DETERMINATION OF ELIGIBILITY OF 318 BUILDINGS AND STRUCTURES FOR INCLUSION ON THE NATIONAL REGISTER OF HISTORIC PLACES

PICATINNY ARSENAL, ROCKAWAY TOWNSHIP, MORRIS COUNTY, NEW JERSEY

FINAL

November 2007

Prepared for:

CULTURAL RESOURCES MANAGER
U.S. ARMY
PICATINNY ARSENAL, NEW JERSEY 07806

Under a Cooperative Agreement with:

U.S. ARMY MEDICAL RESEARCH ACQUISITION ACTIVITY
FORT DETRICK, MARYLAND

Award # DAMD17-00-2-0006, Work Order #2007-22

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Buffalo, New York 14227-1735

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Management Summary

Project Name. Determination of Eligibility of 318 Buildings and Structures for Inclusion on the National Register of Historic Places, Picatinny Arsenal, Rockaway Township, Morris County, New Jersey

Project Location and Environmental Setting. Picatinny (PICA) is located on a 6,500-acre site in the Rockaway and Jefferson Townships, Morris County, New Jersey. Situated within the Green Pond Brook valley, PICA is flanked by uplands to the west and east. Rocky outcrops, steep slopes, and stony soils are characteristic of the region.

Purpose and Goals. Panamerican Consultants, Inc (PCI) was contracted by Picatinny Arsenal under a cooperative agreement with the U.S. Army Medical Research Acquisition Activity to evaluate 318 buildings and structures at PICA for eligibility for listing in the National Register of Historic Places (NRHP). PICA has proposed a number of construction activities (e.g., renovations and demolitions) that may affect these structures, in addition to other mission-specific activities. In order to meet its cultural resources obligations as delineated by numerous federal statues and regulations, PICA requested determinations of NRHP eligibility for all buildings that would be potentially affected.

The U.S. Army, as a federal agency, has management responsibilities concerning the protection and preservation of cultural resources on land it controls or uses. Federal statutes require the Army to identify and evaluate significant cultural resources on these properties, and include: National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et. seq.) through 2000 (which includes Section 106 compliance); National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4371 et. seq.); Historic Preservation Act of 1974 (16 U.S.C. 469-469c); the Advisory Council on Historic Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800); as well as Army Regulation (AR) 200-4 “Cultural Resources Management.”

Cultural Resources Work Completed. Panamerican conducted background and historical research, which included a thorough review of existing cultural resources studies of PICA, local histories, historical maps, real property records, blueprints, and regional/state histories. In addition, a careful review of NRHP criteria, especially those areas dealing with Criteria Consideration G, exceptional importance was completed. In late 1990s, the U.S. Army Materiel Command (AMC) (Picatinny Arsenal is an AMC installation) issued a series of studies and guidelines (e.g., Gaither 1997; USACE, Fort Worth 1997) intended to help guide the process for NRHP eligibility determination of Army buildings and structures as they relate to the Cold War (1946-1989). These sources were carefully reviewed for application to this particular project.

A total of 318 buildings and structures within Picatinny were surveyed, photographed and evaluated. The buildings/structures surveyed were constructed primarily between World War II and the middle of the Cold War. By and large these buildings tended to be small, isolated, or “lost” structures that had escaped previous surveys but still appeared on various Real Property lists. Of the 318 surveyed, 109 have been demolished or are deteriorated to the point that they are no longer standing leaving 209 total buildings. Of the 209 standing buildings and structures, 29 are family housing, which have been privatized as part of the Residential Communities Initiative (RCI). Family housing within the DoD are now owned by private organizations that are responsible for overseeing all aspects of housing, including the maintenance of historic buildings.

Buildings and structures surveyed, photographed and evaluated included:

67, 68, 70, 71, 72, 73, 80, 81, 83, 92, 92A, 94, 97, 121B, 178, 179, 215, 215A, 221A, 224, 225, 231, 232A, 232F, 234, 236, 237, 238, 240A, 242C, 247, 283D, 295, 296, 302F, 305, 314B, 317E, 320, 403A, 407B, 427A, 429A, 436, 452, 454B, 471, 471A, 471B, 472, 476, 477E, 501, 506B, 524, 540, 566, 567, 584, 602C, 603, 603E, 603F, 604H, 606, 606A, 606B, 612, 614, 615, 616, 619, 621A, 622, 623F, 625F, 627, 630, 631, 632, 633, 634, 636, 636B, 637, 637A, 642, 642A, 643, 644, 645, 645A, 646, 647, 649, 650, 651, 652, 652B, 653, 654, 655, 657, 658, 659, 670, 671, 672, 673, 717C, 717G, 717I, 717J, 717L, 732E, 800, 807B, 807C, 809, 810A, 813A, 813D, 816A, 816B, 816C, 816D, 820A, 822, 823, 824A, 825, 900, 902, 903, 926, 1033A, 1036B, 1037, 1038, 1052A, 1071C, 1071G, 1090, 1096, 1101, 1101B, 1102, 1109A, 1114, 1136, 1141, 1178, 1179C, 1179D, 1181, 1182, 1186, 1187, 1201, 1219, 1221, 1222, 1222A, 1227A, 1240, 1242A, 1304, 1308, 1309, 1310, 1350, 1352, 1355, 1366, 1368, 1369, 1370, 1370A, 1374, 1375, 1380, 1381A, 1382A, 1392, 1392A, 1393, 1393A, 1398A, 1501, 1502, 1503, 1504, 1504A, 1505, 1505N, 1505J, 1505K, 1506, 1507, 1507B, 1508, 1509, 1510, 1510A, 1510B, 1511, 1512, 1512A, 1512B, 1513, 1514, 1515, 1517, 1517A, 1518, 1519, 1520, 1521, 1522, 1528, 1529, 1609A, 1615, 3011, 3023, 3024B, 3054, 3056, 3058, 3100B, 3104A, 3104B, 3104C, 3104D, 3106A, 3109, 3117, 3119, 3144, 3145, 3145A, 3151, 3205, 3206, 3207A, 3207B, 3207C, 3207D, 3209A, 3209B, 3209C, 3209D, 3209E, 3210, 3211A, 3211B, 3211C, 3219, 3225A, 3227, 3227B, 3227C, 3227D, 3229, 3232A, 3232B, 3232C, 3232D, 3232E, 3232F, 3233A, 3233B, 3233C, 3233D, 3233E, 3234, 3237, 3237A, 3237B, 3238, 3239, 3240, 3241, 3243, 3249K, 3251, 3253, 3256, 3257, 3258, 3259, 3260, 3261, 3262, 3263, 3264, 3265, 3403, 3404, 3504, 3531, 3939, 3700.

Survey Results. A total of 318 buildings and structures were surveyed, photographed and evaluated. In order to best discuss these buildings/structures, the architectural discussion has been divided into six sections: Industrial/Factory Complexes, Testing Associated with Manufacturing and Quality Assurance, Ammunition and Explosives/General Storage, Infrastructure, Base Operations, and Housing. All 209 of the standing assessed buildings and structures were subsumed into one of these six broad categories.

Only one category, Testing Associated with Manufacturing and Quality Assurance had any NRHP eligible properties. The Rocket Test Area Historic District (Area 1500) was recommended as eligible under Criterion Consideration G and Criteria A and C. The recommended district located off Lake Denmark Road is made up of 34 contributing buildings and 7 non-contributing buildings.

Within the Base Operations category no buildings, structures or landscapes were determined eligible for the NRHP. However, the Golf Course and its other attendant buildings have never been evaluated. Panamerican recommends that the Golf Course and its buildings undergo an NRHP evaluation before anymore Golf Course related buildings are reviewed independent of the landscape for their NRHP status.

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1.0 Introduction

Panamerican Consultants, Inc (Panamerican/PCI) was contracted by Picatinny Arsenal (PICA) under a cooperative agreement with the U.S. Army Medical Research Acquisition Activity to evaluate for eligibility for listing in the National Register of Historic Places (NRHP) 318 buildings and structures at Picatinny, New Jersey. Picatinny (PICA) is located on a 6,500-acre site in Rockaway and Jefferson townships, Morris County, New Jersey (Figure 1-1). PICA has proposed a number of construction activities (e.g., renovations and demolitions) that may affect these structures, in addition to other mission-specific activities. In order to meet its cultural resources obligations as delineated by numerous federal statues and regulations, PICA requested determinations of NRHP eligibility for all buildings that would be potentially affected.

The U.S. Army, as a federal agency, has management responsibilities concerning the protection and preservation of cultural resources on land it controls or uses. Federal statutes require the Army to identify and evaluate significant cultural resources on these properties, and include: National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et. seq.*) through 2000 (which includes Section 106 compliance); National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4371 *et. seq.*); Historic Preservation Act of 1974 (16 U.S.C. 469-469c); the Advisory Council on Historic Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800); as well as Army Regulation (AR) 200-4 “Cultural Resources Management.”

The methods employed were two-fold: background/documentary historical research and in-field evaluation. Background and historical research included a thorough review of existing studies of Picatinny, local histories, historical maps, real property records, blueprints, and regional/state histories. In addition, a careful review of NRHP criteria, especially those examples and selections dealing with Criteria Consideration G, exceptional importance, was completed (Sherfy and Luce 1998). In late 1990s, the U.S. Army Materiel Command (AMC) of which Picatinny is included, issued a series of studies and guidelines (Gaither 1997; USACE, Fort Worth 1997) intended to help guide the process for NRHP-eligibility determination of Army buildings and structures as they relate to the Cold War (1946-1989). These references were carefully reviewed for application to this particular project.

Ms. Kelly Nolte, M.A., Panamerican Vice President and Senior Architectural Historian, Ms. Christine M. Longiaru, M.A., Panamerican Senior Architectural Historian, and Ms. Kelly M. Mahar, M.H.P., Panamerican Architectural Historian, conducted field investigations at PICA from April 16 to May 4, 2007. Ms. Nolte was the principal author and was assisted by Ms. Mahar. Panamerican Senior Historian Mr. Mark A. Steinback prepared the historical background research on the installation and the Cold War context and edited the report. During the field investigation, a total of 318 buildings and structures were surveyed, photographed and evaluated.

The buildings and structures initially enumerated in the Scope-of-Work (Appendix A) was not the complete list of structures surveyed by Panamerican. This list included a number of buildings that had already been surveyed, were known to have been demolished, and/or were no longer of interest as related to planning and other installation activities. As a result, PICA amended the list after Panamerican had begun its field investigation, with Panamerican’s consent. The original SOW also called for the survey of the interior of a number of quarters and compilation of defining architectural features. These requirements were dropped since all quarters have been privatized as part of the Residential Communities Initiative (RCI) and are no longer owned by the Department of Defense (DoD). The current owner of the properties, Gary

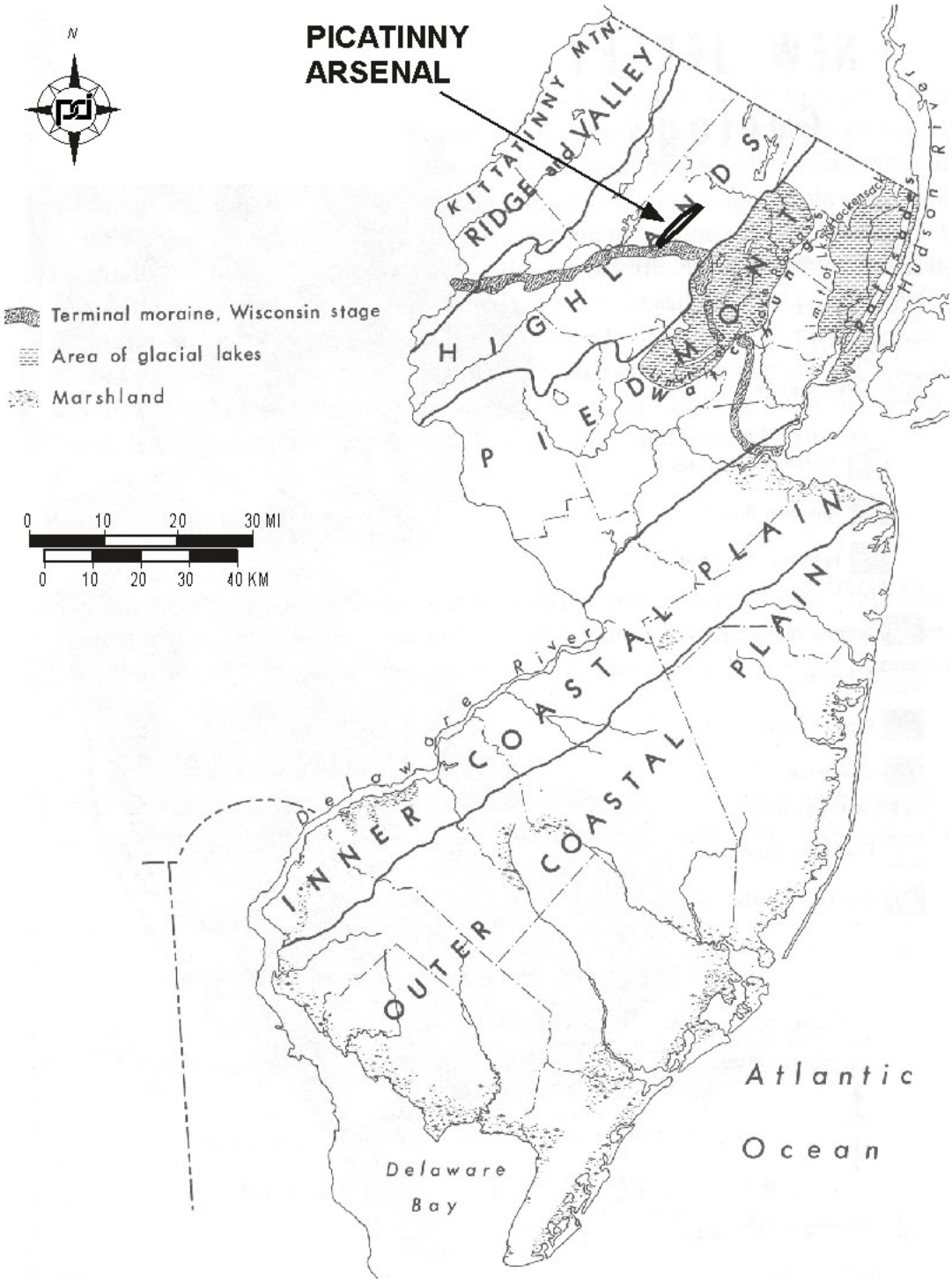

Figure 1.1. Location of Picatinny Arsenal, Morris County, within the physiographic provinces of New Jersey *(adapted from Stansfield 1998: Figure 2.1).*

Michael Holloway (GMH), is responsible for maintaining the historical integrity of any historically significant properties.

Panamerican surveyed, photographed and evaluated a total of 318 buildings and structures within Picatinny (Appendix B). These buildings and structures are listed below:

> 58A, 67, 68, 70, 71, 72, 73, 80, 81, 83, 92, 92A, 94, 97, 121B, 178, 179, 209, 210, 210E, 215, 215A, 221A, 224, 225, 231, 232A, 232F, 234, 236, 237, 238, 240A, 242C, 247, 283D, 295, 296, 302F, 305, 314B, 317E, 320, 403A, 407B, 427A, 429A, 436, 452, 454B, 471, 471A, 471B, 472, 476, 477E, 501, 506B, 524, 540, 566, 567, 584, 602C, 603, 603E, 603F, 604H, 606, 606A, 606B, 612, 614, 615, 616, 619, 621A, 622, 623F, 625F, 627, 630, 631, 632, 633, 634, 636, 636B, 637, 637A, 642, 642A, 643, 644, 645, 645A, 646, 647, 649, 650, 651, 652, 652A, 652B, 653, 654, 655, 657, 658, 659, 670, 671, 672, 673, 717C, 717G, 717I, 717J, 717L, 732E, 800, 807B, 807C, 808, 809, 810, 810A, 813A, 813D, 816A, 816B, 816C, 816D, 820, 820A, 822, 823, 824A, 825, 900, 902, 903, 926, 1033A, 1036B, 1037, 1038, 1052A, 1071C, 1071G, 1090, 1096, 1101, 1101B, 1102, 1109A, 1114, 1136, 1140A, 1141, 1178, 1179C, 1179D, 1181, 1182, 1186, 1187, 1201, 1219, 1221, 1222, 1222A, 1227A, 1240, 1242A, 1304, 1308, 1309, 1310, 1350, 1352, 1355, 1366, 1368, 1369, 1370, 1370A, 1374, 1375, 1380, 1381A, 1382A, 1392, 1392A, 1393, 1393A, 1398A, 1406A, 1410, 1501, 1502, 1503, 1504, 1504A, 1505, 1505A, 1505B, 1505C, 1505D, 1505E, 1505F, 1505N, 1505J, 1505K, 1506, 1507, 1507B, 1508, 1509, 1510, 1510A, 1510B, 1510D, 1511, 1512, 1512A, 1513, 1514, 1515, 1517, 1517A, 1518, 1519, 1520, 1521, 1522, 1527, 1528, 1529, 1609A, 1615, 3011, 3023, 3024B, 3054, 3056, 3058, 3100B, 3104A, 3104B, 3104C, 3104D, 3106A, 3109, 3117, 3144, 3145, 3145A, 3151, 3205, 3206, 3207A, 3207B, 3207C, 3207D, 3209A, 3209B, 3209C, 3209D, 3209E, 3210, 3211A, 3211B, 3211C, 3215, 3219, 3225A, 3227, 3227B, 3227C, 3227D, 3229, 3232A, 3232B, 3232C, 3232D, 3232E, 3232F, 3233A, 3233B, 3233C, 3233D, 3233E, 3234, 3237, 3237A, 3237B, 3238, 3243, 3249K, 3251, 3253, 3256, 3257, 3258, 3259, 3260, 3261, 3262, 3263, 3264, 3265, 3403, 3404, 3504, 3531, 3939, 3700 (see Appendix B).

The buildings/structures surveyed were constructed primarily between World War II and the middle of the Cold War. By and large these buildings tended to be small, isolated, or “lost” structures that had escaped previous surveys but were still appearing on various Real Property lists. Of the 318 structures surveyed, 109 have been demolished or have deteriorated to the point that they are no longer standing, leaving 209 total buildings. Of the 209 standing buildings and structures, 29 of the surveyed buildings are family housing and are no longer property of the Army.

In order to facilitate the discussion of these buildings/structures, the architectural discussion has been divided into six sections: Industrial/Factory Complexes, Testing Associated with Manufacturing and Quality Assurance, Ammunition and Explosives/General Storage, Infrastructure, Base Operations, and Housing. All 209 of the assessed buildings and structures can be subsumed into one of these six broad categories. All buildings/structures were visually inspected and photographed and are detailed in tabular form in Appendix B.

Most of the buildings and structures surveyed are located in areas that Panamerican has previously surveyed or are of a type discussed in earlier reports for which Panamerican as already created historic contexts. Per prior agreement, these contexts are included in this

report. In addition, several of the buildings covered in this survey were previously included as part of Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) documentations that were completed in 1983 (Thurber and Norman). The HAER report that focused on that actual industrial complex and created a context for it was also used.

Picatinny contains four historic districts that have been ruled eligible for inclusion in the National Register of Historic Places: The Administration and Research District; the 600 Ordnance Testing District; the Test Area E, Naval Air Rocket Test Station (NARTS); and NARTS Area D (Guzzo 1999, 2004a). The Navy Commanders Quarters (Building 3250) and its accompanying stable (Building 3316, now a firehouse) also are eligible for the NRHP (Guzzo 1999). In addition, PICA treats the Cannon Gates as NRHP eligible. Three of the properties surveyed are located in two of the historic districts. Building 621A, Ammunition Testing Facility, and Building 623F, Valve House, both found off 20th Avenue, are within the 600 Ordnance Testing District. Both buildings are non-contributing elements to that district. Building 178, Chemistry Laboratory, situated off Kibler Road, is within the Administrative and Research District, and is a non-contributing element to that district.

Aside from surveying, photographing and evaluating the buildings and structures, PCI also interviewed Mr. Jack Lyons, Realty Specialist, PICA; Dr. Patrick Owens, U.S. Army Armament Research, Development, and Engineering Center (ARDEC) Archivist, PICA; Mr. Ken Klingaman, Engineer, 1500 Area, PICA. All of these individuals provided Panamerican with important information, photographs, articles and monographs about the buildings/structures, their history and current status.

2.0 Methodology

The methods utilized to conduct the investigation include both background and documentary research and field evaluation of the buildings and structures. Background and historical research included a thorough review of cultural resource management documents concerning PICA, local histories, historical maps, real property records, blueprints, and regional/state histories. Further, NRHP criteria, especially those examples and selections dealing with Criteria Consideration G (exceptional importance) were consulted. AMC-specific contexts and guidance (Gaither 1997; USACE, Fort Worth 1997) intended to clarify NRHP-eligibility issues for Army buildings and structures as they relate to the Cold War (1946-1989) were carefully reviewed for application to this particular project.

2.1 DOCUMENTARY RESEARCH (STRUCTURES)

Numerous Department of Defense (DoD) and U.S. Army documents were consulted relating to general and specific building types, their occurrences within the greater military community, and their role in military or architectural history. A number of architectural, archaeological and historical documents concerning the areas within what are now the boundaries of Picatinny were utilized, as well. Previous architectural studies about PICA divided the structures into use areas, interrelated individual buildings, and structures constructed to accomplish a specific mission. This methodology is a standard practice and one advocated in the current literature on historic structures of the AMC, PICA'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 an industrial or production line are missing, then the smaller structures become unimportant as a result of the loss of integrity. This distinction is also true for such industrial settings as mining operations (Noble and Spude 1992; see also Nolte 1998).

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 were 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, also must be inspected.

The DoD and the various military services have endeavored to give historical context to a wide range of building types as well as providing a context and architectural evaluations for these buildings. In some cases, the DoD in conjunction with the Advisory Council on Historic Preservation (ACHP) and the National Conference of State Historic Preservation Officers (NCSHPO) 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; Kuranda et al. 1995; Grashof 1986; Kriv 1992; Walsh 1995).

Another factor to consider in evaluating the eligibility of military buildings is the types of materials used. During most of the construction history of the various branches of the military, the services have distinguished two and sometimes 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 material used in its construction. The distinction between construction techniques is vital to understanding a building's potential NRHP status.

Since immediate use context alone was insufficient to determine the eligibility of some structures, PICA buildings were placed in individual categories by family type (e.g., storehouses, quarters, laboratories) and by construction materials. Additional research was 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 PICA'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* (Garner 1993) and *Support and Utility Structures and Facilities (1917-1946) Overview, Inventory and Treatment Plan* (Kuranda et al. 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 World War II structures 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 required the demolition of World War II-era temporary buildings on DoD installations. In 1986, the DoD entered into a Memorandum of Agreement (MOA) with the ACHP and NCSHPO to document World War II temporary buildings on U.S. military bases in preparation for implementing the construction bill. The resulting report (Garner 1993) served as partial fulfillment of the requirements of the NHPA, Section 106.

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

A "temporary" building during this period was described as being constructed with a wooden frame with any number of wall coverings. It was then-estimated that a temporary building would have a lifespan of five years. While this statement serves as 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 Arsenal 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 PICA, were built as temporary structures.

Support and Utility Structures and Facilities (Kuranda et al. 1995). In compliance with the NHPA, as well as other federal cultural resources laws and regulations, the 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, Kuranda et al. (1995) developed a mechanism for the classification, evaluation and treatment of support and utility buildings. The report provided: 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 support and utility structures then in existence; 4) a methodology for evaluating the significance of these facilities; and 5) recommended treatment plans for these properties.

As discussed in the monograph, the structures were 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 were, of course, a number of sub-types within each of these categories and these were covered within the larger context.

In addition to the two documents discussed previously, other important reports consulted to determine NRHP eligibility included: *A Study of United States Army Family Housing Standardized Plans, 1866-1940,* volumes one through six (Grashof 1986); *World War II and the U.S. Army Mobilization Program* (Kriv 1992); and *World War II Ordnance Department's Government-Owned Contractor-Operated (GOCO) Industrial Facilities: Ravenna Ordnance Plant Historic Investigation* (Walsh 1995).

Since many military Cold War buildings and structures are now 50 years of age or older, the U.S. Army, particularly AMC, has begun to issue guidelines and contexts for use by cultural resources offices in determining NRHP eligibility of these structures. *Cold War Property Identification, Evaluation and Management Guidelines* (USACE, Fort Worth 1997) was created to establish a standard for evaluating Army Cold War properties for eligibility to the NRHP; to assist Army personnel in identification, evaluation, and management of Cold War properties that are historic; and to provide a source of information and reference material for use in coordination with State Historic Preservation Offices (SHPO) regarding Cold War properties. This document is a step-by-step guide to determining Cold War NRHP eligibility.

Moreover, AMC has produced a Cold War context, *Looking Between Trinity and the Wall* (Gaither 1997), which analyzes AMC's material culture through an investigation of research and development, testing, and industrial production programs with specific examples of notable buildings and structures discussed in terms of their place and significance in the history of the Army and the nation, the evolution of technology, and the development of architecture and engineering design (Gaither 1997:iii). Picatinny is specifically discussed in great detail within this document, and it is, therefore, an important source of information about PICA's role in the conduct of the Cold War.

Aside from the various DoD and Army reports a significant number of PICA architectural studies have been performed and these reports aided in identifying important structures and significant industrial and research use areas. At least thirteen significant architectural studies (Ashby et al. 1984; Fitch and Glover 1990; Harrell 1993, 1994; Nolte 1998; Nolte et al. 1999a, 1999b, 1999c; Nolte and Steinback 2004a, 2004b; Thurber and Norman 1983; U.S. Department of the Army nd) have been completed on Picatinny in the past 20 years.

