures were specifically designed for explicit purposes in the 600 Area and would seem to be one-of-a-kind buildings. A survey of the facilities at the old-line Army arsenals at Edgewood (Aberdeen) Arsenal, Maryland; Rock Island Arsenal, Illinois; and Watervliet Arsenal, New York reveal no grouping of testing-related structures like those at Picatinny.

3.2.1 Structures of 600 Ordnance Test Area District.

The following is an architectural description and known history of each structure in the 600 Ordnance Test Area District.

Building 604, Environmental Testing. As described by Harrell (1994):

> Building 604 is of concrete (first floor) and wood frame (second floor) construction on a concrete foundation that includes a basement [(Ashby et al. 1982)]. Constructed in 1928 and similar to Buildings 607 and 621, Building 604 originally contained a fragmentation tub supported by steel columns and concrete piers in the basement [(Figure 41)]. Live shells were detonated inside the hopper, which was filled with sand to absorb the shock of the blast, and the shell fragments were retrieved by a screen for examination. The sand, which could be reused, was stored in the basement and lifted to the hopper by means of a bucket elevator. In 1943, the fragmentation tub and the elevator were removed, and the louvers (which served to alleviate structural stress

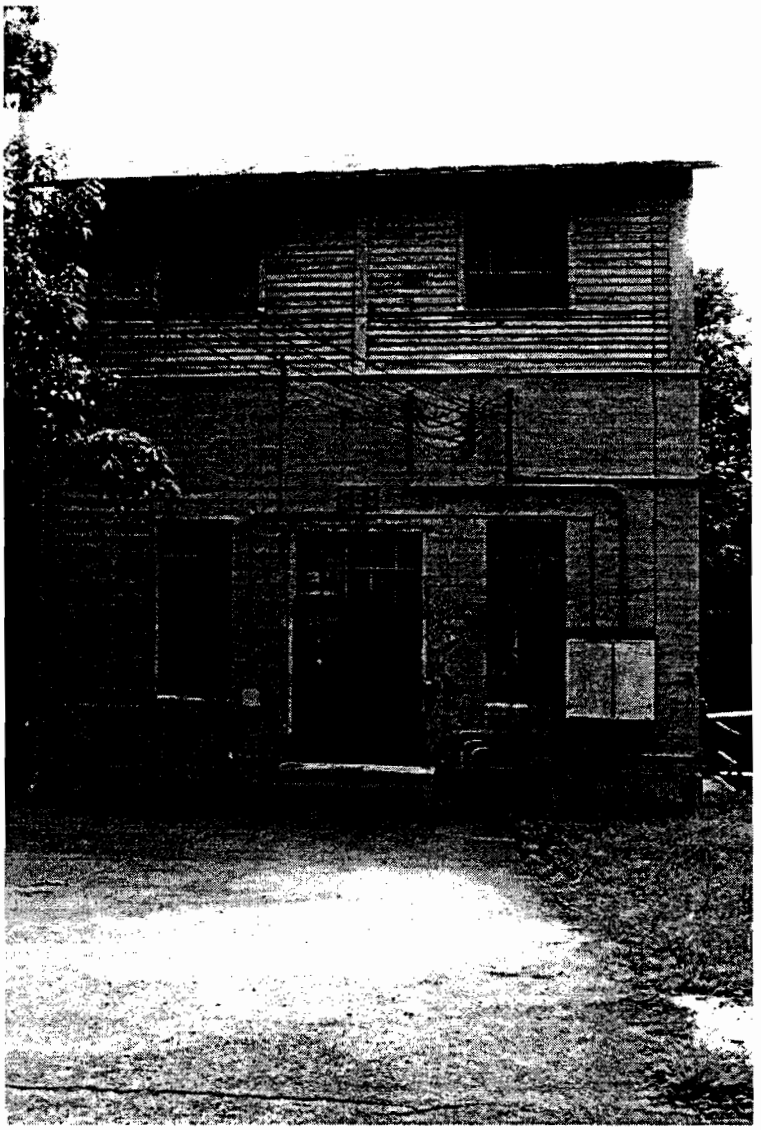


Figure 41. Building 604, Environmental Testing. Picatinny Arsenal, Morris County. New Jersey *(Nolte 1997).*

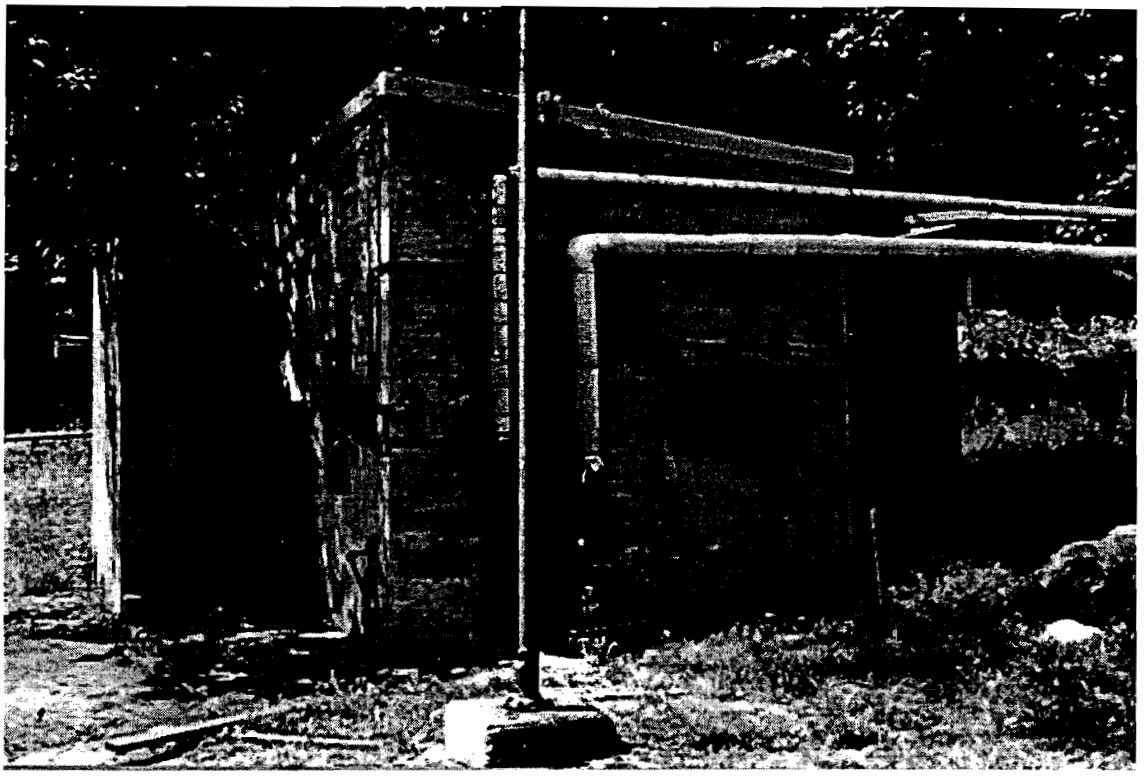


Figure 42. Building 604A, Control House. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

during the explosions) on the second floor were replaced by wooden lap siding. Currently used for storage.

Significant Features. Exterior shell intact. The rectangular, two-story structure has an asbestos protected corrugated metal gable roof and stands almost 35' high. The north front elevation has a center door flanked by two metal industrial windows and two more on the second story. The south rear elevation is similar to the front minus the center door, and contains a basement door. East and west side elevations have one second story window each. One wood lightning pole to the side (Harrell 1994:E-238).

Building 604A, Control House. As described by Harrell (1994):

Building 604A is a one-story, rectangular structure with a concrete foundation, concrete walls, and a concrete with tar and gravel low shed roof (Ashby et al. 1982). Building 604A was constructed in 1928 as a control house for Building 604G, the drop tower [(Figure 42)].

Significant Features. Interior and exterior intact, with original wood door and windows. An L-shaped concrete barricade shields a door on the south side; a half-story above grade basement with concrete walls and a concrete shed roof is attached to the west. A cable runs from an opening in the basement to Building 604-G, the drop tower, via a wood A-frame with pulleys that elevates the cable (Harrell 1994:E-240).

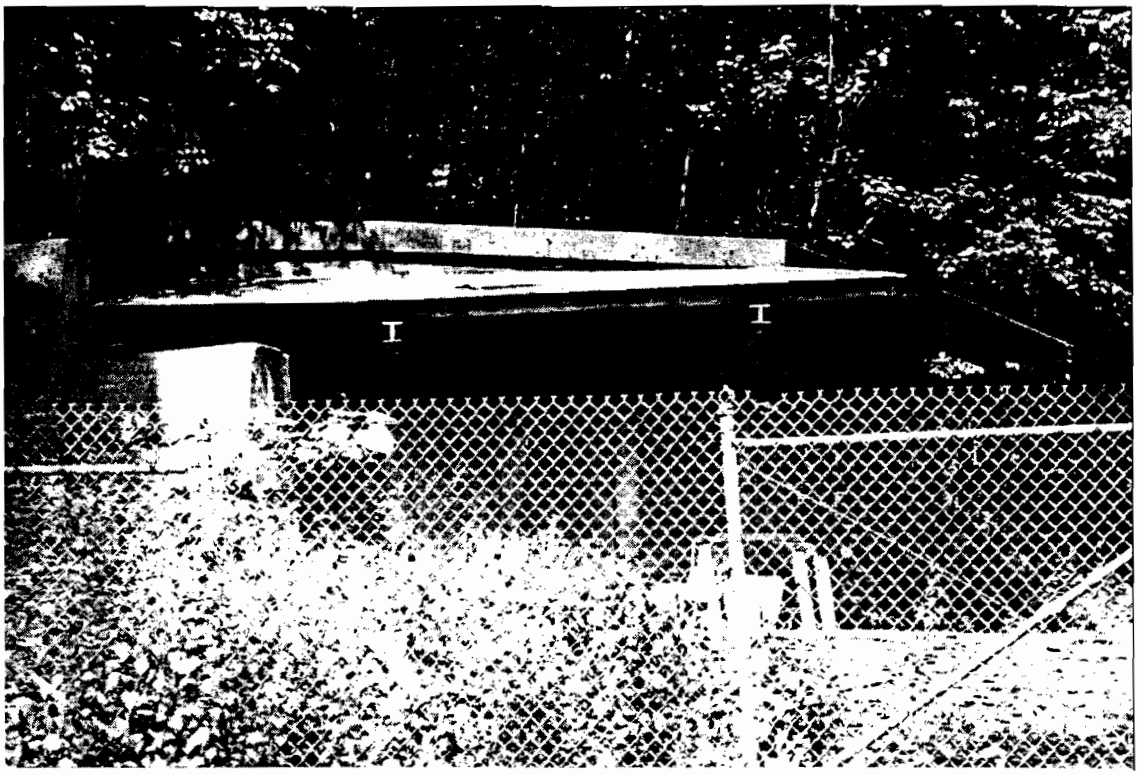


Figure 43. Building 604B, Detonating Chamber. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Building 604B, Detonating Chamber. As described by Harrell (1994):

Building 604B is a one-story, irregularly shaped hexagonal structure with a concrete foundation, tie-rod-reinforced concrete walls, and a flat concrete roof (Ashby et al. 1982). Building 604B was constructed in 1931 as a detonating chamber to test explosives and is still used as such [(Figure 43)].

Significant Features. Entire structure of Building 604B, intact and unaltered, with exterior lighting controls. The roof projects on two sides to form an overhang supported by steel brackets. The entrance to the chamber is shielded on the outside by a concentric concrete wall and on the inside by a concrete barrier wall (Harrell 1994:E-241).

Building 604C, Sectioning Chamber. As described by Harrell (1994):

Building 604C is a row of one-story operating rooms with concrete foundations, concrete walls, and concrete shed roofs (Ashby et al. 1982). Building 604C was constructed in 1928 as a teardown facility for the disassembly of ammunition [(Figure 44)]. It consisted of a control room flanked by two operating rooms, and a separate chamber to the west that housed a lathe. In 1942 a saw room with its own control room was added, and in 1958, a milling machine room was added. Both additions, with their buttressed concrete blast walls, unified Building 604C into one structure. Building 604C continues to function as a teardown facility.

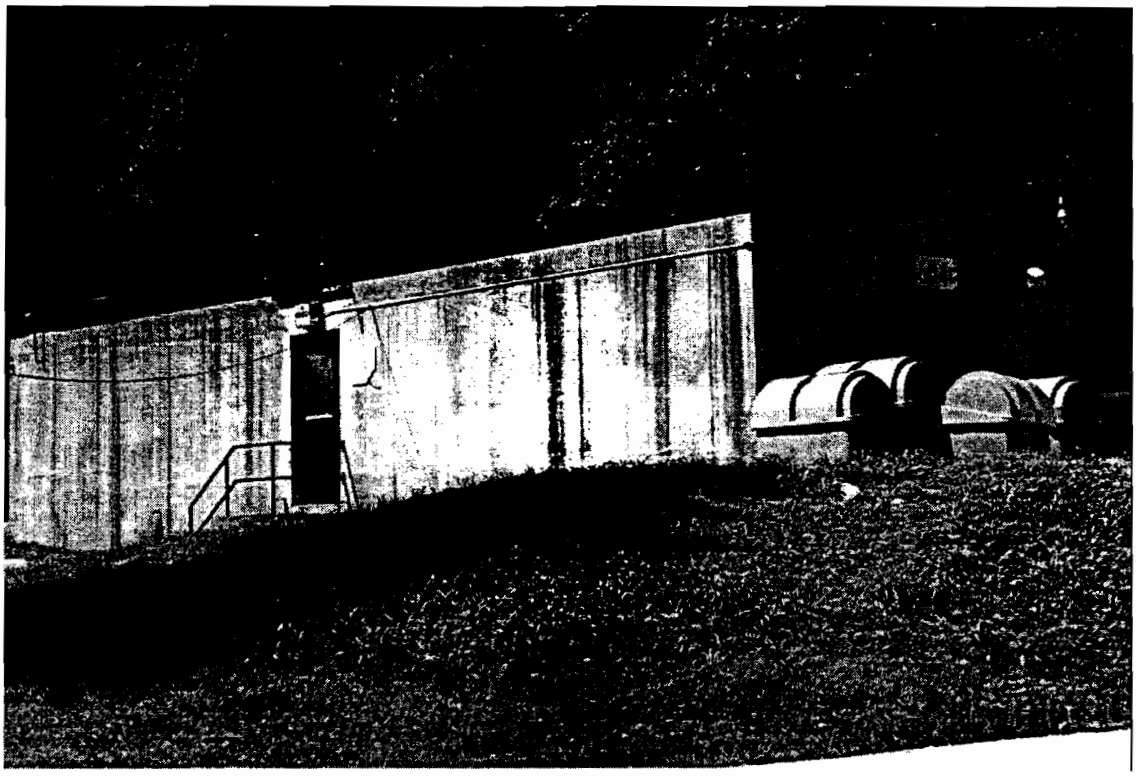


Figure 44. Building 604C, Sectional Chamber. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Significant Features. Interior and exterior intact. The original building consists of a control room flanked by two operating rooms, which are open to the north and faced with wood framed cel-o-glass blowout walls. The later additions are also faced with cel-o-glass, but protected on the north by buttressed concrete blast walls cel-o-glass storefront walls (installed in 1962) and concrete buttress walls (Harrell 1994:E-242).

Building 604D, Drop Tower. As described by Harrell (1994):

Building 604D consists of two connected drop towers (Ashby et al. 1982). The original drop tower was constructed in 1928 for artillery detonation testing [(Figure 45)]. In 1946, an enclosed multiple impact test chute was inserted into the middle of the tower, containing several steel plates placed at varying heights to interrupt the fall of the object being tested. Each plate ledge could be accessed from the exterior by a sliding steel gate. In 1949, another tower was built, with a steel walled detonating enclosure at its base.

Significant Features. Entire structure of Building 604D, which is intact, and monitoring shed. The original tower has a concrete foundation, concrete blast wall at its base, open steel fame, three platforms accessible by a ladder running up the north end, and a multiple impact drop chute that rises to the third platform, which is 47' above grade. The second tower has a concrete foundation, steel-walled drop chamber at its base, open steel frame, and two platforms accessible by stairs. The second platform is 40'

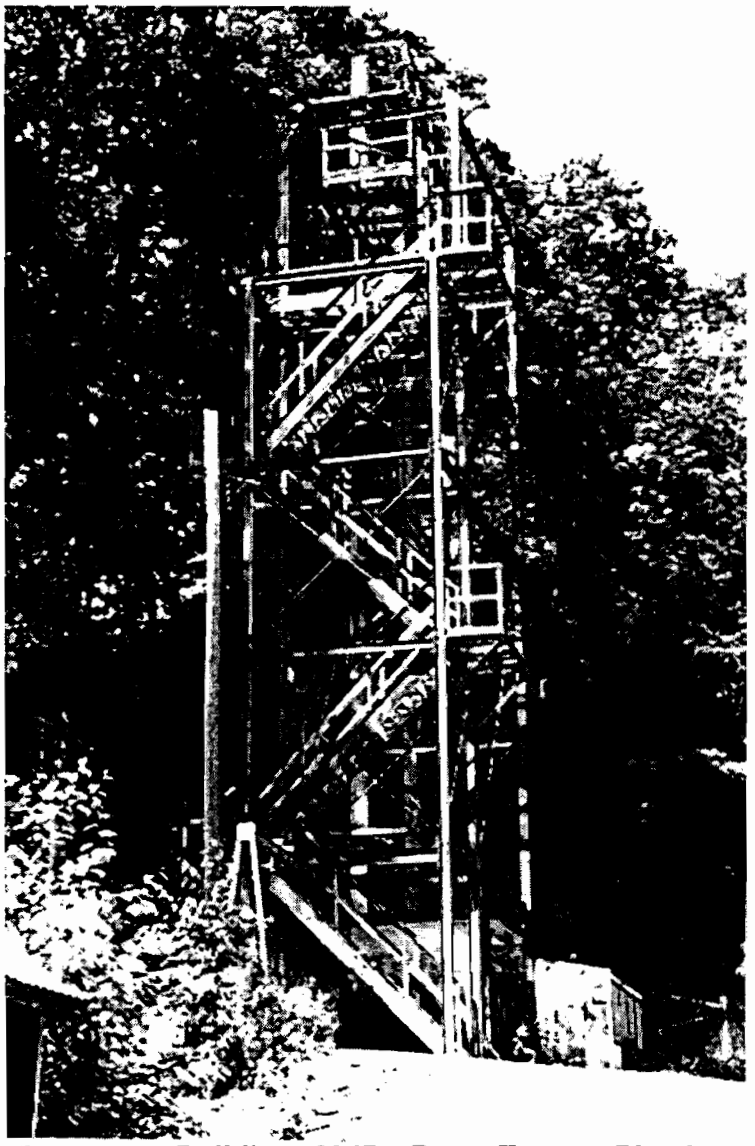


Figure 45. Building 604D, Drop Tower. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

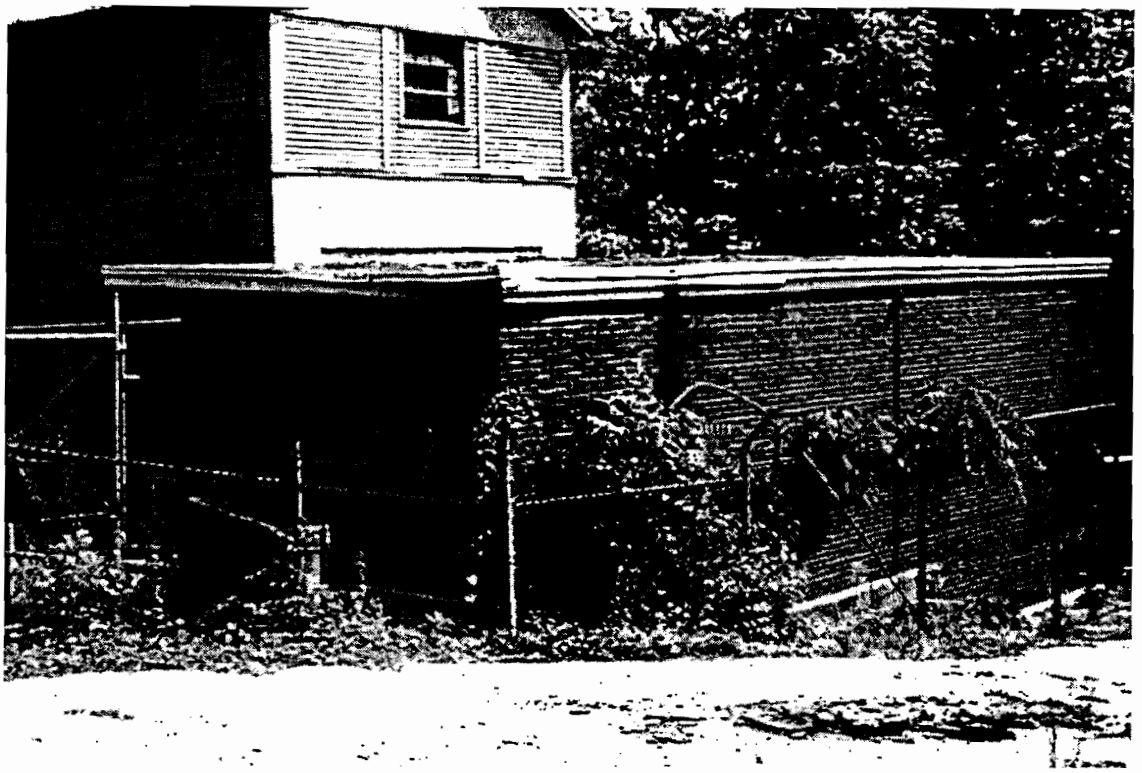


Figure 46. Building 604E, Wind Tunnel. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

above grade. An enclosed monitoring shed, with a metal frame and transite and cel-o-glass walls, is located beneath the original tower (Harrell 1994:E-243).

Building 604E, Wind Tunnel. As described by Harrell (1994):

Building 604E is a one-story, rectangular structure with a concrete foundation, loadbearing brick walls, and a flat, tar and gravel roof (see Ashby et al. 1982). Building 604E was constructed in 1942 as a wind tunnel, and was converted into an office structure in 1961. Currently vacant [(Figure 46)].

Significant Features. Exterior intact; metal windows and wood doors (Harrell 1994:E-244).

Building 604F, Bull Pen. As described by Harrell (1994):

Building 604F is a one story, round structure with a concrete foundation, concrete walls (lined with tarred timber on the inside), and an open roof protected by a steel wire mesh hung from the walls (Ashby et al. 1982). Building 604F was constructed in 1928 as a firing chamber and continues to be used as such [(Figure 47)].

Figure 47. Building 604F, Bull Pen. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Significant Features. Entire structure of Building 604F, which is intact. A steel plate hangs above the mesh to further prevent fragments from escaping during testing. The plate is suspended from two steel beams which are loaded on springs on a steel frame that is independent of the main concrete structure. The springs allow the beams to move with the plate and absorb the force of the blast without jeopardizing the structural integrity of the frame. Also, a wood framed detonation shed is attached to the exterior wall (Harrell 1994:E-245).

Building 604I, Unknown building. This is a non-contributing building to the district.

Building 607, Fragmentation Tub Building and ***Building 621, Fragmentation Tub Building.*** As described by Harrell (1994):

> Buildings 607 and 621 are Fragmentation Tub Buildings, identical except in the aspects noted below. The buildings are small two-story gable roofed buildings, with elevator headhouses projecting above the roofs. The buildings have steel frames, with concrete walls on the first floor and corrugated metal above. (Building 607 is entirely covered with corrugated metal) [(Figures 48 and 49)]. The upper floors contain large panels of metal louvers (Ashby et al. 1982; Harrell 1993).

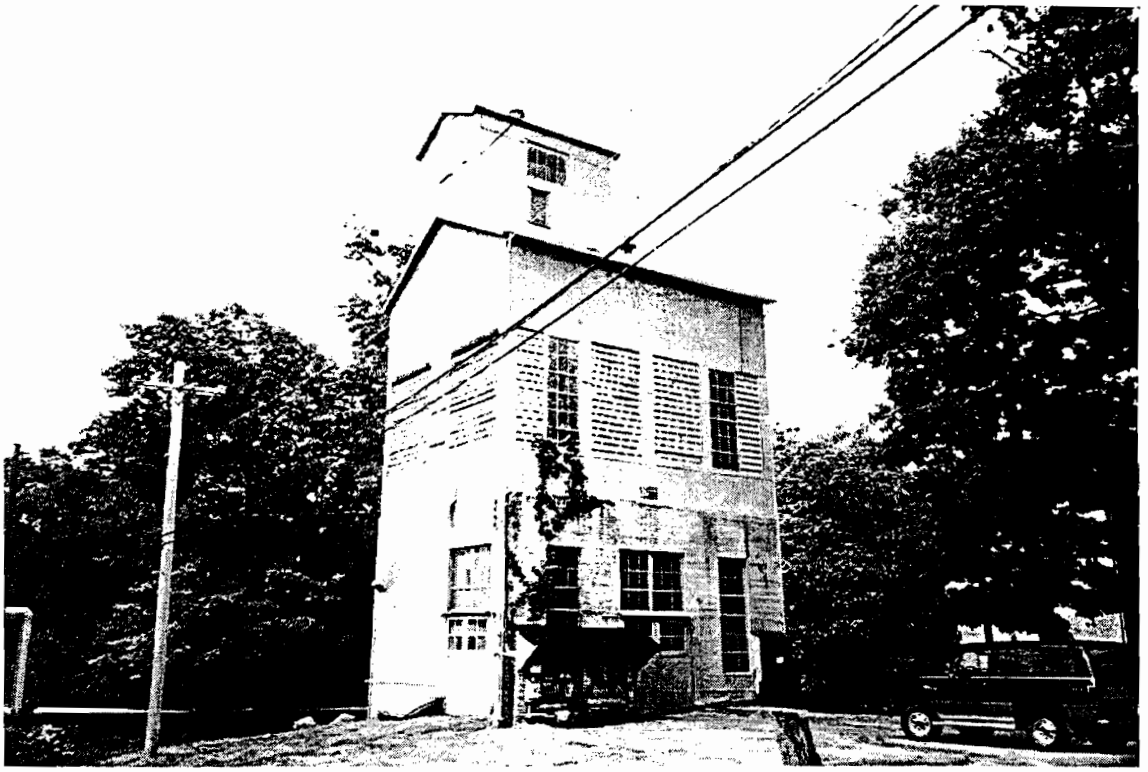


Figure 48. Building 607, Fragmentation Tub Building. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

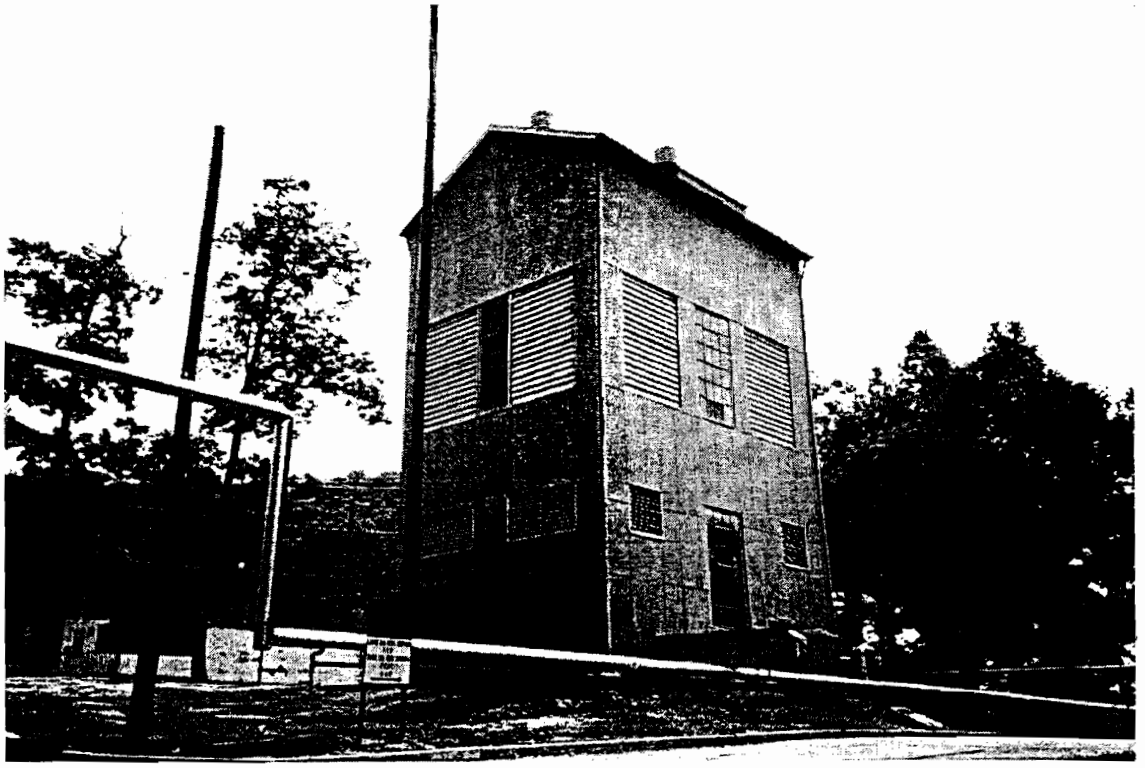


Figure 49. Building 621, Fragmentation Tub Building. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Building 607 was built in 1940 and 621 in 1941 as part of the Arsenal's testing program. Shells to be tested were placed in a large hopper surrounded by sawdust (607) or sand (621), and the shells were detonated. During the blast the louvers ("blast louvers") opened. The roofs of the buildings were reportedly built on flanges so that they could expand with the detonation (Thurber ca.1982). After the detonation, the sawdust or sand was sifted and the metal fragments recovered for examination. A further magnetic process recovered small fragments that had passed through the sieve. Then the sawdust or sand was collected in buckets on a conveyor belt and lifted to the top of the building where they were dumped into a storage hopper above the fragmentation tubs, ready for re-use. Building 607 was designed for shells up to 105 mm, Building 621 for shells 105 to 155 mm. Building 607 is still used.

Significant Features. Building 607 is intact with limited alterations. It has concrete foundation; steel frame; concrete wall; corrugated metal cladding; steel doors and industrial sash; metal louvers and roof trusses covered with corrugated asbestos [(Figure 50)]. The interior includes the original floor plan; steel stairs; second floor wood flooring (covering original steel grating); fragmentation hopper; sawdust (sand) hopper; elevator-conveyor; magnetic separator and exhaust system [(Figure 51)]. Utility/service controls are outside the building (Harrell 1994:E-247).

Building 607A, Disassembly Building. As described by Harrell (1994):

Building 607A is a one-story, pitched roof building, constructed with a concrete foundation, steel frame encased in concrete, hollow tile infill and asbestos protected metal roof on a steel frame (Ashby et al. 1982). Building 607A was built in 1938 as a testing facility in conjunction with Building 607. At present, ammunition is X-rayed to determine the uniformity of its composition.

Significant Features. Building 607A retains original siting, original massing, and construction. The interior contains a fluoroscope and is used to x-ray ammunition (Harrell 1994:E-249).

Building 611, Gun emplacement and ***Building 611A, Armor platebutt.*** Both structures were built in 1965 and are non-contributing elements to the district.

Building 611B, Gas Gun Test Tunnel. As described by Harrell (1994):

Building 611B originally consisted of a one-story, rectangular firing range (373'.9" long) with a concrete foundation, low concrete walls, and a semi-circular corrugated metal roof that gave way to a series of wood barricades mounted on top of the walls [(Ashby et al. 1982)]. Building 611B was constructed in 1929 as a test tunnel for firing rounds of artillery. A drawing from 1955 shows a 75mm gun and labels the structure as a "fuze test tunnel," and calls for repairs to the wood barricades, liners, and concrete walls. In 1959, a gas gun was installed and a concrete barricade end wall with sand fill was inserted into the tunnel, dramatically decreasing the length of the range. That same year, another tunnel was constructed and an instrumentation room was added to the front of the old structure.

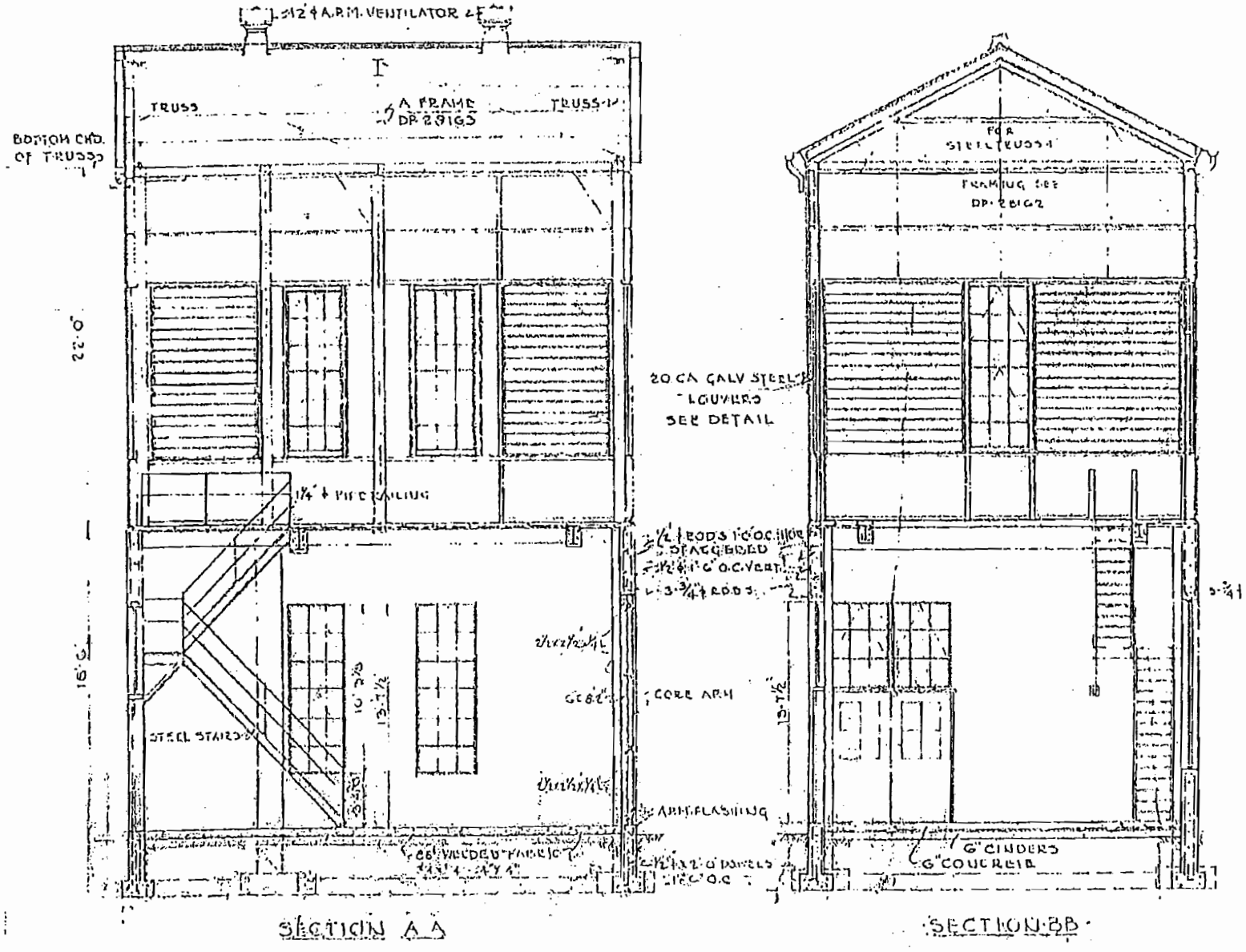


Figure 50. Building 607, Blueprint # DP-28161, detail from *Building No. 607, Shell Fragmentation Bldg., Plans, Elevations and Sections*, May 2, 1940, War Plans Division, Ordnance Department, Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal.)*

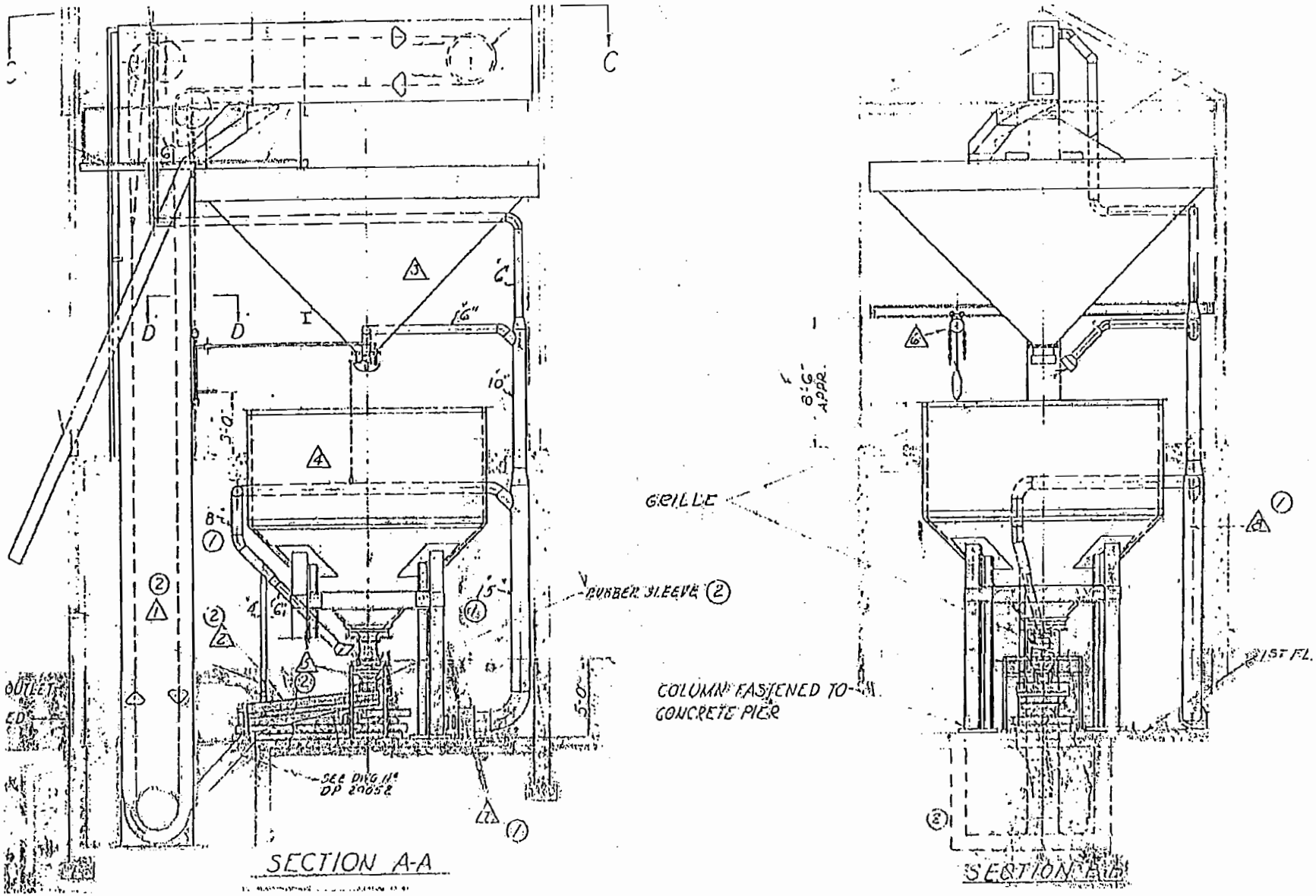


Figure 51. Building 607, Blueprint # DP-28167, detail from *Building 607, Shell Fragmentation Bldg., Plans, Elevations and Sections*, May 15, 1940, War Plans Division, Ordnance Department. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

Significant Features. Building 611B retains its original siting, massing, and construction. The interior is inaccessible due to the use and storage of radioactive materials. The exterior includes: a concrete foundation; low concrete walls and a semi-circular corrugated metal roof that gave way to a series of wood barricades mounted on top of the walls. In addition, there are angled barricades that acted like fixed louvers to absorb the force of the shell's impact and direct it up and away from the walls into the open air. The test tunnel walls were lined with timber and the end of the range was filled with sand. A second tunnel addition (40 feet long), constructed of five sections of concrete sewer pipes, intersects the original tunnel from the west. A wood-framed instrumentation room, on concrete piers with a shed roof and two double wood loading doors, fronts the original tunnel from the south (Harrell 1994:E-251)."

Building 613, Ballistic Mortar Testing. As described by Harrell (1994):

Building 613 is a one-story, rectangular structure with a concrete foundation, brick and concrete loadbearing walls, and a corrugated asbestos protected metal saltbox roof supported by a steel truss. A small concrete shed with a concrete roof is attached to the main building on the east side [(Ashby et al. 1982)]. Building 613 was constructed in 1928 for Ballistics Mortar Testing. Plans indicate overhead mortar support beams inside and the lining of the walls and floor of the concrete shed with wood planks, but more research is needed to determine the function of Building 613 regarding these interior features. In 1944, a brick addition was constructed on the north side, giving the structure its current saltbox roof shape.

Significant Features. Building 613 retains its original siting, massing, and construction. The exterior includes: a concrete foundation; brick and concrete loadbearing walls; and a corrugated asbestos protected metal saltbox roof supported by a steel truss. In addition, there are wood double loading doors, a loading dock and metal awning windows. A small concrete shed with a concrete roof is attached to the main building on the east side (Harrell 1994:E-255).

Building 617, Fragment Cleaning, Reconstruction and Photography. As described by Harrell (1994:E-256):

Building 617 is a one-story, H-plan, building with a concrete foundation, loadbearing hollow clay tile walls, and a gable roof covered with corrugated asbestos and supported by steel purlins. The east-facing courtyard contains a concrete moat which is used to direct rainwater away from the site [(Ashby et al 1982)]. Building 617 was built in 1928 as a Fragment Cleaning, Reconstruction and Photography Building. It is currently used as an Administrative Office Building.

Significant Features. Building 617 retains original siting, original massing, and construction. The exterior includes: a concrete foundation; loadbearing hollow clay tile walls; a gable roof covered with corrugated asbestos and supported by steel purlins. The building has lightning protection and a concrete moat which is used to direct rainwater away from the site. Alterations include: new windows; metal siding and 2x4 foot suspended acoustical ceiling on the interior (Harrell 1994:E-256).

Building 617A, Constant Temperature Powder Building. As described by Harrell (1994):

> Building 617A is a small, one-story, white building with a concrete foundation, steel frame enclosed in concrete, hollow clay tile walls, and gable roof supported by steel frame and covered with corrugated asbestos (Ashby et al. 1982). Building 617A was built in 1928 as a High Explosives Magazine. It is currently used for storage.
>
> *Significant Features.* Building 617A retains original siting, original massing, and construction. The exterior includes: a concrete foundation; steel frame encased in concrete; hollow tile construction; a gable roof supported by a steel frame and covered in corrugated asbestos. There are steel sash windows, painted galvanized metal doors, lightning rods. There are also exterior electric controls, exterior steam heater controls and an unused concrete pad adjacent to one end of the building (Harrell 1994:E-257).

Buildings 617B, Smokeless Powder Storage and ***Building 617F, Magazine.*** As described by Harrell (1994):

> Each building is small, white and one-story, with a concrete foundation, steel frame, corrugated asbestos walls and a gable roof covered with corrugated asbestos (Ashby et al. 1982). Buildings 617B and 617F were built in 1928 as Magazines. They are currently used for storage.
>
> *Significant Features.* Both buildings retain original siting, massing, and construction. The exteriors include: concrete foundation; steel frame; corrugated asbestos walls; gable roof covered with corrugated asbestos. Each building has a rooftop ventilator, a single steel sash window and a painted galvanized metal door with wire glass vision lights. Building 617B has two lightning rods on the roof (these lightning rods are lacking on 617F). The interior includes steel shelves (Harrell 1994:E-258).

Building 617E, Oil and Paint Storage. As described by Harrell (1994):

> Building 617E is a small one-story, shed roof structure constructed with a concrete foundation, four concrete walls, and a 2 x 4 wood frame roof sheathed with plywood, painted green (Ashby et al. 1982). Building 617E was built in 1928 as a Flammable Materials Storage Magazine. It was reportedly used for paint storage. It is currently vacant.
>
> *Significant Features.* Building 617E retains original siting, original massing, and construction. The exterior includes: concrete foundation; four concrete walls; a shed roof with 2x4 wood framing, sheathed with plywood. The structure has a drain to keep contents dry, and contains a small wood shelf. There is no door, and it is only large enough to store small amounts of materials (Harrell 1994:E-259).

Building 617G, Gun Shed. As described by Harrell (1994):

Building 617G is a one-story, shed roof, six-bay, garage-like building, finished with a thin coat of concrete or stucco, painted white (Ashby et al. 1982). Building 617G was built in 1938, and was altered in 1956 and 1964. It was originally used for storing howitzers used in the nearby firing range, and for storing pallets of powder.

Significant Features. Building 617G retains original siting, original massing, and construction. The exterior includes: concrete foundation; loadbearing hollow clay tile and poured concrete walls; concrete roofing beams and concrete roof. The building has lightning rods on a copper-clad roof, and a non-conductive floor, made of concrete with an asphalt coating.

The building appears to have evolved through three phases: Phase 1: one bay structure (westernmost bay) built with loadbearing hollow clay tile walls, concrete roof, garage type vehicular doors; Phase 2: five bays added to the west side of original building, built with poured concrete walls, concrete roof, concrete roof beams with integrated braces, and five additional sets of vehicular doors; Phase 3: selected vehicular doors removed and old openings in filled with windows and/or concrete block (Harrell 1994:E-260).

Building 620, Test Tunnel. As described by Harrell (1994):

Building 620 consists of a long firing range and an office structure attached to the southeast corner of the range. The range has a concrete foundation, concrete walls (first range) and tile walls with steel reinforced concrete piers (second range), and a shingled gable roof supported by a steel truss (Ashby et al. 1982). Building 620 was constructed in 1928 as a small arms firing range with an office that included change facilities in the basement and a vault for the storage of the firing arms [(Figure 52)]. The original range had concrete walls and a shed roof; in 1940, a mirror image addition of tile and concrete construction doubled the width of the building and gave it its current gabled roof shape. The high wall of the old range divides the interior and provides a barrier between the two ranges. In 1970, the hollow tile infill and windows on the east wall were replaced by concrete block. Building 620 is still used as a small arms firing range.

Significant Features. Building 620 retains its original siting, massing and construction. Its exterior includes: concrete foundation; concrete walls (first range) and tile walls with steel reinforced concrete piers (second range), and a shingled gable roof supported by a steel truss. A concrete wall with tile infill splits the gable in half and divides the interior of the building into two ranges of equal width. The office portion is set into a hill and has a concrete foundation/basement, tile walls with concrete piers, and a shingled gable roof. A wood framed covered walkway on concrete piers runs along the east side and connects Building 620 with 620-C, another firing range. Alterations include some new doors and new roofing; industrial metal windows, wood doors, and a storage vault (Harrell 1994:E-261).

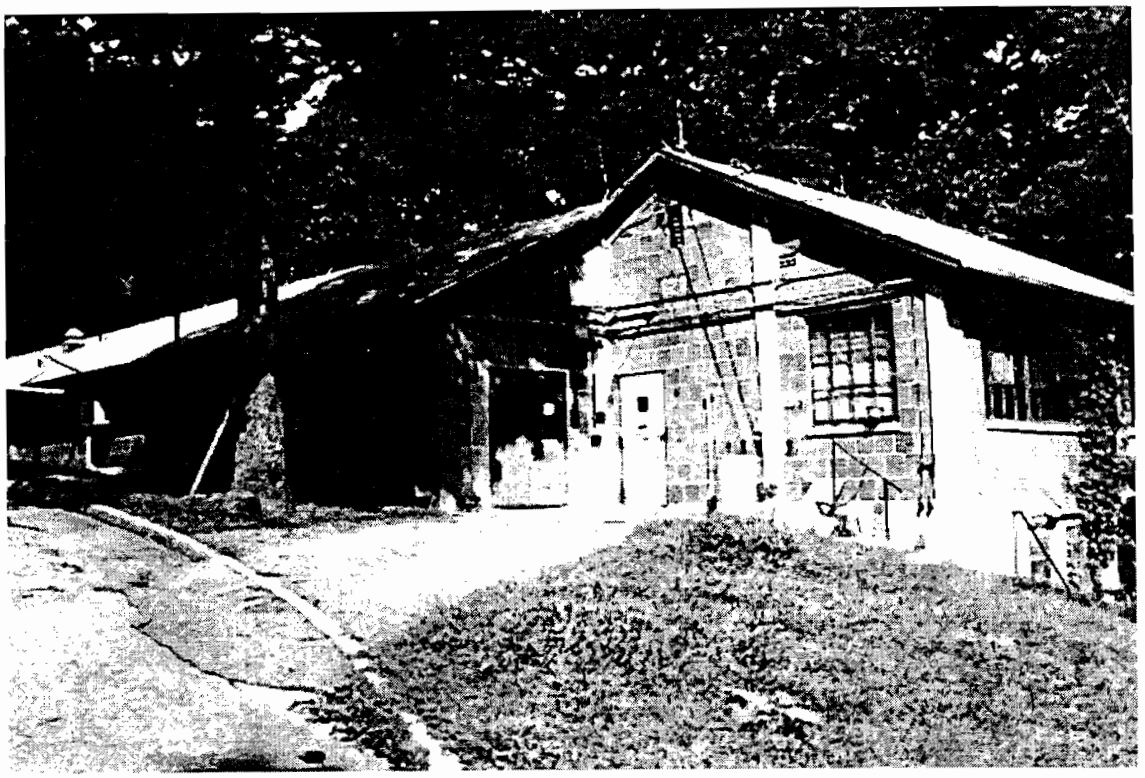


Figure 52. Building 620, Test Tunnel. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Building 620B, Drop Tower and Friction Test. As described by Harrell (1994):

Building 620B is a one-story, rectangular structure with a concrete foundation, steel frame, corrugated asbestos protected metal exterior walls, and a corrugated asbestos protected metal shed roof. A 25' tall steel tower in front of the building has a concrete base that is used as an impact anvil, and an impact hammer above. A steel plate wall, 5'-6" tall, screens the tower base on three sides from the adjacent road (Ashby et al. 1982). Building 620B was constructed in 1921. The tower tested an explosive's sensitivity to direct impact, comparable to normal handling under worst conditions. The hammer was operated remotely from the building via a cable and pulley. The building contains a steel A-frame with a swinging pendulum centered over an anvil; the device was used to test friction resistance of explosive compounds. The controls were located behind a semicircular steel shield (along with the tower controls).