A HABS/HAER Level IV was completed on more than 800 structures that were 50 years of age or older. (Many have since been demolished due to excessive contamination.) This survey (Ashby et al. 1984) and the resulting report (Thurber and Norman 1983) were part of a pilot project undertaken by the U.S. Army Materiel 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 in use, 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 were:

> Category I: Historic properties of great significance that contribute to the national cultural heritage of that installation and its environs, and that should be preserved if at all possible. All Category I historic properties not currently listed on or nominated to the NRHP 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 HABS.
>
> Category II: Historic properties of importance that contribute significantly to the cultural heritage or visual continuity (harmony) and interest of the installation and its environs, and that should be preserved if possible. Category II properties should be treated as if they were on the NRHP and nominated if they are not. These properties should be documented at Level II in accordance with the HABS.
>
> Category III: Historic properties of value that contribute to the cultural heritage or visual harmony and interest of the installation and its environs, and that 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 HABS.
>
> Category IV: Any property that has been inventoried but does not qualify in one of the above categories at the time of the inventory. 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, a HAER was completed for Picatinny Arsenal that provided additional detail to document 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 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 Component 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 Loading; 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 Department of the Interior.

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

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, laboratories, industrial facilities, warehouses, support and utilities structures and one building from the now defunct Navy rocket program. Detailed accounts of the blueprints surveyed appeared for each of the structures. No architects' names were mentioned and the source of creation of the blueprint was not listed. This report recommended that all of the historic structures on PICA be surveyed so that future catalogs could include all components of an industrial line and patterns of construction and modernization could be defined.

WCH Industries and Boston Affiliates, Inc., prepared such a report a year later (Harrell 1994). A total of 527 structures, all of which were 50 years old 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 expressed in the document 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 that occupy most of the installation were simply folded into one large district, which made most of the arsenal's early structures eligible for the NRHP as contributing elements to a single district. This report did not place PICA'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, and Panamerican was asked to reevaluate the 500 structures previously recommended as eligible.

Contracted in response, Panamerican completed three reports: *Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey* (Nolte et al. 1999a), *Definition of Historic Districts for Picatinny Arsenal, Morris County, New Jersey* (Nolte et al. 1999b), 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* (Nolte 1998). These reports recommended that 51 buildings and structures were eligible for the NRHP as contributing elements to three historic districts (Administration and Research District, 600 Ordnance Test District, and the Naval Air Rocket Test Station [NARTS], Test Area E District), and two buildings (3250 and 3316) as being individually eligible. The New Jersey Historic Preservation Office (HPO) concurred with these recommendations (Guzzo 1999). PICA also treats the Cannon Gates as NRHP eligible.

Panamerican later completed an Integrated Cultural Resources Management Plan (ICRMP) for the installation (Schieppati and Steinback 2001), and has completed a NRHP determination of eligibility for the Rocket Powder Propellant Plant (1400 Area), the Detonation Facility (1600 Area, "Little Picatinny"), and the NARTS, Area D (which is NRHP eligible) as well as the Haleite/HE Plant (1000 Area), the Nitroglycerine Plant (1300 Area), Pyrotechnic Testing Facility (640 Area), and the Ammunition Testing Facilities (630 Area) (Nolte and Steinback 2004a, 2004b). Data gathered during those investigations were reviewed as well. Much of the work generated for the later two reports was used in this report.

2.2 CRITERIA USED FOR EVALUATION

During the architectural survey at Picatinny, all buildings were evaluated 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 to structures at PICA 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, PICA is required under Section 106 of the 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, an 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).

The Department of the Interior also provides specific information about the evaluation of landscapes in *How to Evaluate and Nominate Designed Historic Landscapes, National Register Bulletin 18* (Keller and Keller 1998) and *Guidelines for Evaluating and Documenting Rural Historic Landscapes*, *National Register Bulletin 30* (McClelland et al. 1999). The NRHP defines a designed landscape as any of the following:

> A. A landscape that has significance as a design or work of art.
> B. A landscape consciously designed and laid out by a master gardener, landscape architect, architect, or horticulturalist to a design principle, or an owner or other amateur using a recognized style or tradition in response or reaction to recognized style or tradition.
> C. A landscape having a historical association with a significant person, trend, event, etc., in landscape gardening or landscape architecture: or
> D. A landscape having a significant relationship to the theory or practice of landscape architecture [Keller and Keller 1998:2].

Many historic landscapes are NRHP eligible based primarily on their design merits; however, a substantial number of others also possess significance in other areas such as social history (Keller and Keller 1998:2). A property may meet the NRHP criteria but if it does not have integrity, it cannot be eligible. The specific features that a designed historic landscape must retain to have integrity differ for various landscape types. Such features may include, but are not limited to: spatial relationships, vegetation, original property boundary, topography/grading, site furnishing, design intent, architectural features, and circulation system. Although a landscape may not retain all of the characteristic features that it had during its period/s of significance, it must retain enough or have been restored enough of the essential features to make its historic character clearly recognizable. The clearest definition of integrity related to landscape is the presence of identifiable components of the original design (Keller and Keller 1998:8).

Military installations include some of the most historically significant properties in the American cultural landscape and, as with any landscape, the military landscape reflects the history and cultural traditions within which it has evolved (Loechl et al. 1996:3). In an effort to develop guidance applicable to the military landscape, the U.S. Army Corps of Engineers Construction Engineering Research Laboratory (USACERL) developed *Army Guidelines for Identifying and Evaluating Historic Military Landscapes: An Integrated Landscape Approach* (Loechl et al. 1996) to evaluate significance and integrity and assist in determining eligibility and boundaries of historic military landscapes. The guidelines are designed to be used in conjunction with National Register Bulletins 15 (U.S. Department of Interior 1995), 18 (Keller and Keller 1998), 30 McClelland et al. 1999), and 40 (Andrus 1999) as well as additional bulletins and materials addressing specific property types and issues providing a systematic evaluation.

Using the landscape approach to research historic and cultural resources provides a framework for understanding the relationships among history, architecture, landscape architecture, planning, and archaeology (Loechl et al. 1996:3). The USACERL document presents a systematic evaluation process with which to assess the unique development and historical contexts of military installations, emphasizing the importance of the relationships among the

individual buildings, structures, and grounds that contribute to an historic military landscape (Loechl et al. 1996:3). The document defines the historic military landscape as:

> a military landscape that is significantly associated with historically important persons or events, or is an important indicator of the broad patterns of history, or represents a significant example of design or construction. For the purposes of the National Register, a historic military landscape is a category of property eligible for listing on the National Register of Historic Places as a historic site or district. To be eligible for nomination to the Register, a historic military landscape must have sufficient integrity to convey its significance [Loechl et al. 1996:8].

The guidelines further describe different contexts and characteristics with which to interpret and understand the military landscape helpful in making a determination of historical significance and associations. Using this overall landscape approach provides a framework for recognizing the different stages of development of military installations and the relationships among historical trends, military missions, installation types, and landscape appearance (Loechl et al. 1996:19).

Criteria Consideration G, Exceptional Importance. Several buildings/structures and/or complexes at PICA were less than 50 years of age at the time of their evaluation as part of this investigation. Properties generally are required to have attained at least 50 years of age before they are considered for eligibility for listing to the NRHP. Properties that have achieved significance within the last 50 years, however, may be listed on the National Register only if they are of "exceptional importance" (U.S. Department of the Interior 1995; see also Sherfy and Luce 1998). Therefore, Criteria Consideration G must be applied to consider properties less than 50 years old. Because the NRHP intentionally left the word "exceptional" without a clear definition, the determination of exceptional importance is open for interpretation. The Army, in an attempt to assist its cultural resources managers and post commanders, has established a set of steps and tests to help assess possible exceptional properties in the Army Cold War guidelines (USACE, Fort Worth 1997). These guidelines are quite rigorous, but must be used without legalistic thinking. As the guidelines point out, "[a] property does not suddenly become historic on its fiftieth anniversary, having no historical significance the day before. Fifty is not a magic number, but an arbitrary designation…" (USACE, Fort Worth 1997:37).

According to the guidelines, the determination of exceptional importance can be made only after a resource has been shown to be important to one or more Army Cold War themes. These themes, in broad terms, are: Balance of Power; Ideological Confrontation; Technological Imperative; and Survival and Preparation for a Hot War. Specific Army themes include: Mission Focus; Survival; Technology; Militarization of Space; Extraordinary Measures; and Secrecy. The more direct the relationship of the building to one of these themes, the more likely it is to meet the exceptional criteria. In addition, an Army property must undergo five tests, with each test building on its predecessor in complexity, to determine its significance (USACE, Fort Worth 1997). However, properties that are within five years of attaining the 50-year mark should be evaluated under normal NRHP criteria, not just the exceptional rule (USACE, Fort Worth 1997).

Cold War Guidance. The U.S. Army Cold War guidelines (USACE, Fort Worth 1997) generally divide Cold War properties into two categories: Cold War property and Cold War-era property. Below are a list of Army definitions that are basic to the Cold War assessment and evaluation of the selected buildings/structures at PICA.

Cold War. The Army Cold War guidelines define the Cold War as:

The prolonged ideological, economic, military and political competition, tension, conflict short of actual war between the U.S. and the Soviet Union from 1946-1989. The Cold War was marked by the effects of the policies of the two superpowers:

- the reliance on high technology for national security, culminating in the possession of nuclear weapons for strategic and political value;
- the establishment spheres of interest and alliances with other nations;
- the division of Europe into two military alliances, the North Atlantic Treaty Organization (NATO) and the Warsaw Pact;
- the formation of military-industrial complexes, a complex union of the military, universities and industry formed to provide the technological edge deemed necessary for national security;
- attempts to start or prevent revolution in smaller third world nations; and
- less-than-total confrontations between the superpowers such as the Berlin Blockade of 1948-49 and the Cuban missile crisis of 1962 [USACE, Fort Worth 1997:2].

Cold War-Era Property. The Army Cold War guidelines define a Cold War-era property as an Army property that existed during the Cold War period (1946-1989), but is not considered a Cold War property.

Cold War era properties do not reflect through design or association, [sic] the US/Soviet relationship in a direct manner. BASEOPS [i.e., base operations] buildings such as administration, power houses, swimming pools, barracks, etc. are Cold War era properties. They are not considered a direct response to the Soviet threat, but were needed to maintain a standing army for any military mission, regardless of the adversary. Cold War era properties are not exceptional for their Cold War associations unless they contain essential elements that would qualify it as a Cold War property [USACE, Fort Worth 1997:2].

Cold War Property. The Army Cold War guidelines define a Cold War property as follows:

Through the physical design or association with people or events, a property that embodies the mistrust of the Soviet Union and in contrast, promotes American policy, objectives and ideology of the period. An Army Cold War property meets one or more of the following criteria:

1. Was constructed or used between March 1946 and November 1989 in order to:
   - meet a specific real or perceived Soviet military threat; or
   - project force designed to influence Soviet objectives and policy; or
   - carry out major national objectives and policy toward the Soviet Union; or
   - affect global opinion of the relationship between the superpowers.
2. Through its architectural or engineering design, clearly reflects one or primary themes of the Cold War period.
3. Directly related to the US/Soviet relationship through association with a milestone event of the period.
4. Directly related to the US/Soviet relationship through association with the life of an exceptionally significant figure during the period of their contribution.
5. Not normally considered a Cold War property, but an integral contributing part to a Cold War historic district and fundamental to the understanding of the district as a whole [USACE, Fort Worth 1997:2].

Picatinny has two historic districts comprising Cold War properties: NARTS Test Area E and NARTS Area D (Guzzo 1999, 2004a).

A cautionary note must be added here. Researching Cold War activities and places is generally a time-consuming process because of the nature of the Cold War. This period was marked by a significant amount of secrecy related to: weapons, weapon systems, and the weaponization of various chemical and biological agents; the amount and type of knowledge possessed and research conducted related to missiles, planes, rockets, nuclear weapons, and the use of nuclear power; the amounts and types of weapons, particularly nuclear, military vehicles, planes, missiles and other materiel that the United States possessed; and newly created field of satellites and the exploration of space in general. This secrecy was further complicated by the fact that much of the Cold War's research, weaponization and materiel programs in general, as well as missile- and space-related programs were typically conducted as joint ventures among one or more of the military services and several private-sector contractors, creating the so-called military-industrial complex.

Many of these programs were extremely short lived, and when the military lost interest private companies may have continued to pursue aspects of the program. Many times information gleaned privately was then sold back to the military and a new program was initiated using the same private contractor. No one particular item or research topic was the exclusive purview of the military. Dozens of private contractors could be included in a single project making it difficult to understand who did what, where and when for any given project. Even the most secret of satellite programs, like Corona, included private contractors such as Eastman-Kodak and General Electric. After a project had been completed, information relating to its history could and would be scattered among dozens of private and military agencies.

Many of the documents associated with programs are still classified. Some will stay classified for many more years, and others remain classified because no one has bothered to declassify them. Although the DoD has made a huge effort to declassify many Cold War documents, the lack of personnel and budget constraints has prevented a major declassification undertaking.

Finally, because of the inherent secrecy of the Cold War, much of the information available is misleading or disinformation. At PICA nuclear weapons were termed "special weapons" and bombs/warheads, particularly those involving nuclear components, were merely called "devices." Military buildings were merely categorized as "labs" or "magazines," never revealing that they were nuclear materials laboratories or that the magazine stored nuclear warheads. Without knowing the history of an installation and the proper military context under which it can be subsumed, the decoding of information becomes virtually impossible. While information might be decoded, a second, secret layer of disinformation might be added. This disinformation is not particular to any one military or civilian organization; it is inherent to the prosecution of the Cold War. With these criteria, guidelines, and themes in mind, Panamerican examined the 318 properties at Picatinny in order to evaluate their NRHP eligibility.

2.3 FIELD SURVEY

The field investigation was conducted between April 16 and May 4, 2007. During this period, Panamerican architectural historians surveyed all 318 buildings and structures, which entailed physically inspecting all buildings and structures and marking their locations on a map of the installation, completing a ground survey, and digitally photographing all standing buildings and

structures, even those in a derelict condition. Since many of the buildings and structures were enclosed in of-limits areas, PICA provided escorts in all the enclosures, enabling PCI to investigate all of the buildings in the survey. Further, Panamerican also was able to locate and photograph many of the buildings situated in isolated areas that were heavily overgrown with vegetation. However, buildings that Panamerican was unable to find were investigated through the Real Property Manager's office to ensure that the properties had not been missed. Of the 318 buildings/structures in the survey, 109 either had been demolished or were so deteriorated that they had collapsed. By and large, the buildings surveyed tended to be small, isolated, or "lost" structures that had escaped previous surveys but were still appearing on various Real Property lists. It was not a surprise that so many of them had been demolished or were completely deteriorated. When a building was located, it was digitally photographed.

Also during the field investigation, Real Property files were consulted for pertinent information and the Real Property Manager provided assistance with questions and additional information on particular buildings, industrial complexes, or demolitions. In addition, blueprints for all of the properties were reviewed. Blueprints can provide a wealth of information about individual properties or a building complex, and the blueprints at PICA were no exception.

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3.0 Historic Period Overview and Cold War Context

3.1 HISTORIC PERIOD OVERVIEW

Outlining the history of Picatinny Arsenal and the surrounding area, this section summarizes material presented in more detail in Rogers (1931), Klein et al. (1986), Rutsch et al. (1986), Fitch and Glover (1990), and Gaither (1997), and was prepared by Mr. Mark A. Steinback, Panamerican Senior Historian. Portions of this section previously appeared in *Integrated Cultural Resource Management Plan Picatinny Arsenal, Morris County, New Jersey, 2001-2006* (Schieppati and Steinback 2001) and *Determination of Eligibility for Selected Buildings for inclusion on the National Register of Historic Places, Picatinny Arsenal, Rockaway Township, Morris, County, New Jersey* (Nolte and Steinback 2004a).

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 at Sandy Hook Bay, but not without incident—one sailor was killed and two others were wounded when Native Americans attacked his 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 Jacobsz Mey, who sailed around the southern tip of present-day New Jersey (Cape May) and explored Delaware Bay in 1614 (Brasser 1978; Burke 1991).

In 1621 the Staten Generaal 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. After the formation of the West India Company, Africans were brought into New Netherland as slaves beginning in 1626. During the early decades of the colony, slaves were owned for the most part by the West India Company, and private ownership was not customary until the 1650s. In the 1660s, while New Amsterdam remained under Dutch control, at least 400 slaves were landed in New Netherland by the company. At its height, New Netherland extended from present-day Albany, New York, in the north to what-is-now Delaware in the south, and encompassed parts of what are now the states of New York, New Jersey, Pennsylvania, Maryland, Connecticut and Delaware. Comprising a thin band of sparsely settled territory that stretched along the Hudson or North River, the colony in New York linked New Amsterdam at the lower tip of Manhattan Island with the frontier outpost of Fort Orange (the present-day City of Albany) and its satellite at Schenectady. From their base in New Netherland, the Dutch prosecuted the prized 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 (Harper 2003; Becker 1999; Burke 1991:1-18, 123-125; Ellis et al. 1967:18-25; Gehring and Starna 1988:xiii-xxiv; Kim 1978:3-5; Brasser 1978:79-82).

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. These subgroups, neither linguistically nor culturally homogeneous, 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 speculated 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 suggested 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 in the lower Hudson River valley (Fitch and Glover 1990:B/141-143; Goddard 1978:213-216, 221). Nevertheless, 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 (Goddard 1978:222; Williams and Kardas 1982:186, 189-190; Kraft and Mounier 1982:139-141).

Despite 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 in 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 Petrus 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; 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 Prince James, Duke of York and Albany, captured the colony during the Second Anglo-Dutch War. New Netherland was renamed New York and the prince was given control over all land west of the Connecticut River and east of the Delaware River. Colonel Richard Nicolls, commander of the fleet that had ousted the Dutch and military governor of New York, called the land lying between the Hudson and Delaware rivers “Albania.” 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, and also would become king) awarded Albania 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. A misplaced line on a map of the newly seized area was mistaken for a river by the duke, creating the impression that the new land was an island; therefore—Nova Caesaria—becomes New Jersey (Wacker 1982:199; Kim 1978:8-9; Divine et al. 1995:51-53; Halsey 1882:8-9; Stansfield 1998:73-76; Ellis et al. 1967:25-28; Pomfret 1964:8).

Before the arrival of the English, 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 stretch between the entrance to the Raritan and the Delaware Bay [Kim 1978:5].

Prior to Carteret’s arrival, Col. Nicolls as military governor had allowed migrants from New England to take up farms west of the Hudson River, in what would become Essex, Middlesex, Monmouth and Ocean 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 (Fleming 1984; Wacker 1982:199; Kim 1978:8; Pomfret 1964:8-10; Divine et al. 1995:51-53; Halsey 1882:8-9; Stansfield 1998:74-77).

Berkeley, short on cash, grew tired of the proprietary venture, and, in 1674, sold his share for £1,000 to what would become a group of surprisingly quarrelsome Quakers that included William Penn. This sale necessitated the division of the colony into two separate governments known as East and West Jersey. Surveyed in 1687, the Keith Line was supposed to run diagonally through most of the colony from the ocean to the Highlands, but the survey was stopped by the West Jersey governor at the South Branch of the Raritan west of its confluence with the North Branch. Disputed, this dividing line was resurveyed in 1696 (the Thornton line) and in 1743 (the Lawrence Line), but the dispute lingered until 1855. Carteret and his heirs tried unsuccessfully to turn a profit in East Jersey and the West Jersey Quakers went bankrupt. Despite an inability to turn a profit, by the end of the seventeenth century more than 3,300 Quakers were living in West Jersey. The Crown reunited the two Jerseys into a single royal colony in 1702, and recognized New Jersey as an independent colony separate from New York, although the two colonies would share the same governor for more than three decades. In 1700, the population of New Jersey stood at approximately 14,000. Its residents lived on scattered, often isolated farmsteads clustered at the far ends of the colony along the Delaware River and the Hudson River-Atlantic coast; villages of more than a few hundred people were 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; Stansfield 1998:75-77; Manning 1984:43-46, 49-53; Halsey 1882:17-18).

With the advent of active English development of colonial New Jersey, European homesteaders from a variety of backgrounds cleared the land and erected farmsteads in increasing numbers. New Englanders via Long Island began filtering into eastern New Jersey; Dutch immigrants with their African slaves also left Long Island in the 1680s, establishing settlements in the Raritan valley (Wacker 1982:199). At first, West Jersey attracted Irish and English Quakers in large numbers. But after William Penn redirected Quaker settlement to his colony of Pennsylvania after 1682, New England and Long Island Puritans and Baptists from England and Virginia entered the area. The first agglomerated settlements grew up around road junctions and river fords. The area surrounding what is now Trenton was settled in 1679. Social, economic and climatological conditions favored the development of small subsistence farmsteads rather than large agricultural plantations, but these conditions did not preclude the continued existence of slavery. Within a local and regional exchange system, farms grew grain and raised livestock for themselves and their neighbors and only later exported their surplus to merchants in either Philadelphia or New York City (Manning 1984:44-45; Wacker 1982:199-205).

Administrative necessities resulted in the division of the Jerseys into municipalities and counties. Counties were formed in 1681 in West Jersey (Burlington and Salem were the original two) and in 1683 in East Jersey (Bergen, Essex, Middlesex, and Monmouth were the original four). During the late seventeenth century and early eighteenth century, subdivision of the large speculative tracts began as smaller lots were sold to incoming settlers, who occupied scattered farmsteads.

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 would have to rely predominantly on cultivating crops for their livelihood. While those agricultural activities that were conducted in the mountains probably provided generally unfavorable results for those early residents, 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 arsenal) and Dickerson mine (west of the arsenal) 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; Rutsch 1999:3-5; 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 (with exceptions), while his Denmark Tract measured 6,231.21 acres (Rutsch 1999:5-11; Pitney 1914:159; Halsey 1882:41, 53, 334-335; Pope 1945:69-74).

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 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, and 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 near 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 1999). Moreover, the U.S. Army Corps of Engineers Waterways Experiment Station (WES) argued 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 [WES 1995:70].

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

- 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 1999), Halsey inferred 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. (1986:41) added: "A forge is always a place where iron is heated and then worked with a hammer" which produces wrought iron by extruding its slag.

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 Picatinny and several charcoal kilns adjacent to it (WES 1995:68-71; Rogers 1931:7; Fitch and Glover 1990:B-150; Sandy and Rutsch 1992:69; Rutsch et al. 1986:184-186).

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 1984:44, 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 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].

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

Dating to 1710, Mount Hope mine is reported to be the oldest mine not only in Morris County, but the United States as well. The 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). A Swiss formerly employed by the American Iron Company (also known as the London Company), Faesch would make cannon, shot and other implements for the American soldiers during the Revolutionary War (Myers 1984:7; Klein et al. 1986:1-12, 2/9-10). 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 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) erected a dam at the southern end of what is now Picatinny Lake and established one of the earliest forges in New Jersey in 1749. Within the boundaries of what is now Picatinny, Osbourne's forge 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 installation, the Mount Pleasant Forge site is reputed to be in the vicinity of a gas station near the intersection of Route 15 and Route 80 (WES 1995:70; Rutsch ca. 1995). 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).

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 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 tract included 2,079.33 acres 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.) (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 waterpower, 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 of forested land adjacent to his forges. Faesch, like the Fords, 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 Revolutionary War by providing the Continental Army with iron materiel, 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. 1986:2-10). Within Picatinny'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 fieldstones, 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. It is further alleged that three other Revolutionary War veterans, besides Peter Doland, are buried there, as well as a possible Civil War veteran, whose grave is unknown (ARDEC Historical Office nd:Item 19; Rutsch et al. 1986:55).

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 and was located west of Mount Hope and east of Green Pond Mountain (or in the middle of the Green Pond Brook valley). Sources reported that the property was "returned to Courtland Skinner and John Johnson" on 21 June 1774 (Halsey 1882:334; Rogers 1931:5). Skinner and Johnson appeared 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 75 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, 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. George E. Righter, Jacob's son, owned the property 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 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 (ca. 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 arsenal 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 also was 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 Picatinny) connected Morristown to Sparta, Sussex County, through Dover and Mount Pleasant and was the first turnpike established in the vicinity of the project area (ca. 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 Picatinny before going over Green Pond Mountain to Longwood valley (Rogers 1931:7).

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 called Denmark emerged to serve the iron community near that lake, and groups of structures clustered near Picatinny Lake (then known as Lake Clifford) and at the Mount Hope mining complex. Several farmsteads also were 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 federal 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 shutdowns 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 arsenal 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 proliferation of railroads during the middle decades of the nineteenth century. The Morris & 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, Lackawanna & 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. 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. 1986:78-79). Other railroads in the vicinity of Picatinny 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 & Northern Railroad which traversed the arsenal in the 1880s (Rutsch 1999:19-21); and a line constructed by the Morris County Railroad Company in 1887 through Picatinny, 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).

The discovery of iron ore in the Mesabi Range in Minnesota and cheaper Lake Superior shipping doomed the Highlands iron industry. Even during the industry's most productive years, other economic endeavors emerged in the Green Pond Brook valley. Historic maps 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 1999:19-21; 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 pleasant environment of the Highlands became the setting for summer resorts and vacation get-a-ways. An 1844 account of the Green Pond area included bucolic descriptions of a resort "abounding in fish, and surrounded by wild, romantic scenery" (cited in Klein et al. 1986:2-11). Rutsch (ca. 1995:30)

added, "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." 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, but 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).

By the beginning 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). Picatinny Powder Depot was founded in 1880 and provided a major shift in the area's economy and land use. The southern 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 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 from various owners for a total of $62,750, or about $34 per acre. Table 3.1 presents 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).

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 of black powder. With four powder magazines completed by November 1886, the depot received its first shipment of powder (300,000 pounds) 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 of track traversed the powder depot and connected it to the Delaware, Lackawanna & Western Railroad and the Dover Central Railroad of New Jersey at Wharton. A privately owned line called the Northern & Wharton Railroad also ran through the arsenal and maintained five associated stations. Seventy

men were employed at the depot and 900,000 pounds of powder were stored at the facility by that time. 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 1999:19-21).

Table 3.1. Initial Land Purchases for Picatinny Arsenal (Rogers 1931)

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

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

In June 1891, 315 acres of Picatinny Powder Depot land near Lake Denmark were ceded to the United States 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 in two purchases in 1902. By 1892 a shell house, a storage magazine and three residential structures were completed (Rogers 1931:29-31; Klein et al. 1986:2/12-13; Fitch and Glover 1990:B/166-168; Harrell 1994:6).