Significant Features. Building 620B retains its original siting, massing and construction. The exterior includes: concrete foundation; steel frame; corrugated asbestos protected metal walls; and a corrugated asbestos protected metal shed roof. There is a 25' steel tower (abandoned) on a concrete base and a steel plate wall to screen the tower. The interior includes the pendulum (Harrell 1994:E-263).

Building 621B, Shipping and Receiving. As described by Harrell (1994):

Building 621B is a one-story, rectangular structure with concrete foundation, corrugated asbestos walls on a steel frame and corrugated, asbestos protected metal gable roof (Ashby et al. 1982). Buildings 621B was constructed in 1914 for the storage of ammunition and used as a shipping and receiving facility for the 600 Testing Area.

Significant Features. Building 621B retains original siting, massing, and original construction. Its exterior includes: concrete foundation; steel frame; asbestos walls; and a gable roof covered with asbestos protected metal (Harrell 1994:E-266).

Building 623 and 623A-E, Water Tanks. As described by Harrell (1994):

Building 623 and 623A-E form a complex which consists of six water tanks and tank supports arranged in two rows, with three tanks in each row. The upper row is located on relatively high ground, and has simple concrete platforms beneath the tanks. The lower row maintains the tanks at the same level by using tank supports, constructed of square concrete platforms. These platforms are supported by concrete piers at the corners, and have cantilevered octagonal walkways around the base of each tank. The walkways have metal pipe railings for pedestrian protection. The tanks are cylindrical, made of steel, and hold 50,000 gallons each (see Ashby et al. 1982-1984). The upper row of tanks dates from 1929, while the lower row (with the more elaborate tank supports) dates from 1942. These cylindrical tanks were replaced in 1970 and the complex is still used for water storage.

Significant Features. Tanks replaced, but original foundations and platforms extant (Harrell 1994:E-267).

3.2.2 Recommendations for 600 Ordnance Test Area District.

On July 2, 1999 the New Jersey HPO ruled that the 600 Ordnance Test Area District is eligible for the NRHP under Criteria A and C (Guzzo 1999). The 600 Ordnance Test Area District's historic context is: the inter-war years; World War II mobilization; and World War II.

3.3 TEST AREA E, NAVAL AIR ROCKET TEST STATION (NARTS), FORMER LAKE DENMARK DEPOT, DISTRICT.

Structures included in the NARTS Test Area E District (Figure 53) are listed by current building number and historical name below.

3617 Control House (1953)

3618 Test Stand (1953)

Although Picatinny Arsenal had long been involved in cutting edge military research and development projects, its sister installation, Lake Denmark Naval Depot, had always served the Navy simply as a storage facility. While the pace of its activities ebbed and flowed with war and peace, the Depot was never involved in any special research until after

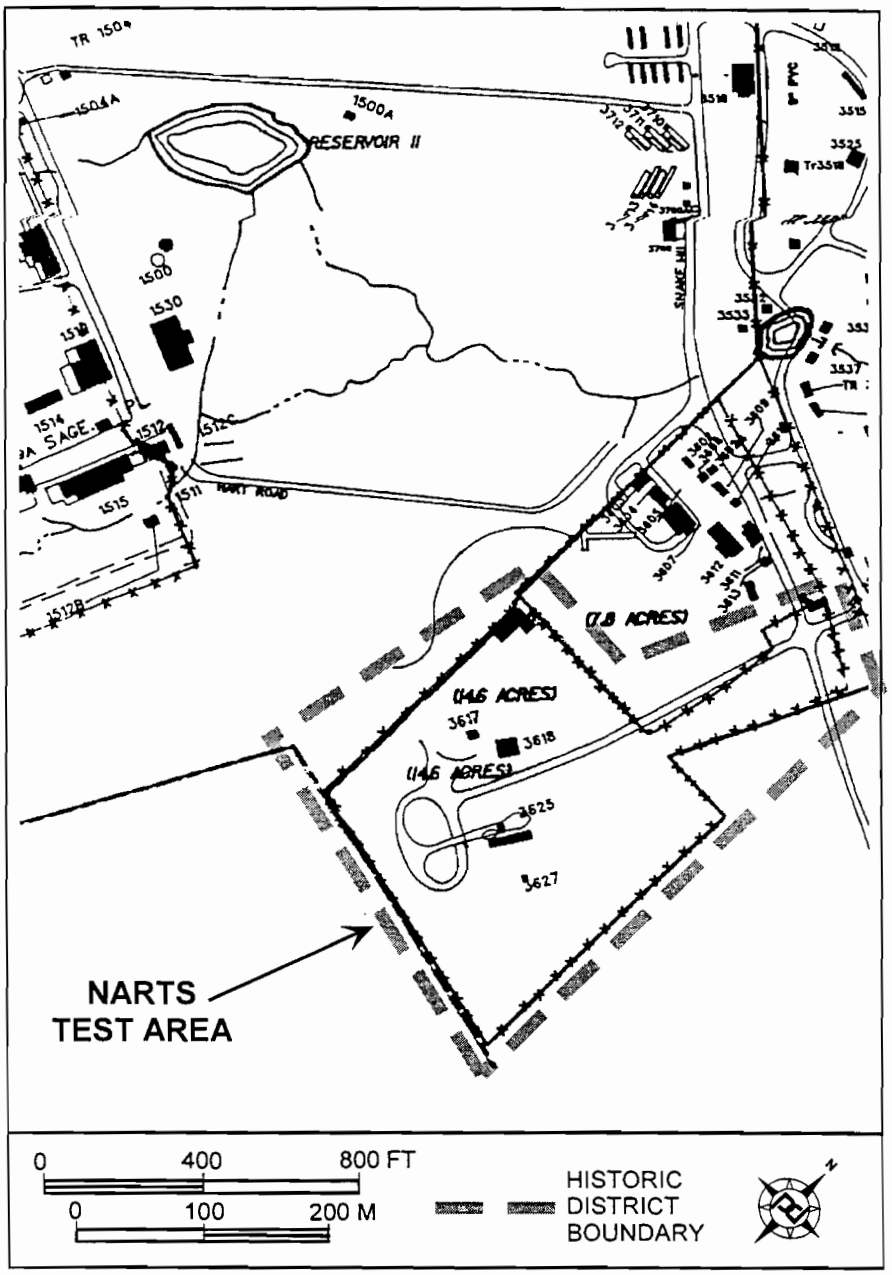


Figure 53. Test Area E, Naval Air Rocket Test Station (NARTS), former Lake Denmark Depot. Note: buildings are misnumbered and not in their correct locations. Picatinny Arsenal, Morris County, New Jersey *(ARDEC 1995).*

WWII, when the Department of the Navy decided to locate a rocket testing facility at its extreme northeastern corner not far from Lake Denmark. The research and testing carried out in this small area would in many ways rival the best work ever done at Picatinny. Every architectural study completed on Picatinny has highlighted this area as significant (Thurber ca. 1983; Ashby et al. 1982-1984; Fitch and Glover 1990; Harrell 1993, 1994).

The Navy Department began to deactivate Lake Denmark Depot after World War II; at that time the Bureau of Aeronautics, foreseeing the need for a rocket engine test center on the east coast, began to modify the existing facilities. In 1948, the Naval Aeronautical Rocket Laboratory, was established at Lake Denmark under an officer-in-charge who reported to the Commanding Officer of the Naval Ammunition Depot for command and the Bureau of Aeronautics for management. Its mission was the "evaluation and development of rocket engines and their components" (Baranowski 1959).

On April 1, 1950, the Naval Ammunition Depot, Lake Denmark was disestablished and redesignated the U.S. Naval Air Rocket Test Station (NARTS), Lake Denmark. It came under the military command and coordination control of the Commandant, THIRD [sic] Naval District and management control for the Bureau of Aeronautics. All physical facilities of the former Lake Denmark Depot were made a part of NARTS. Because of the large amount of ordnance still stored at NARTS, a number of buildings were retained by the Bureau of Ordnance and the station received the additional task to act as an ordnance reserve stock point (Baranowski 1959).

The Naval depot had everything needed for a successful testing facility. It was located in a fairly isolated area but had excellent transportation connections up and down the east coast. The depot was situated in a highly industrialized portion of the country that facilitated the hiring of specialized personnel and the procurement of materials. Empty buildings could be easily adapted and the Navy had already leased a number of them to Reaction Motors, which later became a division of Thiokol Corporation. It was close enough to Washington, DC for liaison with the Bureau of Naval Weapons and the DOD.

By the 1950s, the station consisted of 760 acres and represented a multimillion dollar investment. It was anticipated that the staff would double in the next decade. The earliest work had been devoted primarily to liquid propulsion, but by the 1950s it also covered evaluation of rocket engines and rocket systems, development of methods for analyzing rocket propellents, and the collaboration with private industry on a wide range of experiments and safety manuals. All these functions were a part of NARTS' mission as assigned by the Chief of Naval Operations: "to test, evaluate and conduct studies pertaining to rocket engines, their components and propellants" (U.S. NARTS 1959).

NARTS had three major work categories: qualification tests, preliminary investigations and technical services. Qualification tests included the actual qualification tests themselves; safety and reliability determinations; evaluations of contractor products, age-test programs; and investigations of performance deficiencies in production items in operational use. In the early 1950s NARTS completed qualification programs on the engines, arresting landing and simulated catapulting systems for *BULLPUP* (engine XLR

58-RM-2) and *SPARROW* (engine XLR44-RM-2) and the engines on the Air Force *SIDEWINDER.* NARTS worked a number of major preliminary investigations including: damage control of propellant oxidizers; variable thrust engine for spacecraft application, ultra high-density propellent systems and investigation of monopropellents as gas generates. Technical services were provided by the Rocket Propulsion Laboratory for the Bureau of Weapons (BuWeps), other government agencies and private contractors. These services included the development of specifications and procedures for mixed amin (a group of organic compounds of nitrogen that may be considered ammonia derivatives in which one or more of the hydrogen atoms has been replaced by a hydrocarbon radical) fuel. In the 1950s technical services were being provided to the Standard Oil Company; Fulton Irgon Corporation; Camin Labs; Aerojet-General; Olin Industries; Phillips Petroleum; Grand Central Rocket Co.; Sperry Gyroscope; and Reaction Motors, to name a few (U.S. NARTS n.d.; Technical Information Branch, NARTS ca. 1960).

The heart of the NARTS organization was the Rocket Propulsion Laboratory. All other departments—Administration, Supply and Fiscal, Public Works, Security, Medical and Industrial Relations—served the needs of the Rocket Propulsion Laboratory. The Laboratory itself was grouped into four divisions: Propellents Division, Rocket Engine Division, Engineering Services Division, and a more loosely organized Project Group. The Propellents Division was responsible for analytical chemistry and propellent evaluation as well as physical chemistry and propellent synthesis. The Rocket Engine Division was responsible for design, creation, instrumentation and testing of rocket engines. The Engineering Services Division was responsible for material control, photography, as well as technical publications and a large library. The Project Group was responsible for following through on new ideas and testing hypotheses.

The military and civilian personnel that staffed NARTS in the mid-1950s held impressive credentials. Dr. John D. Clark, NARTS chief chemist from 1949 to mid-1950s, headed the Propellents Division. Clark, a Stanford Ph.D., is best known for the creation of new family of monopropellents and for developing a simplified technique for determining theoretical rocket engine performance as well as the invention of a device for in-field use in the analysis of white fuming nitric acid. Rocket Engine Design, which encompassed the Design, Shops, Test and Instrumentation Branches, was headed by John J. Canavan. The Project Group included Frederick R. Hickerson, the inventor of a unique variable thrust rocket engine. The director of the Laboratory itself was Commander Donald T. Jensen, USN. Jensen, a Naval Academy graduate, had worked on the *LARK* project. The Lab's technical directory was I. Forsten who had worked with Ranger and Grumman and had served as a research scientist with the National Advisory Committee on Aeronautics (NACA, the predecessor of the National Aeronautics and Space Administration) (U.S. NARTS 1959).

The NARTS facilities began as a small liquid propellent test stand, but by the late 1950s the facilities were spread out over more than 700 acres in many buildings, firing bays and other structures. Growth was expected to continue and about 1957 NARTS published a recruitment brochure aimed at luring new college engineering graduates to work at Lake Denmark (Technical Information Branch, NARTS ca. 1957). The amount and

types of projects had greatly increased. Liquid and solid rocket engines could now be test-fired and analyzed at the facility.

The test facilities were generally grouped into six test areas, two used especially by and for NARTS projects and the others leased to Reaction Motors, Inc. (RMI). Areas A, B, and C, which were completed in 1947, and G were leased by RMI. NARTS used Test Areas D and E and sometimes G. Test Area E, completed in 1953, was considered the "elite" among the many facilities at NARTS (U.S. NARTS n.d.). It was here that the Navy fired liquid propellant rocket engines with a thrust up to 350,000 lbs. from one of the largest static test stands on the East coast (U.S. NARTS n.d.). Areas R and S which occupied 263 acres immediately north of the Navy test areas were owned by RMI but were connected to A, B, C, and E Areas by Lake Denmark Road.

Reaction Motors Inc. was formed by James H. Wyld, Lovell Lawrence, Jr., John Shesta and Franklin Pierce, all early members of the American Rocket Society who spent their Sunday afternoons experimenting with rocket engines in the garages of their New Jersey homes. Wyld overcame a major problem of rocket design by developing the first American regeneratively cooled engine, that cooled its combustion chamber by circulation of its propellents. Wyld's principle, formulated in 1938, was close to the solution found about the same time by German scientists working on the development of the V-2 missile.

Awareness of German rocket advances led the United States to start a formal rocket research program. Wyld's new engine was of particular interest to the Bureau of Aeronautics of the Navy Department. After several successful test runs of the Wyld engine, a contract was awarded to the newly formed company named Reaction Motors, Inc. after the motors it was to build.

One week before Christmas 1941, the four founders of RMI pooled their resources and with $5,000 formed the company making it the first enterprise devoted to the commercialization of the rocket engine (Thiokol Propulsion 1999). The group immediately started to work in basement of Shesta's house. From there they moved into a small shop in Pompton Plains, New Jersey, where in nine months the company designed and produced ten different types of rocket engines ranging in size from 50 to 1,000 lbs. thrust (RMI 1957). By 1957, one year before they merged with Thiokol Chemical Corporation, RMI had sales of about $24.5 million dollars and had 1,639 employees (Thiokol Propulsion 1999). RMI, which was affiliated with Olin Mathieson Chemical Corporation and had a major interest in Flight Refueling, Inc., had offices in Denville, New Jersey; Washington, DC; Dayton, Ohio; and Los Angeles, California.

The principal work of RMI was the development and production of solid and liquid propellent rocket powerplant (engine) systems and related components. In addition to the development of specific products, RMI was involved in basic research and state-of-the-art technology work. By 1957 RMI occupied 350,000 sq. ft. of enclosed space and owned 60 acres for the future expansion of the company (RMI 1957). The company had a $4,000,000 plant in Denville, NJ, that was one of the most modern and complete rocket facilities in the U.S. The 200,000 sq. ft. plant featured administrative offices, research activities and pilot

production facilities. It also maintained 150,000 sq. ft. of engineering, manufacturing and test facilities at the Lake Denmark Naval Depot (RMI 1957).

In 1957, RMI's main test area consisted of almost 300 acres (50,000 sq. ft. enclosed) at Lake Denmark just seven miles from its Denville plant. This included 21 test stands for the static hot firing of rocket engines and components; 18 stands with thrust capacities from zero to 20,000 lbs.; and 3 large stands with capacities from 50,000 to 1,000,000 lbs. thrust. Environmental test facilities, instrumentation areas, offices and propellant-handling and storage facilities were also located at Lake Denmark (RMI 1957).

The many engine test stands could hold complete rocket engine systems for simulated flight trials. Engine, propellent lines, tanks and any related equipment could be mounted in the precise locations they occupied on a plan or a missile. Following successful trial runs at Lake Denmark, the engines were released for field testing (RMI 1957). State of the art testing facilities included tank rooms, firing rooms, control rooms all constructed to permit the visual observation of items under test. The instrumentation areas used the highest standards for quality and accuracy in the industry. Equipment could measure for pressure, flow, force, temperature, linear and angular displacement, and acceleration in the form of vibration. A rapid tape recording and play-back system facilitated the analysis and evaluation of data (RMI 1957).

On April 30, 1958, RMI and Thiokol Chemical Corporation merged and RMI became a division within the company. The Thiokol Chemical Corporation was born in 1926 as a result of a serendipitous lab experiment that produced the world's first synthetic rubber. The company was formally created in 1929 taking its name from the Greek words for sulfur and glue, products used to create synthetic rubber. The liquid polymer rubber was used extensively as an indestructible sealant for fuel tanks, gun turrets, and seams of all kinds. Scientists at Cal Tech's Jet Propulsion Laboratory discovered that this liquid polymer made the best solid propellent fuel binder available at the time. Thiokol was suddenly in the rocket business (Thiokol Propulsion 1999).

Thiokol opened its first small scale rocket operations in Elkton, Maryland and by 1950 they had opened facilities at the Army's Redstone Arsenal, in the old Redstone Ordnance Plant's production lines. In 1952 they won a contract to refurbish and operate the Longhorn Army Ammunition Plant in Marshall, Texas. By 1958 Thiokol had a contract with the Air Force to build the first stage rocket motor for the revolutionary Minuteman Inter-Continental Ballistic Missile at their Brigham City, Utah rocket motor plant (Thiokol Propulsion 1999).

On October 14, 1947, Chuck Yeager became the first human to break the sound barrier, flying the RMI powered Bell X-1. In 1956 RMI was awarded the contract to develop the XLR-99 liquid rocket engine for eventual use in the X-15, a joint NACA, Navy, and Air Force project. This engine was the most powerful, most complex, and safest man-rated (safe to carry a human being) throttle-able rocket propulsion system in the world. The engine would prove exceptionally reliable and extraordinarily safe despite its long development period. The testing for that engine was done at Lake Denmark in Test Area E which RMI leased from the Navy.

Test Area E was considered by the Navy to be its premier rocket engine testing area. NARTS engineers completely designed the original plan for Test Area E. They drew up the preliminary specifications and maintained an active role during the final architectural detailing and construction. The architectural and engineering firm chosen was Frank Grad & Sons, an old firm with an outstanding reputation from Newark, New Jersey, that also had offices in Washington, DC. This project was considered one of the major accomplishments of the NARTS engineering staff. When the stand was first put into use it was one of the largest static test stands on the East coast (U.S. NARTS n.d.).

In a public relations brochure on NARTS and the NARTS facilities, the Navy described Test Area E:

> Static firings can be made at any attitude on Test Stand E-1 with the test engine 'tied' to a mount fastened to trunnions 15 ft apart and located on a cantilevered balcony 60 ft above grade. The engine mount is basically a hollow beam of rectangular cross-section bridging the space between the trunnions. A sliding roof permits vertical erection of missiles up to 90 ft in length.
>
> Two set of double doors (like a bomb bay) are affixed in the operating floor under the mount. Located under the floor are separate tank rooms for fuel and oxidizer and separate cascade rooms for individual pressurizing of propellants. The liquid oxygen tank capacity is 2500 gal and is rated at 50 psi while the working pressure of the 3000 gal ammonia tank is 225 psi. Also located in the propellant tank room is a 2400 gal water tank, rated at 1500 psi, which is used to cool the engine jacket. Propellants are pressurized by gas stored at 2000-2200 psi. Nitrogen gas is used for pressurizing fuel and cooling water and gaseous oxygen is used for pressurizing the liquid oxygen.
>
> The control room for Test Stand E-1 is located below grade in a concrete building 250 ft away. Instrumentation provides measurement of all the usual rocket engine parameters—pressure, force, flow rate and temperature. The total number of installed recording channels includes 35 potentiometer recorders, eight direct writing Sanborn recorders, and a 2-channel cathode ray oscilloscope. Terminations are also installed in the recording racks for two 18-channel magnetic oscillographic recorders. Thus there are 79 allocated recording channels with 17 spare channels available (U.S. NARTS 1959).

Aside from the testing of the XLR-99 motor, NARTS had already established an impressive record of notable contributions to rocket engine and propellent research and development. These included:

1951-1954 Development of analytical methods for hydrazine, methyl hydrazine, butyl mercaptan and mixed acid.

1952 Development of methods for inhibiting corrosion of nitric acid.

1953 Design and construction of largest rocket test stand in East.

1954 Discovery of the mechanism of corrosion of stainless steal by nitric acid.

1954 First complete qualification test of rocket engine by a government laboratory.

1955 Origination of Mollier charts for decomposition of hydrogen peroxide.

1955 Developing a shorthand method for rocket propellent performance calculation.

The brochure advertising these accomplishments quickly adds that these are just the ones "that can be named" publicly (Technical information Branch, NARTS ca. 1957). More intensive investigation would probably uncover a host of then highly classified NARTS achievements.

After the Navy left the Depot in 1960 and it became a part of Picatinny Arsenal, the entire Lake Denmark Test Area was leased by the Thiokol Chemical Corporation. A *Test Facilities Data Book* (Edson 1962) prepared by Thiokol in 1962 provides an excellent overview of all of the facilities at that time. This volume was intended for use by the Test Area operating personnel, engineering and management personnel of RMI, other divisions of Thiokol, and interested industrial companies that had questions about using the facilities.

3.3.1 Structures at Test Area E, NARTS, Lake Denmark Depot District

Building 3617, Test Area E Control Room Building. Building 3617, the control house, was built in 1953 as part of a special NARTS facility for the testing of rocket engines with 350,000 lbs. and could be modified to test engines up to 1,000,000 lbs. thrust (Figure 54). The structure itself has no discernable style or ornamentation. It is a rectangular, steel-framed reinforced concrete two-story structure with a corrugated metal roof. The building is built into a precipitous slope and uses that slope to shield a portion of the first story from the actual test stand (Figure 55). The control house is built on a concrete foundation and has industrial steel sash windows. The interior includes an antenna and mirrors in periscope arrangement to allow rocket engine firings to be observed safely.

The 1962 Thiokol test area book describes the control house, then designated as building # 801-3617, as being..."basically a two story, 42' X 50', 4161 Sq. Ft. reinforced concrete building [Figure 56]. The ground floor control room and instrumentation center is housed in 2' thick reinforced concrete ceilings and walls. All exposed walls are earth" (Edson 1962). Utilities included 110/220 volt, 3 phase, 60 cycle electricity; 28 volt DC; steam heat; potable water; and 1500 psi Nitrogen gas.

The Control House had two basic functions, to serve as the Area E control room and instrumentation center and to serve as a mechanical laboratory. The control room was housed on the ground floor. The structure and observation of the E-1 test stand some 275 feet distant was by means of periscope windows (Figure 57). Located within the air conditioned control room was the central control panel with 54 control circuits for testing on the stand. Data acquisition equipment in the control room included: 48 Brown Recorders, direct readout, 4 cps response; 54 CEC Oscillograph channels, 600 cps response; 8 Sanborn Recorder direct readout channels; 14 channels of tape. RMI boasted that this maze of instruments was capable of continuously recording separate events, occurring within the engine, at intervals ranging from one-tenth of a second to less than one millisecond (RMI 1957). Adjacent to the control room was a utility room which had work and storage space (Edson 1962).