Historical development within PICA 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. The initial phase of development covers the depot/storage period from 1880 until 1907. The depot’s first phase of operation involved powder storage and increasing involvement in the assembly of cannon charges. In 1897, workers at the depot assembled powder charges that included manufacturing and filling the storage bags. Between 1902 and 1906 armor-piercing shells were assembled at the depot, where projectiles were filled with explosives, such as Maximite and Explosive "D" (WES 1995:73; 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. PICA 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). When the United States entered 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 PICA personnel 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 extensive 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 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 radius of the epicenter. Beyond this 3,000-foot radius many structures were severely damaged, both within the Navy depot and the adjacent PICA 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. The results of the investigation led to changes in safety and ammunition storage procedures and standards. Since PICA 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 PICA 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:

- powder and explosives production and handling;
- powder and explosives storage;
- powder and explosives testing; and,
- 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, which included operation of experimental and production plants for the development of a range of propellants and explosives. By the time of the entry of the United States into World War II, the arsenal contained 567 buildings and was producing smokeless powder, high explosives, fuzes and primers, assembled rounds of artillery ammunition, bombs and grenades, and pyrotechnics (e.g., airplane flares and signal smokes), all at experimental or peace-time levels (Thurber and Norman 1983; Fitch and Glover 1990:B/177-180; Harrell 1994). In addition, PICA was responsible for the standardization of new designs for artillery fuzes and for the development of nose and tail bomb fuzes. Arsenal personnel also improved the design of artillery primers, trench mortars and rounds of chemical and tracer ammunition, and the Research and Chemical Branch developed fuze powders, primer mixtures, pyrotechnic compositions, propellant compositions, and new high explosives.

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. For example, during the 1930s, researchers at DuPont and Picatinny developed flashless, non-hygroscopic (i.e., non-water absorbent) powders or FNH. DuPont developed M1 powder, and Picatinny developed M3 powder, both of which were tested for composition and specific weapons at the arsenal (Thurber and Norman 1983; Green et al. 1990).

During World War II, many important advances, new products or simplified methods of production were made at the arsenal in its newly constructed laboratories and testing facilities. As the importance of Picatinny's research and development (R&D) activities grew, more emphasis was placed on 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 PICA and passed along to other plants, saved the United States more than $3 million (Kaye 1978). While expanding production capabilities to meet the munitions requirements of fighting a two-front war, the arsenal continued to conduct research on tetryl manufacturing and nitrocellulose powder. It also provided explosives and powder production training to both civilian and military personnel.

The Mechanical Branch of the Technical Division was responsible for the development and design of ammunition and special bombs for specific jobs. During the war, a number of special components were designed and tested at Picatinny, including both aboveground and long-delay bomb fuzes. In addition, the Mechanical Branch created pyrotechnic devices, such as flares and signals (Thurber and Norman 1983; Kaye 1978; Fitch and Glover 1990:B/179-183). One of the most important bombs developed for a particular need was created to blow up the Ploesti oil fields in Rumania, a vital source of oil for Nazi 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 PICA. Although just entering production a the end of the war, haleite (ethylenedinitramine or EDNA) 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). During research subsequent to the development of haleite, PICA's chemists created another explosive, PTX-2 (Picatinny Ternary Explosive), a combination of PETN (pentaerythritol tetranitrate), RDX ("Research Department Explosive") and TNT (trinitrotoluene). Preliminary firings at the arsenal revealed that it was adaptable to shaped-charged ammunition, although by the end of the war PTX-2 was still in the testing stage (Green et al. 1990).

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 suggested that the 3400 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 (Thurber and Norman 1983; Fitch and Glover 1990:B-183) and it appears likely that no POWs were ever held there (Hanley et al. 2004:3/8, 13).

The post-war years were marked by both the Cold War with the Soviet Union and hot wars in Asia and the Middle East. During this period, PICA continued as a center for research and development for new weapons systems and advances in the production process. Innovations in

production processes and the development of new materials had occurred consistently at the arsenal over its history. 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, HONEST JOHN, SERGEANT, and other nuclear and conventional 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; Gaither 1997:94, 102).

After World War II, the Navy's Bureau of Aeronautics decided to establish a rocket-engine test center on the east coast, and initiated modifications to the existing facilities at Lake Denmark. On 1 July 1948, the U.S. Naval Aeronautical Rocket Laboratory (NARL) was established there. Less than two years later, the Naval Ammunition Depot was officially disestablished and the NARL was redesignated the Naval Air Rocket Test Station (NARTS) on 1 April 1950. All physical facilities of the former Lake Denmark depot were made a part of NARTS. As it evolved, NARTS had three major work categories: qualification tests, preliminary investigations, and technical services, all of which were included in its mission "to test, evaluate and conduct studies pertaining to rocket engines, their components and propellants" as assigned by the Chief of Naval Operations (U.S. Department of the Navy 1997a, 1997b; Nolte et al. 1999c).

Prior to 1950 the NARL had a number of temporary test stands at which the Navy had tested the rocket engines for the Douglas SKYROCKET, the Bell X-1, and the LARK. It also had a large test stand for the development of the 20,000 lb-thrust Viking engine, the Consolidated-Vultee MX-774, and for certain other tests on the SKYROCKET. By the 1950s, the station consisted of 760 acres and represented a multimillion-dollar investment.

The history of NARTS is intimately associated with the history of Reaction Motors, Inc. (RMI). RMI was formed in 1941 and was the first enterprise devoted to the commercialization of the rocket engine (Shesta 1978; Nolte et al. 1999c). By the middle of 1946 all of RMI's activities had been transferred to Lake Denmark, where a construction program for rocket test stands was underway. By 1958, RMI and Thiokol Chemical Corporation merged and RMI became a division within the company (RMD). In 1956 RMI was awarded the contract to develop the XLR-99 liquid rocket engine for eventual use in the X-15. The initial testing, including test firings, of that engine was conducted at Lake Denmark, much to the displeasure of the local residents. By 1960 the Navy decommissioned NARTS and it became part of Picatinny Arsenal under the Ammunition Development Division of the Ammunition group at PICA. Renamed the Liquid Rocket Propulsion Laboratory, the entire facility was leased almost immediately to the Thiokol Chemical Corporation, RMD. As a result of changes in the rocket industry during the 1960s, RMD at Lake Denmark was shutdown by 1972. The rocket test areas of the Lake Denmark site were abandoned to the Army and have been largely unused since, except as backdrops for training exercises (Shesta 1978; Nolte et al. 1999c; U.S. Department of the Navy 1997c).

By 1977 most production of weapons and ammunition had ceased at PICA and its activities focused on research and development. At that time the Army established the U.S. Army Armament Research and Development Center (ARRADCOM), headquartered at Picatinny, to be responsible for developing new and improving old weapons and munitions. In 1983, ARRADCOM was disestablished and its mission was transferred to the Armament, Munitions and Chemical Command (AMCCOM), Rock Island Arsenal, Illinois. The munitions and weapons R&D activities remaining at Picatinny were renamed the U.S. Army Armament Research and Development Center (ARDC). In 1986, ARDC was renamed the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) with its headquarters at PICA. ARDEC was transferred from AMCCOM to the Tank-Automotive and Armaments Command

(TACOM) in 1994. Representing the technical expertise of the U.S. government in guns and ammunition of all sizes, from pistols to howitzers, ARDEC played an essential role in developing items and technologies as diverse as warheads, gun fire control, mines, and smart ammunition, among other responsibilities (ARDEC 1995). In the mid-1990s, over 1,000 buildings were spread out over Picatinny's nearly 6,500 acres, making PICA "the largest Army installation devoted solely to research and development" (STV/Lyon Associates, Inc. 1994). In 2003, ARDEC was transferred from TACOM to the U.S. Army Research, Development and Engineering Command (RDECOM). As the Army's "Center of Lethality," ARDEC at Picatinny is "the Army's principal researcher, developer and sustainer of current and future armament and munitions systems" (ARDEC 2006).

3.2 MILITARY ARCHITECTURE

The military services have always had a need for structures that facilitate 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 are vital for a successful defense. The architectural styles of these structures mirrored those of the greater non-military community. A survey of military installations 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 adequate structures from though out 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 World War I illustrated the necessity of being able to sustain a lengthy worldwide 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 these 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, "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 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 PICA.

During the 1930s, the Army created a set of standardized plans, called the 700 Series, for a number of typical structures that it would be required to build in the event of war. Based in part on the inadequate 600 Series of World War 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 side of military building was not as fully addressed since in the past 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 prolonged, global 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 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 joined to design prototypical industrial structures for very specialized materiel production. Picatinny Arsenal and Edgewood Arsenal became testing grounds for new industrial buildings and processes related to ordnance and chemicals. Their experiences combined with the building plans from the private sector were the basis of military industrial building design.

Also during this period, it was believed that industrial facilities would be of permanent construction, much like private sector factories. Permanent in this instance referred to buildings with a 25-year life span. Functional design was the top priority for industrial facilities, thereby determining the basic architectural and engineering design. Major General Levin H. Campbell, Chief of Ordnance from 1942 to 1946, stated that "the object of building plants [was] to produce munitions required to win the war" (Kriv 1992). These industrial buildings were exceptionally plain utilizing the pioneering work of Albert Kahn, the great industrial facilities architect, as springboard for understanding 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 eight inches wide, which 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 of temporary construction. 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 or asbestos paneling, and with little or no steel framing. This change from permanent to temporary had a great affect on all installations.

At present, a variety of World War II temporary structures are extant on most military installations, and PICA is no exception. Garner (1993) listed 36 Army posts as having 100 or more units of temporary, World War II buildings and some installations, 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, as well as 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. Volatile compounds, such as TNT, that were originally produced in buildings made with substantial steel beams were frequently manufactured in structures of almost flimsy construction. Even old-line production facilities, like Picatinny Arsenal, had to make do with temporary, light frame buildings. A number of these types of buildings still can be found in former production areas.

In general, 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 essentially an 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 found on a number of PICA's extant covered walkways in the 1600 "Little Picatinny" Area.

The branches of a particular service also influenced the types of structures built. The Ordnance Department, the Chemical Corps, and the Signal Corps each had different building regulations that 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 U.S. Army Corps of Engineers, at the beginning of the war several disparate departments guided the build-up.

At present, 500 World War II structures are extant on Picatinny, which is the largest number of buildings from a particular period on the facility. Of these 500, almost all are exclusively related to the production and storage of materiel. Although PICA 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.

3.3 GENERAL COLD WAR CONTEXT

The U.S. Army defines the Cold War as "the prolonged ideological, economic, military and political competition, tension, and conflict short of actual war between the U.S. and the Soviet Union from 1946 [to] 1989" (USACE, Fort Worth 1997:8). Thus, for the purposes of this study, the beginning of the Cold War is marked by former Prime Minister of Great Britain Winston Churchill's Iron Curtain speech on 5 March 1946, which iterated the results of Soviet activities in Eastern Europe to control countries freed from Nazi occupation during World War II. The end of the Cold War is considered the fall of the Berlin Wall in November 1989, which signaled the beginning of the break-up of the Eastern Bloc (Gaither 1997:1-3; USAEC 1998:9). The following sections will review and discuss developments at the Army's Picatinny Arsenal and the Navy's Lake Denmark Ammunition Depot within this chronological context.

The U.S. Army played an important role in containing the spread of communism during the Cold War. During this period, "the primary mission of the Army was to deter or defeat communist growth in conjunction with other services or allied nations, without using strategic nuclear warfare, preferably without using nuclear weapons. A secondary mission was to support the defense of the United States through antiaircraft missiles and antiballistic missiles" (USAEC 1998:2). In an effort to accomplish these missions, the military services, in general, and the Army, in particular, underwent significant reorganization that included the 1947 National Security Act and the 1962 reorganization of the Army's technical services and formation of the Army Materiel Command. Underpinning the Army's ability to carry out its mission was a growing reliance on increasingly sophisticated technology "that involved communications, surveillance, logistics, guidance, and early warning systems, as well as research, development, and testing in

institutions both public and private" (Gaither 1997:9-10). The following subsections review and discuss national events and developments that form a general context in which activities occurring at PICA (and related organizations) can be placed.

3.3.1 Groundwork for the Cold War (1945-1949). In 1945, a number of events occurred that could be seen as being part of the "beginning" of the Cold War. The Yalta Conference in February 1945 is often cited as one of those early events presaging future acrimony between the United States and the Union of Soviet Socialist Republics. It marked a point where the American-Soviet mistrust, while having earlier roots, became apparent. This growing rivalry also was manifested at the Potsdam Conference in July 1945 and grew over specific disputes, among them Germany, Eastern Europe and atomic weapons (LaFeber 1985:1-7, 14-18, 24-28). In August of that year, the United States dropped atomic bombs on Hiroshima and Nagasaki, and announced its intention to occupy Korea south of the 38th parallel. The following month, Ho Chi Minh seized power in Hanoi and declared an independent Vietnam, followed closely by the re-entry of French troops. In Eastern Europe, the Soviet Union, which had begun to consolidate its control over Poland and Czechoslovakia, was quickly expanding its influence and hold. Despite the fact that the Communists received a small percentage of the vote in the Hungarian elections, Soviet dictator Josef Stalin sent in troops to crush the opposition. Soon after, Yugoslavia became a federated republic under Tito. The Western powers viewed these actions as imperialist or hegemonic (an attempt by the Soviets to spread communism on a global scale). This dynamic helped lay the groundwork for the 45 years of misunderstanding and mistrust that were to follow, and was exacerbated by the fact that the Western allies could not negotiate from a position of strength, much less impose their will on Stalin. At the end of the war, the Soviet army in Europe consisted of 12 million men in 300 divisions compared to General Dwight Eisenhower's 4 million men in 85 divisions.

U.S. Secretary of State James F. Byrnes' "get tough with Russia" speech, early in 1946, was closely followed in March by Churchill's famous speech at Westminster College in Missouri. Churchill stated that an "Iron Curtain" had come down across Europe. This speech marked the "official" start of the Cold War. The year 1946 saw the formation of the Strategic Air Command (SAC), an icon of the Cold War, as well as the beginning of the French Indochina War. On-going hostilities between communist and anticommunist forces in Greece and Turkey led to the formulation of the Truman Doctrine (1947) which offered support and funding to forces resisting communism. The Marshall Plan (1947), which offered economic assistance to 16 European countries, further bolstered this policy, the precursor of the Containment policy, a basic Cold War framework.

The following year the National Defense Act was passed, reorganizing the American military and intelligence-gathering apparatus. As part of this act, the Air Force was created as a separate branch of the armed services, and Central Intelligence Agency (CIA), the National Security Council (NSC), and the Joint Chiefs of Staff were also formed. As a result of this act, the Air Force was assigned strategic missile development and the Army was assigned tactical missile development. Further, the U.S. Congress created a National Military Establishment (NME) at that time, which united the Army, Navy, Marines and Air Force under a Secretary of Defense. Congress strengthened this effort at unification by creating a DoD with the Army, Navy, and Air Force as subordinate departments within it (Kuranda et al. 1995a:18).

The early post-war period was marked by the dramatic and extensive demobilization of military personnel with a concomitant decrease in funding for military operations and equipment. Army strength declined from more than eight million soldiers and 89 divisions in September 1945 to 684,000 soldiers and 12 divisions in June 1947, with additional reductions occurring in 1948.

Military spending declined from approximately $45 billion in 1946 to $13 billion by 1949. Further, the Army and Navy endured the severest cuts, while the strategic defense of the United States was placed in the hands of the Air Force, notably SAC's bombers.

In the early Cold War period, nuclear weapons and the ability to deliver them were key justifications for increased funding. Until the development of guided missiles, the Air Force was the only service with the ability to deliver them. SAC, with its heavy bombers, was almost the exclusive user of nuclear weapons, and as nuclear weapons became more important in the American arsenal, the Air Force played an essential role in the formulation and later implementation of the defense strategy of containment.

The unification of the services provoked animosity within the Army and Navy throughout the 1950s. The timing of the process of unification dovetailed with post-war budget and funding reductions that affected all the services. Both the Army and Navy were angered about receiving disproportionate budget cuts in the wake of the increasing importance (and dollars) the Truman and Eisenhower administrations were placing in the Air Force. As a result, the Army and Navy competed with the Air Force not only for appropriations for development of long-range missiles, but also to assert relevance during the Cold War in terms of nuclear deterrence.

One of the major events of this period was the Berlin Blockade, which began 1 April 1948. In an effort to force the Western powers out of West Berlin, the Soviet Union blocked all land routes in and out of the city, leaving only the three air corridors open. The West responded by blockading East Germany and undertaking a massive airlift of supplies to West Berlin. Faced with the resolve of the West, the Soviets ended the blockade a little less than a year later.

A number of important events marked the end of this period, including the formation of the North Atlantic Treaty Organization (NATO) in April 1949. Initial membership included the United States, Great Britain, France, Italy, Canada, Belgium, the Netherlands, Luxembourg, Iceland, Denmark, Norway and Portugal. Greece, Turkey and Spain joined in later years. The Federal Republic of Germany (West Germany) was formed in September and would later become a NATO member. This groundwork period of the Cold War ended with the unexpected Soviet explosion of an atomic bomb in August and the formation of the People's Republic of China in October.

One of the more significant advances in military technology to emerge from World War II was the development of ballistic missiles (e.g., the German V-2). A group of American officers visiting Europe at the end of the war saw the potential of this weapon. This group was the first to suggest the development of weapons to defend against such a weapon and thus the ballistic missile defense (BMD) concept was born. Operation Paperclip, by the end of 1945, relocated 130 German rocket scientists along with tons of captured documents to Fort Bliss, Texas. Soon afterward, the NIKE project began. The NIKE was a surface-to-air missile that, in later versions, became the basis for an anti-ballistic missile (ABM). This group of German scientists contributed to the development of intermediate range ballistic missiles (IRBMs) and intercontinental ballistic missiles (ICBMs) by the late 1950s. They also played a crucial role in the development of the U.S. space program.

After World War II, PICA's overall mission moved away from massive ammunition production to a greater emphasis on research and development. Gradually, its primary role was converted to research and engineering of new ordnance for the most modern and efficient means of combat (Kaye 1978). As the war was coming to an end, the arsenal began a significant expansion of its high explosives capabilities by constructing a Rocket Propellant Powder and Cast High Explosives Plant on the eastern ridge of Picatinny known as Nitro Hill. The plant, which was

designed to concentrate on explosives for the newly burgeoning rocket industry within the Army, featured state-of-the-art equipment for the creation of specialty explosives in practically every geometric shape and size. In 1948, the Ordnance Department designated Redstone Arsenal as the center for rocket and missile R&D, however much missile-associated work was conducted at PICA, including research at its solventless propellant line (Gaither 1997:90).

At about this time the U.S. Navy determined that Lake Denmark Naval Ammunition Depot, at one time the Navy's largest ammunition depot, was excess for then-current needs and began to deactivate the facility. However, the Navy recognized the opportunity to establish a centralized, East coast rocket engine test center with applications for naval aviation, and decided to change the facilities mission. Modifying the existing depot, the U.S. Naval Aeronautical Rocket Laboratory (NARL) was established at Lake Denmark on 1 July 1948. Its mission was the "evaluation and development of rocket engines and their components" (NARTS 1950: Progress Report for January; Baranowski 1959). The Navy envisioned this site as its version of the Air Force Rocket Test Facility in Muroc, California (now, Edwards Air Force Base).

Because of the paucity of Naval engineers trained in the field of rocketry, the Navy offered the use of buildings and land at NARL to Reaction Motors, Inc. (RMI), a rocket-engine company that had worked closely with the Navy during World War II. By the middle of 1946 all of RMI's activities were transferred to NARL where a massive construction program for rocket test stands was underway (*The RMI Rocket* December 1951).

NARL and RMI began work on a number of important engine tests including the Douglas SKYROCKET, the Bell X-1, the LARK, the VIKING, and the Consolidated-Vultee MX-77. The NARL test areas grew and plans were for made for the expansion of NARL programs and eventual corporate relocation of RMI to nearby Denville, New Jersey. Naval rocket plans were now in full swing.

3.3.2 Korea and Nuclear Expansion (1950-1954). By 1950, the Soviets had the atomic bomb and, with the TU-4 strategic bomber (a reverse engineered B-29), the means to deliver it. This development, along with the Sino-Soviet Pact in February, created enough paranoia in the United States to allow the "Red Scare," smoldering since the establishment of the President's Security Loyalty program during the Truman administration, to ignite into the so-called McCarthy Era. McCarthyism, as the phenomenon became known, dominated this entire period, at least on the American domestic front. Senator Joseph McCarthy and the House Committee on Un-American Activities prominently hunted for Communists in all sectors of American life, especially government services, such as the State Department and the Army. His investigations spread to other sectors of American society including the media and the arts. Most called before the committees had their reputations tainted, if not destroyed, often by innuendo. Many, especially writers, were blacklisted for even the most indirect connection to the Communist Party. Despite the condemnation of McCarthy's tactics by President Harry Truman in 1952 and a subsequent denunciation by President Eisenhower, the era did not end until the Senate censured McCarthy in December 1954. The blacklisting, however, continued for many years afterward.

Of critical importance during this period was National Security Circular No. 68 (NSC 68). In early 1950, President Truman directed the secretaries of Defense and State to re-examine the Soviet threat in light of its newly acquired nuclear capability. The resulting report, delivered in April, was NSC-68, which shifted the Cold War emphasis from the political to the military sphere based on the appraisal that the Soviets were bent on global military dominance. The report called for increased defense spending on a build-up of both nuclear and conventional forces. While this recommendation was unpopular domestically, it received support, of sorts, when the

North Koreans (with the approval of the Soviets) crossed the 38th parallel a few months later, beginning the Korean Conflict (LaFeber 1985:96-98). Within several months, South Korean and American forces had pushed the North Koreans back and were nearly in control of the peninsula when, on 19 October, Chinese forces ("volunteers") crossed the Yalu River. The allied forces, which eventually became a United Nations coalition, were forced south of the 38th parallel. During the following three years, the war remained more or less stalemated. A cease-fire was negotiated by the Eisenhower administration in 1953, and is still technically in effect.

This period also saw the first "proxy wars": the Soviets lending military aid to the Chinese and North Koreans, while the United States was giving military aid to the French in Vietnam. In December 1950, the United States and Vietnam signed a mutual defense assistance agreement that marked the beginning of America's 25-year involvement in that country. In 1954, the French were defeated at Dienbienphu and withdrew from Vietnam. The country was divided into North and South at the 17th parallel.

Late in 1952, the United States exploded its first hydrogen bomb, upping the ante in the U.S.-Soviet arms race. The Soviets responded by exploding their first hydrogen bomb in August of the following year. The arms race was a dominant issue for the next 40 years.

Josef Stalin died in March 1953 and, after a bitter power struggle between Nikita Khrushchev and Georgi Malenkov, was finally succeeded by Khrushchev, who consolidated his power over the following two years. Later, Khrushchev would begin the process of "de-Stalinization" which resulted in the release of hundreds of thousands from forced labor camps (the "gulag") and exposed, for the first time, the magnitude of the crimes committed by Stalin against his own people. While some moderation in Soviet domestic policy occurred during this period, their foreign policy remained essentially intact.

Military technology progressed throughout the period. With the growing importance of nuclear weapons to American defense policy, both the Navy and the Army proposed new solutions to counter the Air Force supposition that strategic bombing "rendered conventional ground and naval forces obsolete." During the Truman administration, the Navy began development of a new aircraft carrier that could launch heavy bombers (and, hence, deliver nuclear bombs), but the president canceled the project (Kuranda et al. 1995a:19). During the 1950s the Navy "increased its ability to protect the North Atlantic sea lanes" and American communications with its European allies (Kuranda et al. 1995a:19) through the development of supercarriers such as the *Forrestal*, surface-to-air missiles (SAMs), and later the nuclear-powered submarine *Nautilus*. To counter the Air Force, the Army developed the Pentomic concept and later air mobility (discussed below).

Eisenhower's New Look defense policy emphasized nuclear weapons for maximum military effectiveness at a minimum cost, since these weapons were cheaper than conventional weapons, "and by focusing on nuclear striking power, the United States could reduce the size of its conventional military forces" (Lewis et al. 1995:25, 30). "This was based on Secretary of State John F. Dulles' suggestion that the United States rely chiefly on its nuclear superiority and the threat of massive retaliation to thwart Communist aggression" (Lewis et al. 1995:30).

Further, the Eisenhower administration-created Surprise Attack Panel, chaired by James R. Killian, issued a report in 1954, which laid the groundwork for defense strategy through the 1950s. The so-called "Killian Report" was prepared for the NSC as an assessment of the United States' capability to maintain deterrence. The report found that despite an initial advantage in nuclear airstrike capability, the United States was vulnerable to a surprise attack because of the

lack of an early warning system and an inadequate air defense. The Eisenhower buildup in nuclear weapons would offset Soviet improvements to their bombers. The report concluded by exploding the myth held in the United States that by the end of the 1950s American science and technology would easily keep its forces superior to those of the Soviet Union. The report concluded by offering a number of recommendations that when implemented became essential elements of American defense policy.

> The report recommended that the highest national priority be placed on the development of the USAF ICBM program, IRMB capabilities for land and shipboard launch, construction of an early warning system in the Arctic, and research and development into a possible anti-missile system.
>
> To monitor Soviet nuclear capabilities, especially their ICBM development, the Killian Report also recommended that the most advanced technology be utilized for intelligence gathering. The result was the development and use of the high-flying U-2 photo-reconnaissance plane by 1956, and the highest priority and approval for project WS-117L, the development of reconnaissance satellites.
>
> The Killian report concluded by recommending the study of limited nuclear war as an alternative to massive retaliation and the New Look. The report foresaw that the nuclear arms race would result in a stalemate (deterrence) based on the idea that a first-strike by either side would result in retaliation and MAD [mutually assured destruction]. Limited nuclear war was a means by which MAD could be avoided. This concept allowed for successful military exchanges, or an intercontinental counterforce strike, without leading to a strategic exchange involving deliberate nuclear attacks on cities [Lewis et al. 1995:32].

The Soviets unveiled their first jet-propelled, long-range bomber immediately followed by the deployment of the NIKE AJAX missile, arguably the first developmental step in the American ballistic missile defense program. NIKE was a program that covered surface-to-air, anti-aircraft guided missile systems as a defense against maneuverable, high-flying jet aircraft. They were the first guided missiles. NIKEs would be used in the event that the Air Force failed to destroy attacking Soviet bombers. In the NIKE system, the missiles were targeted and guided entirely through ground-based radar and computer systems. The first in the series, the NIKE AJAX, was initially fired in 1946 and successfully tested in 1951, with deployment beginning in 1954. Power was supplied to the two-stage NIKE AJAX missile by a liquid-fueled motor using a combination of unsymmetrical dimethyl hydrazine (UDMH), inhibited red fuming nitric acid (IRFNA), and JP-4 jet petroleum with a solid-fuel booster. The AJAX could reach speeds in excess of 1,600 miles-per-hour, and heights up to 70,000 feet, but its range was only 25 miles. It carried three separate high-explosive, fragmentation-type warheads. By 1958 nearly 200 NIKE AJAX batteries had been deployed throughout the United States (Bender 1999; WSMR Historical Foundation 2001a; Lonnquest and Winkler 1996:165, 170-172; Combat Air Museum 2007a).

The AJAX's successor beginning in 1958 was the NIKE HERCULES. The HERCULES could reach speeds in excess of 3,200 mph, and heights up to 100,000 ft, with a range of approximately 90 miles. A sustainer motor using solid rocket fuel provided the missile's power. The HERCULES was designed to carry a nuclear warhead, but could carry a high-explosive, fragmentation-type warhead, the T-45. Moreover, the HERCULES package had improved radar and more sophisticated electronic guidance especially by the early 1960s. During the Cold War, 145 NIKE HERCULES batteries were deployed. In 1963, the last AJAX in the United States was deactivated. By the end of the decade of the 1960s the NIKEs were considered obsolete and

included within the reductions agreed to by the United States and the Soviet Union in the Anti-Ballistic Missile (ABM) Treaty of 1974 (Bender 1999; WSMR Historical Foundation 2001b; Lonnquest and Winkler 1996:172, 177).

During the Korean Conflict, Picatinny reassumed it earlier missions: meeting emergencies on time, and the mass production of the ordnance it had designed and developed (Kaye 1978). When the North Koreans introduced the Russian-made T34 medium tanks into battle, the Army's hold on Taejon began to slip because then-current weapons could not stop the massive, heavier T34s. In the United States a new more powerful bazooka had just been produced and at Picatinny a rocket shell for the improved weapon was produced on a pilot-plant basis. General Douglas MacArthur issued a call for the new bazookas and the best possible ordnance. Within 24 hours Picatinny's pilot plant was expanded in a full-scale production assembly line. Seven days after MacArthur issued his urgent call, Korean tanks were being knocked off the battlefield and within a matter of months, the T34s were no longer a major menace. PICA also was responsible for developing and creating a new illuminating rifle grenade (Kaye 1978).

While the arsenal was meeting its production mission, it conducted research for the development of the various members of NIKE missile family: the AJAX, HERCULES, and ZEUS. The arsenal worked on the "business end"—the warhead systems—of these missiles, including the nuclear warhead for the NIKE HERCULES (Kaye 1978). In addition to the NIKEs, PICA personnel also conducted extensive missile research and developed warhead components for the HAWK, CORPORAL, HONEST JOHN, LACROSSE, REDSTONE, and PERSHING missiles, among others (Gaither 1997:94, 102). In the early 1950s, the Army also conducted research to develop tactical (i.e., battlefield) nuclear weapons. Developed at Picatinny Arsenal, the experimental 280mm Atomic Cannon could fire an atomic projectile. As the first nuclear artillery weapon, it was fired on 23 May 1953 at the Nevada Test Site, but the cannon had numerous drawbacks as a battlefield weapon: it was too heavy, had limited range, was difficult to transport, and was "obsolete as soon as [it was] deployed" (Gaither 1997:10-11, 13; Bacevich 1986:74-75).

On 1 April 1950, the NAD was officially disestablished and the NARL was redesignated the Naval Air Rocket Test Station (NARTS), under coordination control of the Third Naval District Commandant and the management control of the Bureau of Aeronautics (BuAer). All the physical facilities of the Lake Denmark Depot became a part of NARTS. NARTS and RMI began a vigorous campaign of testing. Extensive engineering studies were made and plans for a new 350,000-lb thrust, rocket test stand were made. NARTS worked on the qualification tests for rocket engines, safety and reliability determinations, evaluations of contractor productions, age-test programs and investigations of deficiency in production items in operational use. Qualification tests were completed in systems for BULLPUP (engine XLR-58-RM-2), the SPARROW (XLR-44-RM-2) and the Air Force SIDEWINDER. NARTS began to offer its services to a wide range of non-military businesses, including Standard Oil and Olin Industries, to name just a few (Baranowski 1959; NARTS ca. 1959, ca. 1960).

A 1957 NARTS brochure detailed that the following activities were accomplished between 1951 and 1954: the development of analytical methods for hydrazine, methyl hydrazine, butyl mercaptan and mixed acid; the development of methods for inhibiting corrosion of nitric acid; the design and construction of the largest rocket test stand in the east; the discovery of the mechanism of corrosion of stainless steal by nitric acid; and the first complete qualification test of rocket engine by a government laboratory. The brochure was quick to point out that these were only the projects that could be named (NARTS ca. 1957).

As indicated above, between 1951 and 1953, the Navy conceptualized and constructed its premier rocket-engine testing area, Area E. The East coast's largest rocket test stand was a collaborative effort between NARTS and RMI. It was the construction of this massive test stand that would eventually lead to the apex of NARTS's rocket activities: testing of the X-15 rocket engine (XLR-99).

3.3.3 Inter-war Years and the Pentomic Army (1955-1963). This period is generally characterized by the increasing belief among American policy-makers that the Soviet Union was a nuclear threat, an issue that would come to dominate the Cold War. In May 1955, the Warsaw Pact was formed to offset NATO. The military alliance consisted of the Soviet Union, Poland, Hungary, Bulgaria, East Germany, Rumania, Albania, and Czechoslovakia. In the following month, the United States conducted its first national civil defense exercise. Although the B-52 was deployed by the United States in 1955, there was a widespread belief that a "bomber gap" existed between the U.S. and Soviet Union. (This was only the first "gap"-issue to be raised by American politicians: missile, warhead, and conventional forces gaps would follow.)

Soviet and American intercontinental ballistic missiles (ICBMs) made their first appearance in 1957. Concurrent with these were developments in space. While the United States had announced, in 1955, its intention to launch a satellite, they were beaten to the punch by the Soviets who launched Sputnik in October and Sputnik 2 (carrying a dog) in November 1957. Three months later, the United States launched Explorer I into orbit, and thus began the "Space Race."

During the latter part of this period, Cuba became one of the dominant issues for the United States after Fidel Castro assumed power after overthrowing the regime of Fulgencio Batista. In 1960, the United States began training Cuban exiles to undermine Castro's regime. The following year, the United States broke diplomatic relations and later sponsored an invasion of Cuba by the American-trained exiles. Known as the Bay of Pigs incident, the operation failed when promised American air support was withdrawn and Castro's forces quickly routed the exile force. In October 1962, as a result of U-2 photographs showing the construction of Soviet missile sites, President John Kennedy ordered a naval blockade of Cuba. Threatening to invade the island if the bases were not removed, Kennedy also informed Khrushchev that an attack on the United States from the Cuban bases would be considered an attack by the Soviet Union and result in full American retaliation. Less than a week after the crisis began, Khrushchev agreed to dismantle the bases. In return, the United States withdrew its missiles from Turkey and promised not to sponsor incursions by Cuban exiles.

Significant events with Cold War repercussions also occurred in other parts of the globe. In 1961, East Germany closed the Brandenburg Gate that linked the two halves of the divided City of Berlin, and began construction of the infamous Berlin Wall, another Cold War icon. At about the same time, the American advisors arrived in Vietnam, deepening American involvement there. After years of bickering and on-again, off-again aboveground testing, the Limited Test Ban Treaty was agreed to and signed by the president. The period came to a tragic close with two assassinations in November 1963: President John Kennedy and Vietnamese President Ngo Dinh Diem.

By this time it was clear that both the United States and the Soviet Union had enough nuclear weapons to destroy the other side several (to become many) times over and that enough would survive a first strike to provide a significant retaliatory force. This situation gave birth to the concept of "mutually assured destruction" or MAD. This balance, often referred to as the "Balance of Terror," prevented nuclear weapons from ever being used. As a result of the

lessons learned in the Cuban missile crisis, as well as the growing size of the nuclear arsenals (ICBMs and strategic bombers) on both sides, in June 1963 the "Hot Line," a permanent communication line, was established between Washington and the Kremlin to prevent accidental war.

As with the arms race, the space race accelerated exponentially from the Sputnik launches in late 1957. The National Aeronautics and Space Administration (NASA) was created the following year and the Mercury Project was established soon after. In 1959, less than two years after the launch of Sputnik, the Soviets crash-landed a spacecraft on the moon. In April 1961, Soviet cosmonaut Yuri Gargarin became the first human in space, followed in May by Alan Shepard, the first American in space. About the time that NASA was created, the Advanced Research Projects Agency (ARPA) was established within the DoD to oversee research primarily in weapons and defense projects as well as the military aspects of space. The agency later became the Defense Advanced Research Projects Agency (DARPA), an organization that controlled much of the significant Cold War military research (Space Division HQ 1993).

During this period, the U.S. Army was in a state of transition. Early on, the Army's mission was viewed by some as mop-up and occupation following a nuclear encounter. The Air Force was in charge of both the strategic bomber and ICBM forces and, as Air Force budgets increased, Army budgets decreased. Within the American military scheme, the Army was quickly being relegated to a secondary role. This trend was reversed by two events towards the end of this period. The first event was the introduction of tactical nuclear weapons (e.g., nuclear artillery). The second was that the Army was put in charge of the ABM development program, keeping the Army in the "nuclear game." Another action taken by the Army to adapt to the nuclear battlefield was the formation of the Pentomic Army (below). As events unfolded throughout the Cold War, it became obvious that a nuclear war was unlikely to occur and a strong Army was needed to handle the numerous conventional military actions that were likely to occur during the second half the twentieth century and into the twenty-first century.

Pentomic Army. Two events in the early 1950s, the transformation of the atomic bomb into a battlefield weapon and the Korean War, prompted the Army to reevaluate its mission and organization (Burford 1994:86). While in Korea, General Maxwell Taylor concluded that the traditional triangular Army structure, based on three large infantry regiments, was outdated (Taylor 1991:213). Taylor believed that modern battlefield communications allowed a division commander to oversee up to five subordinate units. The Korean Conflict contributed to significant changes in American national security policy and military strategy (Bacevich 1986:8). The period after the Korean War created considerable changes in American foreign and defense polices.

As Chief of Staff, Taylor pursued the Pentomic concept, which consisted of five reinforced battalions called battle groups (Taylor 1991:213). The new Pentomic Division was organized based on the theory that no conventional division could fight as a single entity on the nuclear battlefield of the future, which would require five separate combat groups each formed by an enhanced infantry battalion, capable of independent operations (Burford 1994:86). All infantry divisions adopted the Pentomic structure with the battle group as the basic fighting unit of the division. Support units also conformed to a similar cellular multiple of five to facilitate function. The artillery group was divided into five batteries of howitzers and a battery of HONEST JOHN rockets.

Opponents of the new division contended that the versatility of the HONEST JOHN was limited in comparison to conventional artillery (Taylor 1991:214). Other complaints about the Pentomic

concept included such areas as manpower and firepower, service support, and command and control. As early as 1959, the Army began planning another reorganization. In 1961, a new divisional concept known as ROAD (Reorganization Objective Army Division) was announced. The new structure increased firepower, improved air-mobility and enhanced command and control by the addition of brigade and battalion headquarters (Smith 1991:11; Hart 1978:76). Basic components of the new ROAD organization were nine infantry battalions, a cavalry squadron and three artillery battalions.

As the Army's emphasis shifted to nuclear issues, so did Picatinny's. As noted, one of PICA's most notable achievements occurred during this period: the development of an atomic shell that was capable of being fired from an artillery gun (i.e., 280mm Atomic Cannon). Later, Picatinny directed the development of other sizes of atomic weapons, including the Davy Crockett atomic mortar (in 1958), for use by the infantry. As noted, PICA engineers also participated in "the development of the explosive, fuzing, safing, and arming devices for warhead [systems] for the NIKE family of missiles, and developed warheads for most other Army atomic weapons, including the HAWK, CORPORAL, HONEST JOHN, LITTLE JOHN, LACROSSE, REDSTONE, PERSHING, SERGEANT, SAM-D, LANCE, and SAFEGUARD" (Gaither 1997:102, 10; Kaye 1978; USAAMCCOM 1987:2). The HONEST JOHN and LACROSSE rockets were both intended for support of the Pentomic concept. Work was undertaken on converting some nuclear warhead systems into conventional systems, much as with the HONEST JOHN (Stein and Trevena 1962).

At NARTS, RMI began a serious expansion of its test areas, stands and buildings. On 30 April 1958, RMI and Thiokol Chemical Corporation merged and RMI became the Reaction Motors Division (RMD) of Thiokol. Thiokol had been working with the Army at Redstone Arsenal, Huntsville, Alabama, and at Longhorn Army Ammunition Plant, Marshall, Texas, and in 1958 it won an Air Force contract to build the first stage rocket motor for the revolutionary Minuteman ICBM. Work continued apace at the NARTS RMD site.

NARTS began using the new Test Area E rocket test stand, continuing work on a variety of rocket and rocket-related projects. Achievements for the year 1955 included the origination of Mollier charts for the decomposition of hydrogen peroxide and the development of a shorthand method for rocket propellant performance calculation (NARTS ca. 1957). Mollier charts, sometimes called psychrometirc or I-x diagrams, where named for German scientist Richard Mollier (1864-1935) who developed a graphic method for defining air properties (Morlan 2003).

The initial testing, including test firings of the XLR-99 rocket engine intended for use in the X-15, began in 1958 and was conducted exclusively at the NARTS Test Area E facility. However, the excessive noise, vibration, and clouds of hydrogen peroxide, immediately caused a backlash from the surrounding neighborhoods (*The Citizen* 1958-1960). Although NARTS and RMD took out full-page advertisements declaring that the excessive noise was the "sound of freedom" and undertook vibration studies concluding that there was no excessive vibration, a number of citizens filed lawsuits against Thiokol Corporation, the parent company of RMD, which had been contracted to test and evaluate the engine (*The Citizen* 1958-1960; Winter 1987).

Quite unexpectedly and in spite of its many accomplishments, NARTS was disestablished on 1 August 1960, and the facilities reverted to the U.S. Army for incorporation into Picatinny Arsenal. The Army was ecstatic with the new addition proclaiming it would immediately begin work on liquid rocket propellants, but it never did (PICA ca. 1961). Almost immediately the Army leased the entire Lake Demark test area to Thiokol, and RMD continued its work on the XLR-99.

3.3.4 Vietnam Period (1963-1973). This period began with changes in leadership in both the Soviet Union and the United States. In the USSR, Khrushchev had been a reformer. His reforms began with his de-Stalinization programs in the mid-1950s, after which he targeted party corruption including the privilege enjoyed by the party elites. As a result, as his reforms proceeded, his political support within the party began to whither. The Cuban debacle provided the excuse that the anti-reformists sought and Khrushchev was ousted in October 1964, replaced by Leonid Brezhnev and Alexei Kosygin. Khrushchev's reform programs were immediately halted. The new leadership was fully aware that the Cuban setback was due in part to disparity in the two nuclear arsenals with the Americans holding a clear advantage at the time of the crisis. As a result, the Soviets embarked on an accelerated nuclear build-up resulting in parity with the United States.

In the United States, Lyndon Johnson became president after Kennedy's assassination. The new president's domestic programs, including civil rights and the "War on Poverty," were overshadowed by the deepening American involvement in Vietnam. In August 1964, the North Vietnamese allegedly attacked two American destroyers in the Gulf of Tonkin. Several days later, Congress passed the Gulf of Tonkin resolution giving the President wide discretionary powers to retaliate using military forces. Fifteen years of indirect (or proxy) involvement ended in 1965 when U.S. Marines landed at Da Nang. In November, the first direct action against the North Vietnamese forces occurred in the la Drang Valley and by the year's end nearly 200,000 men were in-country. A year later, the number of U.S. forces doubled to just less than 400,000.

U.S. involvement in Vietnam sparked the beginning of the anti-war movement in 1966. The movement polarized the United States and played an important role in the eventual withdrawal of American military forces from Vietnam. The news media played a significant role in the war, as this was the first conflict covered by television.

Between 1967 and 1969, the number of American forces in Vietnam hovered around the half-million mark. Important milestones in the conflict included the Tet offensive, initiation of the Paris peace talks in 1968; President Richard Nixon's Vietnamization program in 1969 that marked the initial step toward the withdrawal of American troops; and the invasion of Cambodia and Laos in 1970 and the subsequent killing of four student protesters at Kent State University and two at Jackson State College. These two incidents, along with the publication of the "Pentagon Papers" in early 1971, are generally believed to be the catalysts that moved the majority of the American public into the anti-war camp. Over the next two years, the virtual stalemate in Vietnam continued. Nixon's stepped-up bombing of North Vietnam in 1972 appeared to put added pressure on the Paris negotiators leading to the Paris Accords in January 1973. Active American military presence in Vietnam ended by the end of March, although the bombing of Cambodia continued until August. In November, Congress passed the War Powers Act, which limited the President's power to wage an undeclared war.

Research into ABMs began shortly after the Second World War and by the mid-1960s both the Soviet Union (the Galosh ABM system) and the United States (Sentinel) had developed deployable systems. A Ballistic Missile Defense (BMD) program was well established by the mid-1960s. In fact, over four billion dollars were spent on BMD research and development between 1955 and 1967 (Reiss 1992). The Sentinel system was designed to protect the United States from a relatively unsophisticated ICBM attack (China had exploded an atomic bomb in 1964 and a hydrogen bomb in 1967).

Other advances in military technology occurred during the period and were coupled with advances in the space program and the experiences of the Vietnam War. Laser-guided

munitions, which were first used during that war, were one such advance. In the United States, the MINUTEMAN II ICBM entered service in 1966 and MRV technology had been developed allowing a single ICBM to carry multiple warheads. This development was followed in 1970 by deployment of the MINUTEMAN III, which was capable of carrying multiple independently targeted re-entry vehicles (MIRVs). MIRVs had an important effect on the arms race and on arms reduction negotiations. It lowered the cost of nuclear delivery since nuclear warheads are inexpensive relative to an ICBM. This resulted in an increase in the nuclear arsenals at very little cost. Nuclear arms reduction negotiations now had to consider both numbers of warheads and numbers of launchers. These technologies also sent the ABM researchers back to the drawing boards and prompted SALT I.

In space, the U.S. Ranger VI spacecraft landed on the moon in 1964, followed in 1966 by the soft landing of Surveyor I. At about the same time, the Soviet Venus IV landed on Venus. In July 1969, astronauts Neil Armstrong and Buzz Aldrin landed on the moon, fulfilling President Kennedy's pledge that the United States would put a man on the moon before the end of the decade. The final lunar landing, Apollo 17, took place in December 1972.

The continued involvement of the United States in the Vietnam War created a gradual increase in the country's budget for chemical and biological weapons development (Smart 1997:56). At that time, the United States explored the possibility of creating more "humane" chemicals that would remove or greatly decrease the necessity to kill (Gaither 1997:26). Much of this research was conducted at Edgewood Arsenal where the incapacitants EA (Edgewood Arsenal) 1298 and BZ were developed. American forces extensively used anti-crop weapons and defoliants, most notably Agent Orange, developed at Fort Detrick (Harris and Paxman 1982:191). During the 1960s, outdoor chemical and biological test ranges as well as indoor laboratories were used at Dugway Proving Ground, Utah (Harris and Paxman 1982:190). In 1967, the Army began requesting money to produce binary agents (Gaither 1997:31). Binary chemical weapons, containing less lethal precursors, created lethal nerve agents only after the weapon delivering the agent had been fired and two separate components were mixed in flight to produce the lethal agent (Harris and Paxman 1982:232). While the escalating American involvement in Vietnam led to an increase in budgetary allocations for chemical weapons development, the American public began to exhibit pronounced hostility toward chemical and biological weapons. In 1969, President Nixon initiated action against chemical and biological warfare by reaffirming the no-first-use policy for chemical weapons (excluding defoliants, such as "Agent Orange"), by resubmitting the Geneva Protocol to the U.S. Senate for ratification, by renouncing the use of biological weapons and by limiting research to defensive measures only (Smart 1997:64).

After the 1962 reorganization of the Army, which created the Army Materiel Command and abolished the seven technical services (of which the Ordnance Department was one), Picatinny Arsenal was subsumed into AMC. The Munitions Command (MUCOM), one of five commodity commands under AMC, was headquartered at Picatinny with the responsibility of providing ammunition. "More specifically, it was in charge of forecasting future requirements; designing, developing, producing, and fielding munitions; inventory logistics; maintenance of munitions stocks; and the retirement and demilitarization of obsolete or damaged munitions" (Gaither 1997:50). PICA was one of three primary commodity centers under MUCOM (Edgewood Arsenal and Frankford Arsenal were the others) and was responsible for conventional and nuclear munitions. Closely related to MUCOM was the Weapons Command (WECOM), with its headquarters at Rock Island Arsenal. WECOM was responsible for "the production of weapons and weapons systems (other than missiles) for the Army, and with the preservation of manufacturing know-how" (Gaither 1997:50). In 1973, MUCOM and WECOM merged to form the U.S. Army Armament Command (ARMCOM), headquartered at Rock Island Arsenal, with

jurisdiction over PICA. During the Cold War, Picatinny Arsenal was the commodity center for both nuclear and conventional munitions. During the 1960s, PICA was “responsible for the management of research and engineering and such procurement, production, and quality assurance as directly applied to commodity management” (Gaither 1997:102).

As during the Korean conflict, PICA moved into production mode during the Vietnam War until industry could be refit to resume that role. PICA continued working on new families of ammunition for specialty guns including the development of 40mm ammunition for helicopter and infantry use, development of ammunition for the highly versatile 157mm gun, the streamlining of the 81mm and 4.2-in mortar shell to provide greater accuracy and range, and increasing the range of the 105mm and 155mm howitzers (Kaye 1978).

The arsenal also developed and engineered a new weapon system for use in Southeast Asia called Beehive ammunition. Beehive ammunition, produced in varying calibers, dispersed great numbers of tiny, lethal steel darts. This type of ammunition was particularly useful in Vietnam since it lent itself to use against troops in frontal mass assault as well as those entrenched behind the cover of heavy jungle (Kaye 1978). The arsenal also was involved in the study of the placement of mines and the revision of mine-warfare doctrine as a result of the creation of Mass Scatterable Mines. PICA worked on the development of anti-tank and anti-personnel mine systems as a result of new technology and doctrine (Kaye 1978).

Although NARTS had been disestablished, RMD continued to work on various rocket programs including the X-15 engine. However, changes in rocket development, notably the switch from liquid to solid propellants, caused a decline in business for the Denville Thiokol plant. Further, its location undermined the plant’s ability to attract clients like NASA, which sought to make bigger and more powerful rocket engines. Although Lake Denmark had been secluded in 1949, the area by the late 1960s had grown substantially, creating a plethora of complaints from residents about noise and damage form shock waves. Moreover, the New Jersey State Supreme Court had ruled that Thiokol was liable for property damage caused by the testing of the X-15 (Winter 1987). The company ceased work in the liquid propulsion field by 1970 and less than two years later it had ceased its operations at Lake Denmark (Shesta 1978, Ordway 1985, 1987). Rocket engine testing had ended at Picatinny Arsenal.

3.3.5 The Final Years of the Cold War.

Post-Vietnam War Years (1973-1980). Following its Vietnam War experience, the United States became somewhat withdrawn from the international political arena and unilaterally reduced defense expenditures. In 1974, the Watergate affair led to President Nixon’s resignation and contributed to this inertia and introspection. This condition was compounded by the Arab Oil Embargo (1973-74) and the fall of Saigon in April 1975 to the communists. The Soviet Union (as well as Cuba) used this period to expand their influence in Africa, the Caribbean and Central America. Examples include the Cuban involvement in Angola and Grenada, the civil war in El Salvador, and the Marxist regime in Nicaragua. During this period, the Soviet Union reached parity with the United States in strategic nuclear weapons and deployed the SS-20 medium range ballistic missile (MRBM) targeted at Western Europe. These actions by the Soviet Union during this time did not go completely unanswered by the United States despite its apparent malaise. In 1979, NATO announces dual track Intermediate Nuclear Forces (INF) deployment to counter the Soviet SS-20.

The most important example of Soviet expansion was its invasion of Afghanistan in 1979. Afghanistan became a proxy war similar to Vietnam with the United States turning the tables by

supplying Afghani rebels through the Central Intelligence Agency (CIA). The Red Army, mired in Afghanistan for ten years, lost 30,000 men. (The United States lost 57,000 in Vietnam.) The war became as unpopular in the Soviet Union as Vietnam had been in the United States. The United States put additional pressure on the Soviet Union by re-establishing diplomatic relations with China in 1979 and giving what support it could to Solidarity and worker unrest in Poland (1980).

Beginning approximately in 1975, reports circulated that chemical and biological agents had been used in various small wars in Southeast Asia and Afghanistan, and these reports gained the attention of the United States. Vietnamese and Russian forces were suspected of possibly using chemical weapons in Laos. The United States perceived the use of chemical and biological weapons by the Soviets as an indication that the Soviets were continuing an active chemical and biological program (Smart 1997:67-68). In 1980, the United States publicly stated the Soviets' chemical warfare had been used in Southeast Asia and Afghanistan.

Following the election of Jimmy Carter as president in 1976, efforts by the United States as peacemaker, particularly in the Middle East, met with some success (the Camp David Accords in 1978, for example). President Carter recommended bolstering NATO forces and ending *détente*, but his administration also negotiated the SALT II Treaty, which was signed in 1979, but never ratified. The United States, however, was unable to prevent the expulsion of the Shah of Iran and the subsequent takeover of that country by an Islamic government hostile to the United States. The prolonged Iranian hostage crisis, in which Iranians held American embassy personnel, and the subsequent failed rescue attempt contributed to Carter's defeat by Ronald Reagan in 1980.