Figure 54. Building 3617, Test Area E Control Room, front view, former Lake Denmark Depot. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

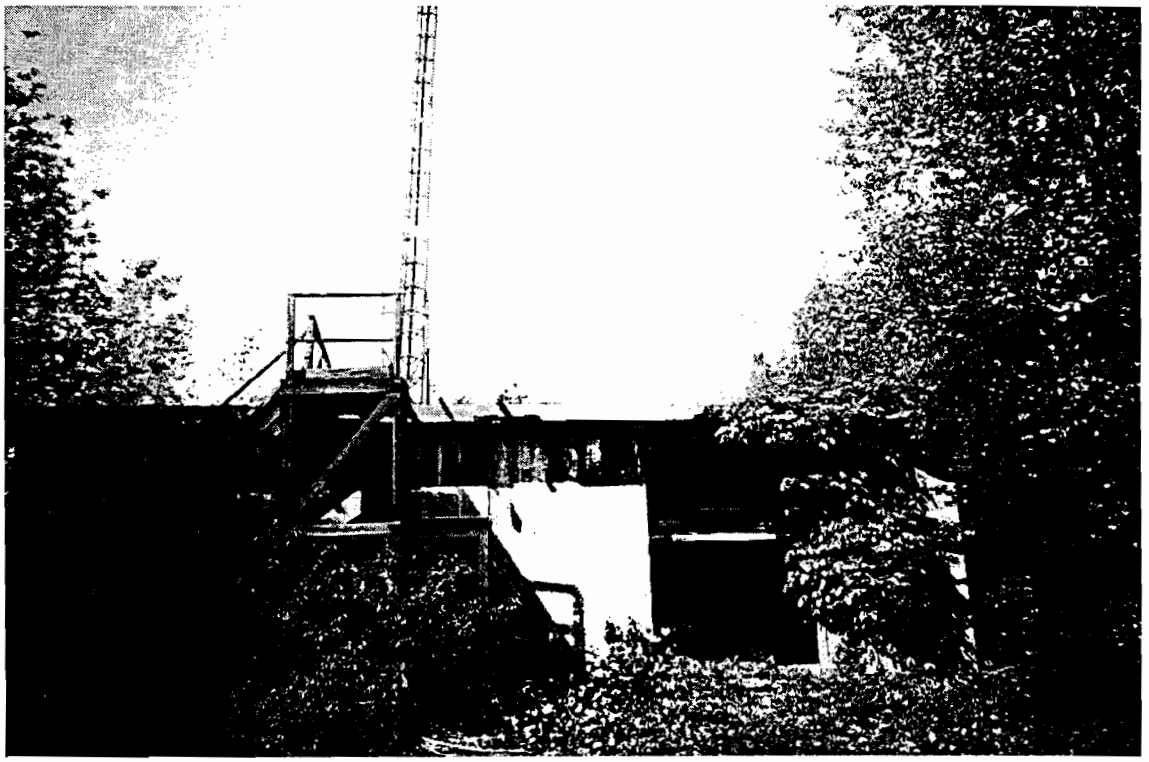


Figure 55. Building 3617, Test Area E Control Room, rear view, former Lake Denmark Depot. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

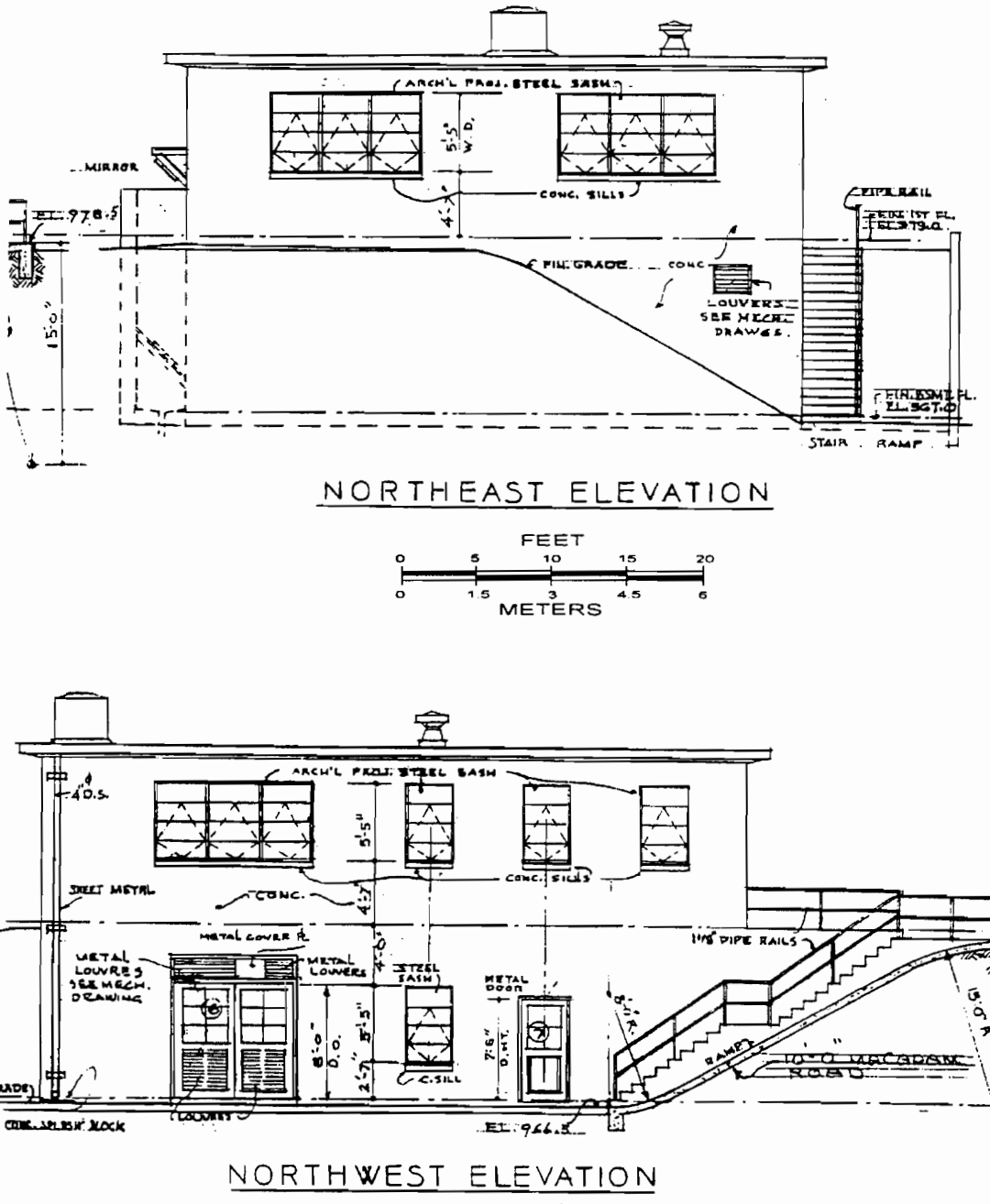


Figure 56. Building 3617, Test Area E Control Room, Blueprint # DP-142533, detail of *Control House Plans, Elevations, Sections,* Feb. 5, 1942, Frank Grad & Sons, Architects and Engineers, Newark, NJ and Washington, DC. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

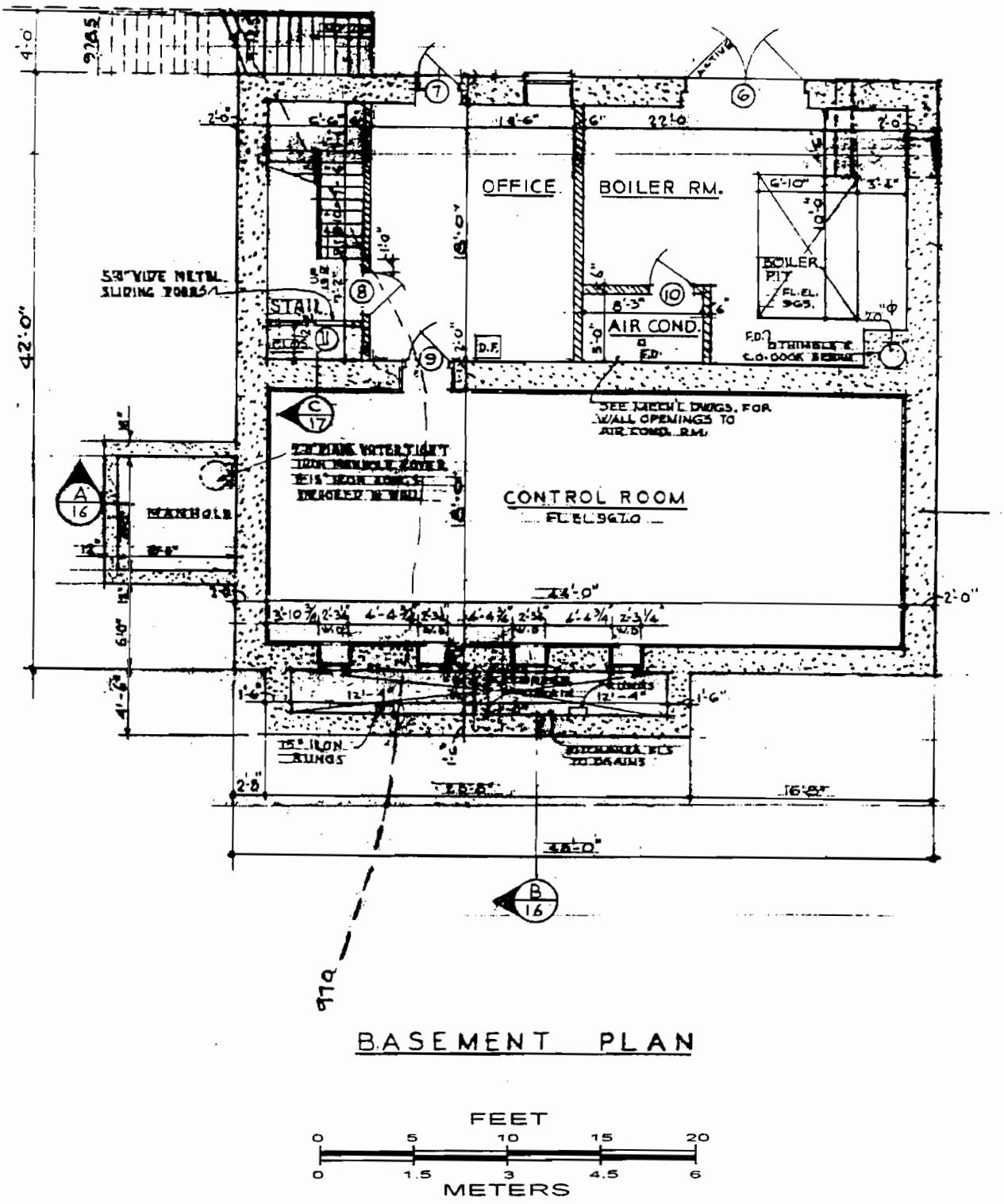


Figure 57. Building 3617, Test Area E Control Room, Blueprint # DP-142533, detail of *Control House Plans, Elevations, Sections*, Feb. 5, 1942, Frank Grad & Sons, Architects and Engineers, Newark, NJ and Washington, DC. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

The Mechanical Laboratory was located on the second story of the building and occupied a total floor space of about 1800 sq. ft (Figure 58). The area was divided into a "white" room for lox (liquid oxygen) clean assembly, a valve and component repair lab and a general assembly area. The valve lab included: 2 pneumatic benches with four stages of nitrogen gas regulation from 0-1500 psi; complete sets of tools; some spare parts for the service of most commercial valves used in the test area and a polyethylene bag sealing machine for protecting delivered components (Edson 1962). RMI boasted that the instrumentation available in all its test areas "has the highest standards for quality and accuracy in the industry" (RMI 1957).

The steam plant for Area E was located on the first floor of the Control House. Steam was delivered to Test Stand E-1 through a 3-inch fiberglass insulated main. The Control House itself was heated by forced air-steam coil heat in the control room and radiators in the upstairs lab (Edson 1962). The water system for Test Area E was renovated in mid-1961. Water was purchased from Picatinny Arsenal on a general, flat rate utility basis. The supply was plentiful—and potable—and it was believed that Picatinny's water supply could accommodate all future requirements. Because of the Area E altitude, a boost pump was required to send the water through 8-inch service piping (Edson 1962).

Today the Control House is in complete disrepair. Almost nothing has been done to the structure since it was abandoned in the late 1960s-early 1970s. An antenna has been placed on the roof, but the placement does not seem to include any permanent changes to the building. Some original equipment is still in the building including computer and monitor casings, control panels, and control keys. A closer inspection will probably identify more equipment. Unfortunately, the entire E Area has been used by various government agencies for training exercises. These exercises included the use of weapons. Bullet impacts have caused the concrete to spall, especially under the eaves, exposing the rebar and allowing it to rust. The interior has also been bullet-riddled causing the shattering of glass walls and partitions creating a general state of serious interior disrepair. Debris and broken furniture fills the various rooms.

Building 3618, Test Stand E-1. Test Stand E-1, # 3618, built in 1953, dominated the entire Naval test area (Figure 59). At the time of its creation it was the largest all attitude rocket test stand on the East Coast. In 1963, the structure was described as consisting of

> basically a 2-story reinforced concrete and corrugation [SIC] enclosed structural steel building [Figure 60]. The ground level concrete sub-structure includes space with massive walls for tank rooms, gas storage, equipment rooms and utility areas. The structural steel second level contains the motor room and adjacent work area. The motor room exhaust exit is fitted with a roll up doorway. For vertical firings a floor section is retracted allowing the engine, which overhangs the hillside, to fire into a 65' deep pit [Figure 61]. The roof is retractable to allow space for 40' long test units in the vertical attitude. The engine mount and rotating structure are rated at 350,000 lbs. in any attitude. The 2nd level motor room is serviced by vehicles along a 100' long concrete access ramp [Edson 1962] [Figure 62].

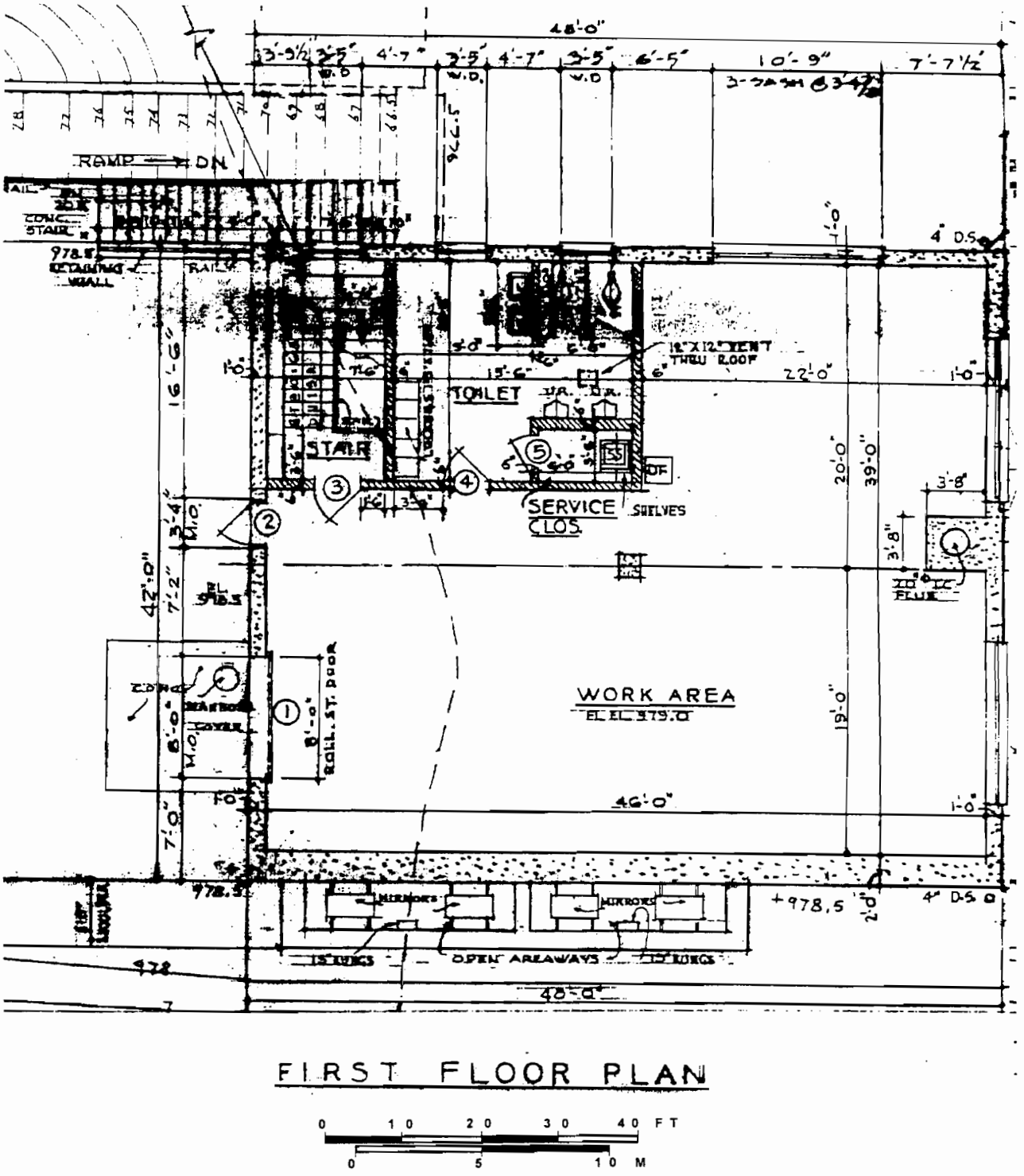


Figure 58. Building 3617, Test Area E Control Room, Blueprint # DP-142533, detail of first floor from *Control House Plans, Elevations, Sections,* Feb. 5, 1942, Frank Grad & Sons, Architects and Engineers, Newark, NJ and Washington, DC. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

Figure 59. Building 3618, Test Stand E-1, former Lake Denmark Depot. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

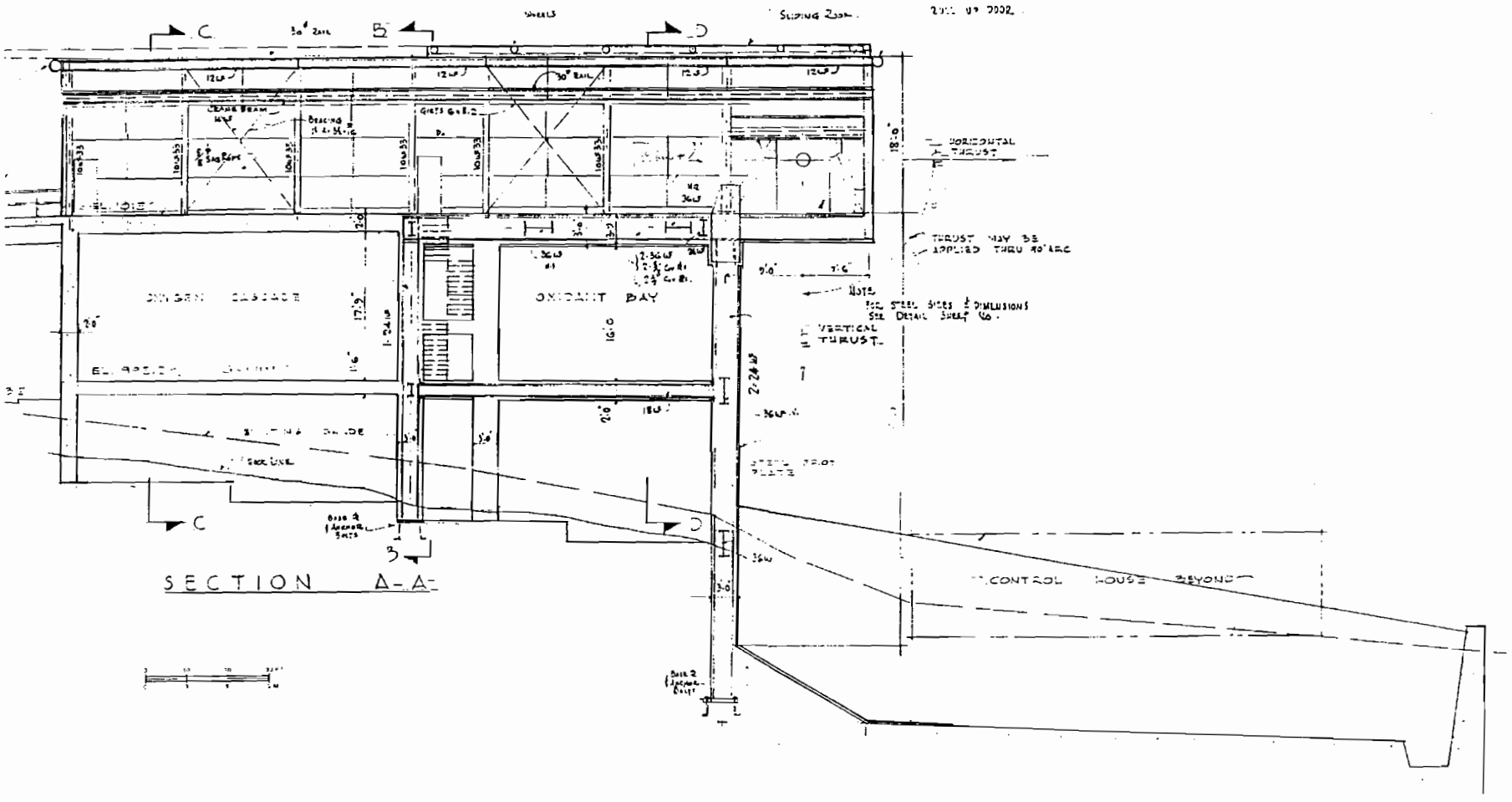


Figure 60. Building 3618, Test Area E-1, Blueprint # DP-142548, detail of first floor from *Rocket Test Stand E-1, Roof Plans*, Frank Grad & Sons, Architects and Engineers, Newark, NJ and Washington, DC. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

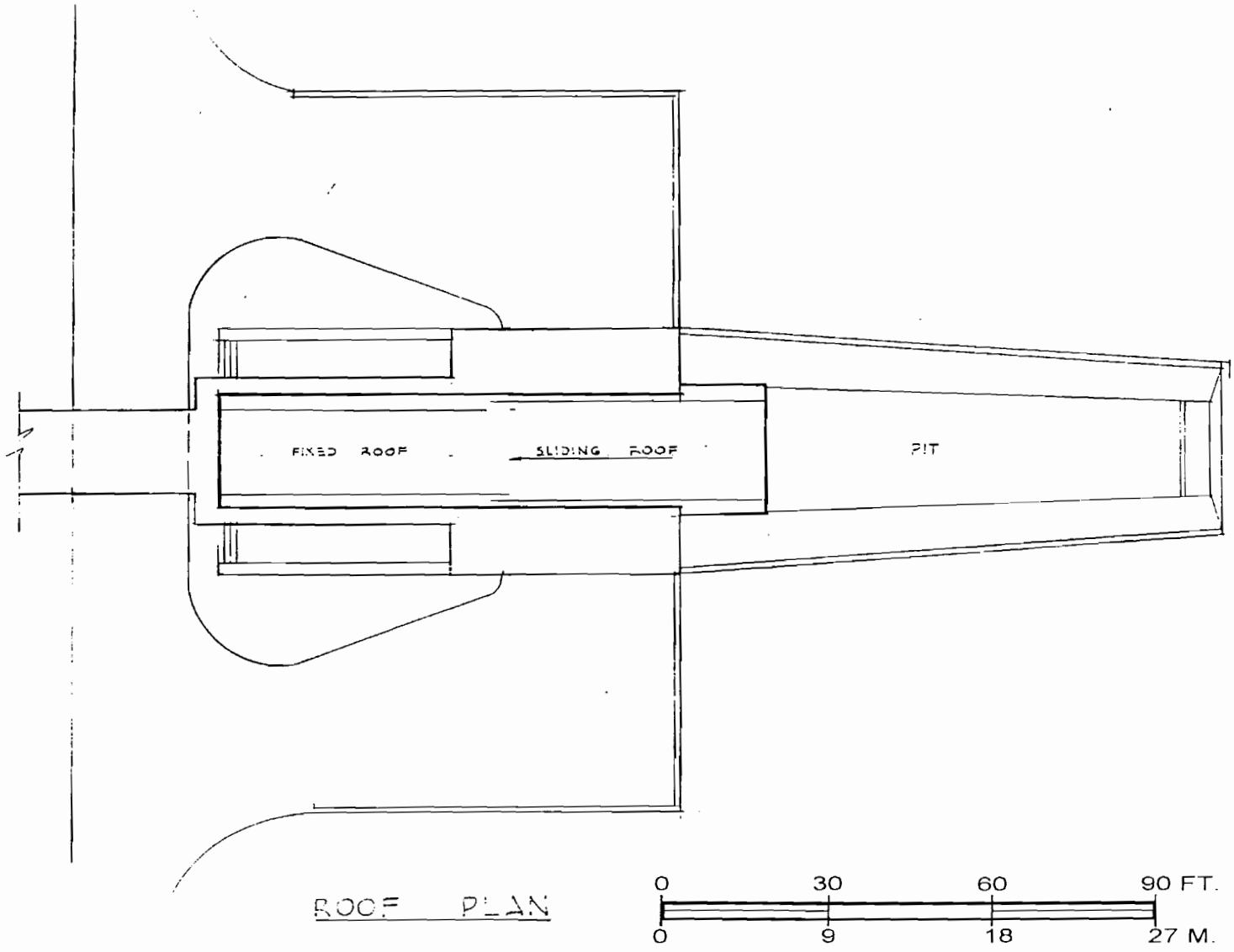


Figure 61. Building 3618, Test Area E-1, Blueprint # DP-142546, detail of first floor from *Rocket Test Stand E-1, Roof Plans,* Frank Grad & Sons, Architects and Engineers, Newark, NJ and Washington, DC. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