While research in military technology continued during the period, few new deployments occurred. The Safeguard ABM system was deployed near at Grand Forks Air Force Base, North Dakota, in April 1975. However, Congress shut the site down four months later citing the ABM Treaty and the technical difficulties associated with the system. These large, phased-array radars were vulnerable to attacks that could blind the system. In addition, explosion of the Spartan and Sprint warheads could blind the system, too. On a political level, the ABM was seen by many as destabilizing and an arms-race catalyst. The Soviets continued the operation of their ABM site protecting Moscow and the U.S. Army was directed to continue its research as a hedge against Soviet advances.

Following the Apollo moon landing, the American space program contracted and NASA concentrated on development of the space shuttle. The Soviets focused on space station development and research into prolonged space flight. There was some cooperation between the two programs, punctuated by the Apollo-Soyuz link-up in 1975. The U.S. Viking I spacecraft landed on Mars the following year.

After the Vietnam War, PICA continued to explore ways and means of developing new and improved versions of existing munitions that would be required to meet the challenges of future confrontations of a different nature (Kaye 1978). The arsenal continued to work with the development of nuclear and conventional warheads, rocket-assisted projectiles, tank weaponry, and flare development. By 1974, Picatinny became the home to the Large Caliber and Nuclear Munitions Center, which was responsible for research, development and engineering of nuclear weapons. At that time, it was also "'the lead laboratory for studies in energetic materials and was 'charged with the formulation, coordination management and conduct of comprehensive basic research, exploratory development and advanced development programs executed by eleven (11) separate government agencies'" (Gaither 1997:102, citing USAARMCOM ca. 1975:1-6).

In 1977, ARMCOM split into R&D and readiness subcommands—Armament Research and Development Command (ARRADCOM) with headquarters at PICA and Armament Materiel Readiness Command (ARRCOM) with headquarters at Rock Island Arsenal. PICA's mission continued to include research and development of new and improved versions of existing munitions and weapons. This division was only temporary because in 1983 the subcommands were reunited as Armament, Munitions, and Chemical Command (AMCCOM) with its headquarters at Rock Island. PICA subsequently became the home of the Armament Research and Development Center (ARDC) (Gaither 1997:51, 102-103; Kaye 1978). ARDC was "responsible for research, development, procurement, and production support for the Army's nuclear arsenal, and for the development of future nuclear gunnery." PICA was the home of the Army's Large Caliber Weapon Systems Laboratory, which conducted R&D for nuclear warhead components and was the lead laboratory for 155mm nuclear artillery development and the design of nuclear components (Gaither 1997:103).

During this period, the Army began to experiment with ballistic rail guns and conducted penetration studies at PICA. A ballistic rail-gun track and associated test cells were built in the former NARTS Area D to accommodate that study. The track and the gun are still used for occasional special testing; however, a new ballistic rail-gun site was scheduled for construction in the 600 Testing Area of the installation in 2004.

The military services became more and more involved in simulation studies as a result of the high cost of munitions systems, the increasing complexity of weapons systems, and a number of international bans limiting some types of testing. As a result, simulation studies would play a larger and larger role in weapons and materiel research, development, testing and evaluation. Toward this end, in 1975, a Track Accelerator was installed at PICA to simulate and evaluate effects of acceleration on missile components (Gaither 1997:71).

NARTS and RMI/RMD work on the XLR-99 X-15 rocket engine was reevaluated during the development of the space shuttle, and proved invaluable to the shuttle program development. "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). Test sites for this pioneering program continued to be used for a variety of activities, none of them related to the testing of rocket engines.

The Reagan Era (1981-1989). The Reagan era is discussed separately because the period is distinct, especially when compared to the Ford/Carter era. Within the first year of his administration, President Reagan began to fulfill his campaign promises regarding the rebuilding of the American military. He directed the construction of 100 B-1 bombers and pressured Congress to fund the deployment of the MX ICBM, which was eventually authorized (1983). To counter the Soviet SS-20 threatening Western Europe, Reagan encouraged European governments to accept deployment of ground-launched cruise missiles and the Pershing II. Reagan presided over the largest peacetime military expansion in American history. Ironically, at the end of the first year, he proposed the "zero option," the complete elimination of nuclear weapons. This proposal set the stage for the Strategic Arms Reduction Treaty (START) negotiations that began the following year.

By the end of his second term, Reagan presided over the deployment of numerous new weapons systems, including strategic systems like the B-1 bomber, air-launched cruise missiles, and the MX ICBM (renamed "Peacekeeper"); tactical systems such as ground-launched cruise missiles and PERSHING II; and upgrades of the F-15, F-16 and B-52. New armored vehicles,

such as the Abrams main battle tank and the Bradley armored fighting vehicle, were deployed as well as the PATRIOT, an air-to-air missile with ABM capabilities. In March 1983, two weeks after his “Evil Empire” speech, President Reagan proposed the Strategic Defense Initiative (SDI), which called for development of a ballistic missile shield using the most advanced technology.

This was a period of political and economic turmoil in the Soviet Union. It had four different leaders in less than three years: Leonid Brezhnev died in November 1982; his successor, Yuri Andropov, the former KGB head, died in February 1984; Andropov’s successor, Konstantin Chernenko, a hard-liner, died in March 1985; and Mikhail Gorbachev, who came to power in the spring of 1985. Gorbachev was the first Soviet leader who did not rise to power under Stalin. After a year in office, he introduced *Perestroika*, a restructuring of the government and bureaucracy. Three years later he introduced the idea of *Glasnost* or openness. The cost of the arms race had been a significant strain on the Soviet economy that had often been referred to as a Third-World economy. Up to this point, the arms race focused primarily on nuclear weapons, which are relatively inexpensive. Faced with the prospect of having to match the American lead in military technology, and especially a significant upgrade of its conventional force, the fiscal pressures were too much to bear. This strain became particularly apparent when Reagan proposed SDI.

In addition, the Soviets were unable to consolidate what little they achieved during the Ford/Carter era. The Cubans were ejected from Grenada in 1983 and disengaged from their involvements in Africa, primarily Angola. Unrest reverberated throughout the Warsaw Pact, amplified by events in Poland. Political and economic instabilities were exacerbated by a major meltdown that occurred at the Chernobyl nuclear power plant in April 1986. In all, it was not a good decade for the Soviet Union, and the precariousness of their situation placed extreme pressure on the Soviets to come to the bargaining table. In addition to START, the Nuclear and Space Talks began in Geneva in 1985. In 1986, Gorbachev proposed the complete elimination of nuclear weapons in 15 years, provided that the United States abandoned SDI. While little was accomplished at the summit, Reagan and Gorbachev did sign the Intermediate-range Nuclear Forces (INF) Treaty in 1987 and early in the following year the Soviets agreed to withdraw from Afghanistan. In December 1988, Gorbachev announced that the Soviets would unilaterally cut its conventional armed forces by 500,000 men.

Technology advanced on a number of fronts during the period. In space, newer and more advanced reconnaissance satellites were launched by both sides and were a factor in the verification aspects of some of the treaty negotiations. The maiden voyage of the space shuttle *Columbia* took place in April 1981 and launches continued throughout the decade into the present, although the program paused following the *Challenger* explosion in 1986 (as it would again following the disintegration of *Columbia* over the American Southwest in 2003).

Great strides also were taken on two fronts. The first was in conventional and nuclear forces, some of which were enumerated above, and to these can be added stealth technology, embodied in the F-117; the use of the Global Positioning System (GPS) for battlefield management; general advances in computerization, night warfare, smart and laser-guided weapons; and helicopters, among others. The ICBM force was upgraded by deployment of the Peacekeeper (MX), which became operational in 1986. The last remaining TITAN wing was decommissioned the following year.

The other military-technology front entailed research associated with SDI. Between 1983 and 1985, SDI became the Pentagon’s largest single research and development program as well as

the most capital-intensive program of the Cold War (Gaither 1997). Prior to SDI, the 1985-1989 budget projection for ballistic missile defense was $13 billion. The actual spending for that period included $16.2 billion for the Strategic Defense Initiative Organization (SDIO) and the Department of Energy (DoE) alone. These, however, were not the only agencies spending money on SDI research. For example, the Army SDI budget in 1988 was $2.5 billion. SDI contracts in 1987 from all sources totaled $10.7 billion. Cost estimates for deployment of Phase 1 (initial deployment) of the Strategic Defense System (SDS) were placed between $69 and $150 billion and full build-out of SDS at $1 trillion (Reiss 1992). Later, following the introduction of Brilliant Pebbles, the Phase 1 cost estimate was lowered to $55 billion (SDIO 1990).

One of the first and most promising areas of research, after ABM, was the directed energy weapon (DEW). This class includes lasers, of which there are a number of varieties, and particle beams. Since placing these weapons in space violated a number of agreements, including SALT, initial research focused on ground-based platforms. In 1985, the ground-based Mid-Infrared Advanced Chemical Laser (MIRACL) destroyed a TITAN booster. However, MIRACL is one of the largest and most powerful continuous beam lasers ever built. Edward Teller, a vocal SDI advocate, and others favored Excalibur, a nuclear pumped x-ray laser touted as a super weapon. Excalibur and x-ray lasers were researched for a number of years but were eventually abandoned as impractical. In 1986, both kinetic energy weapons (KEW) and particle beam weapons were successfully tested. Much of this research was already taking place and not included in SDI funding. The ground-based DEWs were always problematical since the beams are significantly affected by particles in the atmosphere. Also, since ground-based DEWs could not intercept ICBMs in the booster phase, MIRVs (multiple independently targeted re-entry vehicles) and decoys would likely overwhelm them.

In 1990, the Brilliant Pebbles concept was introduced. The system would consist of satellites, each armed with ten interceptor rockets. The advantage, and the reason for widespread support, was that ICBMs could be intercepted before they deployed their MIRVs. DEWs would require a complex system of orbital mirrors to boost phase intercepts. However, SDI was overtaken by political events.

By the fall of 1988, the Soviet policies of *glasnost* and *perestroika* had begun to undermine the single party, Communist governments of the Warsaw-Pact nations. Beginning the following year, Communist-dominated countries in Eastern Europe began leaving the Soviet bloc one by one. By spring, elections in Hungary had purged the Politburo of Communists. In June, elections in Poland ushered in a majority of Solidarity-affiliated candidates into parliament. Continuing demonstrations in Czechoslovakia lead to the collapse of the Communist government and the election of Vaclav Havel as president. By November, East Germany's long-serving, hard-line premier Erich Honecker and Bulgarian President Todor Zhivkov had resigned, and the Berlin wall had been breached. In the following month, Rumanian President Nicolae Ceausescu was overthrown, and later executed along with his wife. This same dynamic would undermine local governments in the USSR, inspiring independence movements among the numerous ethnic groups in the various Soviet states, such as the Baltic states and the Islamic republics along Soviet southern tier. The Cold War was over.

Picatinny continued to play a major role in the final years of the Cold War when it was designated as the Army center of nuclear weapons and warhead research and development (Gaither 1997). By 1977 most production of weapons and ammunition had ceased at PICA and during the 1980s, research and development activities at PICA were renamed the U.S. Army Armament Research and Development Center (ARDC). In 1986, ARDC was designated the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) with its

headquarters at PICA. Representing the technical expertise of the U.S. government in guns and ammunition of all sizes, from pistols to howitzers, ARDEC played an essential role in developing items and technologies as diverse as warheads, gun fire control, mines, and smart ammunition, among other responsibilities (ARDEC 1995).

3.3.6 Immediate Post-Cold War Events. With the end of the Cold War, the administration of President George H.W. Bush shifted away from the original SDI concept to Global Protection Against Limited Strikes (GPALS). The research continued, though, and was worth $15 billion under Bush. It continues to the present. Events in 1990 reflected or were a reaction to the apparent end of the Cold War. The American airborne command plane, “Looking Glass,” was taken off continuous alert, the two Germanys reunified and the treaty on European conventional forces was signed. The START was signed in July 1991. In the fall of that year two events occurred which together many consider the unequivocal end of the Cold War. The first occurred in September when the bulk of the U.S. nuclear force was taken off alert. The second was the dissolution of the Soviet Union in December, and the subsequent formation of six independent states—Armenia, Byelorussia (what is now Belarus), Kazakhstan, Kirghizia, Russia and Ukraine. On 25 December 1991 Gorbachev resigned as leader of the defunct nation.

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4.0 Architectural Findings

A total of 318 buildings and structures within Picatinny were surveyed, photographed and evaluated (see Section 1.0 and Appendix B for the list of buildings/structures). The buildings/structures surveyed were constructed primarily between World War II and the middle of the Cold War. By and large, these buildings tended to be small, isolated, and or "lost" structures that had escaped previous surveys but were still appearing on various Real Property lists. Of the 318 surveyed, 109 had been demolished or have deteriorated to the point that they are no longer standing, leaving a total of 209 buildings/structures formally surveyed. Of the 209 standing buildings and structures, 29 of them are family housing. All quarters have been privatized as part of the Residential Communities Initiative (RCI) and are no longer the property of the DoD. The current owner of the properties at Picatinny, Gary Michael Holloway, is responsible for maintaining the historical integrity of any historically significant properties.

In order to facilitate the discussion of these buildings/structures, the presentation of the architectural findings has been divided into six sections: Industrial/Factory Complexes; Testing Associated with Manufacturing and Quality Assurance; Ammunition and Explosives/General Storage; Infrastructure; Base Operations; and Housing. All 209 of the assessed buildings and structures can be subsumed into one of these six broad categories. All buildings/structures were visually inspected and photographed and are detailed in tabular form in Appendix B.

As noted, PICA contains four historic districts that have been determined eligible for the National Register of Historic Places: The Administrative and Research District (under Criteria A and C); the 600 Ordnance Testing District (Criteria A and C); the NARTS Test Area E (Criteria A and D); and NARTS Area D (Criteria A and C) (Guzzo 1999, 2004a). The Navy Commanders Quarters (Building 3250) and its accompanying stable, now a Firehouse (Building 3316), also are eligible for the NRHP (Guzzo 1999). In addition, PICA treats the Cannon Gates as National Register eligible. Three of the properties surveyed are located in two of the historic districts. Building 621A, Ammunition Testing Facility, and Building 623F, Valve House, both found off 20th Avenue, are within the 600 Ordnance Testing District and both buildings are non-contributing elements to that district. Building 178, Chemistry Laboratory, situated off Kibler Road, is within the Administrative and Research District, and is a non-contributing element to that district.

4.1 INDUSTRIAL/FACTORY COMPLEXES

Prior to World War II, the mission of Picatinny Arsenal was to provide the Army with a munitions manufacturing center that included experimental and production plants for a range of propellants and explosives. PICA was an important explosives and ammunition research center, the explosion at the nearby Lake Denmark depot, notwithstanding. The arsenal's facilities continued to serve both the Army and private industry during the inter-war years. By the time of the United States' 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 (e.g., airplane flares and signal smokes), all at experimental or peace-time levels (Thurber and Norman 1983).

During the interwar years (1918 to 1940), PICA 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 also was instrumental in improving and redesigning artillery primers, trench mortars and rounds of chemical and tracer ammunition. Its Research and Chemical

Branch developed fuze powders, primer mixtures, pyrotechnic compositions, propellant compositions, and new high explosives. In addition, Picatinny's mission called for the development of new munition 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, new products or simplified methods of production were made at the arsenal in its newly constructed laboratories and testing facilities. As the importance of Picatinny's research and development activities increased, more emphasis was placed on this R&D function, which would retain at PICA after the war. In one year the job-training methods, research projects and improved work developments originating at PICA and passed along to other plants saved the United States 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 1978).

The Technical Division, created in 1925, was responsible for all R&D 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 and Norman 1983). The new procedure proved less hazardous and less expensive.

The Propellants Subsection 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 the war. The improvement in the production and composition of nitrocellulose powder proved to be significant to the war effort. This subsection also was responsible for studies of powder ignition and the standardization of all Army ammunition testing procedures (Thurber and Norman 1983).

Development of flashless, non-hygroscopic (FNH) cannon powders became an urgent research initiative. The military had a long-standing problem with the chemical compositions of powders that absorbed moisture, which in turn altered the ballistic and chemical properties of that powder. If flashless and smokeless qualities could be added to the non-hygroscopic (i.e., non-water absorbent) qualities, the advantages would be inestimable. Researchers at Picatinny and DuPont both eventually developed non-hygroscopic, flashless powders, but used different research avenues. DuPont developed M1 powder, and Picatinny developed M3. These two powders were tested at the arsenal, both for composition and specific weapons (Thurber and Norman 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 responsibility included artillery fuzes, boosters and grenades. During the war a number of special components were designed and tested at Picatinny, including two types of bomb fuzes, aboveground 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 and Norman 1983). The heavy fog conditions encountered in Europe created a 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. A flare of this type 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).

The Mechanical Branch also created special bombs for special jobs. For example, one of the most important bombs developed by the arsenal for a particular need was created to blow up the Ploesti oil fields in Rumania, a vital source of oil for the Nazi forces. 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 PICA. The development of new and more powerful explosives that were also dependable and could be safely handled was essential to winning on the battlefield. At the beginning of the war, the Allies had only a few special explosives with a higher brisance (shattering effect) than TNT (trinitrotoluene). The two most important were cyclotrimethylene-trinitramine, which the Americans called cyclonite and the British called RDX (Research Department explosive), and pentaerythritol tetranite (PETN). RDX and PETN were too sensitive to be used in a pure state in a shell. As a result, 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. 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).

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 PICA's chemists from developing other explosives. 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% PETN, 43.2% RDX and 28.8% TNT. Preliminary firings at Picatinny revealed that it could be adapted into shaped-charge ammunition, although 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, 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 ensured Picatinny's continuing role in the Army's R&D program.

Fortunately, at the beginning of the war, Picatinny was equipped with almost new laboratory facilities that had been constructed after the 1926 explosion. A series of new laboratories, special storage spaces, and offices facilitated World War II research efforts. During the war, buildings throughout 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 use 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.

While Picatinny made many important materiel contributions to the war effort, one of its greatest contributions was the standardized design of military industrial facilities related to the production of ammunition. This design included all aspects of ammunition manufacture from the creation of casings to the formulations of explosives to the packing and shipping of completed rounds. The arsenal designed production layouts, specific buildings, machinery, special safety precautions and the training programs for the facilities. In order to do this, PICA created pilot production lines and tinkered with all aspects of production to create the safest, fastest, least expensive line possible. When the experiment was completed and the results forwarded to other production facilities, the pilot line could be changed into an entirely new pilot line or could serve almost any other function.

After the war, Gen. Levin Campbell, Army Chief of Ordnance, summarized PICA's contribution to the Allied victory: "Had it not been for Picatinny, it is difficult to imagine how private industry could have met the challenge of war and produced the necessary ammunition in so short a time. Picatinny not only could manufacture ammunition and explosives...but also passed the know-how that was of great help the industry" (Kuranda et al. 1995).

4.1.1 Determination of NRHP Eligibility for Military Industrial/Factory Buildings and Structures. Because the military factory is quite different from the non-military factory, Panamerican evaluated the industrial/factory buildings presented in this report using the following criteria. Determination of NRHP eligibility begins with the determination of a building or site's integrity. Integrity, as noted in Section 2.2, is the ability of a property to convey its significance. To be placed in the NRHP, a building must be significant and it must have integrity. Integrity is determined by seven elements: location, design, setting, materials, workmanship, feeling and association. To retain integrity, a property must possess several, and usually most, of these aspects. Although determining integrity is subjective, it 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).

Clearly, integrity is lost when a structure has been allowed to deteriorate or has been severely damaged by weather or fire/explosion, and a few structures at Picatinny are in such a state. In Picatinny's case, a number of these buildings have been left to deteriorate because of the excessive levels of toxic chemicals found in and around them, a not uncommon occurrence on properties associated with industrial processes. Others have deteriorated from disuse. This is especially true of structures that have endured intensive, potentially destructive, past uses, which have contributed to their present dilapidation. Integrity also can be lost when a structure has been changed beyond recognition or been moved. But more importantly, especially for this evaluation, integrity can be lost when the siting of a structure has been changed.

Setting is the physical environment of an historic property. While location refers to a specific place where a structure was built or an event occurred, setting refers to the character of the place. It involves how, not just where, the property is situated and its relationship to surrounding features and open space. Setting reflects the basic physical condition under which a property was built and the functions it was intended to serve.

A great many structures at PICA associated with industrial process have lost their setting and setting is the very element that defines them (Nolte et al. 1999b). An Army industrial setting comprises a number of large and small buildings, all directly related. The industrial process was

spread out among several structures to reduce the chance of sympathetic explosion and the loss of an entire plant. The loss of only one building specializing in only one activity could be quickly replaced, whereas an entire factory housed in a single building could not be so easily restored. This concern resulted in the construction of redundant buildings or easily adaptable ones, reducing the risk of complete loss of production.

Through trial and error and exigencies brought about by World War I, the Army discovered that the best industrial buildings were those that were most easily changed. A building outfitted to load only one type of ammunition was useless for loading another type; therefore, Army industrial buildings tended to be large, open-space structures with fire and blast walls at various intervals. Some possessed specialized cranes, gravity feed systems, and isolation rooms, but they were never so specialized that they could not be adapted to other uses or to the movement of new materials. Traditional magazines, office buildings, change houses, storehouses, and power-generating structures were enfolded into the industrial line. The easy adaptability of former industrial buildings to other uses after production ceased is testament to this concept. The military-industrial line was created to be efficient, safe, productive, adaptable and inexpensive.

PICA's industrial lines performed a variety of functions, so that describing a typical line is difficult. These lines contained, however, a number of common elements. In general, one or two large structures dominated a single production line where the product was made or loaded. These buildings set the context for the rest of the plant. These larger buildings were connected to number of smaller support buildings by a series of covered walkways or monorails. The walkways provided pedestrian cover as well as extra workspace for a line that many times covered several acres. The monorails moved materials from one space to another in safety. Many of the smaller buildings, such as magazines, were quite a distance away in order to reduce the chance of sympathetic explosion, and a monorail was an efficient way to move material to and from these distant places. Other support buildings that might have been connected by walkways included employee change houses, laboratories, offices, paint and box buildings, and shipping and receiving buildings. One of the most essential elements of a line was the railroad connection. At one time, PICA had its own rail yard and was covered by an intricate web of railroad tracks. While trucks played a role in the movement of materiel, the train was the universal transportation element in the production sequence.

None of the production lines at Picatinny remain intact (Nolte et al. 1999b; Nolte 1998). All of them have lost their major production building or those buildings are in the approval process for demolition because of toxic chemical contamination. Further, the railroad lines that connected each line to the other are no longer extant and the covered walkways that connected the line to its component buildings are missing or in a state of serious disrepair. Some areas, like the 500 Powder Area, have been so fractured by the loss of original buildings and introduction of new ones that it is difficult to tell that any industrial activity ever occurred there. In other areas, structures stand isolated, having lost all defining elements. These solitary structures tell little and mean even less without the proper setting. Such serious loss of setting and, therefore, integrity means that no industrial areas or associated structures at Picatinny are eligible for the NRHP.

4.1.2 Industrial Complexes. The industrial complexes will be discussed in numerical order.

200 Area Shell Component and Loading Area/Propellant Powder Plant. The 200 Area is located in an area roughly bound by Phipps Road to the north, Reilly Road to the south, Farley Avenue to the west and the 700 Area to the east (Figure 4.1). It is currently undergoing extensive demolition, renovation, and improvement. The buildings in the area are:

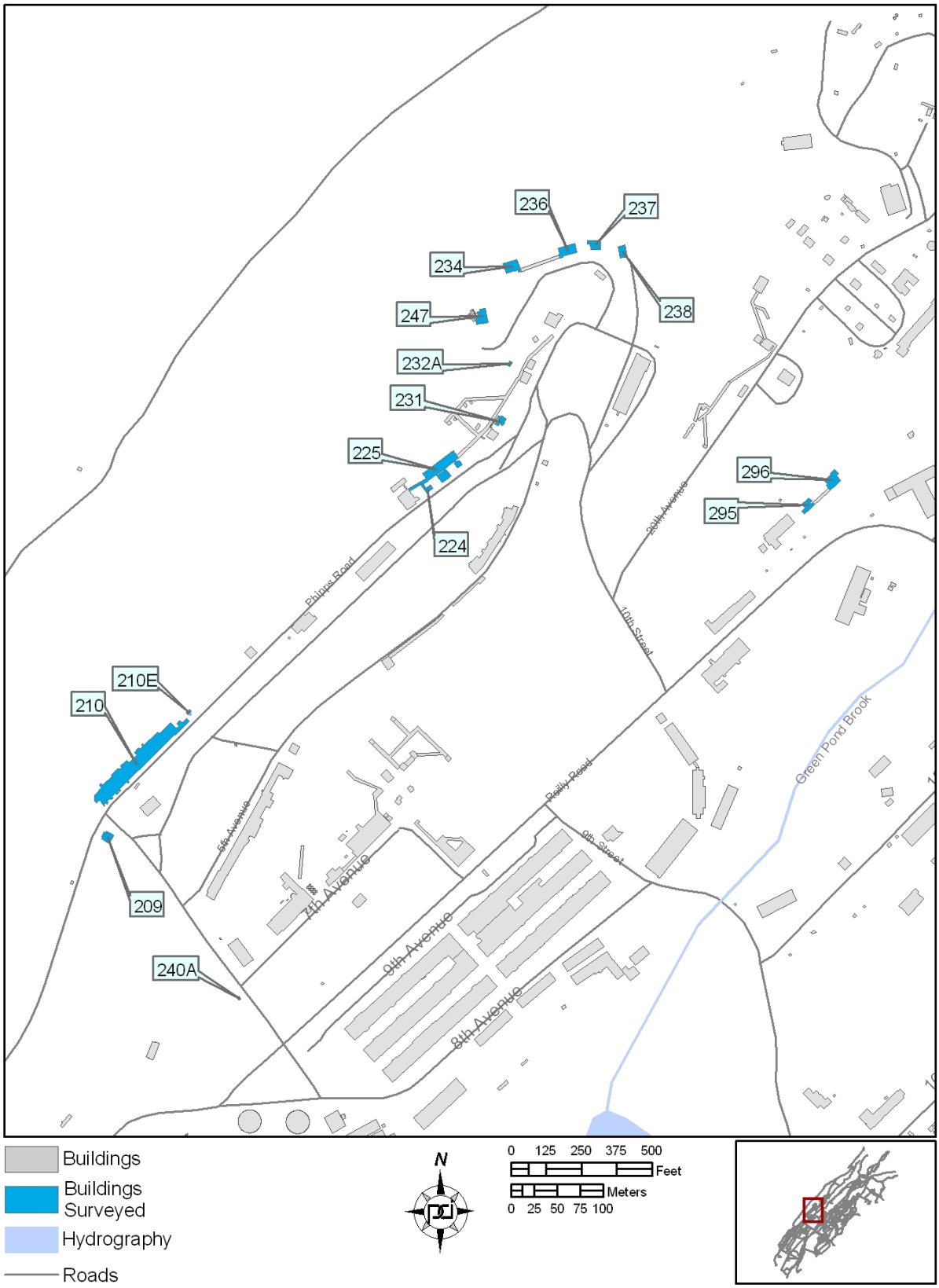

Figure 4.1. Locations of buildings surveyed in Area 200 Shell Component and Loading Area/Propellant Powder Plant, Picatinny Arsenal, NJ *(base map: Chugach Industries 2007).*

209 (1956)	General Storehouse (Figure 4.2)
210 (1956)	Major Caliber Propellant Loading; derelict (Figure 4.3)
210E (1956)	Ready Magazine; derelict (Figure 4.4)
224 (1962)	Electrical Equipment Facility (HAER 1983) (Figure 4.5)
225 (1946/1956)	Operating Facility (HAER 1983) (Figure 4.6)
231 (1959)	Cast High Explosive (HE) Filling Plant (HAER 1983) (Figure 4.7)
232A (1959)	Flammable Material Storehouse (Figure 4.8)
234 (1959)	Cast HE Filling Plant (HAER 1983) (Figure 4.9)
236 (1959)	Ordnance Facilities (Figure 4.10)
237 (1959)	Press Barricade (Figure 4.11)
238 (1942)	Indoor Firing Range (HAER1983) (Figure 4.12)
240A (1957)	Sentry Station (Figure 4.13)
247 (1962)	Hydrostatic Isostatic Press (HAER 1983) (Figure 4.14)
295 (1941)	Blending and Pelleting Plant; derelict (HAER 1983) (Figure 4.15)
296 (1941)	Tracer Composition; derelict (HAER 1983) (Figure 4.16)

Buildings 234, 236, 237, and 238 are all scheduled for demolition.