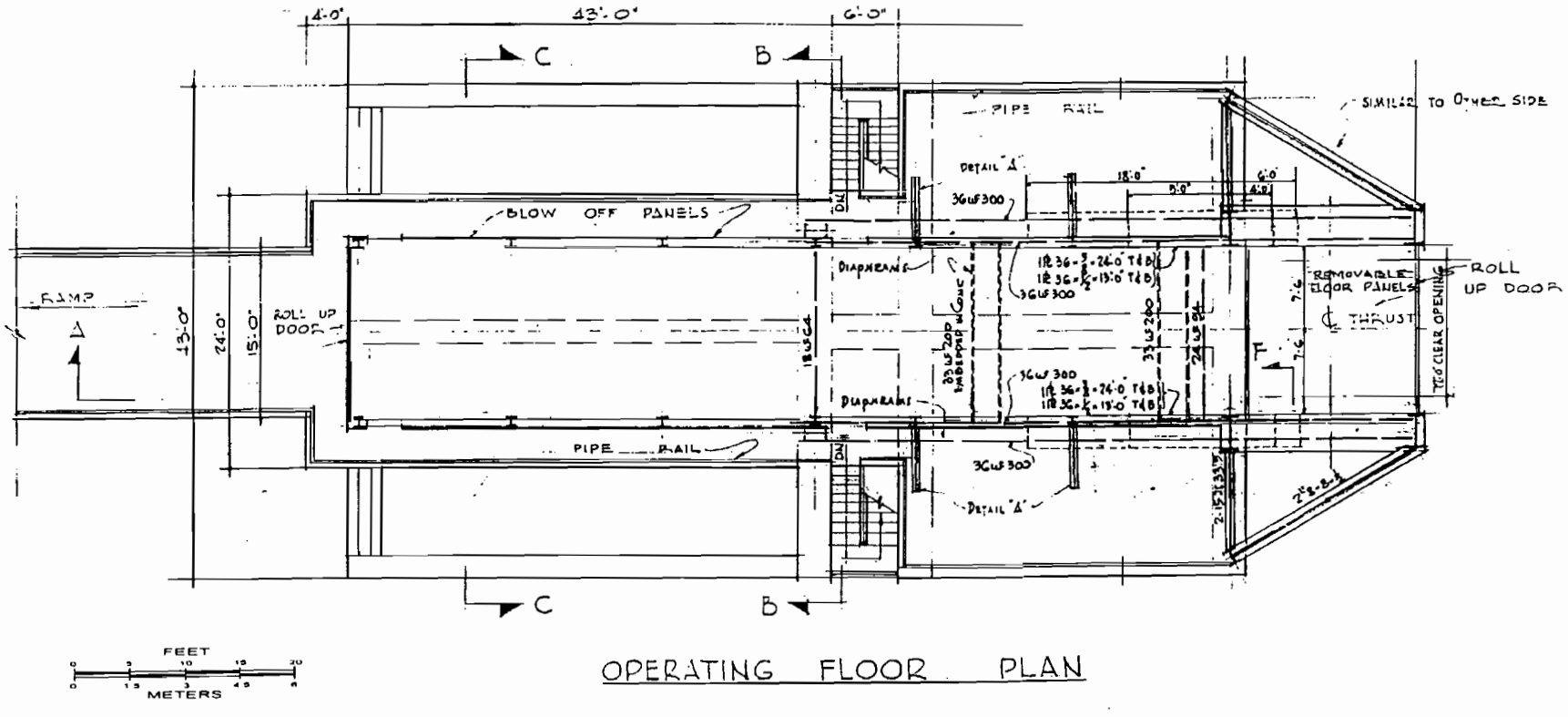


Figure 62. Building 3618, Test Area E-1, Blueprint # DP-142546, detail from *Rocket Test Stand E-1, Roof Plans,* Frank Grad & Sons, Architects and Engineers, Newark, NJ and Washington, DC. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

The total floor space was 5313 sq. ft. The motor room was 1389 sq. ft.; the fuel bay, 500 sq. ft.; the oxidizer bay, 500 sq. ft.; the work room, 1424 sq. ft., and another 1500 sq. ft. of space was available. Utilities included: nitrogen from the E Area cascade; potable water; 110/120 electricity; steam from the E Area plant located in Building 3717; space heaters; a flashing warning light, telephone and intercom communications and an observation periscope. Instrumentation and control equipment included 48 low response channels; 60 medium response channels, 14 high response channels all wired to the Control House. Fifty-four control functions were also wired to the Control House. The test stand featured an overhead deluge system, nitrogen gas regulation system, rotating beam thrust mount, and tanks of various sizes including a cryogenic tank (Edson 1962). The tanks were located under the operating room floor and were separated into cascade rooms which were created for individual pressurizing of propellents (Figure 63). Along with the propellent tanks was a 2400-gallon water tank, rated at 1500 psi, which was used to cool the engine jacket (U.S. NARTS n.d.).

Test Stand E-1 was leased to RMI by the Navy for testing the X-15 rocket engine. In the early 1950s, NACA began to tackle the problems of Hypersonic Aerodynamics. A part of that program was the development of the X-15, essentially a rocket powered airplane. In December 1954, NACA and representatives from the Air Force and the Navy signed a memorandum of agreement to develop such an aircraft. The X-15 was designed to explore the identifiable problems of space and atmospheric flight at very high speeds and altitudes. The altitude to be achieved was tentatively set at 250,000 ft and flight speed at Mach 6.6 or greater.

The creation of the powerful 57,000-lb thrust rocket engine was contracted to Thiokol Corporation. The Reaction Motors division located at Lake Denmark was responsible for testing this engine. The first test firings were carried out at NARTS much to the annoyance of the local residents because of the extreme noise and resulting noise-related damage. The firing schedule was so heavy that on many days ten firings occurred during each 12-hour work day (Winter n.d.). Numerous problems developed in the Thiokol XLR-99 engine; when the first X-15 was test flown in 1959 under the command of test pilot Scott Crossfield, an older Thiokol engine, XLR-11 had to be used to propell it.

Some two dozen flights were completed before the first flight-rated XLR-99 rocket engine was installed in the X-15. This engine was the most powerful, most complex, and safest man-rated (safe to carry a human being) throttle-able rocket propulsion system in the world. It had undergone exhaustive testing at Lake Denmark. This testing included the artificial creation of every conceivable malfunction. This testing would result one of the safest rocket engines ever created. The engine would prove exceptionally reliable and extraordinarily safe despite its long development period.

Between 1959 and October 1968, the X-15 made 199 flights. Until the maiden flight of the space shuttle *Columbia* in 1981, the X-15 held the world altitude and speed records for winged aircraft—67 miles high with a speed of 6.7 times that of sound, 4,518 mph. The X-15 program was one of the most successful aeronautical research endeavors ever undertaken (Schultz 1992).

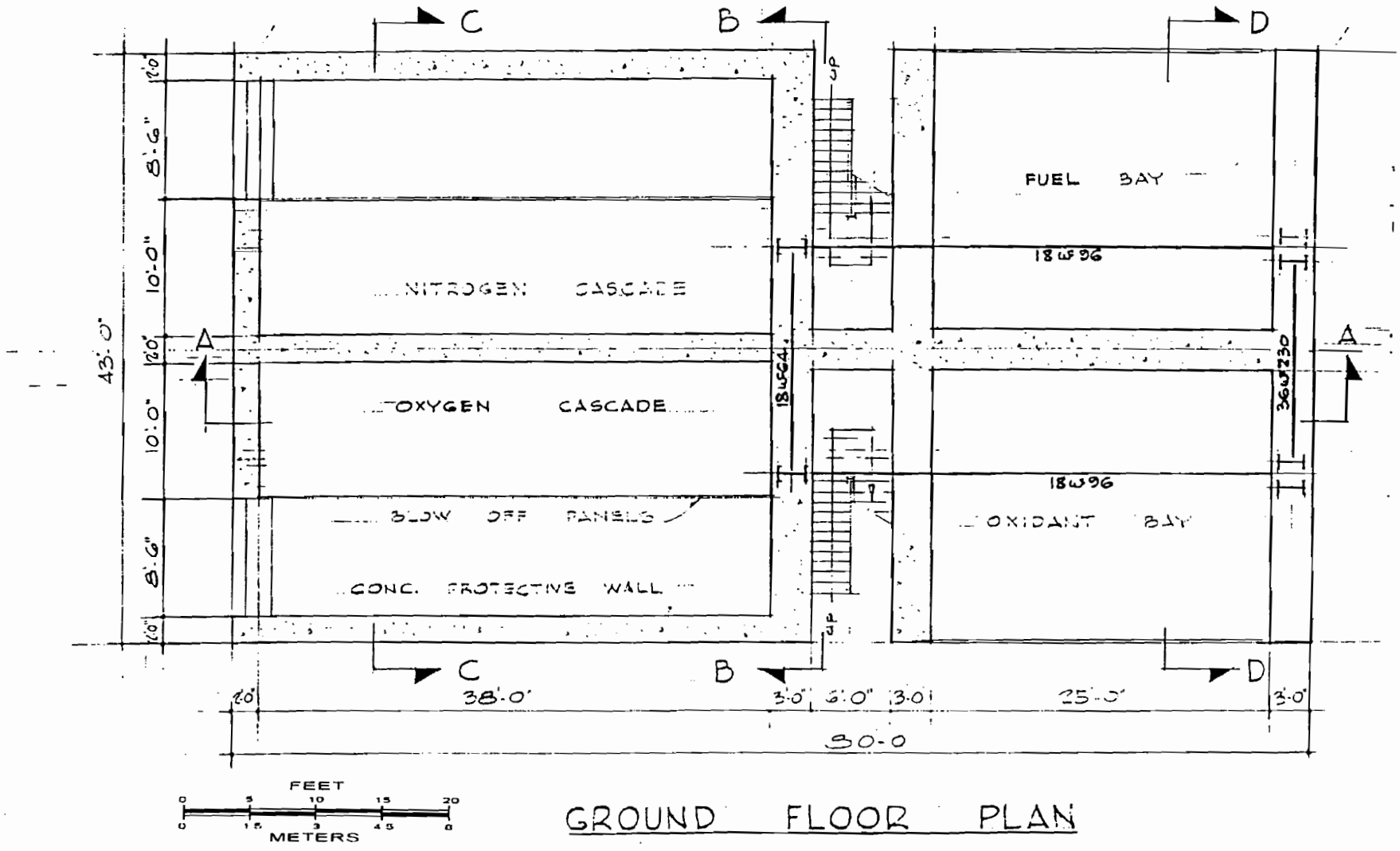


Figure 63. Building 3618, Test Area E-1, Blueprint # DP-142546, detail from *Rocket Test Stand E-1, Roof Plans*, Frank Grad & Sons, Architects and Engineers, Newark, NJ and Washington, DC. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

While the X-15 set many records and provided an extraordinary amount of information, it served a more important function as the "test bed" for techniques and systems that would later be used in the development of the Space Shuttle. The shuttle's re-entry characteristics are similar in all important aspects to those of the X-15 (Schultz 1992). The X-15 project was vital to future space programs in the United States and the rocket engine that propelled this unique aircraft was tested and honed at Lake Denmark Navy Depot in Area E.

Today, Test Stand E-1, Building 3618, is in disrepair. A significant amount of equipment is still intact including: the equipment panel, gantry winch, rotating beam, exhaust fan, oxygen tanks and nitrogen cascade. A closer inspection would probably reveal other important features. The roll-up roof has rusted through and allows the elements to buffet the equipment and precipitation to seep into exposed areas of the concrete. Further, the entire area has been used by various government agencies for training exercises which included the firing of weapons in and around the test stand. Large spalls of concrete from the impact of bullets have exposed the rebar causing it to rust. Debris is plentiful both inside and outside the structure adding to the state of disrepair.

3.3.2 Other Test Area E Structures and Landscaping.

Test Area E occupies 14 acres on a precipitous slope. Aside from the Control House and the Test Stand, the area included: a smaller horizontal-only test stand, E-1A, with a thrust rating of 50,000 lbs.; a lox tank area which was installed on a concrete pad; and large water storage tank (Edson 1962). None of these are extant. The road system that circled the area is barely discernable today. A small unidentified, rather crudely crafted structure stands to the east of the test stand. Its date of construction is unknown and its existence is not mentioned in any available literature. An exposed electrical transformer bank is located to the northwest of the Control House. The individual circuits were lightning-rodded at the transformer primary and protected by air circuit breakers set at varying trip levels within the individual circuits. Electrical power was purchased from Picatinny Arsenal on a general utility basis; Picatinny also provided emergency service in event of disability of the main station or the primary power line (Edson 1962).

By the late 1960s, the Denville RMI plant experienced a loss of business due to the change in the rocket industry from liquid to solid propellent. Efforts were made to retool the plant and to undertake new more profitable projects. By 1970 the Denville office of RMI was phased out and by 1972, a complete shutdown of all activities occurred (Steve Lawson, personal communication 1997). The rocket test areas of the Lake Denmark site were abandoned to the Army.

3.3.3 Recommendations for Test Area E District.

On July 2, 1999 the New Jersey HPO ruled that Test Area E was eligible for listing to the NRHP and the New Jersey Register of Historic Places as a district under Criteria A and D. Clearly this is a site that illustrates the symbiotic relationship of private industry and government agencies in the creation of the vital military industrial complex that sent the United State into space. Test Area E District's historical context is the Cold War.

Before this area can be nominated and preserved, it must have a full structural assessment since the buildings appear to have a significant amount of rusted rebar. If the assessment finds that the buildings cannot be saved, it is PCI's recommendation that a HAER Level II be performed and that the entire test area be mapped with careful consideration to test burn areas. Our professional opinion is that this site is extremely significant and that measures should be taken to insure that it is recorded nationally. For the results of PCI's reassessment, see Nolte et al. 1999.

3.4 INDIVIDUALLY ELIGIBLE STRUCTURES

On July 2, 1999, the New Jersey HPO ruled that Buildings 3250, the Navy Hill Commander's Quarters, and 3316, the associated Stable, were NRHP-eligible under Criteria A and C (Guzzo 1999). The historic context of the structures includes World War I; the inter-war years, World War II mobilization; World War II; and the Cold War (Figure 64).

The 1926 explosion virtually flattened the installation at Lake Denmark. When the time came to construct its larger buildings the Navy employed the Colonial Revival style (see Section 3.1). Without an available history of the evolution of the Depot the standing structures themselves can provide a glimpse of that evolution, but the picture is imperfect.

The oldest remaining structure on the Depot is the Navy Hill Commander's Quarters (#3250) which was built in 1890 (Figure 65). This Colonial Revival style house is made of puddingstone like those in the Army area. It is known that local workers and craftsmen worked on both facilities, perhaps effecting an exchange of architectural custom as relates to native stone. Whatever happened, the pudding stone quarters of both military branches were built only some ten years apart and are clearly an architectural unit; perhaps they were even designed by the same unknown architect. At the turn of the century a stable was added to the house in the Dutch Colonial style which has long been identified with historic New Jersey architecture.

Since a comprehensive history of the Depot does not exist, it is not clear where the administrative center of the facility was intended to be located. Eventually Colonial Revival barracks were built not far from the Commander's Quarters, a Colonial Revival Boiler House and a number of lesser administrative buildings all feature some aspects of Colonial Revival decoration, primarily brick quoining. But none of these buildings are located in a central area which could form an administrative district. The most impressive building on the Depot for many years appears to have been the Colonel's Quarters. Certainly, these imposing quarters stood as a symbol of the authority contained within.

Building 3250, Navy Hill Commander's Quarters. As described by Harrell (1994):

> The Naval Depot Commander's Quarters is a two-story puddingstone Colonial Revival residence with a hipped roof [(Ashby et al. 1982; Harrell 1993)]. This residence was built in 1890 to house the Commanding Officer of the Naval Powder Depot [(see Figure 8)]. There are few drawings which show the evolution of this structure; the plans on file refer solely to the alterations to utilities. Both side sun porch and rear ell, while of similar style

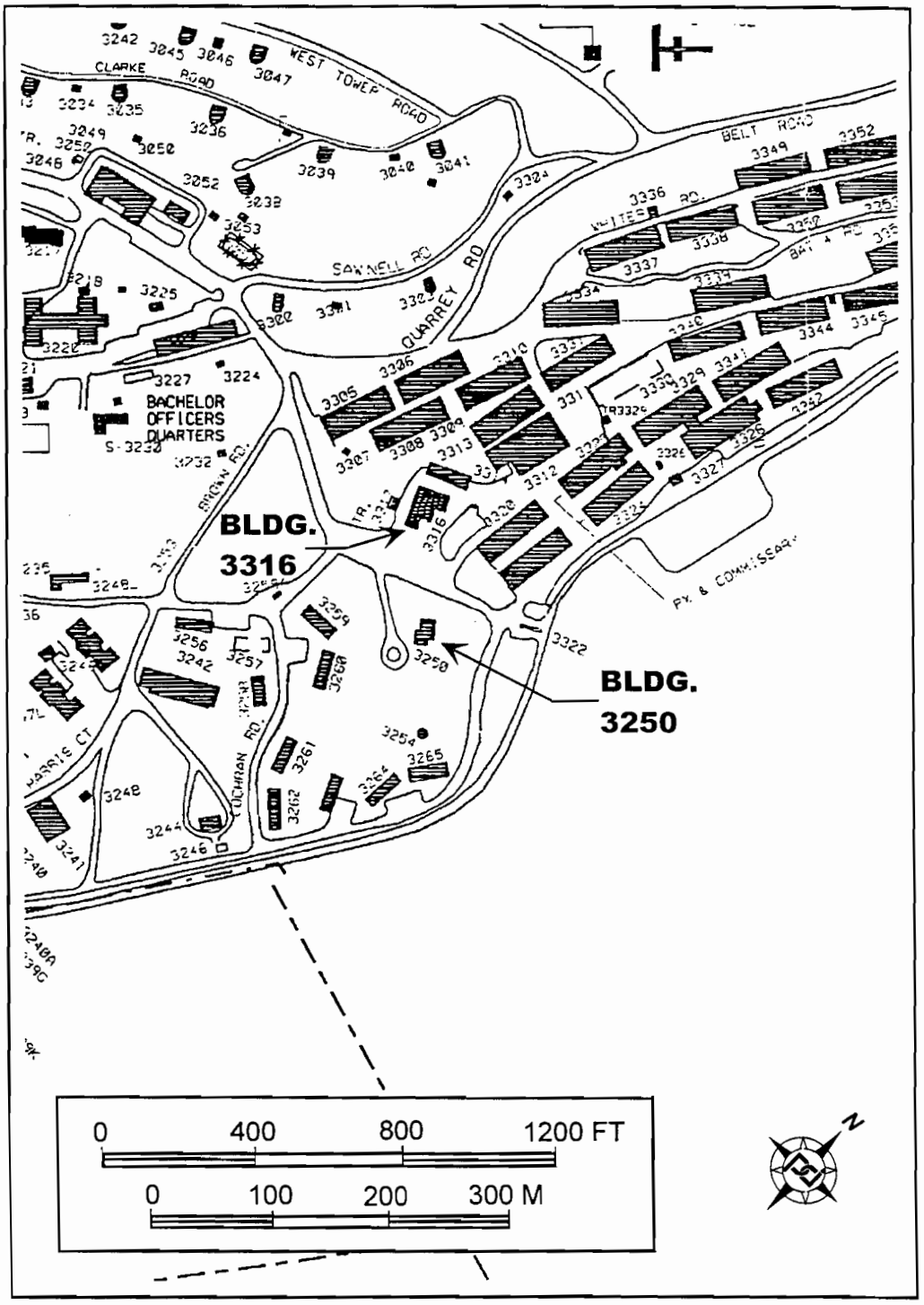


Figure 64. Individually eligible Buildings 3250 and 3316. Picatinny Arsenal, Morris County, New Jersey *(ARDEC 1995).*

Figure 65. Building 3250, Navy Hill Commander's Quarters, former Lake Denmark Depot. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

to the main house, differ in materials and thus appear to postdate original construction [(Figure 66)]. The original exterior wall is exposed in the sunroom. An irregular pattern in the living room floorboards suggests removal of a dividing wall to combine two smaller rooms into one large area. This residence became a part of Picatinny Arsenal in 1960. The remains of the lawn tennis court are still visible in the front yard. The naval guns that once flanked the front door are now at the Museum.

Significant features. Building 3250 is intact with limited alterations. It has a puddingstone facade, rough cut granite lintels [(Figure 67)], sills and foundation course [(Figure 68)]; decorative grapevine mortar joint; ornate wooden cornice (one over each bay); decorative scrolled parapets and Dutch gabled Dormer [(Figure 69)]. There are two additions (rear ell and side sunroom); historical marker, landscaping, including weaponry ornamental features. The interior retains its original floor plan with original wood finishes [(Figure 70)] (Harrell 1994:E-439).

Building 3250's fine workmanship, architectural decoration and prominent sitting express its important function at the Naval Powder Depot. Despite the 1926 explosion, its sturdy construction and geographic location protected it from serious damage. The only damages sustained were broken windows, and doors and falling plaster. During the Navy commanders' occupancy the property included a stable, paddock, garden and fenced field. The location of the tennis court is still marked by a masonry end wall in the front yard (History Office, Picatinny Arsenal n.d.). The fruit trees which now grow around the house are believed to be part of the original plantings.

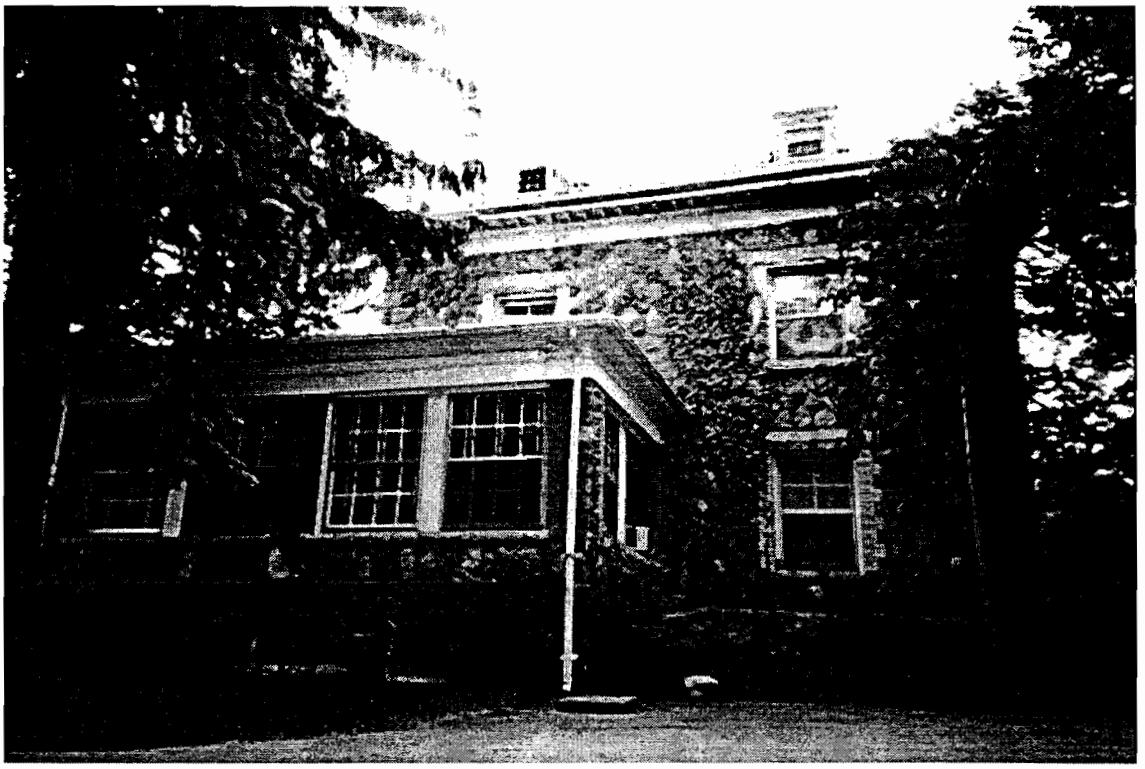


Figure 66. Building 3250, Navy Hill Commander's Quarters, sunroom detail. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Figure 67. Building 3250, Navy Hill Commander's Quarters, window detail. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

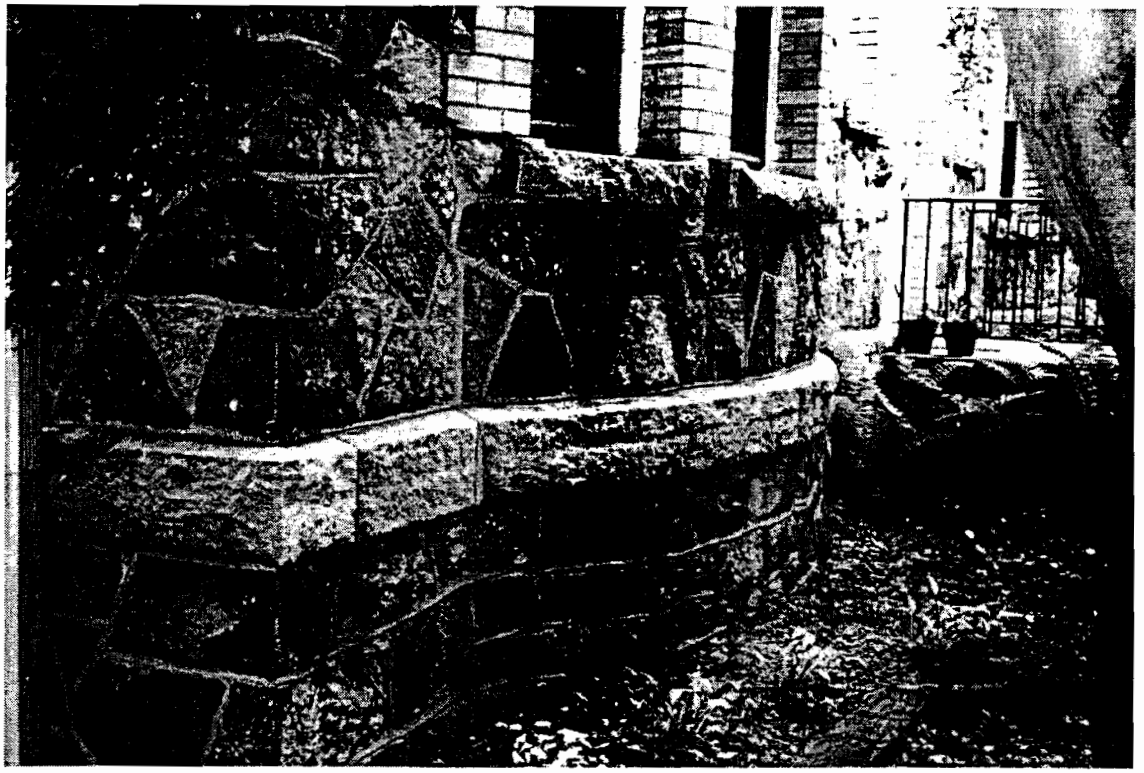


Figure 68. Building 3250, Navy Hill Commander's Quarters, foundation detail. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