Building 209 (1956), previously used as a general storehouse and situated off of Phipps Road and Sixth Street, is a long, rectangular, gable-roofed structure. The building sits on a concrete foundation, has hollow tile walls, and a corrugated galvanized iron roof (see Figure 4.2).

Building 210 (1956), previously used as an ordnance facility/major caliber propellant loading facility, is located along Phipps Road and has deteriorated. According to Real Property records, the building had a concrete foundation, hollow tile walls, and a corrugated build-up roof (see Figure 4.3).

Figure 4.2. Building 209, General Storehouse, off Phipps Road, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.3. Building 210, Major Caliber Propellant Loading, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.4. Building 210E, Ready Magazine, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.5. Building 224, Electrical Equipment Facility, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.6. Building 225, Operating Facility, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.7. Building 231, Cast HE Filling Plant, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.8. Building 232A, Flammable Material Storage, Shell Component and Loading Area, Picatinny Arsenal, NJ. Note covered walkway (*Panamerican 2007*).

Figure 4.9. Building 234, Cast HE Filling Plant, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.10. Building 236, Ordnance Facility, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.11. Building 237, Press Barricade, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.12. Building 238, Indoor Firing Range, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.13. Building 240A, Sentry Station, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.14. Building 247, Hydrostatic Isostatic Press Building, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.15. Building 295, Blending and Pelleting Building, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.16. Building 296, Operating Building, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 224 (1962), previously an electronic equipment facility and control bunker for explosive machining performed in Building 225, is located off Phipps Road. It is rectangular with a ramped earth west wall, and a flat roofed structure located along a covered walkway. The building sits on a concrete foundation, has concrete walls, and a concrete roof (see Figure 4.5).

Building 225 (1946/1956), an ordnance facility off Phipps Road, is a rectangular, gable-roofed structure. It sits on a concrete foundation, has framed clapboard walls, and a roll-on wood roof. Same Number as above (see Figure 4.6).

Building 231 (1959) is a cast high explosive filling plant with equipment for central bunker, located off Tenth Street. It is a rectangular, flat roofed structure with three recessed closed bays. The building sits on a concrete foundation, has 6-inch, concrete slab walls faced in corrugated metal, and a concrete roof (see Figure 4.7).

Building 232A (1956), previously used as a flammable material storehouse, is located off Tenth Street and is a rectangular; shed-roofed structure with a side entry door. The building sits on a concrete foundation, is executed in frame with corrugated metal walls, and a wooded roof faced in corrugated iron (see Figure 4.8).

Building 234 (1959) is a metallurgy laboratory off Tenth Street. It is a rectangular shaped, gable-roofed structure connected to Building 236 by a covered walkway. The building sits on a concrete foundation, has 8-inch concrete block walls, and a 5-ply build-up roof (see Figure 4.9).

Building 236 (1959) is an ordnance facility off Tenth Street. It is a rectangular shaped, flat roofed structure with a shed-roof addition to the east elevation. It is connected to Building 234 by a covered walkway. The building sits on a concrete foundation, has concrete walls, and a build-up corrugated aluminum roof (see Figure 4.10).

Building 237 (1959) is an ordnance facility off Tenth Street. The building is a rectangular shaped, two-story flat roofed structure with a metal safety slide at the south façade and a covered loading dock to the north. There is a one-story shed roof addition with a center entry. The building sits on a concrete foundation, has concrete block walls, and a frame and aluminum roof (see Figure 4.11).

Building 238 (1942), an indoor firing range off Tenth Street, is a rectangular, gable-roofed structure with a one-story shed-roof addition to the west façade and a covered loading dock on the east facade. The building sits on a concrete foundation, has tar and concrete walls, and a corrugated asbestos roof (see Figure 4.12).

Building 240A (1957) is a sentry station off Sixth Street, across from the 600 Area enclosure gate. It is a small square, flat roofed structure with overhanging eaves and a band of fixed windows around structure. The building sits on a concrete foundation, has steel walls, and a build-up roof (see Figure 4.13).

Building 247 (1962), previously used as a press building, is located off Tenth Street. It is an irregular shaped, gable-roofed structure with a covered shed roof loading dock, two double wings and a television tower to the center. The building also has a concrete barricade with steel reinforcements. The building sits on a concrete foundation, has steel insulated walls, and a build-up roof (see Figure 4.14).

Building 295 (1941), an operating lead azide primer mix, blending and pelleting building, is found off Reilly Road. It is a rectangular structure located along a covered walkway. The building sits on a concrete foundation, has hollow tile walls, and a corrugated asbestos roof (see Figure 4.15).

Building 296 (1941), an operating building off Reilly Road, is a rectangular, gable-roofed structure with a hipped roof wraparound porch. There is a rear hollow tile false front addition and a side-framed shed structure. The building sits on a concrete foundation, has hollow tile walls, and a corrugated asbestos roof (see Figure 4.16).

The Shell Component and Loading Area runs northwest of Reilly Road from Sixth Avenue to Tenth Street and backs up to a wooded ridge (see Figure 4.1). In 1983, there were 70 buildings in this area, most of which were hollow tile construction with a number of World War II, temporary wooden buildings as well as some galvanized steel structures erected during periods of rapid expansion. This area also contained some of PICA's oldest storage magazines, which are now no longer extant (Thurber and Norman 1983).

After World War I, the army decided to establish new shell loading lines and most of the buildings within the 200 Area were built for that expansion. Completed rounds of ammunition were assembled in the district until the construction of a separate melt load area—the 800 Area—in the 1930s (Thurber and Norman 1983). After the war, the emphasis shifted to research and development of specialty timing devices and fuzes. Production activities resumed during the Korean and Vietnam wars and some buildings are periodically used for pilot production runs and experimentation (Thurber and Norman 1983).

While the buildings in the 200 Area began as shell component loading buildings, after 1920, their focus became fuze assembly. The fuze controls the timing and character of an explosion and is the most complicated part of a shell. Activities within the 200 Area included the production of mercury fulminate, lead azide and tetryl, the subassembly of the major components of the fuze (primers, delays, and detonators, and the final assembly of the complete fuze (Thurber and Norman 1983; Figure 4.17).

In 1983, of the total number buildings in 200 Area Shell Component Powder District, 70 buildings were selected for HAER documentation (Thurber and Norman 1983; Figure 4.18). Only about 30 buildings, less than half of the total number of buildings, remain in the 200 Area. Panamerican surveyed 15 of these remaining buildings, of which nine (buildings 210, 224, 225, 231, 234, 238, 247, 295, and 296) were included in the 1993 HAER documentation. In 1999, the area was determined to have no integrity (Guzzo 1999). Nevertheless, the area has been HAER documented and this type of documentation traditionally has been accepted as mitigation-level recordation. Panamerican's recordation of the additional 15 buildings does not change its findings. The 200 Area is not eligible for the NRHP and none of its buildings are individually eligible because of their lack of integrity. There are no associated landscapes.

400 Area Gun Bag Loading Area. The 400 Area is located in the north-central portion of the installation, roughly between Buffington Road on the east, Picatinny Lake on the north, Green Pond Brook on the west, and Ninth Street on the south. This area was used for a number of other ammunition production activities as well (Thurber and Norman 1983; Figure 4.19). The buildings and structures surveyed within the Gun Bag Loading Area include:

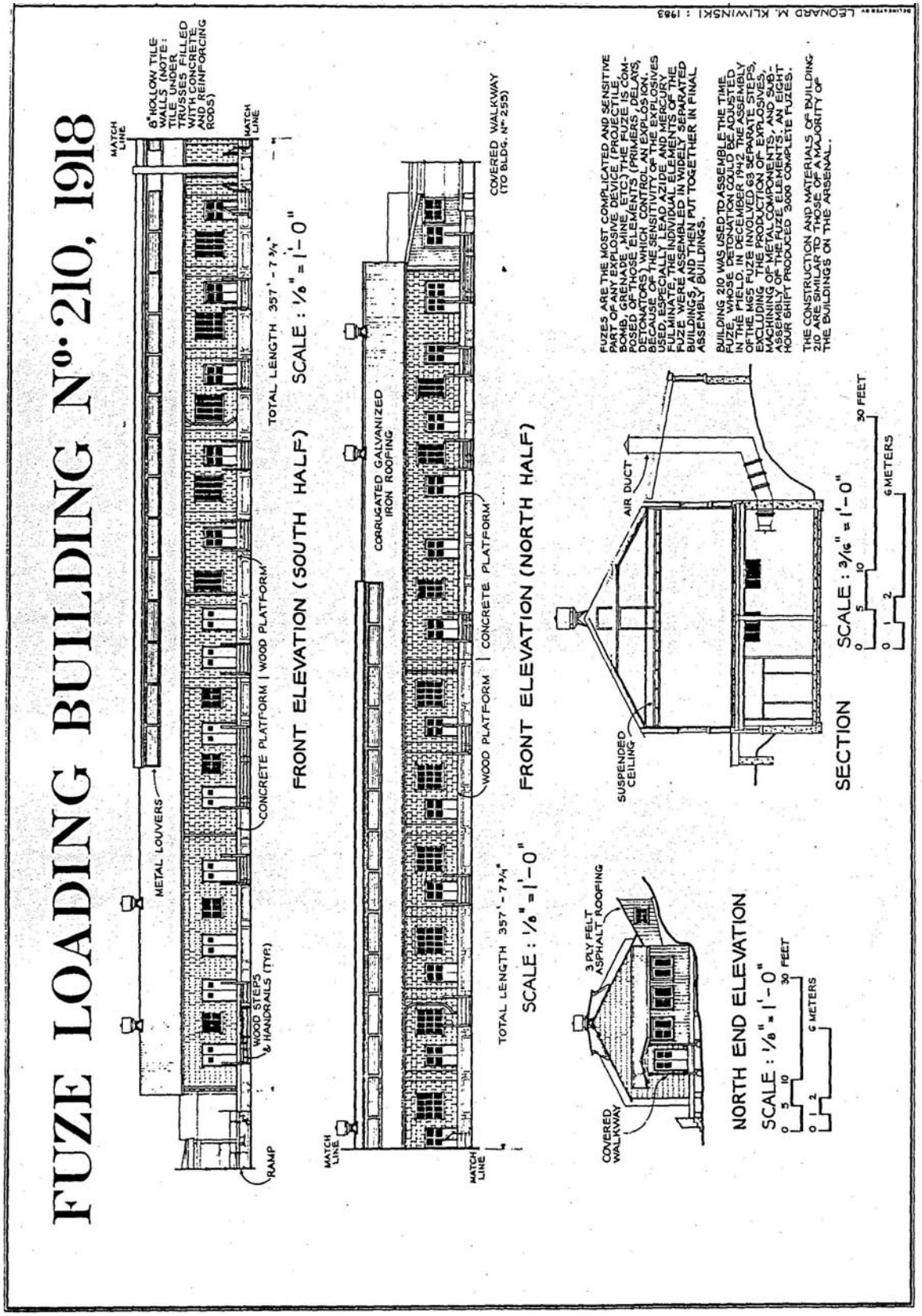

Figure 4.17. Building 210, Fuze Loading Building, 1918, Shell Component and Loading Area, Picatinny Arsenal, NJ *(Thurber and Norman 1983, Drawing by Leonard Kliwinski 1983).*

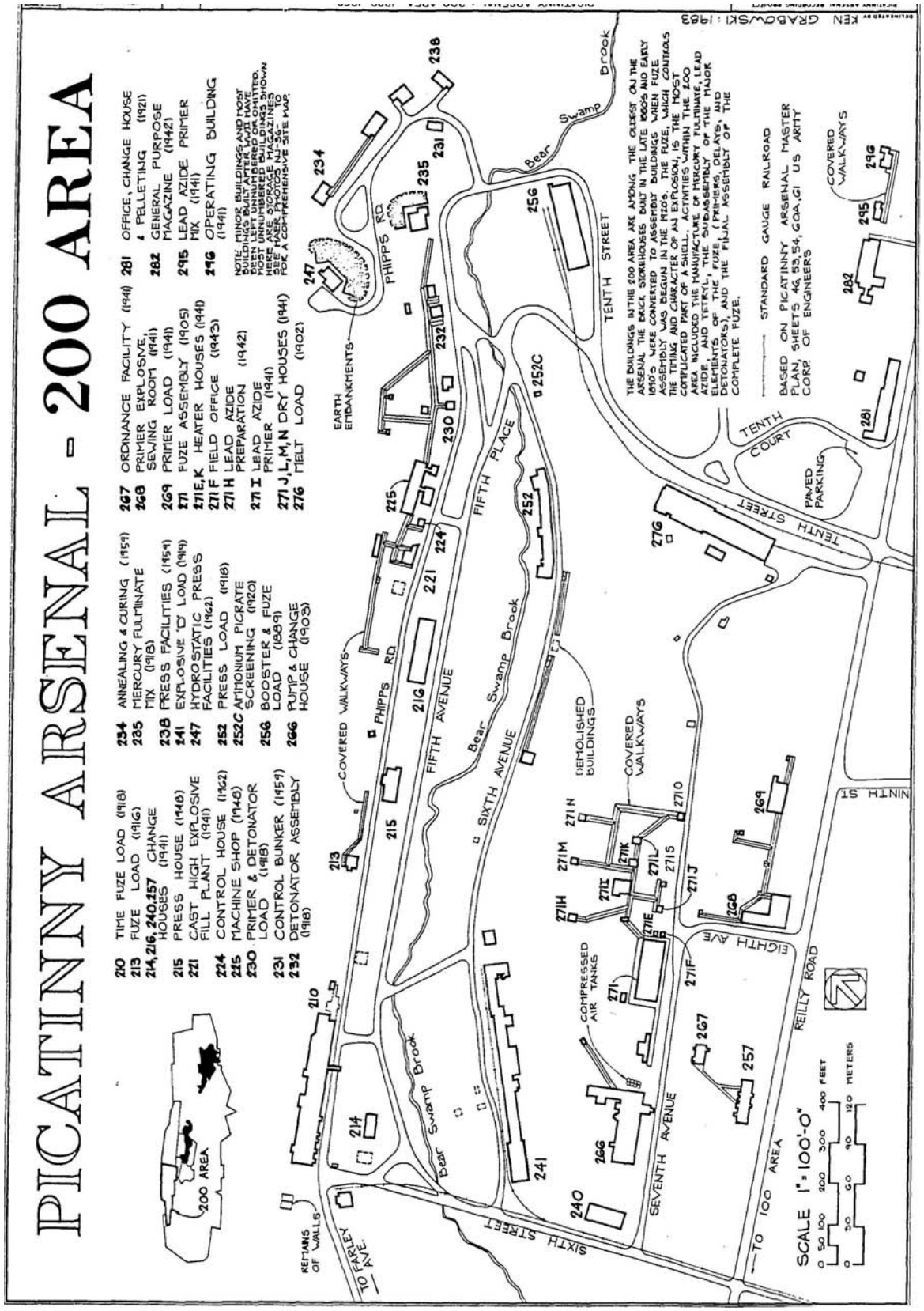

Figure 4.18. ***Picatinny Arsenal 200 Area, 1880-1962.*** **Shell Component and Loading Area, Picatinny Arsenal, NJ** *(Thurber and Norman 1983; Drawing by Ken Grabowski 1983).*

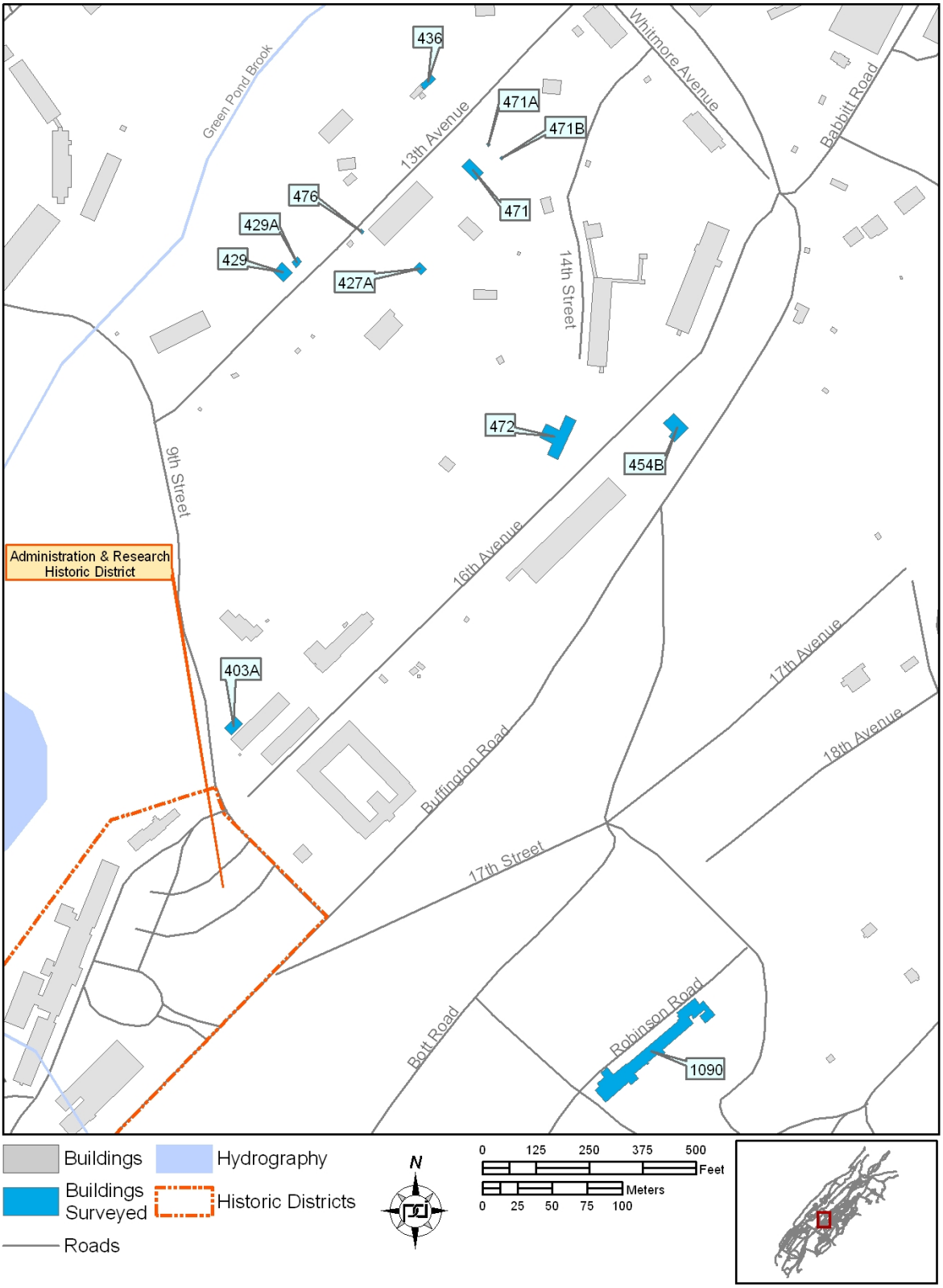

Figure 4.19. Locations of the buildings surveyed in Area 400 Gun Bag Loading Area, Building 1090, and the Administration & Research Historic District, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

403A (1947/1956)	General Storage; derelict (Figure 4.20)
427A (1949)	Chemistry Laboratory (Figure 4.21)
429A (1954)	HE Magazine; derelict (Figure 4.22)
436 (1948/1956)	Propellant Processing Plant (Figure 4.23)
454B (1942)	Magazine (HAER 1983) (Figure 4.24)
471 (1944/1969)	Change House (Figure 4.25)
471A (1962)	Flammable Materials Storage (Figure 4.26)
471B (1962)	Flammable Material Storage (Figure 4.27)
472 (1942/1967)	Chemistry Laboratory (HAER 1983) (Figure 4.28)
476 (1978)	Environmental Pollution Monitoring Station (Figure 4.29)

Building 403A (1947/1956), a general storage facility off Ninth Street, is a rectangular, gable-roofed structure with double-hinged doors and a four-light casement window at the gable end. The building sits on a concrete foundation, has framed walls faced with roll roofing, and a rubberoid on wood roof; derelict (see Figure 4.20).

Building 427A (1949) was previously used as a flammable materials storehouse and is located off Thirteenth Avenue. It is a rectangular, shed-roofed structure with two entrance doors at north facade. The building sits on a concrete foundation, has frame walls, and roll on sheathing roof (see Figure 4.21).

Building 429A (1954) was previously used as a high explosives magazine, off Thirteenth Avenue. It is a small, square, shed-roofed structure with side entrance door. The building sits on a concrete foundation, has transite walls, and a roll roof; derelict (see Figure 4.22).

Building 436 (1948/1956), previously used as a propellant processing plant and a mix and dry propulsion systems facility, is situated off Thirteenth Avenue. It is a rectangular, three-bay, gable-roofed structure with internal and external blast walls and two square cement-block outbuildings with flat roofs that are attached by piping. The building sits on a concrete foundation, has hollow tile walls, and a corrugated APM roof (see Figure 4.23).

Building 454B (1942), previously used as a magazine, is situated off Sixteenth Avenue. It is a rectangular, gable-roofed structure with a porch incorporated under the main roof on the east and west facades. The building sits on a concrete foundation, has hollow tile walls, and a corrugated APM roof; derelict (see Figure 4.24).

Building 471 (1944/1966), previously used as an administration building and a change house for Building 427, is located off Thirteenth Avenue. It is a rectangular prefabricated, gable-roof structure. The building sits on a concrete foundation, has corrugated metal walls, and a corrugated asbestos roof (see Figure 4.25).

Building 471A (1962) was previously used as a flammable materials storehouse. Off Thirteenth Avenue, the building is a small, square, shed-roof structure with a central entrance door. It sits on a concrete foundation, has corrugated metal walls, and a corrugated asbestos roof (see Figure 4.26).

Building 471B (1962), previously used as a flammable materials storehouse, is found off Thirteenth Avenue. It is a small, square, shed-roof structure with a central entrance door. The building sits on a concrete foundation, has corrugated metal walls, and a corrugated asbestos roof (see Figure 4.27).

Figure 4.20. Building 403A, General Storage, derelict, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.21. Building 427A, Flammable Materials Storage, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.22. Building 429A, HE Magazine, derelict, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.23. Building 436, Propellant Processing Plant, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.24. Building 454B, Magazine, derelict, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.25. Building 471, Change House, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.26. Building 471A, Flammable Material Storage, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.27. Building 471B, Flammable Materials Storage, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.28. Building 472, Chemistry Laboratory, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.29. Building 476, Environmental Pollution Monitoring Facility, Gun Bag Loading Area, Area 400, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 472 (1942/1967), a storehouse on the corner of Sixteenth Avenue and Eleventh Street, is a long, eight-bay, rectangular, gabled-roof structure. The building sits on a reinforced-concrete foundation, has masonry walls, and an asphalt shingle roof (see Figure 4.28).

Building 476 (1978), a monitoring facility off Thirteenth Avenue, is a small, square, gable-roofed, prefabricated structure with a single entrance door. The building sits on a concrete foundation, has fiberglass walls, and a fiberglass roof (see Figure 4.29).

The buildings in the Gun Bag Loading Plant are a miscellaneous group with storage facilities predominating. Three of the surveyed buildings are derelict—403A, 429A, and 454B. Twenty buildings within the Gun Bag Loading Area have undergone HAER recordation (HAER No. NJ-36; Thurber and Norman 1983), but none of the buildings surveyed by Panamerican were included in the HAER, although that document covers the area within which some of the buildings are located.