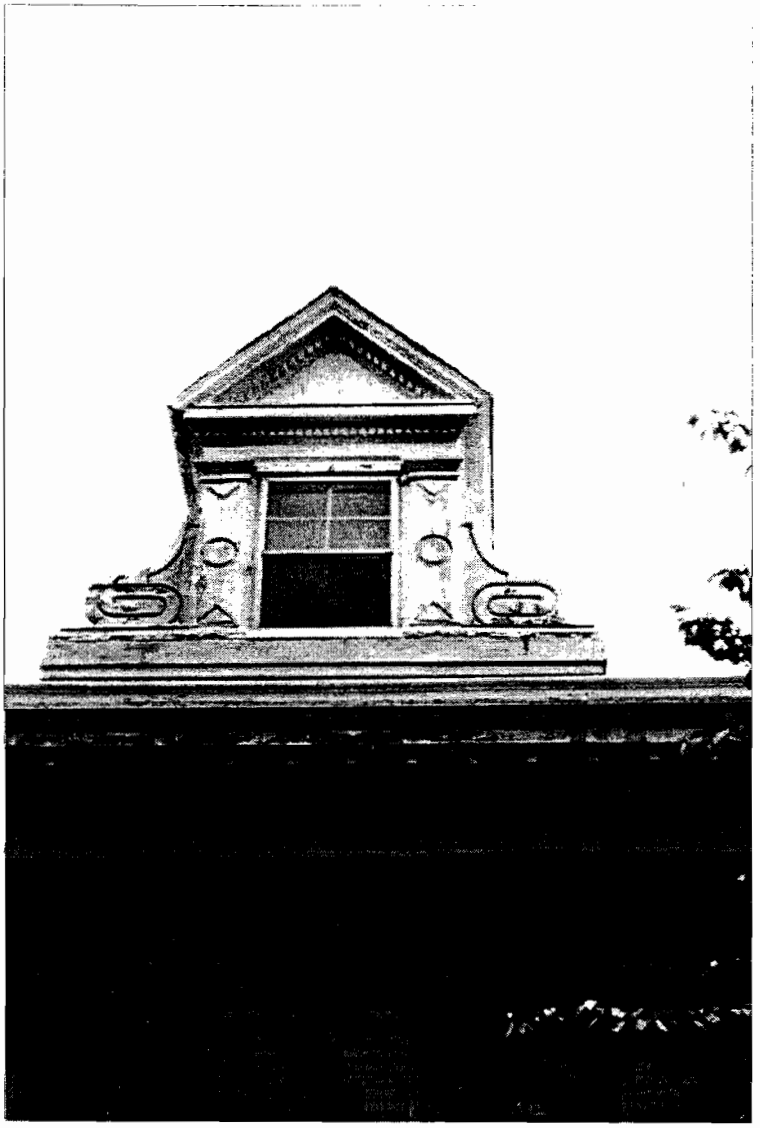
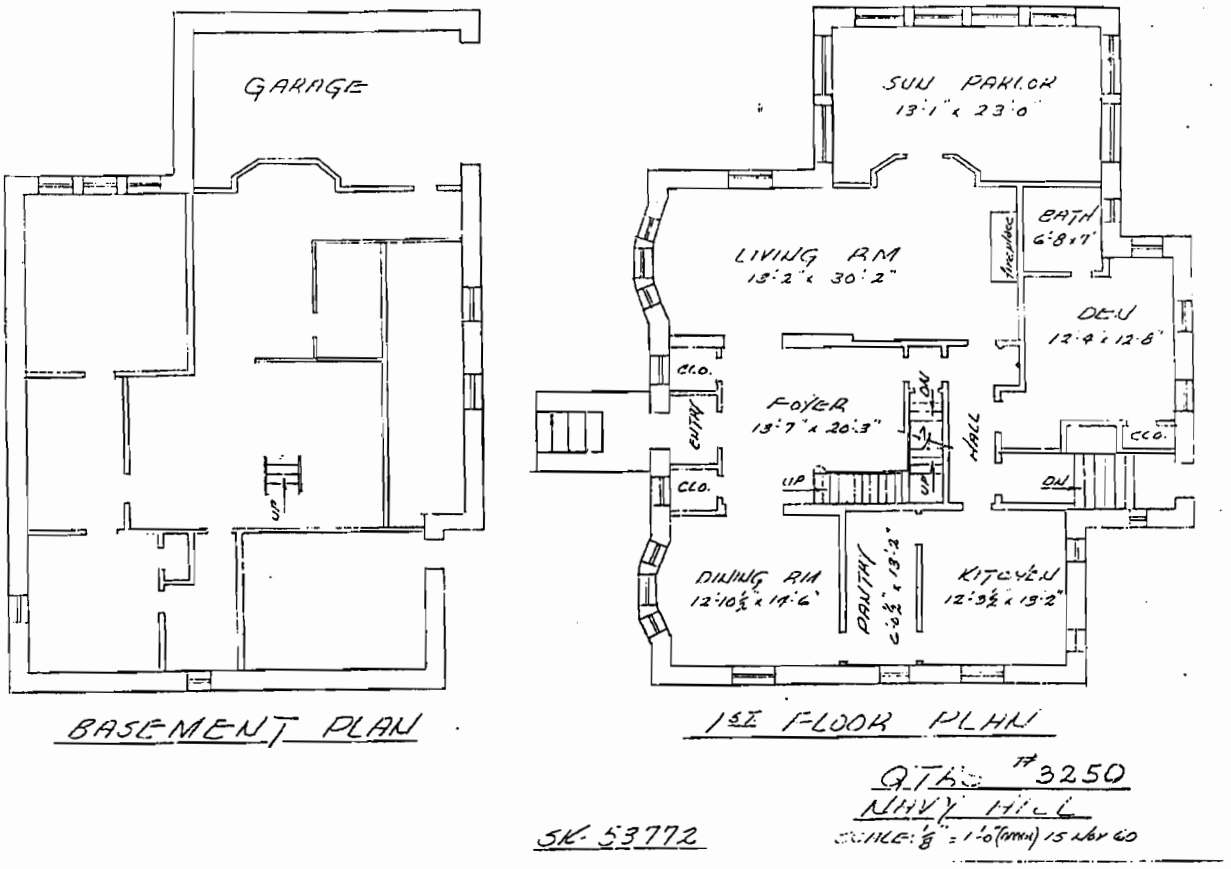


Figure 69. Building 3250, Navy Hill Commander's Quarters, dormer detail. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*



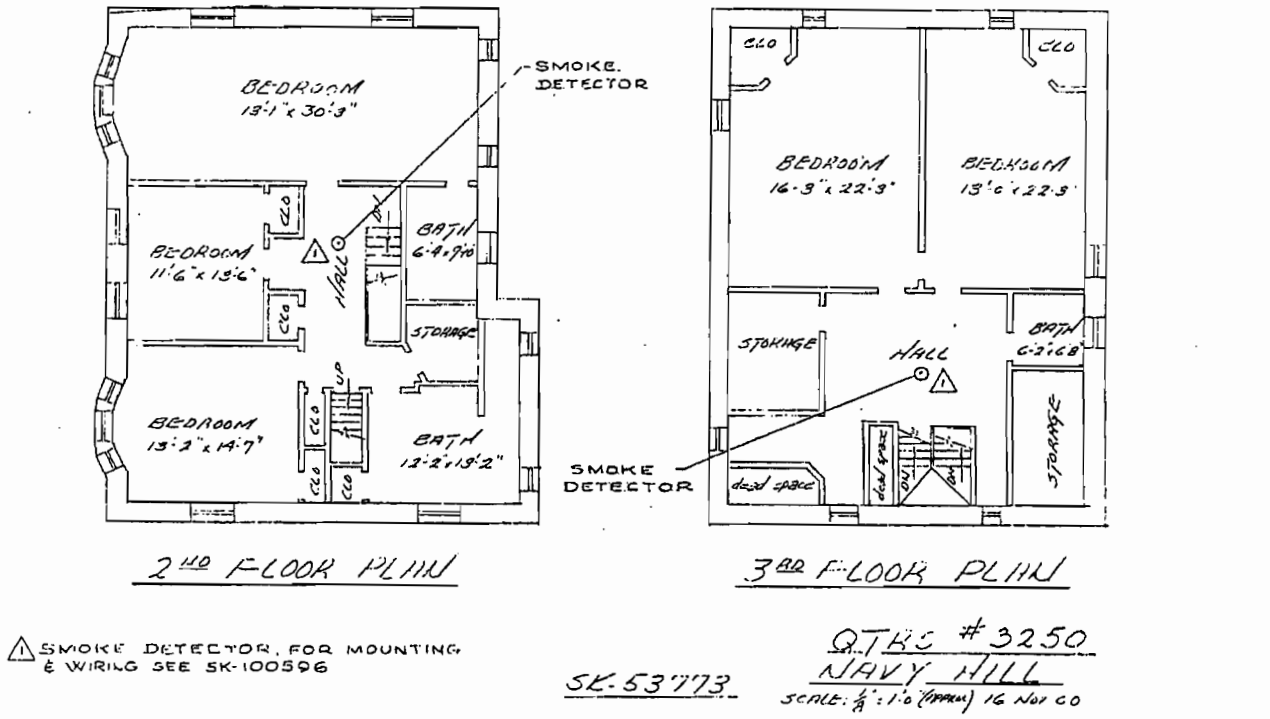


Figure 70. Building 3250, Navy Hill Commander's Quarters, Blueprint # SK-53772 (Nov. 15, 1960) and 53773 (Nov. 16, 1960), as built floor plans, *Qtrs. # 3250, Navy Hill.* Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

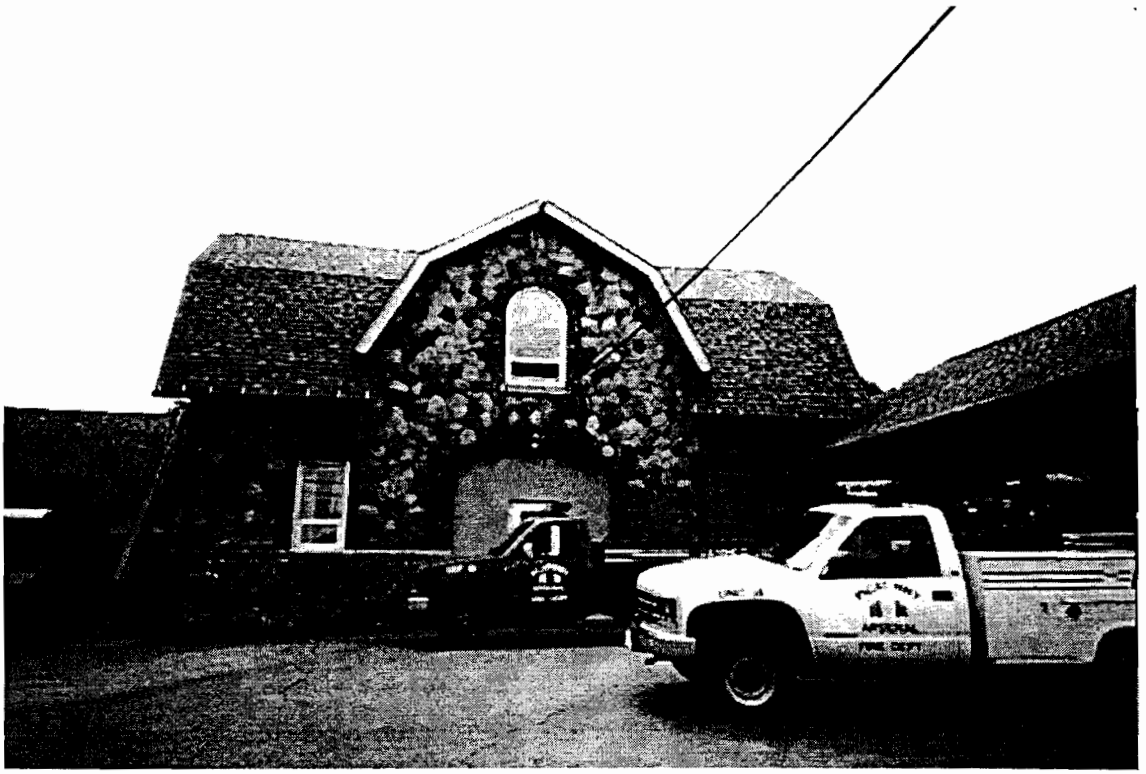


Figure 71. Building 3316, Fire House/Stable, former Lake Denmark Depot. Picatinny Arsenal, Morris County, New Jersey *(Nolte 1997).*

Building 3316, Fire House/Stable. As described by Harrell (1994):

Building 3316 is a two-story puddingstone structure with a bituminous shingled cross-gamble roof and round-headed windows [(Figure 71)]. There are two rectangular single-story puddingstone wings and a rectangular brick addition, all with shingled gable roofs [(Ashby et al. 1982; Harrell 1993)]. Originally constructed as a stable in 1903, the building was converted into a dormitory and main fire headquarters for the Navy in 1945 [(Figure 72)]. It has remained fire headquarters, with upgraded facilities. Interior space was converted into offices and a garage as early as 1946.

Significant features. Building 3316 is intact with alterations. It has a concrete foundation; puddingstone rubble walls with brick surrounds to door and window openings and granite belt course; brick walls; some original double hung sash windows. The floor plan dates from the firehouse conversion of the 1940s (including fire apparatus bays, work areas, office and upstairs dormitory). The interior includes a fire pole. The exterior has rings on granite course for tying up horses when the building was a stable, a small greenhouse, and hose drying rack. Alterations include some metal replacement windows, closing down of segmentally-arched stable entrance with a single door and interior renovation.

Although puddingstone is used on a number of structures throughout the facility, this is one of the few structures made entirely of that stone. The building is intact in its exterior shell and interior arrangement that reflects its use as a firehouse since the 1940s, with some exterior details from its former use as a stable (Harrell 1994:E-446).

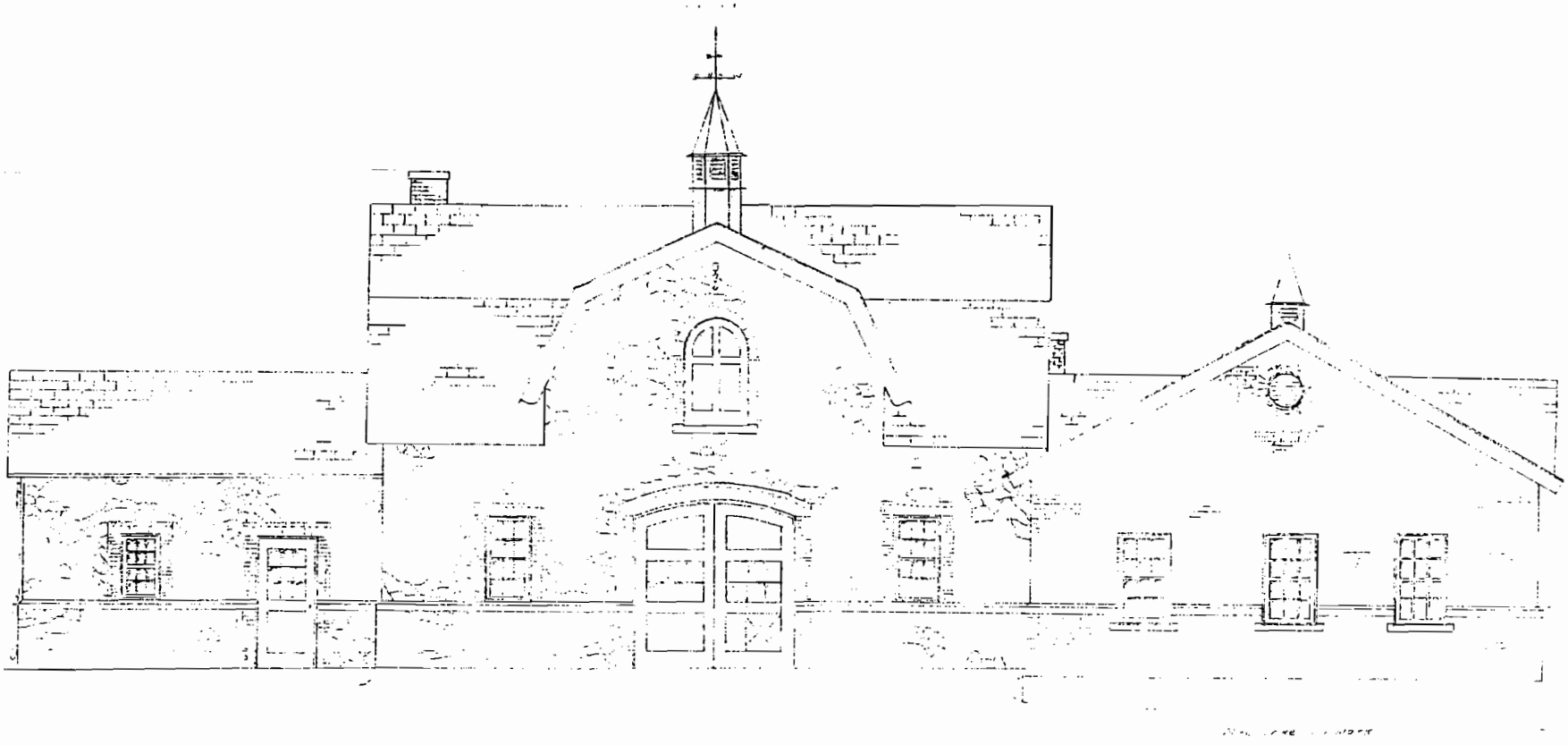


Figure 72. Building 3316, Firehouse/Stable, Blueprint # PW-B-7, NAD Lake Denmark building # 25, April 1945. Picatinny Arsenal, Morris County, New Jersey *(on file in DPW, Picatinny Arsenal).*

At the turn of the century, the term Colonial Revival was used broadly to cover a number of building styles which have since been separated from it. One of these styles was Dutch Colonial, an early New Jersey house style, that was exceptionally popular, cutting across social and economic lines.

The earliest houses of New Jersey's Dutch settlers were the simplest of structures, tending to be very small. By the eighteenth century distinctive features such as the flaring bell eave were common Dutch Colonial characteristics. Larger additions were generally added laterally and many additions use the gambrel roof, that roof line so identified in popular culture with the Dutch house. Although the gambrel roof is associated with Dutch-built houses, the English and the Swedish also used this style. Generally the nature of the angle of the roof indicates its point of origin (Schwartz 1983). Besides the gambrel roof and the flaring eave, was the occasional front stoop (Schwartz 1983). The Dutch houses in Morris County tended to use puddingstone for walls and foundations (Schwartz 1983).

This common folk form did not escape the attention of the Colonial Revivalists. In 1877 at a talk given by J. Cleveland Cady to the Association of American Architects, he referred to the "Dutch" house as "simple" and "expressive. . .seeming to have grown out of the hillside. . .timbered and ceiled ceiling. . .far prettier in color and light and shade than any expanse of plaster could be." He was also animated by the "broad horizontal lines," which would later inspire the bungalow movement (Schwartz 1983).

While the Dutch Colonial style was very popular and Morris County was the home of many real Dutch homes, the stable was the only structure on the Navy or Army facility built in this style. Perhaps this folk form was considered less imposing and was used only for a more informal structure like a stable. Original intentions aside, this is one of the most interesting structures on the entire facility and the only outbuilding remaining from what was once a large living complex.

3.4.1 Recommendations for Individually Eligible Structures.

On July 2, 1999 the New Jersey HPO ruled that the Navy Commander's Quarters (Building 3250) and former Stable/now Firehouse (Building 3316) were eligible for listing to the NRHP and the New Jersey Register of Historic Places as individual structures under Criteria A and C.

4.0 Conclusions and Summary

PCI reevaluated 500 historic structures on Picatinny Arsenal and the former Lake Denmark Navy Depot which were previously judged eligible for the National Register of Historic Places by WCH/Boston Affiliates (Harrell 1994). The task of reevaluating 500 structures included two methodological strategies: in-field inspection and research evaluation. The 500 structures were visually inspected and their NRHP status evaluated utilizing NRHP criteria and several DOD architectural reports concerning the NRHP status of a number of types of military structures present within that system. For a complete discussion of the reevaluation of Picatinny's historic structures, please see *Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey* (Nolte and Steinback 1999).

Of the 500 structures resurveyed, 51 were judged to be eligible for the NRHP as contributing structures to three historic districts, four were judged to be non-contributing to a district, and two as individually eligible. Figure 73 depicts the three proposed historic districts within the arsenal.

Under previous guidance when the structures had been initially evaluated (Harrell 1994), it was believed that all of Picatinny Arsenal formed a single historic district. It is PCI's professional opinion that the entire facility does not have sufficient integrity to form a single district; instead three smaller areas were determined to be eligible as districts.

The first district is an Administration and Research District which encompasses the old and new general administration area on Parker Road and "Chemistry Row" (see Figure 5). The Administrative and Research District is made up of 23 contributing structures and one non-contributing building and are architecturally united by the Colonial Revival style. Given the history of these buildings, particularly as relating to their research and administrative activities during World War II, the New Jersey HPO ruled that the Administrative and Research District is eligible for listing to the NRHP under Criteria A and C (Guzzo 1999).

The second district is the 600 Ordnance Testing Area (see Figure 40). This area has been carefully documented by a 1984 Historic American Engineering Record (HAER) report (Thurber and Norman 1983) and consistently highlighted in previous architectural reports as being significant.

The complete planning of this area in 1928 was carried out by the Engineering Department of the Arsenal with the assistance of the Quartermaster and outside contractors (*Plant Design* ca. 1945). World War II blueprints note that structure designs were created by The War Plans Division, Ordnance Department, Picatinny Arsenal (Picatinny Arsenal, DPW n.d.). Certainly numerous structures were specifically designed for explicit purposes in the 600 Area and would seem to be one-of-a-kind buildings. A survey of the facilities at the old line Army Arsenals at Edgewood (Aberdeen) Arsenal,

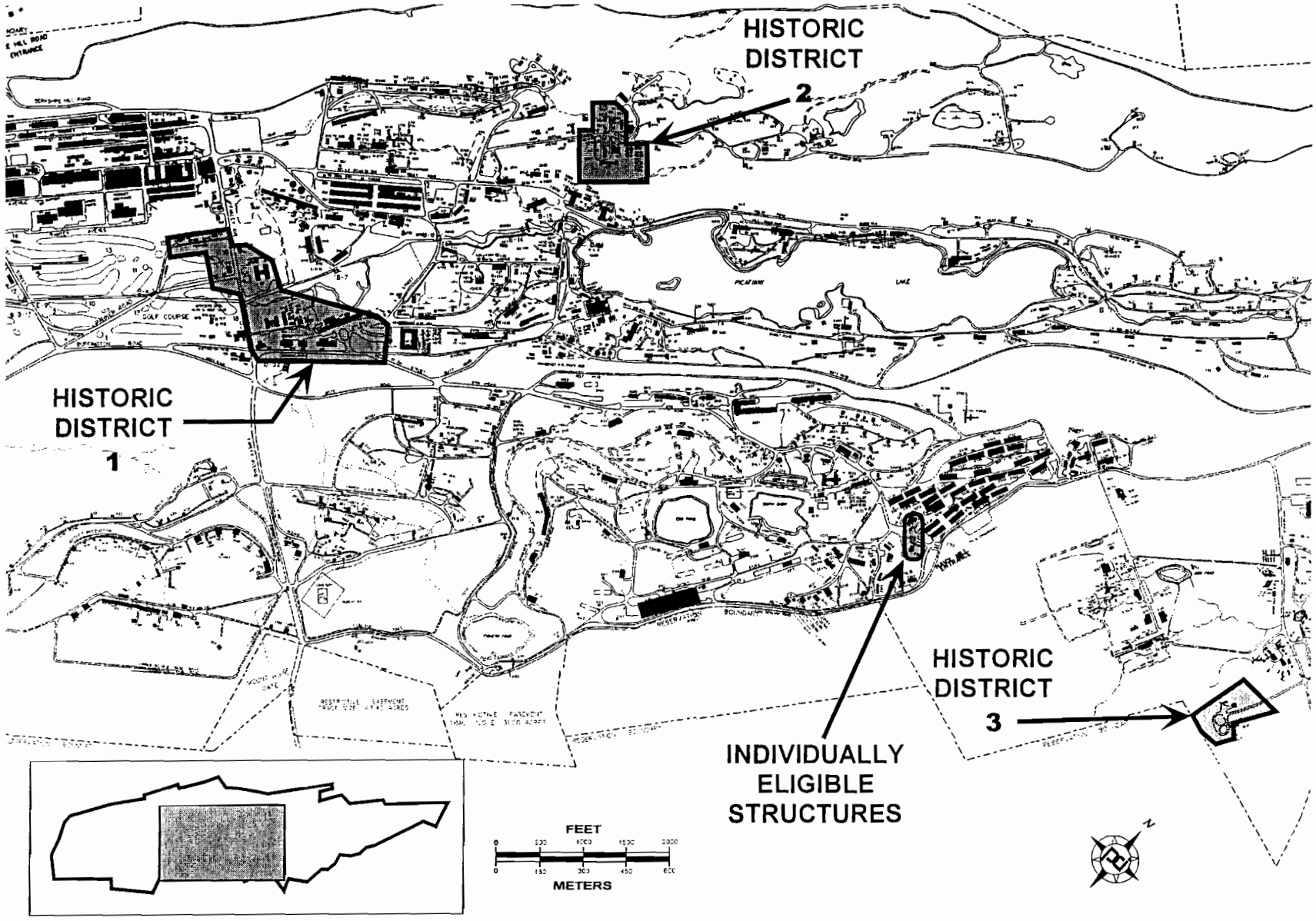


Figure 73. The three proposed Historic Districts and two individually eligible structures (Buildings 3250 and 3316) within Picatinny Arsenal. Picatinny Arsenal, Morris County, New Jersey *(ARDEC 1995).*

were created by The War Plans Division, Ordnance Department, Picatinny Arsenal (Picatinny Arsenal, DPW n.d.). Certainly numerous structures were specifically designed for explicit purposes in the 600 Area and would seem to be one-of-a-kind buildings. A survey of the facilities at the old line Army Arsenals at Edgewood (Aberdeen) Arsenal, Maryland, Rock Island Arsenal, Illinois, and Watervliet Arsenal, New York reveal no grouping of testing-related structures like those on Picatinny.