Firing an artillery weapon requires three basic components: a weapon, a projectile, and a propellant, the explosive that propels the projectile. Black powder was the earliest propellant but, by the late nineteenth century, it had been replaced by nitrocellulose. To use nitrocellulose as a propellant, it was necessary to develop a system of loading the powder into bags, then attaching a primer and detonator to initiate the explosion. Different types of guns required different amounts of propellant powder, bagged in various sizes, to operate properly (Thurber and Norman 1983:78).

Silk bags were used to hold the powder and were made at Picatinny Arsenal, although in cases of emergency or a rush order, local women would assist by sewing bags at home. During World War II as many as 500 sewing machines were used to produce silk and cotton bags. However, because of the volatile nature of the powders used, even sewing was a hazardous activity. Something as small as a broken needle could cause the powder being sewn into the bag to ignite, which, in fact, happened in the late 1920s, resulting in the burning of five women, three of them seriously. By the 1960s, powder was heat-sealed into polyethylene bags (Thurber and Norman 1983).

The Gun Bag Loading Area originally included such buildings as a change house, bag loading houses, storage magazines, rest houses, weigh and mix houses, cloth storage as well as dyeing and cutting and sewing houses. The remaining buildings are scattered throughout the area and make little or no reference to each other or to their original use, gun bag loading and later ordnance activities. Portions of this area are enclosed because of pollution concerns and are monitored for ground water infiltration.

The Gun Bag Loading Area, and, for that matter, all industrial complex lines at Picatinny, have been determined to have no integrity, and it is, therefore, not eligible for the NRHP (Guzzo 1999). The few remaining buildings within this area in no way provide enough information to demonstrate the required integrity for the Gun Bag Loading Plant. The individual buildings surveyed are not eligible because they lack the integrity for the Gun Bag Plant. Nevertheless, the Gun Bag Loading District has been HAER documented and includes two of the buildings in this survey—buildings 454B and 472 (Figure 4.30). HAER documentation is generally accepted as mitigation recordation. There are no associated landscapes.

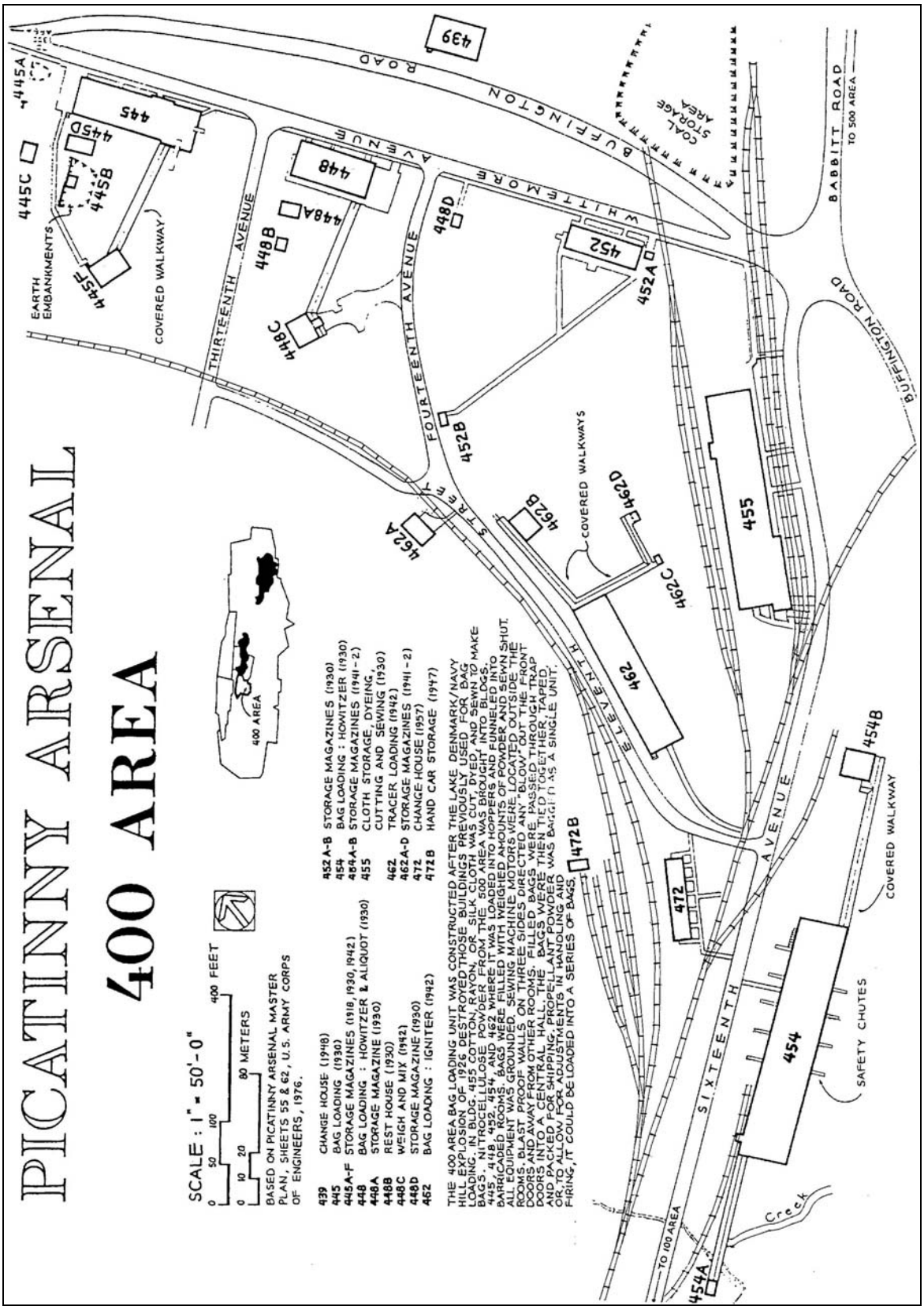

Figure 4.30. ***Picatinny Arsenal 400 Area, 1918-1948.*** **Gun Bag Loading Area, Picatinny Arsenal, NJ** *(Thurber and Norman 1983, drawing by Leonard Kliwinski 1983).*

500 Area Powder Plant/Smokeless Powder Line. Southeast of Picatinny Lake, the 500 Area is bound roughly to the north by Babbitt Road, to the south by Bott Road, to the west by Buffington Road, and to the east by Willis Street. The eastern-most part of the complex is within an enclosure (Figure 4.31). The buildings surveyed within the Powder Plant and the Smokeless Powder Plant Line include:

501 (1928/1945)	Measuring Equipment Building (HAER 1983; Figure 4.32)
524 (1956)	Change House (Figure 4.33)
566 (1954/1956)	Propellant Screening Building; derelict (HAER 1983; Figure 4.34)
567 (1954/1958)	Rest House; derelict (HAER 1983; Figure 4.35)

Building 501 (1928/1945) was previously used as a general purpose magazine, Plant Engineering (PE) maintenance shop, and a measuring equipment and repair building. Located off Babbitt Road, it is a long, rectangular, gable-roofed structure. The building sits on a concrete foundation, has hollow tile walls, and a build-up roll roof (see Figure 4.32).

Building 524 (1955), previously used as a change house and general purpose building, is located off Water Road. It is a long, rectangular, gable-roofed structure. The building sits on a concrete foundation, has concrete block walls, and an asbestos shingle roof (Figure 4.33).

Building 566 (1954/1958) was previously used as an ordnance facility, and is found off Babbitt Road. It is two-story rectangular, gable-roofed structure with metal slide extending from a second floor door. The building sits on a concrete foundation, has frame transite walls, and an asbestos roll roof. The interior floor is lined with lead; derelict (see Figure 4.34).

Building 567 (1954/1956), previously used as a propellant plant, ordnance facility, rest house and storehouse, is found off Babbitt Road. It is a twelve-bay, rectangular, sawtooth-roof structure. Interior blast walls in the bays extend beyond the roofline giving it a sawtooth appearance. The building sits on a concrete foundation, has concrete-block walls, and a concrete roof; derelict (see Figure 4.35).

During the early 1980s there were approximately 60 buildings that comprised the factory. However, because of the nature of the materials used, made, and discarded, the area was considered extremely contaminated and many buildings were in the process of being demolished and burned (Thurber and Norman 1983). The area was HABS/HAER recorded in 1983 (Figure 4.36).

Construction of the powder factory at PICA began in 1907 and by 1916 the basic buildings of the plant had been completed and a regular production schedule was maintained. During World War I, the arsenal was the initial American producer of propellant powder of all sizes, although real production was carried out in larger facilities. The 1926 explosion destroyed several buildings within the plant and damaged most of the other buildings. This provided the opportunity to upgrade the plant and change some production techniques (Thurber and Norman 1983; Figures 4.37 through 4.39).

As in World War I, PICA was the first facility during World War II to produce propellant powder and assisted other production facilities in the creation of their production facilities. After the war, production declined, but increased once again during the Korean and Vietnamese wars. After 1970, production slowed and some machinery was moved to other parts of the installation. By 1983, production in the 500 Area had completely ceased (Thurber and Norman 1983).

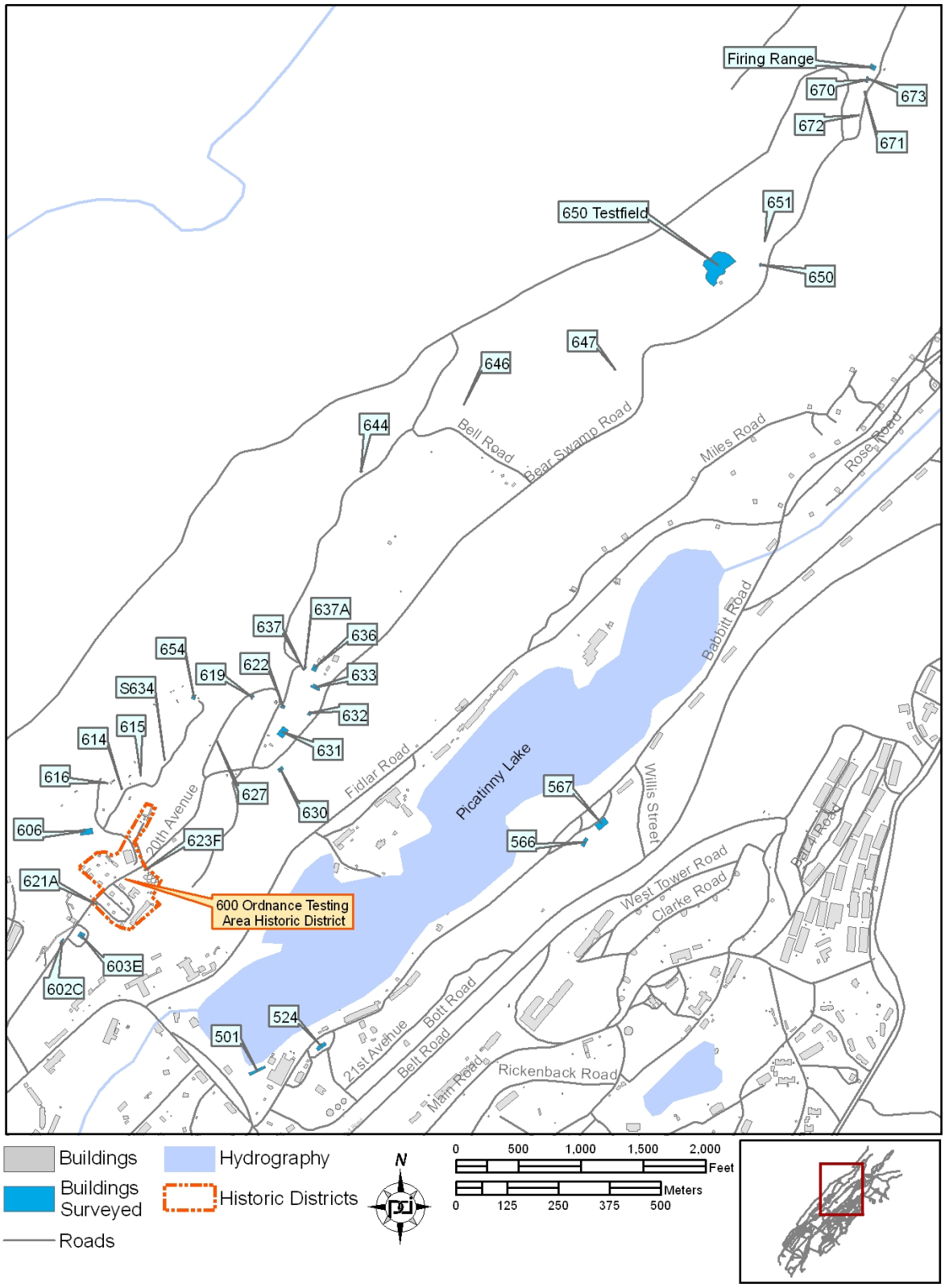

Figure 4.31. Locations of buildings surveyed in Area 500 Powder Plant and Area 600 Testing Areas and the 600 Ordnance Testing Area Historic District, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.32. Building 501, Measuring Equipment Building, Powder Plant, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.33. Building 524, Change House, Powder Plant, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.34. Building 566, Propellant Screening Building, Powder Plant, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.35. Building 567, Rest House, Powder Plant, Picatinny Arsenal, NJ *(Panamerican 2007)*.

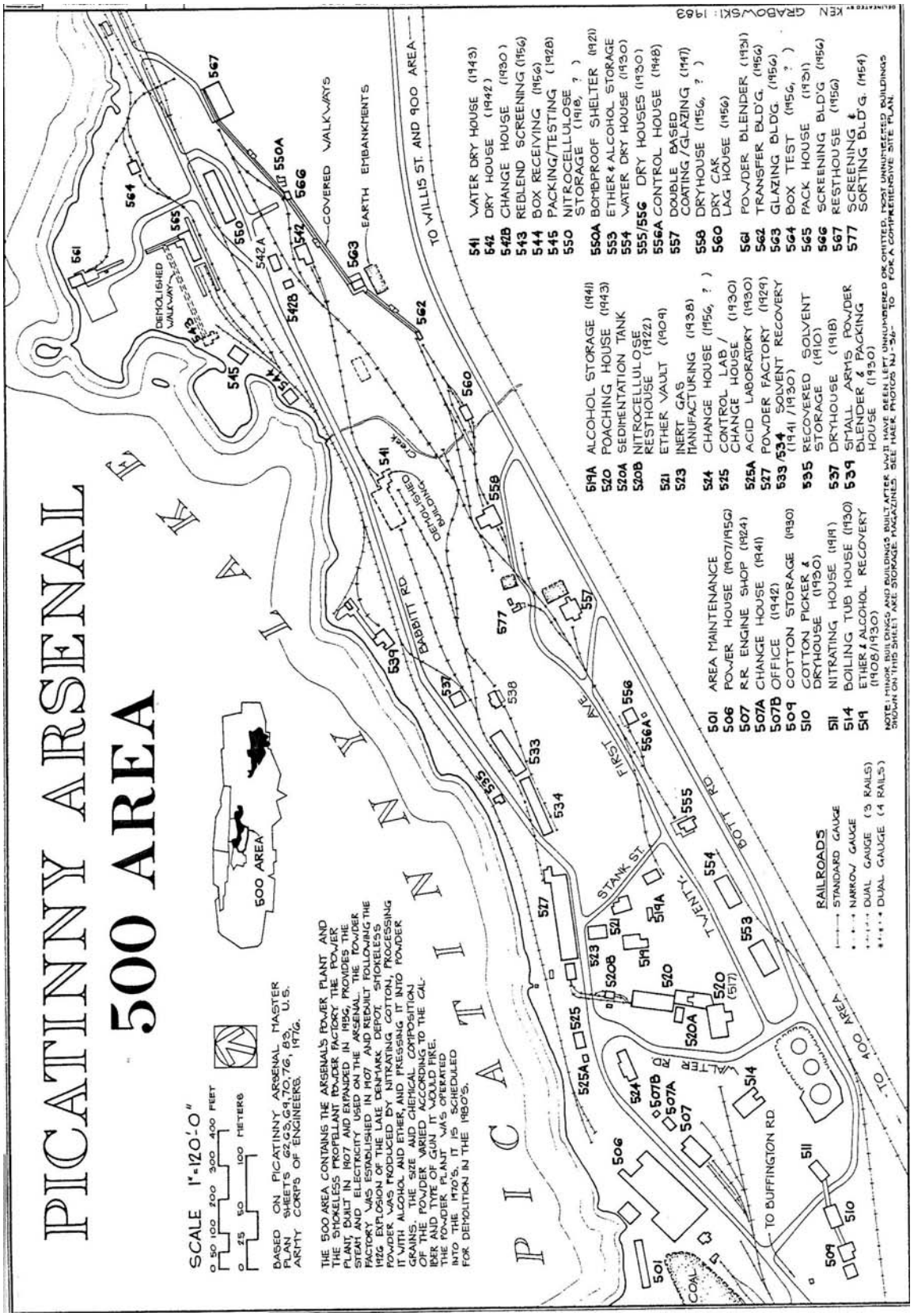

Figure 4.36. ***Picatinny Arsenal 500 Area,*** **Powder Plant, Picatinny Arsenal, NJ** *(Thurber and Norman 1983, drawing by Leonard Kliwinski 1983).*

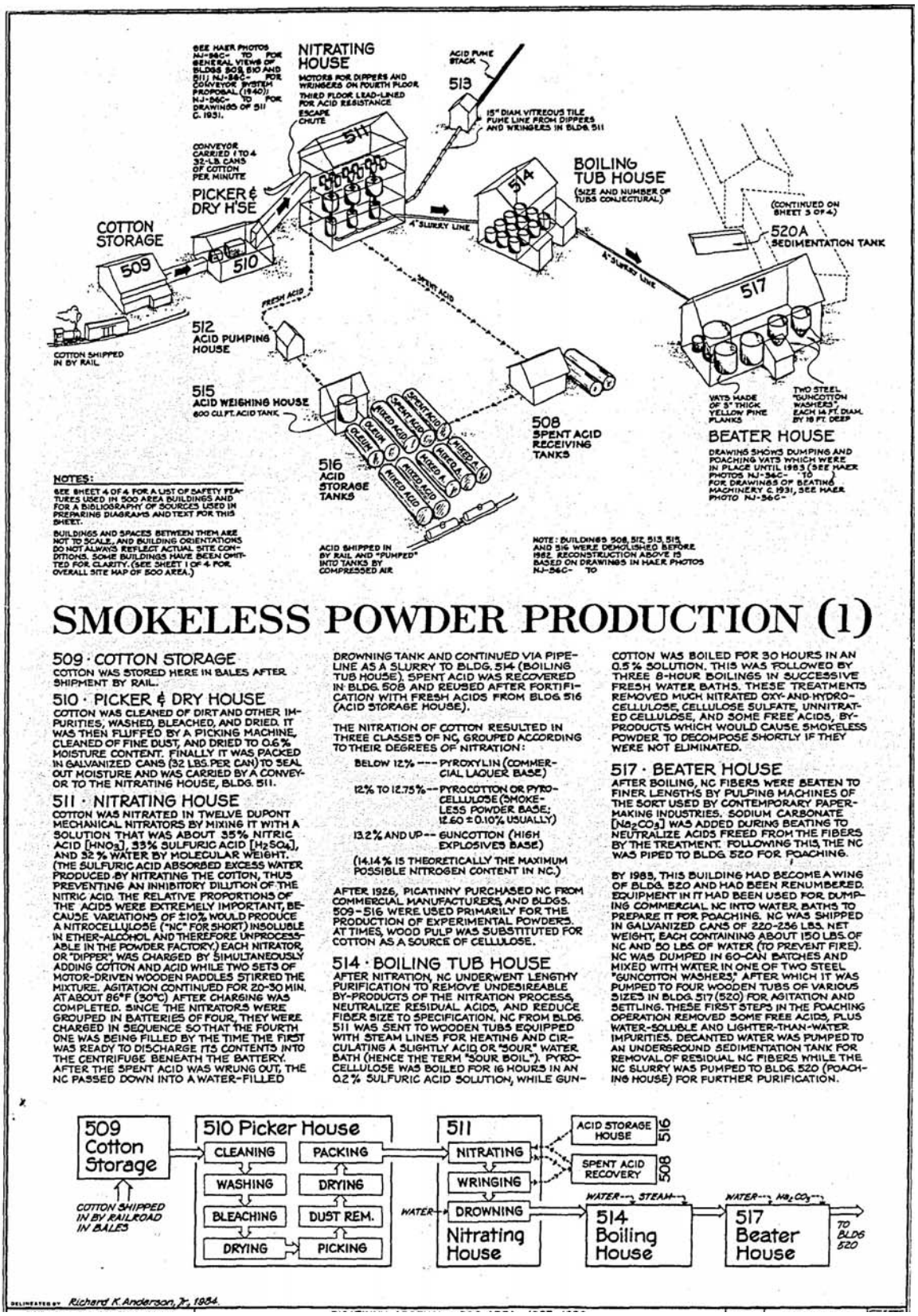

Figure 4.37. *Smokeless Powder Production (1),* Powder Plant, Picatinny Arsenal, NJ *(Thurber and Norman 1983, drawing by Richard K. Anderson, Jr. 1984).*

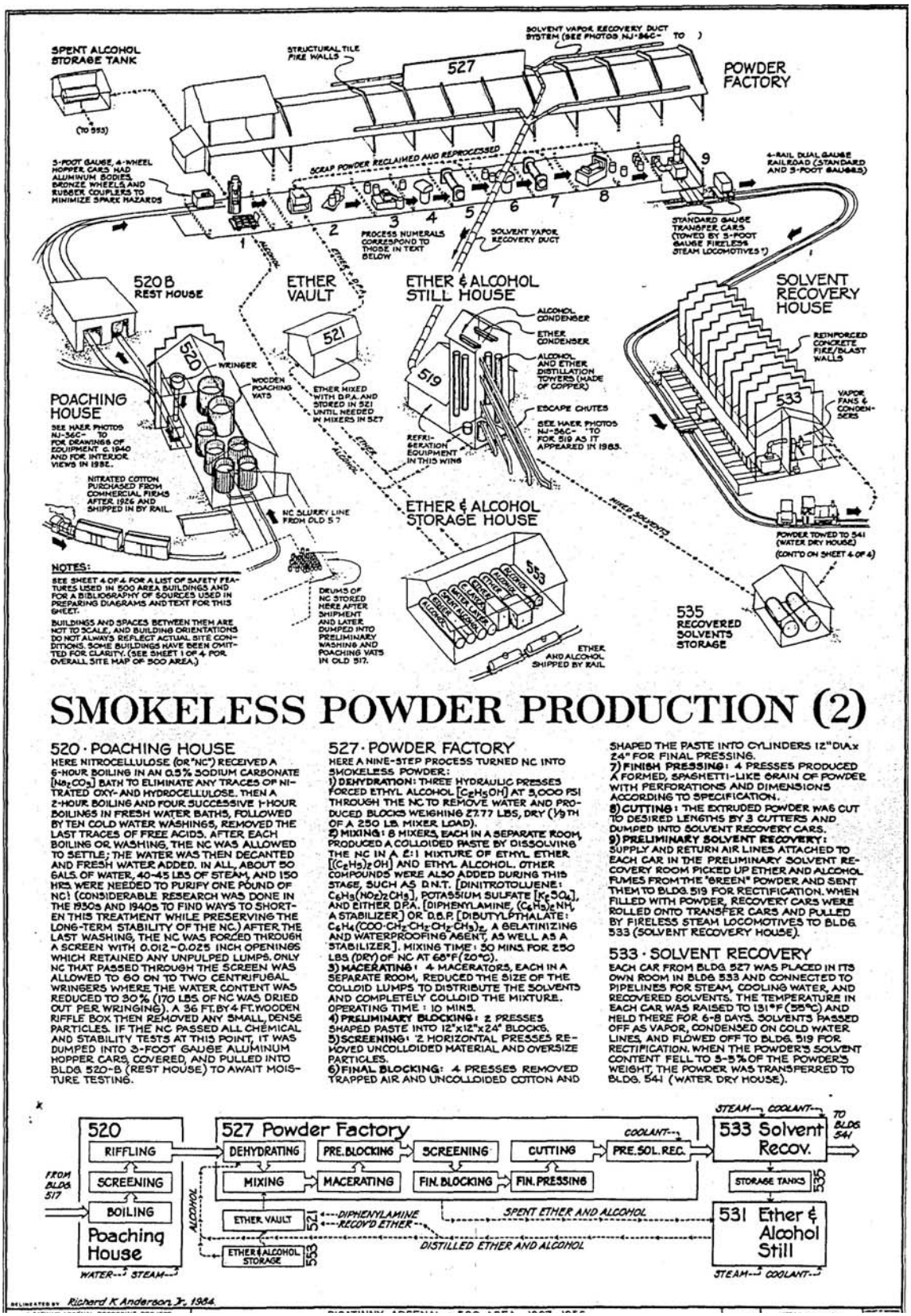

Figure 4.38. ***Smokeless Powder Production (2),*** **Powder Plant, Picatinny Arsenal, NJ** *(Thurber and Norman 1983, drawing by Richard K. Anderson, Jr. 1984).*

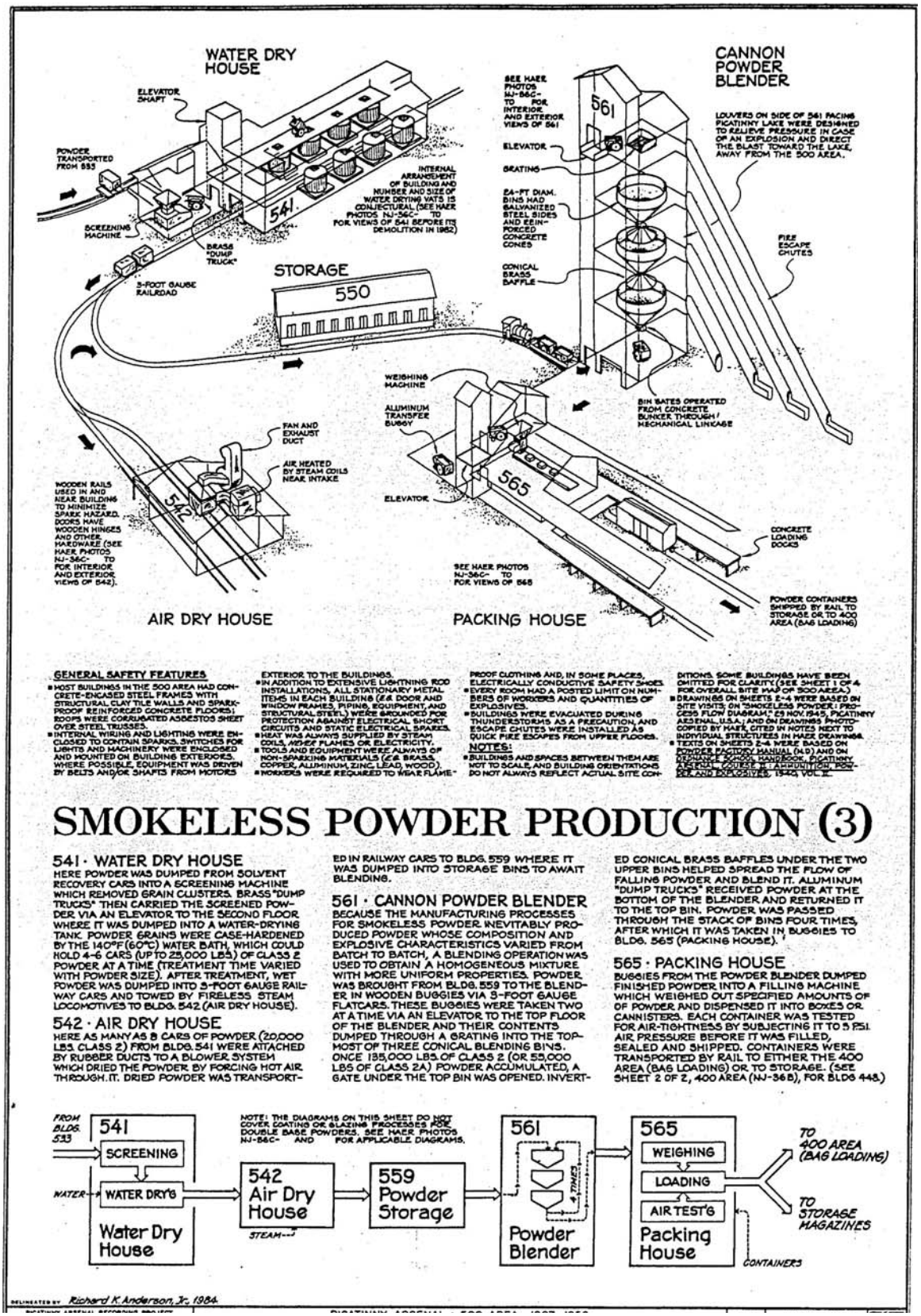

Figure 4.39. *Smokeless Powder Production (3),* Powder Plant, Picatinny Arsenal, NJ *(Thurber and Norman 1983, drawing by Richard K. Anderson, Jr. 1984).*

At the time of the investigation, only 17 of the 60 buildings noted in 1983 still existed. Of these 17, three—buildings 501, 524 and 566—appeared in the HABS/HAER documentation. The area has no integrity and is, therefore not eligible for the NRHP. The four buildings surveyed by Panamerican lack context (two of them are derelict), and as a group they are unable to shed any additional light onto the workings of the plant. They are not individually eligible because they lack integrity. There are no landscapes associated with this area.