The 600 Ordnance Testing Area District is made up of 26 contributing structures and three non-contributing buildings. Given the industrial architectural significance and the historic role played by these buildings, particularly as relates to their research during the inter-war years and World War II, the New Jersey HPO ruled that the 600 Ordnance Test Area District is eligible for the NRHP under Criteria A and C (Guzzo 1999).

The third district is Test Area E, Naval Air Rocket Test Station (NARTS), Lake Denmark Depot District, created in 1948 (see Figure 61). The earliest work at NARTS was devoted primarily to liquid propulsion, but eventually encompassed a wide range of activities including evaluation of rocket engines and rocket systems, development of methods for analyzing rocket propellants, and the collaboration with private industry on a wide range of experiments and safety manuals. All of these functions were a part of the NARTS mission as assigned by the Chief of Naval Operations: "to test, evaluate and conduct studies pertaining to rocket engines, their components and propellants" (U.S. NARTS ca. 1959).

The test facilities at NARTS were generally grouped into six test areas, two used especially by and for NARTS projects and the others leased to Reaction Motors. NARTS used Test Areas "D" and "E" and sometimes "G". Test Area E was considered the "elite" among the many facilities at NARTS (U.S. NARTS ca. 1959). It was here that the Navy fired liquid propellant rocket engines with a thrust up to 350,000 lbs. from one of the largest static test stands on the East coast. When the area first went into operation it was used for the testing of the X-15 power plant under a use-agreement contract with RMI.

Given the historic importance of Test Area E, Naval Air Rocket Test Station (NARTS), Lake Denmark Depot District, both nationally and regionally, and the information it might potentially supply about the military industrial complex's role in the early Cold War, the New Jersey HPO ruled that this site is eligible for the NRHP and the New Jersey Register of Historic Places as a district under Criteria A and D. Clearly this is a site that illustrates the symbiotic relationship of private industry and government agencies in the creation of the vital military industrial complex that sent the United States into space. Before this area can be nominated and preserved, it must have a full structural assessment since the buildings appear to have a significant amount of rusted rebar. If a structural assessment determines that the buildings can not be saved, PCI recommends that a HAER Level II be performed, and that the entire test area be mapped with careful consideration to test burn areas. For additional information see Nolte et al. 1999.

Buildings 3250 (Navy Hill Commander's Quarters) and 3316 (Stable) were determined to be individually eligible for the NRHP under Criteria A and C (Guzzo 1999).

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5.0 Bibliography

Acroterion

1986/87 *Morris County Historic Sites Survey: New Jersey Historic Sites Inventory Morris County Cultural Resources Survey.* Acroterion, n.p. Prepared for the Morris County Heritage Commission, Morristown, New Jersey.

ARDEC (Armament Research Development & Engineering Center), Scientific and Technical Information Division

1945 *Picatinny Arsenal's Accomplishments During the Second World War (7 Dec. 1941 to Sept. 1945).* Armament Research Development & Engineering Center, Scientific and Technical Information Division. No place of publication. (Available in the Command Historian's Office, Picatinny Arsenal, New Jersey).

1995 *Picatinny Arsenal Historic Structures Map.* Drawing No. DP-81, Sheet 1 of 1. (Available in the Real Property Division, Picatinny Arsenal, New Jersey).

Ashby, David E., David G. Buchanan, Robie Lange, John D. Mocum, Pamela J. Thurber and Debra Wolf

1982-1984 *HABS/HAER Inventory Cards for Picatinny Arsenal, NJ.* HABS/HAER Pilot DARCOM Project, Picatinny Arsenal, New Jersey.

Baranowski, John J., Captain

1959 Command Histories: Report Symbol 3ND-5750-1. Correspondence with Commandant, Third Naval District, July 31, 1959. On file in the Naval Historical Center, Washington DC.

Brasser, T.J.

1978 Early Indian-European Contacts. In *Northeast*, edited by Bruce G. Trigger, pp. 78-88. Handbook of North American Indians, Vol. 15, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Building Technology Inc.

1984 *Historic Properties Report, Redstone Arsenal, Alabama with the George C. Marshall Space Flight Center.* For the Historic American Building Survey/Historic American Engineering Record by Building Technology Inc., Silver Spring, Maryland.

Bureau of Electronic Publishing, Inc.

1995 *Multimedia U.S. History.* Bureau of Electronic Publishing, Inc., Parsippany, New Jersey.

Burke, Thomas E., Jr.

1991 *Mohawk Frontier: The Dutch Community of Schenectady, New York, 1661-1710.* Cornell University Press, Ithaca, New York.

Cannan, Deborah K., Leo Hirrel, Hugh McAloon, and Brooke V. Best

1996 *Historic Context for the Army Materiel Command's World War II Facilities.* R. Christopher Goodwin & Associates, Inc., Frederick, Maryland.

Cinquino, Michael A., Marilyn Kaplan, Frank J. Shieppati, Michael S. Raber, Mark A. Steinback, Edward V. Curtin, Gary McGown, Kerry L. Nelson
1996 *Cultural Resource Management Plan for the Picatinny Arsenal, Rockaway Township, Morris County, New Jersey.* Panamerican Consultants, Inc., Depew, New York. Prepared for the U.S. Army Corps of Engineers, New York District.

Craig, Robert W.
1991 *Preliminary Index to Architects, Builders & Engineers Identified in Nominations of New Jersey Properties Listed in the New Jersey Register of Historic Places and the National Register of Historic Places, Prior to January 1, 1990.* Office of New Jersey Heritage, Division of Parks & Forestry, Department of Environmental Protection, Trenton, New Jersey.

Department of the Army
1990 *Army Materials Technology Laboratory Closure with Transfers to: Detroit Arsenal, Michigan, Picatinny Arsenal, New Jersey, Fort Belvoir, Virginia, Supporting Documentation.* Department of the Army, n.p.

Department of Defense, Legacy Project
1994 *Coming in from the Cold: Military Heritage and the Cold War.* Legacy Project, Department of Defense, Washington, D.C.

Department of the Navy
1999a *Chronology of Significant Events in Naval Aviation, 1946-1949.* Naval Historical Center Web Page, Department of the Navy, Naval Aviation Branch, Washington Navy Yard, Washington, D.C. http://www.history.navy.mil/branches/avchr6.htm

1999b *Chronology of Significant Events in Naval Aviation, 1950-1953.* Naval Historical Center Web Page, Department of the Navy, Naval Aviation Branch, Washington Navy Yard, Washington, D.C. http://www.history.navy.mil/branches/avchr7.htm

1999c *Chronology of Significant Events in Naval Aviation, 1960-1969.* Naval Historical Center Web Page, Department of the Navy, Naval Aviation Branch, Washington Navy Yard, Washington, D.C. http://www.history.navy.mil/branches/avchr9.htm

Divine, Robert A., T.H. Breen, George M. Fredrickson, and R. Hal Williams
1995 *America Past and Present.* Vol. 1, 4th ed. HarperCollins Publishers, New York.

Dulles, Foster Rhea, and Melvyn Dubofsky.
1984 *Labor in America: A History.* 4th ed. Arlington Heights, Illinois.

Edson, D.
1962 *Test Facilities Data Book.* Thiokol Chemical Corporation, Reaction Motors Division, n.p.

Ellis, David M., James A. Frost, Harold C. Syrett, and Harry J. Carmen
1967 *A History of New York State.* Cornell University Press, Ithaca, New York.

Fitch, Virginia A., and Suzanne Glover
1990 Historic and Prehistoric Reconnaissance Survey Picatinny Arsenal, New Jersey in *Army Materials Technology Laboratory Closure with Transfers to Detroit Arsenal, Michigan,*

Picatinny Arsenal, Fort Belvoir, Virginia. Supporting Documentation. Department of the Army, Washington, D.C. Originally submitted by The Public Archaeology Laboratory, Inc., Pawtucket, RI for Daylor Consulting Group, Boston and Department of the Army, Corps of Engineers, New England Division, Waltham, Massachusetts, 1989.

Garner, John S.
1993 *World War II Temporary Military Buildings.* USACERL Technical Report CRC-93/01, U.S. Army Engineering and Housing Center (USACERL), Champaign, Illinois.

Goddard, Ives
1978 Delaware In *Northeast*, edited by Bruce G. Trigger, pp. 213-239. Handbook of North American Indians, vol 15, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Grandine, Katherine E. and Deborah K. Cannan
1995 *Support and Utility Structures and Facilities (1917-1946) Overview, Inventory, and Treatment Plan.* R. Christopher Goodwin & Associates, Inc., Frederick, Maryland. Prepared for the Department of the Navy, Atlantic Division, Naval Facilities Engineering Command, Norfolk, Virginia.

Grashof, Bethany C.
1986 *A study of the United States Army Family Housing Standardized Plans (PX-0001-50835).* Vols 1-6. Center for Architectural Conservation, College of Architecture, Georgia Institute of Technology, Atlanta.

Green, Constance McLaughlin; Harry C. Thompson and Peter C. Roots
1990 *United States Army on World War II, The Technical Services, The Ordnance Department: Planning Munitions for War.* Center for Military History, U.S. Army, Washington, D.C.

Guzzo, Dorothy P.
1999 Letter to Ronald J. Kraus, Director of Public Works, Picatinny Arsenal, New Jersey (July 2). Historic Preservation Office, Trenton, New Jersey.

Halsey, Edmund Drake
1882 *History of Morris County, 1739 - 1882.* W.W. Munsell and Co., New York.

Harrell, Pauline Chase
1993 *Final Report, Annotated Catalogue of Building Drawings and Evaluation of Architectural Features Picatinny Arsenal, Dover, New Jersey.* WCH Industries, Inc., Waltham, Massachusetts and Boston Affiliates, Inc., Boston. Prepared for the New York District, U.S. Army Corps of Engineers.

1994 *Revised Draft Report, Evaluation of Structures Built Prior to 1946 at Picatinny Arsenal, New Jersey.* WCH Industries, Inc., Waltham, Massachusetts and Boston Affiliates, Inc., Boston. Prepared for the New York District, U.S. Army Corps of Engineers.

Headquarters, Department of the Army
1984 Army Regulation 420-20, *Facilities Engineering, Historic Preservation.* Washington, D.C.

Historical Office, Picatinny Arsenal
n.d. *Itinerary for a Historic Tour of Picatinny Arsenal.* Prepared by Historical Office, Picatinny Arsenal, Dover, New Jersey. Typewritten manuscript at Department of Public Works, Picatinny Arsenal, Dover.

1984 *A Remembrance of the Past . . . A Recognition by the Present: Historical Guide to Picatinny Arsenal, U.S. Army Armament Research and Development Center, Dover, New Jersey.* 3rd ed. Historical Office, Picatinny Arsenal, Dover, New Jersey.

Jenkins, Dennis R.
1996 *The History of Developing the National Space Transportation System: The Beginning through STS-75.* Walsworth Publishing Company, Marceline, Missouri.

Kaye, Seymour M.
1987 *Encyclopedia of Explosives and Related Items.* Vol. 8. U.S. Army Armament Research and Development Command, Large Caliber Weapon Systems Laboratory, Dover.

Kim, Sung Bok
1978 *Landlord and Tenant in Colonial New York: Manorial Society, 1664-1775.* University of North Carolina Press, Chapel Hill.

Klein, Joel I., Leonard G. Bianchi, Lorraine E. Williams, and Sydne B. Marshall
1986 *An Archaeological Overview and Management Plan for Picatinny Arsenal.* Envirosphere Company, Lyndhurst, New Jersey. Prepared for National Park Service, Philadelphia, and U.S. Army Material Development and Readiness Command, n.p.

Kraft, Herbert
1986 *The Lenape: Archaeology, History, and Ethnology.* The New Jersey Historical Society, Newark.

Kraft, Herbert C., and R. Alan Mounier
1982 The Late Woodland Period in New Jersey: ca. 1000 B.C.-1600 B.C. In *New Jersey's Archaeological Resources from the Paleo-Indian Period to the Present: A Review of Research Problems and Survey Priorities*, edited by Olga Chesler, pp. 139-184. Office of New Jersey Heritage, New Jersey Department of Environmental Protection, Trenton.

Kriv, Arlene R., ed.
n.d. *World War II and the U.S. Army Mobilization Program: A History of 700 and 800 Series Cantonment Construction.* Legacy Resources Management Programs, Department of Defense, United States Department of the Interior, National Park Service, Cultural Resources, HABS/HAER. No place of publication.

Lev Zetlin Associates
1992 *Future Development Master Plan for U. S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ, Commanders' Summary.* Lev Zetlin Associates, New York, NY. Prepared for the U.S. Army Corps of Engineers, New York District.

Lowry, Bates
1985 *Building a National Image: Architectural Drawings for the American Democracy, 1789-1912.* For the National Building Museum. Penshurst Press Limited, Great Britain.

Manning, Alice E.
1982 Nineteenth Century Farmsteads on the Inner Coastal Plain of New Jersey. In *Historic Preservation Planning in New Jersey: Selected Papers on the Identification, Evaluation, and Protection of Cultural Resources,* edited by Olga Chesler, pp. 42-92. Office of New Jersey Heritage, New Jersey Department of Environmental Protection, Trenton.

McAlester, Virginia and Lee McAlester
1984 *A Field Guide to American Houses.* Alfred A. Knopf, New York, NY.

Myers, Manny
1984 Revolutionary War Origins of Picatinny Arsenal. In *A Remembrance of the Past . . . A Recognition by the Present: Historical Guide to Picatinny Arsenal, U.S. Army Armament Research and Development Center, Dover, New Jersey,* prepared by the Historical Office, p. 7, 3rd ed. Picatinny Arsenal, Dover, New Jersey.

Noble, Bruce J., Jr., and Robert Spude
1992 *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties.* National Register Bulletin 24. U.S. Department of the Interior, National Park Service, Interagency Resources Division, National Register of Historic Places, Washington, D.C.

Nolte, Kelly and Michael V. Taylor
1997 *Architectural Assessment of the World War II Military and Civilian Works, U.S. Army Missile Command, Redstone Arsenal, Madison County, Alabama.* Panamerican Consultants, Inc., Tuscaloosa, Alabama. Prepared for the U.S. Army Missile Command.

Nolte, Kelly and Mark Steinback
1999 *Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey.* Panamerican Consultants, Inc., Buffalo, New York.

Nolte, Kelly, Michele H. Hayward, Mark A. Steinback, and Elizabeth S. Burt
1999 *Development of a Treatment Strategy for and Additional Research Regarding Structures 3617, 3618 and Others at the Former Naval Air Rocket Test Station (NARTS), Test Area E, Picatinny Arsenal, Morris County, New Jersey.* Panamerican Consultants, Inc., Buffalo, New York. Prepared for Northern Ecological Associates, Inc., Canton, New York.

Perry, Kevin
1993 *History.* One page MS on file at Department of Public Works, Picatinny Arsenal, Dover, New Jersey.

Picatinny Arsenal, Directorate of Public Works (DPW)
n.d.a Military Real Property Card Files, 405-90f. On file, Directorate Of Public Works, Picatinny Arsenal, Dover, New Jersey.

n.d.b General Real Estate Construction Files, 405-B. On file, Directorate Of Public Works, Picatinny Arsenal, Dover, New Jersey.

n.d.c Vertical building drawing files and blueprints, ordered by building number. On file, Directorate Of Public Works, Picatinny Arsenal, Dover, New Jersey.

Pitney, Henry C., Jr. (ed)
1914 *A History of Morris County New Jersey; Embracing Upwards of Two Centuries, 1710 - 1913.* Vol. 1. Lewis Historical Publishing, New York.

Plant Design, Picatinny Arsenal
ca. 1942 *Plant Design* N.p. (On file in the Command Historian's Office, Picatinny Arsenal, New Jersey).

Pomfret, John E.
1964 *The New Jersey Proprietors and Their Lands.* Princeton University Press, Princeton, New Jersey.

Pope, Jennie Barnes
1945 The Old Iron Industry. In *The Story of New Jersey*, edited by William Starr Myers, pp. 66-85. Princeton University Press, Princeton, New Jersey.

Ramsey, N. F., Maj., Ord. Dept., U.S.A.
1926 "Picatinny Arsenal", *Army Ordnance* 7:37 (July-August) *Report of Work Accomplished by Agencies Assigned to Work with Picatinny Arsenal.* ca. 1940 n.p. (On file in the Command Historian's Office, Picatinny Arsenal, New Jersey).

RMI [Reaction Motors, Inc.]
1957 *This is RMI Power for Progress.* Reaction Motors, Inc., Denville, New Jersey.

Rogers, J. A., Jr.
1931 *The History of Picatinny Arsenal.* Picatinny Arsenal, Dover, New Jersey.

Rutsch, Edward S.
c.1995 *Draft: Iron History at Picatinny Arsenal.* Historic Conservation and Interpretation, Inc., Newton, New Jersey. Ms on file at Department of Public Works, Picatinny Arsenal, Dover, New Jersey.

Rutsch, Edward S., and Holly van Voorst
1989 *A Supplemental Stage I Cultural Resources Survey of the Proposed Mount Hope Pumped Storage Hydroelectric Facility in Rockaway and Jefferson Townships, Morris County, New Jersey.* Historic Conservation and Interpretation, Inc., Newton, New Jersey. Prepared for TAMS Consultants, Inc., New York.

1991 *Cultural Resources Survey Report C of the Proposed Mt. Hope Pumped Storage Hydroelectric Facility* [sic] *and Transmission Lines Rockaway and Jefferson Townships, Morris County, New Jersey.* Historic Conservation and Interpretation, Inc., Newton, New Jersey. Prepared for TAMS Consultants, Inc., New York.

Rutsch, Edward S., William Sandy, Richard F. Porter, and Leonard G. Bianchi
1986 *Cultural Resource Investigation of the Proposed Mt. Hope Pumped Storage Hydroelectric Facility and Transmission Lines Rockaway and Jefferson Townships, Morris County, New Jersey.* Historic Conservation and Interpretation, Inc., Newton, New Jersey. Prepared for Tippetts-Abbett-McCarthy-Stratton, New York and Bloomfield, New Jersey.

Salwen, Bert
1978 Indians of Southern New England and Long Island: Early Period. In *Northeast*, edited by Bruce G. Trigger, pp. 160-176. Handbook of North American Indians, vol 15, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Sandy, William, and Edward S. Rutsch
1992 *Stage One Cultural Resources Survey of Three Areas for the Proposed Mt. Hope Pumped Storage Hydroelectric Facility Rockaway and Jefferson Townships, Morris County, N.J.* Historic Conservation and Interpretation, Inc., Newton, New Jersey. Prepared for TAMS Consultants, Inc., New York.

Schultz, James
1992 *Winds of Change; Expanding the Frontiers of Flight.* For the National Aeronautics and Space Administration, Government Printing Office, Washington, D.C.

Schwartz, Helen
1983 *The New Jersey House.* Rutgers University, New Brunswick, New Jersey.

Seifert, Donna J.
1995 *Defining Boundaries for National Register Properties.* National Register Bulletin 21. U.S. Department of the Interior, National Park Service, Interagency Resources Division, National Register of Historic Places, Washington D.C.

Sherfy, Marcella and W. Ray Luce
n.d. *Guidelines for Evaluating and Nominating Properties that Have Achieved Significance Within the Last Fifty Years.* National Register bulletin 22. U.S. Department of the Interior, Washington, D.C.

STV/Lyon Associates, Inc.
1994 *Installation Design Guide for Picatinny Arsenal, New Jersey.* STV/Lyon Associates, Inc., Baltimore. Prepared for U.S. Army Corps of Engineers, New York District, New York.

Summerson, John
1963 *The Classical Language of Architecture.* The MIT Press, Cambridge.

Technical Center of Expertise for Preservation of Historic Structures and Buildings, The
ca. 1995 *Historic Materials Source Book for Army Family Housing.* The Technical Center of Expertise for Preservation of Historic Structures and Buildings, Seattle. Prepared for the Assistant Chief of Staff for Installation Management, Housing Division.

Technical Information Branch, NARTS
ca. 1957 *Prospect Careerwise; Engineering Opportunities at U.S. Naval Air Rocket Test Station, Lake Denmark, Dover, New Jersey.* Technical Information Branch, NARTS, Lake Denmark, Dover, NJ (on file in the Naval Historical Center, Annapolis, MD).

ca. 1960 *Test Evaluation.* N.p. On file at the Naval Historical Center, Washington, DC.

Thiokol Propulsion
1999 *Thiokol Propulsion History.* From the Thiokol Propulsion Home Page located on the Internet at: http://www.thiokol.com/History.htm

Thompson, Harry C. And Lida Mayo
1960 *United States Army in World War II, The Technical Services, The Ordnance Department: Procurement and Supply.* Office of the Chief of Military History, Department of the Army, Washington, D.C.

Thurber, Pamela
ca. 1983 *Historic American Building Survey, Picatinny Arsenal, New Jersey, HAER # NJ-36.* Picatinny Arsenal, New Jersey.

Thurber, Pamela and Sandy Norman
1983 *Historic American Engineering Record, Picatinny Arsenal, New Jersey, HAER # NJ-36.* Picatinny Arsenal, New Jersey.

Trigger, Bruce G. (editor)
1978 *Northeast.* Handbook of North American Indians, vol. 15, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

U.S. Department of the Army
n.d. *Draft, National Register of Historic Places Inventory, Nomination From for Picatinny Arsenal, New Jersey.* U.S. Department of the Army, Picatinny Arsenal, New Jersey. (Available in the Real Property Division, Picatinny Arsenal, New Jersey).

U.S. Department of the Interior
1991 *Guidelines to Complete the National Register Registration Form.* National Register Bulletin 16A and 16B. U.S. Department of the Interior, National Park Service, Cultural Resources, Interagency Resources Division, National Register Branch, Washington, D.C.

1995 *How to Apply to the National Register Criteria for Evaluation.* National Register Bulletin 15. U.S. Department of the Interior, National Park Service, Cultural Resources, Interagency Resources Division, Washington, D.C.

U.S. NARTS
n.d. *All About NARTS, U.S. Naval Air Rocket Test Station, Lake Denmark, Dover, N.J.* No place of publication (Available in the Command Historian's Office, Picatinny Arsenal, New Jersey).

ca. 1959 *All About NARTS, U.S. Naval Air Rocket Test Station, Lake Denmark, Dover, N.J.* No place of publication (Available in the Command Historian's Office, Picatinny Arsenal, New Jersey).

Walsh, Rita
1995 *The World War II Ordnance Department's Government-Owned Contractor-Operated (GOCO) Industrial Facilities: Ravenna Ordnance Plant Historic Investigation.* Geo-Marine, Inc, Plano, Texas. Prepared for the U.S. Army Corps of Engineers, Ft. Worth District. U.S. Army Materiel Command Historic Context Series, Report of Investigations, Number 7A.

Wacker, Peter O.
1982 New Jersey's Cultural Resources: A.D. 1660-1810. In *New Jersey's Archaeological Resources from the Paleo-Indian Period to the Present: A Review of Research Problems and Survey Priorities*, edited by Olga Chesler, pp.199-219. Office of New Jersey Heritage, New Jersey Department of Environmental Protection, Trenton.

WES (Waterways Experiment Station), U.S. Army Corps of Engineers
1995 *Identification and Analysis of Wetlands, Floodplains Threatened and Endangered Species and Archaeological Geomorphology at Picatinny Arsenal, NJ.* Vol. 1: Text. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. Prepared for U.S. Army Environmental Center, Aberdeen Proving Ground, MD and U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, New Jersey.

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 Paleo-Indian Period to the Present: A Review of Research Problems and Survey Priorities*, edited by Olga Chesler, pp. 185-198. Office of New Jersey Heritage, New Jersey Department of Environmental Protection, Trenton.

Williams, Diane E., Anne I. Malanka and David W. Moore, Jr.
June 1995 *Fort Jackson, South Carolina: An Army Infantry Training Facility in the Southern Department and Fourth Corps Area, 1917-1946.* Hardy Heck Moore & Associated, Inc., Austin, Texas for Gulf Engineers & Consultants, Baton Rouge.

Winter, Frank H.
n.d. Pioneering Commercial Rocketry in the United States of America: Thiokol's Reaction Motors Division, 1958-1972, Part 4: RMD Project History. National Air and space Museum, Smithsonian Institution, Washington, D.C.

Workers of the Federal Writers Project
1986 (reprint) *The WPA Guide to 1930s New Jersey.* Sponsored by the Public Library of Newark and the New Jersey Guild Associates. Works Progress Administration for the State of New Jersey. Reprint by Rutgers University Press, New Brunswick, New Jersey.

APPENDIX A

New Jersey Historic Preservation Office Letter

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Division of Parks & Forestry
Historic Preservation Office
PO Box 404
Trenton, NJ 08625-0404
TEL: (609)292-2023
FAX: (609)984-0578

Robert C. Shinn, Jr.
Commissioner

July 2, 1999
HPO-G99-10

Ronald J. Kraus, Director
Public Works
Department of the Army
United States Army Tank – Automotive and Armaments Command
Armament Research, Development and Engineering Center
Picatinny Arsenal, New Jersey 07806-5000

Dear Mr. Kraus:

As Deputy State Historic Preservation Officer for New Jersey, in accordance with 36 CFR Part 800: Protection of Historic Properties, as published in the Federal Register 18 May, 1999 (Vol. 64, No. 95, 27071-27084), I am providing **Consultation Comments** for the following project:

Morris County, Picatinny Arsenal
General Officer's Quarters
Buildings 112 and 113 Exterior Rehabilitation
U.S. Department of the Army

Summary: These comments on the proposed exterior rehabilitation of Buildings 112 and 113 are in response to your letter about the project. The project will have **no adverse effect** on Buildings 112 and 113. This letter also includes revised boundaries for the Picatinny Historic District.

800.4 Identification of Historic Properties

Please note that these comments address only architectural/above ground resources.

I largely concur with the boundaries of the Picatinny Arsenal Historic District established in the submitted reports: *Definition of Historic Districts for Picatinny Arsenal, Morris County, New*

Jersey, Revised Draft, March 1998, prepared by Panamerican Consultants, Inc. for U.S. Army Corps of Engineers; *Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey* Revised Draft, March 1998, prepared by Panamerican Consultants, Inc. for U.S. Army Corps of Engineers; and *Response to New Jersey Historic Preservation Office Review of Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County , New Jersey and Definition of Historic Districts for Picatinny Arsenal, Morris County, New Jersey, Addendum*, August 1998, prepared by Panamerican Consultants, Inc. for U.S. Army Corps of Engineers. Buildings 112 and 113 are contributing buildings in the Picatinny Arsenal Historic District as defined above.

I accept that Picatinny Arsenal no longer forms the larger (series) of contiguous Historic Districts as identified in the draft nomination of Picatinny prepared ca.1987, and the subsequent revised draft report *Evaluation of Structures Built Prior to 1946 At Picatinny Arsenal, New Jersey* prepared by WCH Industries, Inc. dated December 30, 1994. The originally proposed district (as identified in the draft nomination) has been rendered ineligible due substantial loss of buildings, often buildings which were key parts of the larger district, and due to the extent of alteration of many of the buildings which remain. I have also considered Picatinny Arsenal as a cultural landscape, in part because of its separated lines and storage areas. Unfortunately, because of the almost complete loss of the extensive rail system which connected the isolated components of Picatinny together, the Arsenal no longer reads as a coherent cultural landscape of separate, but functionally connected facilities.

Based on the reports referenced above, and on site visits made by staff reviewer Dan Saunders, it is my opinion that the following properties are eligible at Picatinny Arsenal:

1. The Administration and Research District which is eligible under Criteria A and C. While I concur with the eligibility of this District, I do not accept the discontiguous components of the District as part of this District. The Cannon Gates fall too far from this District to be included. Rather than including the Navy Commander's Quarters and stable in this District, I have listed them as eligible as a separate entity at #4 below.
2. The 600 Ordnance Testing Area is eligible under Criteria A and C.
3. Test Area E, Naval Air Rocket Test Station is eligible under Criteria A and D.
4. The Navy Commander's Quarters (Building 3250) and stable (Building 3316, now the firehouse.) are eligible under criteria A and C.

800.5 Assessment of Adverse Effects – Apply the Criteria of Adverse Effect

The project will have no adverse effect on Buildings 112 and 113.

Additional Comments

While the contractor you have chosen is very experienced in preservation work, it is very unusual to rely solely on the expertise of the contractor to ensure that the project will be completed to the standard of quality that we would all like to see. In future, I strongly encourage

you to consider using an architect who meets the Secretary of the Interior's Standards for Historic Architecture on projects within the Picatinny Arsenal Historic District.

If you have any questions, please contact Dan Saunders of my staff at (609) 633-2397.

Sincerely,

Dorothy P. Guzzo
Deputy State Historic
Preservation Officer

DPG/DS981218
C: Nancy Brighton

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

14 May 1998

REPLY TO
ATTENTION OF

Environmental Analysis Branch
Environmental Assessment Section

Ms. Dorothy Guzzo, Deputy
State Historic Preservation Officer
New Jersey Historic Preservation Office
Department of Environmental Protection
CN 404
Trenton, New Jersey 8625-0404

(97-311)
DS

98-1218 DS

Dear Ms. Guzzo:

The New York District, Corps of Engineers (Corps) has been assisting Picatinny Arsenal, located in Morris County, New Jersey, in the completion of the identification of historic districts on the Arsenal's property. The enclosed reports entitled "Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey" and "Definition of Historic Districts for Picatinny Arsenal, Morris County, New Jersey" are submitted for your review and comment as part of the Section 106 consultation process.

The reports are intended to focus discussion on historic properties which contribute to the unique context of historic districts within Picatinny Arsenal. Previous coordination between Arsenal and Corps representatives and Mr. Terry Pfoutz, and others of your office had identified the need to clearly distinguish buildings and structures which are of significance in the Picatinny Districts. In the report entitled " Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey" the rationale for determining whether or not particular structures and buildings are contributing elements is discussed for each property. In the report entitled "Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey" the resulting Historic Districts are fully discussed.

As discussed between Mr. Pfoutz and Ms. Roselle Henn (Corps), the Arsenal and Corps would appreciate an opportunity to meet with your staff once your review is complete. An early June meeting date appears to be mutually acceptable and the Corps will contact your office to finalize the schedule. If your review should raise questions which we can address prior to our meeting, please contact Ms. Roselle Henn (212/264-2119).

Your cooperation in this matter is appreciated.

Sincerely,

Frank Santomauro, P.E.
Chief, Planning Division

Cf: Tim Miller
Chief, Environmental and
Natural Resources Division,
U.S. TACOM-ARDEC
Picatinny Arsenal, New Jersey

198 BUILDINGS
AT PICATINNY ARSENAL, NEW JERSEY
TO BE EXCLUDED FROM NOMINATION
TO THE NATIONAL REGISTER
OF HISTORIC PLACES

Buildings 18, 19, 22, 22C, 23, 31A, 33B, 63, 64, 66, 78A, 80A, 80B, 84, 99, 101A, 104A, 114A, 115B, 116A, 121, 121A, 124, 154, 161, 168, 174, 232C, 252A, 252C, 252F, 266A, 268, 281, 282B, 282C, 282D, 290, 291, 301, 301A, 302B, 302C, 302E, 303, 304, 308, 308A, 308B, 311, 314, 314C, 321D, 323D, 324A, 337, 342, 404, 405, 407A, 407F, 408, 410, 410A, 424B, 424C, 430A, 430B, 438, 456, 456B, 462E, 477F, 537A, 542B, 603J, 609, 610, 611B, 611C, 617, 617A, 617B, 617E, 617F, 621B, 623, 623A, 623B, 623C, 623D, 623E, 635, 636A, 642B, 717, 717A, 717B, 717D, 722, 727, 732A, 732H, 803, 1061, 1103, 1104, 1104A, 1105, 1109, 1111, 1112, 1113, 1116, 1117, 1118, 1120, 1124, 1125, 1126, 1132, 1138, 1139, 1140, 1142, 1144, 1144A, 1145, 1146, 1147, 1148, 1149, 1176, 1179, 1200A, 1200S, 1222B, 1227, 1357A, 1359A, 1363, 1363A, 1381, 1382, 1398, 1408B, 1412A, 1418, 1608A, 1618, 1619, 3002, 3005, 3007, 3012, 3052, 3057, 3100, 3109, 3111, 3124, 3141, 3159, 3162, 3175, 3183, 3200, 3201, 3214, 3217, 3219, 3219A, 3220, 3221, 3223, 3226, 3228, 3231, 3242, 3254, 3259A, 3315, 3317, 3326, 3327, 3401, 3402, 3408, 3409, 3409A, 3410, 3617, 3618, 3700A, B-4, B-19, railroad tracks (page E-464), and steam distribution system (page E-465).

1123
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29 HABS CAT III

3 0 HABS Cat II

STORAGE/GARAGE
DATE FROM PERIOD

Enclosure 2

APPENDIX B

Vitae of Project Personnel

PCI BUFFALO • TUSCALOOSA • MEMPHIS • TAMPA

Buffalo Branch Office • 2390 Clinton Street • Buffalo, NY 14227 • (716) 821-1650 • Fax (716) 821-1607

KELLY NOLTE
Architectural Historian

EDUCATION

M.A. Humanities, Old Dominion University, Norfolk, VA, 1989
Emphasis: Architectural History
Thesis: *John Kevan Peebles: Dean of Virginia Architects, 1875-1943*

B.A. Humanities, Cum Laude, University of West Florida, Pensacola, 1976
Emphasis: Architectural History

EXPERIENCE

Ms. Nolte has more than twenty (20) years experience researching and writing about American architecture and architects. Her research on historic structures has been national in scope and has included residences, exhibition buildings, industrial and military structures, religious and public service edifices as well as the architects who built them. Currently Architectural Historian with Panamerican Consultants, Inc. (February 1996-present), Ms. Nolte's duties include acting as Principal Investigator, conducting field work and research, and writing reports related to historic architecture as well as aiding in the development of proposals and budgets for projects. Her other responsibilities include supervision of field crew members, maintenance of field reports and budget management. Ms. Nolte works closely with other departments to develop budgets, plan field expeditions and create new business opportunities. In addition, she maintains working relationships with State Historic Preservation Offices (SHPOs); national, state, and local agencies, advisory groups and commercial organizations; cultural and social groups and individuals. She is well-versed in the Section 106 process, Historic American Building Survey (HABS)/Historic American Engineering Record (HAER) levels and recordation, National Register of Historic Places (NRHP) nomination criteria, and U.S. Department of Defense cultural resource regulations. She is experienced at conducting investigations on large-scale projects such as military installations and highway projects as well as for smaller, individual buildings.

REPRESENTATIVE PANAMERICAN CONSULTANTS, INC. EXPERIENCE

For the Niagara Mohawk Power Corp., Ms. Nolte served as Architectural Historian for a recently completed HAER-level recordation of a nineteenth century former gasholder structure in Saratoga Springs, New York. The investigation was required by the USEPA as part of the design of an environmental remediation project at the site. The investigation included background historical research, field recordation, and photographic documentation.

Currently, Ms. Nolte is serving as Principal Investigator and Architectural Historian for HAER-level recordations of three historic period bridges (Double Bridges, B.B. Comer Bridge, and Montgomery Swing Bridge) for the Alabama Department of Transportation.

She also served as Principal Investigator and Architectural Historian for a HAER-level recordation of the Greenbrook/Lincoln Boulevard/East Main Street Bridge in Somerset and Middlesex Counties, New Jersey. The investigation was conducted for the U.S. Army Corps of Engineers, New York District.

Ms. Nolte served as principal investigator and architectural historian for a Phase 1B cultural resource survey of the Denis Bay Plantation (Archaeological Site Number 12VAm3-71 and NRHP number 81000095), St. John, U.S. Virgin Islands. She co wrote the report.

Ms. Nolte served as principal investigator and architectural historian for the evaluation of 23 bridges and 158 buildings for the Green Brook Flood Control Project in Union, Middlesex and Somerset Counties, New Jersey under contract to the U.S. Army Corps of Engineers, New York District in 1997. In 1998-99 she completed investigations/evaluations for an additional 19 structures in this area.

In 1997 she served as architectural historian and principal investigator for an architectural reevaluation of more than 500 structures at Picatinny Arsenal, Morris County, New Jersey. Three historic districts were recommended for creation. Two reports were prepared for the New York District, USACE. At Picatinny in 1998 Ms. Nolte conducted architectural investigations and National Register evaluations at the Doland House (a nineteenth century civilian residence) and investigations for developing treatment strategies for structures at the former Naval Air Rocket Test Station facility.

Ms. Nolte was the architectural historian during the cultural resources investigations including National Register eligibility assessment of selected buildings at the Fort Hamilton Military Reservation, Brooklyn, NY. The purpose of architectural component of this study was to document Building 117, the reputed home of Robert E. Lee during his assignment at Fort Hamilton. The project included an historical and archival background research combined with a detailed photographic and architectural recordation. Several other historic period buildings also were included in the study for the possible creation of a National Historic District at the fort.

She served as architectural historian for the Cultural Resources Investigations for the Joseph G. Minish Passaic River Waterfront Park and Historic Area, Newark, Essex County, New Jersey. The investigation documented the remains of three historic nineteenth century manufacturing sites along the Passaic River. She co-wrote the report for the New York District, USACE.

Ms. Nolte served as architectural historian for a Phase 1B cultural resources survey of selected sites on Lovango Cay, U.S. Virgin Islands and co-wrote the report.

She served as Principal Investigator and architectural historian for an archaeological Phase I Survey and architectural structures assessment of a factory village in Huntsville, Alabama; co-wrote the report with Matthew Hartzell in March 1996.

As architectural historian and Principal Investigator she conducted an Historic American Buildings Survey of the Taylor-Cook House, Sylacauga, Talladega County, Alabama; co-wrote report with Kristen Zschlomer in 1996.

In 1996, she was architectural historian and Principal Investigator for an *Architectural Assessment of the World War II Military and Civilian Works on and Around Lines 1, 2, 3, 4, and 5 of the Former Redstone Ordnance Plant (1941-1945) Now the Redstone Arsenal Rocket Engine (RARE) Facility, U.S. Army Missile Command, Redstone Arsenal, Madison County, Alabama.*

OTHER EXPERIENCE

Architectural Historian/Cultural Resources Manager, Portsmouth, VA, August 1994- February 1996.

Partner in a Cultural Resources Management group specializing in Phase I, II, and III archaeological and architectural surveys. Performed field work, research, written and photographic recordation, and creation of reports. Accessed and analyzed findings for dispensation recommendations including National Register Nominations and preservation plans. Qualified as a Historian and Architectural Historian under Federal Government Professional Guidelines.

Education Programs Manager, Nauticus, The National Maritime Center, Norfolk, VA, January 1994-1995.

Director of Public Programs, The Virginia Air and Space Center and Hampton Roads History Center, Hampton, VA, November 1992-January 1994.

Public Programs Manager, The Virginia Air and Space Center and Hampton Roads History Center, Hampton, VA, November 1991-November 1992.

Assistant Director, Jamestown Settlement Museum, Williamsburg, VA, May 1986 - October 1991.

Senior Education Officer, The Mariners' Museum, Newport News, VA, January 1986 - May 1986.

Education Officer, The Mariners' Museum, Newport News, VA, January 1984 - January 1986.

Assistant Education Officer, The Mariners' Museum, Newport News, VA, August 1981- December 1983.

Program Director III, Phyllis Wheatley Branch, Peninsula Association, Y.W.C.A., Newport News, VA, August 1980 - August 1981.

Instructor/Research, Museum Bureau, Education Department, Pensacola Preservation Board, Pensacola, FL, January 1975 - October 1977.

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MARK A. STEINBACK
Historian

EDUCATION

M.A. Local and Regional History, State University of New York at Albany, 1987
B.A. History (with Honors), State University of New York at Albany, 1985

EXPERIENCE

Mr. Steinback is currently Historian for Panamerican Consultants, Inc. (PCI) and director of report and proposal production at the Buffalo Branch office (in Depew, New York). He has over ten (10) years experience conducting historic period and archival research and analysis. His experience includes preparing summaries of local ethnohistoric and historic period background and assessing historic period site sensitivities and significance for various cultural resource and archaeological projects. These investigations include preparation of historic period background of project sites; archival, documentary, ethnohistoric, and cartographic research; prehistoric and historic site file analysis; relevant federal and state census and deed research; and preparation of written evaluations for inclusion in archaeological and cultural resources reports.

He is experienced at conducting historical and archival research for large-scale projects including pipeline/corridor projects, military installations, and flood control projects, which often require detailed archival and historical map research, design of research questions as part of field methodologies, and report preparation (including Historic American Engineering Record [HAER]-level documentation). He has more than five (5) years editorial experience and has edited more than twenty (20) cultural resource, archaeological, structural, and environmental assessment reports for both public and private sector clients.

Between 1991 and 1995 Mr. Steinback taught courses in American History and Western Civilization at Schenectady County Community College, Schenectady, New York, as an adjunct history instructor. His early research interests focused on the development and practice of mercantilist theory as it concerned English colonization of North America and the Caribbean. Later research interests involved the industrialization of America from the 1840s through the 1920s with a special focus on socio-cultural history of workers and their responses to industrialization, immigration and urbanization. He is a member of the Organization of American Historians.

REPRESENTATIVE PANAMERICAN CONSULTANTS, INC. EXPERIENCE

For the New York District Corps of Engineers, Mr. Steinback conducted background and archival research and prepared the historic period background for seven (7) projects at the United States Military Academy (USMA) at West Point, Orange County, New York. These projects included five (5) Phase I cultural resource surveys (the proposed Stony Lonesome Child Development Center,

the proposed Stony Lonesome One-Stop Shopping Center [PX], the proposed Cat Hollow Swamp/Beaver Pond Timber Harvest, the proposed Long Pond/ Stillwell Lake Timber Harvest, and the proposed Firebreak 2 Timber Harvest), one Phase II survey (the proposed Stony Lonesome PX), and one Phase III data recovery project (Revolutionary War Hut Site #6).

For the Savannah District Corps of Engineers, he has conducted background and archival research in preparation for the development of a Historical and Archaeological Resources Protection Plan (HARP) for the Beaufort-Marine Corps Air Station, Beaufort, South Carolina. The focus of the research was pre-installation land use activities. In addition, he has conducted archival and documentary research for Phase II investigations at six selected historic period and prehistoric archaeological sites at the U.S. Marine Corps Recruit Depot, Parris Island, South Carolina. He prepared the historic period discussion for these documents.

Since 1996, Mr. Steinback has also conducted historic research and prepared reports involving numerous local (Buffalo-area) projects, including a Phase I cultural resources survey for the Proposed French Road Commons, Town of Cheektowaga, New York for Seneca Creek Development Corp.; Phase IA cultural resources survey for the Main-LaSalle Revitalization Project (GEIS), City of Buffalo, New York for Phenix Environmental, Inc.; a Phase IA/B cultural resource survey for the proposed Images West Subdivision, Town of Greece, Monroe County, New York for LaDieu Associates P.C.; a Phase I cultural resource survey for the proposed Line K realignment in the Town of Orchard Park, Erie County for NEA, Inc. and National Fuel Gas Corporation; a Phase IA cultural resources survey for Woodlawn Beach, Erie County, New York for URS Greiner; a Phase I cultural resource survey for the Marczak Property, Union Road, Cheektowaga, New York; a Phase I cultural resource survey for 437 Tonawanda Street, City of Buffalo for the Blind Association of Western New York; a Phase IA for the Quaker Road Retail Development, East Aurora, New York for Benderson Development Company, Inc.; a Phase IA for the proposed Cayuga Road Sports Complex, Town of Cheektowaga, New York for TVGA Engineering, Surveying, P.C.;a Phase IA for the proposed Ellicott Creek Trailway Extension, Audubon Recreation Area, Town of Amherst, New York for URS Greiner Woodward Clyde; a Phase I for the proposed waterline construction for the Town of Newstead Water District #5, Erie County, New York for Wendel Design; and two Phase IA for the Chautauqua County Department of Public Facilities (the proposed Chadakoin Riverfront Park and Waterway Trail, Town of Ellicott and the proposed property acquisition adjacent to the Chautauqua County Airport, Town of Ellicott).

For the New York District Corps of Engineers, Mr. Steinback conducted background research and prepared the historic period and environmental background sections for the archaeological and historic structures investigation of selected sites within the Fort Hamilton Military Reservation, Fort Hamilton, Brooklyn, New York. He was also principal historian for cultural resource investigations of the Morris Canal Right-of-Way for the Joseph G. Minish Passaic River Waterfront Park and Historic Area, Newark, New Jersey, under subcontract to Northern Ecological Associates, Inc.

For the New York District, USACE, Mr. Steinback has conducted research and written historic period background sections for the Phase I survey at the airfield area at Seneca Army Depot Activities, Romulus, New York, and for the Phase I survey of the Upper Basin of the Green Brook Flood Control Project, Union and Somerset Counties, New Jersey, and its addendum for the Stony Brook Sub-Basin. He also edited the final report for each of the above mentioned projects.

For the Jacksonville District, USACE, Mr. Steinback edited the report for cultural resource survey of the Río Ojo de Agua flood protection project in the Municipio of Aguadilla, Puerto Rico, and the report for the cultural resource survey of the Río Loco flood protection project in the Municipio of Guánica, Puerto Rico.

For the New York District Corps of Engineers, Mr. Steinback prepared historic period overviews and compiled environmental and relevant background information for inclusion in integrated cultural resource management plans (ICRMPs) for Watervliet Arsenal, Albany County, New York, the Rotterdam Housing Areas (of Watervliet Arsenal), Schenectady County, New York, Fort Hamilton, Brooklyn, New York, and Picatinny Arsenal, Dover, New Jersey.

For the New York District, USACE, he prepared the historic period overview for an evaluation of 23 bridges and 158 flood proofing/buy out structures for the Green Brook Flood Control Project, Middlesex, Union, and Somerset Counties, New Jersey.

In 1995 Mr. Steinback conducted archival and background research and prepared the historic period overview section of the report for the Phase I archaeological investigation at Griffiss Air Force Base, Rome, New York for Tetra Tech, Inc. In 1996, he conducted archival research and prepared the site-specific historic discussion section for the Phase II archaeological investigation of 20 sites at Griffiss Air Force Base. He also edited the draft and final reports of the Phase II. In 1997, he prepared the site-specific historic discussion for the Phase II investigation at PCI Site 3 at Griffiss Air Force Base and edited the draft report.

In 1996, Mr. Steinback co-authored the *Research Design: Phase I Cultural Resources Survey of Civil War and Postbellum Sites (1862-1892)* for U.S. Marine Corps Recruit Depot at Parris Island, South Carolina for Savannah District Corps of Engineers. In 1997, he conducted additional archival and background research and prepared the historic period write-up for Phase II archaeological investigations of six (6) sites at the Marine Corps Recruit Depot at Parris Island and for the historical and archaeological resources protection plan for the Marine Corps Air Station, Beaufort, South Carolina.

In 1997, Mr. Steinback conducted archival research and prepared the historic discussion for the Phase II cultural resources site mitigation for the Proposed One-Stop Shopping Center (PX) at the USMA, West Point, New York, for the Phase III archaeological mitigation of Revolutionary War Hut #6 (USMA-81) at the USMA, and for the Phase I cultural resource investigation for the Long Pond-Stillwell Lake Timber Harvest at the USMA. He prepared the historic period background sections for an architectural study of bridges and flood proofing/buy-out structures for the Green Brook Flood Control Project, Middlesex, Union, and Somerset Counties, New Jersey, and for an architectural assessment of structures and potential historic districts at Picatinny Arsenal, Dover, New Jersey.

In 1998, Mr. Steinback conducted archival research and prepared the historic discussion for the Phase I cultural resources investigation for the Proposed Firebreak 2 Timber Harvest at the USMA, West Point, New York. He conducted documentary research and prepared a written historical context for the draft environmental impact statement for the proposed renovation of the Arvin Physical Development Center at the USMA, and for the Phase I cultural resource investigation for the Long Pond-Stillwell Lake Timber Harvest at the USMA.