800 Area Complete Rounds/Melt Loading District. The 800 Area is located within an enclosure approximately along Fidlar Road between Crain Road on the south and Miles Road to the north (Figure 4.40). The buildings surveyed within the Completed Rounds/Melt Loading District, also referred to as the Melt Pour Area, include:

800 (1957)	Special Projects, Ammunition Teardown (HAER 1983; Figure 4.41)
808 (1930)	Equipment Shed (Figure 4.42)
809 (1925)	Ordnance Facility (HAER 1983; Figure 4.43)
810 (1930)	Ordnance Facility (HAER 1983; Figure 4.44)
810A (1944)	Vacuum Pump House; derelict (HAER 1983; Figure 4.45)
813A (1941)	Magazine (Figure 4.46)
813D (1948)	Vacuum Pump House; not extant (HAER 1983)
816A (1944)	Vacuum Pump House (HAER 1983; Figure 4.47)
816B (1941)	Compressor House (HAER 1983; Figure 4.48)
816C (1930)	Magazine (HAER 1983; Figure 4.49)
816D (1930)	Magazine (Figure 4.50)
820 (1930)	Complete Rounds Building (HAER 1983; Figure 4.51)
823 (1925)	Ordnance Facility; derelict (HAER 1983; Figure 4.52)
824A (1938)	Dust Collector; derelict (Figure 4.53)
825 (1930)	Magazine (HAER 1983; Figure 4.54)

Panamerican was unable to photograph Building 813D, a vacuum pump house, which is scheduled for demolition, because the area around the building was undergoing construction activity and was cordoned off. The buildings themselves in general are wedged between earthen blast berms and Picatinny Lake, which made photographing Building 813D impossible. Nevertheless, Building 810A is also a vacuum pump house from approximately the same period and built from the same construction materials, therefore, 813D should look something like 810A.

Building 800 (1957) was previously used as a special projects operating and loading building and an ammunition teardown building. Located along Crain Road, it is a rectangular, gable-roofed structure with an interior blast wall and an open side, covered loading dock at one end. The building sits on a concrete foundation, has concrete block walls, and a corrugated asbestos roof (see Figure 4.41).

Building 808 (1930), an equipment shed located, is a square, flat roofed structure. Situated off Melt Load Road, it sits on a concrete foundation, has corrugated metal walls, and a corrugated metal roof (see Figure 4.42).

Building 809 (1925) was previously used as an ordnance facility located off Melt Load Road. It is a large, rectangular, gable-roofed structure that sits on a reinforced concrete foundation, has corrugated metal walls, and a corrugated asbestos roof. An addition was made to it in 1966 (see Figure 4.43).

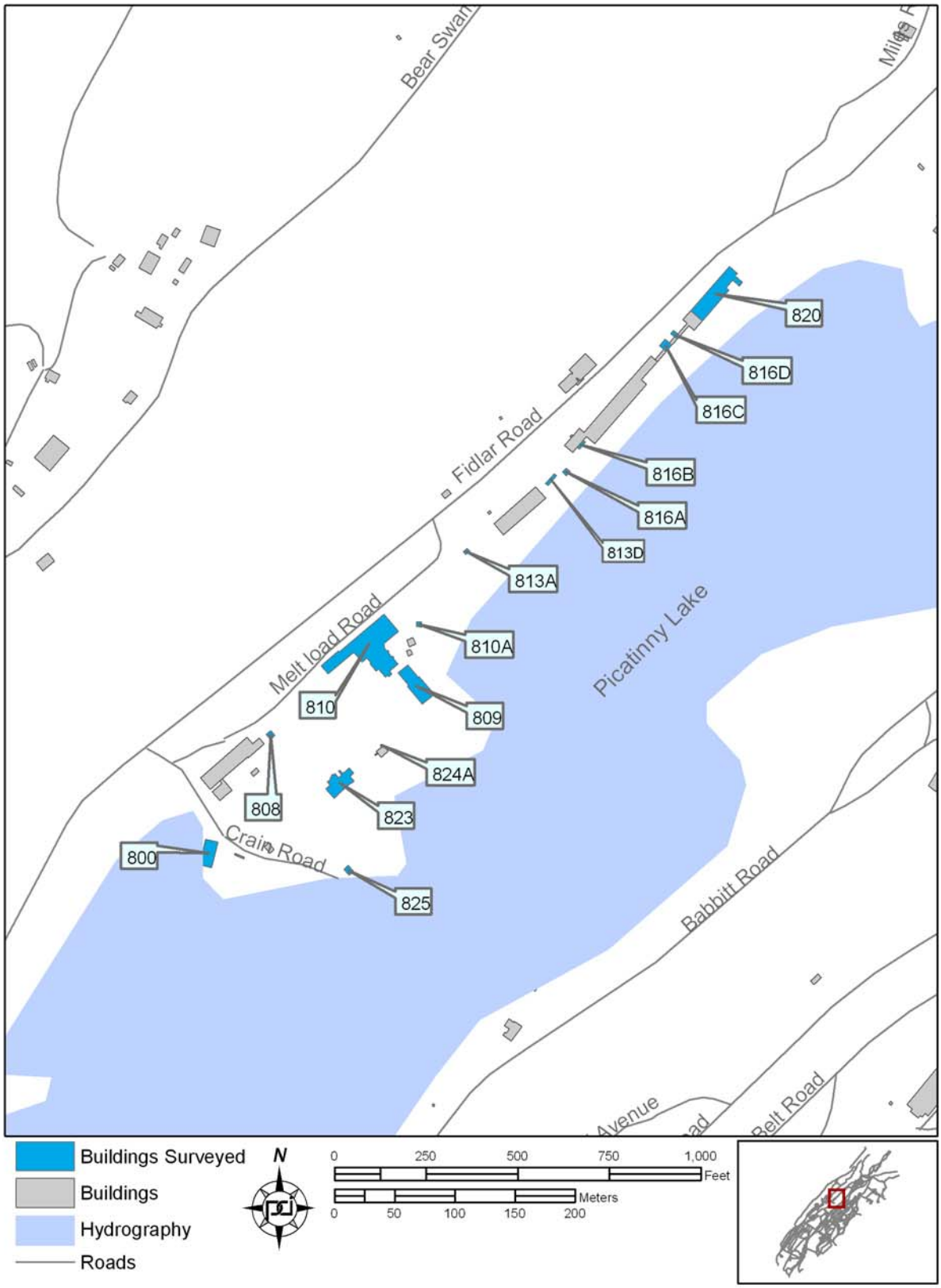

Figure 4.40. Locations of buildings surveyed in Area 800 Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.41. Building 800, Special Projects Ammunition Teardown, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.42. Building 808, Equipment Shed, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.43. Building 809, Ordnance Facility, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.44. Building 810, Ordnance Facility, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.45. Building 810A, Vacuum Pump House, derelict, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.46. Building 813A, Magazine, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.47. Building 816A, Vacuum Pump House, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ. Because of its location between Building 813, an earthen berm and Picatinny Lake, only the roof of 816A is visible *(Panamerican 2007).*

Figure 4.48. Building 816B, Compressor House, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.49. Building 816C, Magazine, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.50. Building 816D, Magazine, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.51. Building 820, Hazardous Waste Storage, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.52. Building 823, Loading Plant, derelict, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.53. Building 824A, Dust Collector, derelict, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.54. Building 825, Magazine, in an enclosure at the end of a covered walkway on Lake Picatinny, Complete Rounds/Melt Loading Facility, 800 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 810 (1930), previously used as an ordnance facility, is a long, rectangular, gable-roofed structure with a covered walkway incorporated under the main roof line. Located along Melt Load Road, the structure has a side addition that contains internal blast walls extending above the roof line and a metal safety slide. The building sits on a concrete foundation, has hollow tile walls, and a corrugated asbestos roof (see Figure 4.44).

Building 810A (1944) was previously used as an ordnance facility, a major caliber projectile loading plant, and a vacuum pump house. Found along Melt Load Road, it is a rectangular, shed-roofed structure with double door entry. The building sits on a concrete foundation, has hollow tile and concrete walls, and a corrugated asbestos roof (see Figure 4.45).

Building 813A (1941), previously used as a general purpose magazine, is situated off Fidlar Road and is a small, rectangular, gable-roofed structure. The building sits on a concrete foundation, has 8-inch, hollow tile walls, and a corrugated asbestos roof (see Figure 4.46).

Building 813D (1948) was previously used as an ordnance facility, a major caliber projectile loading plant, and a vacuum pump house. Located of Fidlar Road, it is a concrete foundation.

Building 816A (1944), previously used as an ordnance facility, a major caliber projectile loading plant, and a vacuum pump house, is a rectangular, gable-roofed structure with interior blast walls extending above the roof line. Overhanging eaves create a covered walkway and a north gabled-roof garage addition was added to the structure. The building sits off Fidlar Road on a reinforced concrete foundation, has concrete walls, and a corrugated asbestos roof (see Figure 4.47).

Building 816B (1941) was previously used as an ordnance facility found off Fidlar Road. A rectangular, shed-roofed structure not visible from the road, the building sits on a reinforced concrete foundation, has 8-inch, hollow tile walls, and a corrugated concrete roof (see Figure 4.48).

Building 816C (1930) was previously used as a general purpose magazine located along Fidlar Road. It is a rectangular, gable-roofed structure attached to a covered walkway. The building sits on a concrete pier foundation, has 8-inch hollow tile walls, and an APM roof (see Figure 4.49).

Building 820 (1930) was previously used as hazardous waste storage. It is a long, rectangular, gable-roofed structure with a covered loading dock incorporated under the roof line. The building sits along Fidlar Road on a concrete pier foundation, has 8-inch hollow tile walls, and an APM roof (see Figure 4.51).

Building 823 (1925) was previously used as a major caliber projectile loading plant and an ordnance facility. Found between Crain and Melt Load roads, the building is a two-story, rectangular, gable-roofed structure located along a covered walkway. It sits on a concrete foundation, has 8-inch hollow tile walls, and an APM roof (see Figure 4.52).

Building 824A (1938) was previously used as a major caliber projectile loading plant and an ordnance facility. The building is located off Melt Load Road and is a one-story, rectangular, shed-roof addition to Building 824. It sits on a cinder-block foundation, has transite walls, and a white roll roof (see Figure 4.53).

Building 825 (1930), previously used as a general purpose magazine barricade, is a rectangular, gable-roofed structure, located behind a chain-link fence. The building is barely visible from the walkway. Found at the end Crain Road, it sits on a concrete foundation, has 8-inch, hollow tile walls, and an APM roof (see Figure 4.54).

The Complete Rounds/Melt Load District was completed in 1930 as a project motivated by the 1926 explosion at the Navy's Lake Denmark Depot. Until the construction of the 800 Area, the work of completing rounds was carried out in buildings scattered throughout the installation. The new facility provided for a smooth flow of materials and explosives through a straight-line-grouping of four major buildings that were connected by covered walkways. This straight line of buildings was approximately 2,400 feet long (Figure 4.55). Storage and other types of service buildings were spaced along the line to facilitate a smooth and quick flow of materials, while providing the greatest safety for workers. Almost all of the explosives used in the 800 Area were manufactured outside of PICA and shipped in by train (Thurber and Norman 1983).

The major buildings of the Complete Rounds/Melt Load District have concrete-encased steel frames and eight–inch thick, hollow tile walls. The original gable roofs were covered in asbestos-protected metal but are now covered in faux, standing seam, red, metal roofs (Thurber and Norman 1983). A number of buildings from the original line were derelict at the time of the investigation, but the 800 Area is still in use.

The full production process of loading shells and assembling complete rounds was carried out in this area during World War II. The area was reactivated during the Korean War as a full production unit and is still used as test load facility. This work involves filling both shells and bombs for test firing on the arsenal and testing both the explosive filling of the projectile and the composition of the projectile itself (Thurber and Norman 1983).

The Complete Rounds/Melt Load District was established to load, assemble and pack for shipment various calibers of complete rounds, as well as shells for semi-fixed rounds, separate loaded shells, and fragmentation and demolition bombs. Various explosives were used in the 800 Area including: TNT (trinitrotoluene); 50/50 Amatol (50 percent ammonium nitrate and 50 percent TNT); 65/35 Amatol (65 percent ammonium nitrate and 35 percent TNT); Trimonite (88 percent picric acid and 12 percent mononitronaphthalene); Ammanol (67 percent TNT, 22 percent ammonium nitrate, and 11 percent flake aluminum); and black powder (Thurber and Norman 1983:130-131).

The method used to load the shell varied depending upon the item loaded, its size and the explosive used. Primary forms of loading in the 800 Area included:

- Casting—loading the explosives in a liquid or molten state, such as TNT, Amatol, Trimonite and Ammanol;
- Pelleting—used primarily for filling 100-pound and larger bombs; this method used a combination of molten TNT and TNT pellets;
- Lobbing—mixing 65/35 Amatol to the consistency of thick concrete and loading it;
- Base charging—used to fill shrapnel with black powder and involved pouring black powder into funnels and shrapnel vibrated until the powder lodged in the space provided (Thurber and Norman 1983:131).

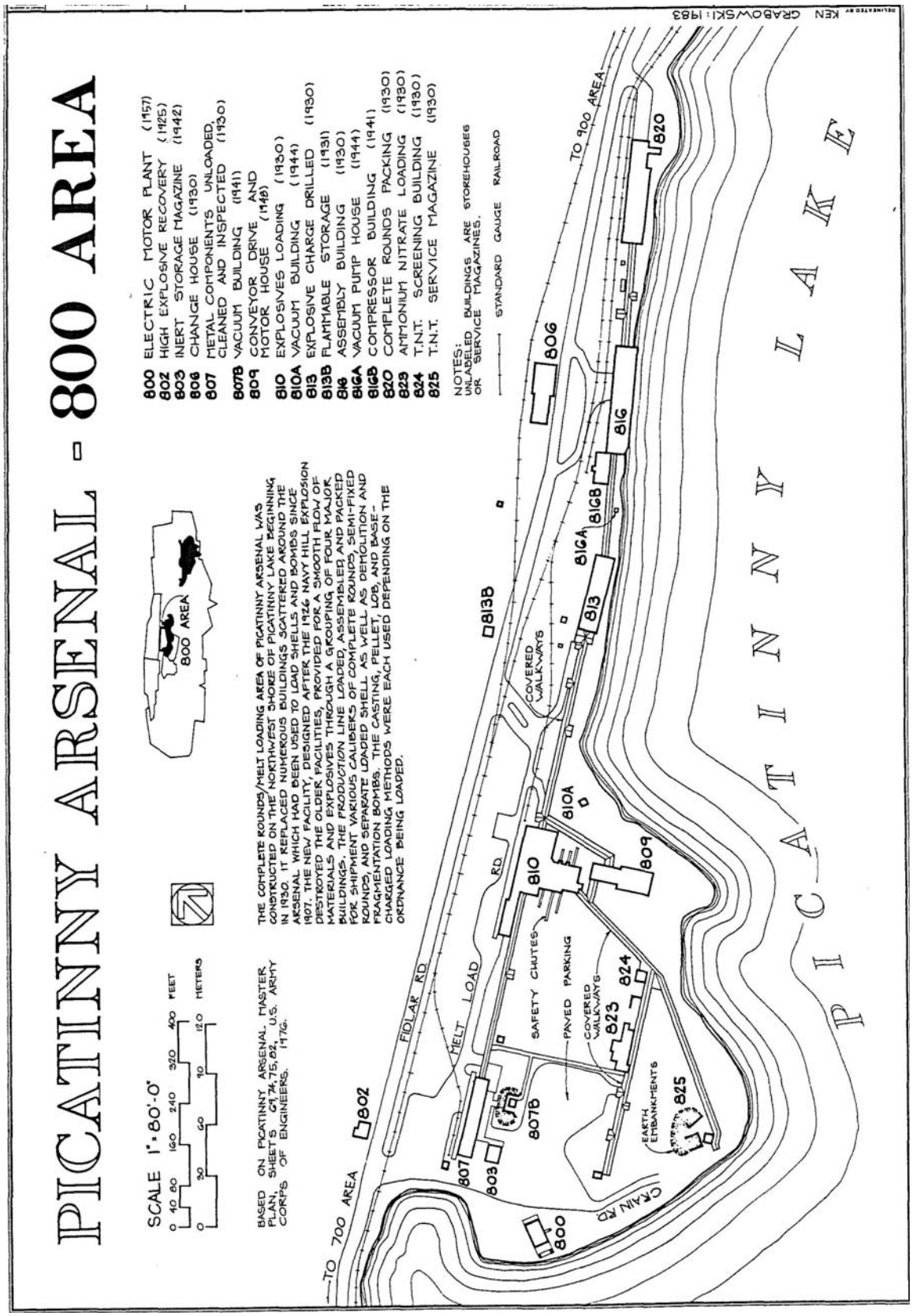

Figure 4.55. Picatinny Arsenal 800 Area, Complete Rounds/Melt Loading Facility, Picatinny Arsenal, NJ *(Thurber and Norman 1983; drawing by Ken Grabowski 1983).*

After shells and bombs were loaded, they were drilled for booster or fuze cavities. This was done either vertical or horizontal drilling machine, depending upon the size of the item drilled. Excess explosives were cleaned from the threads with brass, bronze or steel picks depending on the explosive. A cloth dampened with acetone cleaned any remaining explosive from the threads. Gauges were used to ensure that the booster cavity conformed to the proper size (Thurber and Norman 1983:134).

"The complete rounds assembly consisted of putting live primers in the cartridge case, weighing smokeless powder charges and check-weighing, assembling projectile to cartridge cases, gauging for profile and alignment of the round, inserting fuzes and assembling waterproof covers" (Thurber and Norman 1983:134). Once the rounds were assembled, they were sent down the line to be painted, stenciled, packed and shipped. All rounds were painted with two coats of paint or shell lacquer and compete rounds were placed in fiber containers, boxes, or bundle packs. Containers were sealed with colored adhesive tape to indicate the type of round: yellow tape for high explosive, red tape for shrapnel rounds, and blue tape for practice rounds. The tape was stenciled with data to identify the round, lot number and date of assembly (Thurber and Norman 1983:135).

According to the HAER documentation, by factory standards, the activity of the 800 Area was simplistic: The buildings were few and the machinery simple. From the screening of TNT to the inspection and packing of shells, only 16 steps were required. Most of the required activities were accomplished by hand, such as using kettles, brushes, buckets and gauges (Thurber and Norman 1983).

The 800 Area has been a production or an experimental production plant for all of its 77 years. During this time, the manufacturing process for assembling ammunition has changed dramatically as have the buildings within the physical plant. Many of the buildings have become derelict as a result of disuse, while others have been changed beyond recognition. As a whole, the Complete Rounds/Melt Loading Plant's quixotic use of buildings within the line while others fall derelict has caused the plant to lose its integrity. It is no longer clear how the production sequence moved down the line through the original four major buildings, and, in fact, the production sequence seems to no longer move through the same buildings as it once did. Without integrity, the Complete Rounds/Melt Loading Plant is not eligible for the NRHP. The buildings themselves lack integrity and are not, therefore, individually eligible.

Nevertheless, the Complete Rounds/Melt Loading District has been HABS/HAER recorded (Thurber and Norman 1983). This recordation, which traditionally has been used as a mitigation tool, is a complete recorded of how the industrial process worked. There are no associated landscapes.

1000 Area Experimental High Explosives Plant/Haleite Plant. The HE/Haleite Plant (1000 Area) and its sister plant, Nitroglycerine, TNT, TNA (2, 3, 4, 6-Tetranitroaniline) (1300 Area), as well as the Rocket Propellant Powder Plant (1400 Area) are all located on a hill at the eastern-most end of Farley Avenue. The hill is known by most Picatinny old-timers as "Nitro Hill" in honor of the many explosives activities that have dotted the area, particularly on the north side, the side of the HE Plant, where the earliest plants were found. Like all of Nitro Hill, the HE Experimental Plant is highly contaminated with black powder, nitroglycerine, various rocket propellants, TNT and TNA. Almost all of the plant's buildings are no longer extant (see Figure 4.19). Panamerican surveyed one building within the Haleite Plant, Building 1090:

1090 (1948) Haleite Screening and Packing Building (Figure 4.56)

Figure 4.56. Building 1090, Haleite Screening and Packing, Experimental High Explosives Plant/Haleite Plant, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 1090 (1948) was previously used as a special weapons plant and a general purpose laboratory, as well as originally as the haleite screening and packing building. Located off Robinson Road, the building is a long, rectangular, gable-roofed structure with several one-story additions. The building sits on a reinforced concrete foundation, has CMU (concrete masonry unit) and plaster-covered walls, and a corrugated asbestos roof (see Figure 4.56).

As discussed earlier in this section, PICA has been responsible for R&D related to explosives since World War I. The quest for better powder mixtures is still conducted at Picatinny today. Powder ignition, chemical compositions, stability, life expectancy, testing, manufacture and development of explosives were and are intensely explored at the arsenal.

Until the devastating 1926 explosion at the Lake Denmark Naval Depot, Picatinny's research, production, and storage facilities, as well as its housing were all generally mixed together. New chemical compositions were frequently tested out of the back door of research buildings and, in general, safety was not a principal concern. However, after the explosion, the Army's Special Review Board of Enquiry made a series of recommendations for the rearrangement of certain facilities with a view toward greater safety and economy of operation (PICA 1942; Rogers 1931). These recommendations included dividing the reservation into specific use categories. The three main use categories were: 1) the manufacturing area, in which explosives were handled; 2) storage areas, in which propellants and high explosives were kept; and 3) manufacturing activities, where non-hazardous materials were handled and where administrative, engineering and research activities were carried out (PICA 1942). In general, the central section of the post was designated for explosives manufacturing and a small tetryl plant was built on the eastern slope (i.e., Nitro Hill) of the arsenal. (Tetryl—Trinitrophenyl-methylnitramine—was a standard booster explosive in both World War I and World War II.)

The explosive system of a weapon consists of three parts: 1) the detonator, a small primary charge that explodes a secondary or intermediate charge; 2) the booster, which builds up the initiating shock; 3) the bursting charge, the primary charge. These components taken together form a high explosives chain. High explosives are characterized by the extreme rapidity with which they detonate, decompress. When initiated by a blow or a shock, a high explosive decompresses almost instantaneously. High explosives include TNT, nitroglycerine, and Composition A, B, C and D. Low explosives are primarily solid combustible materials that decompose rapidly but do not normally explode. Low explosives, such as black powder, do not usually propagate a detonation, however, under certain circumstances they can react in the same manner as high explosives and they may detonate (The Ordnance Shop 2004). With a few exceptions, the chemical components used in the production of high explosives are poisonous. The work conducted within these plants was dangerous.

During both World War I and World War II, factories at Picatinny Arsenal created explosive substances, formulas, the substances themselves, the manufacturing techniques, and pilot production lines, as well as the procedures for packing, shipping and storing the material. Aside from ammunition of all types and calibers, these substances were also used in pyrotechnics, screening smokes, and incendiaries. PICA experimented with and used virtually every explosive substance with military applications.

After the explosive substances themselves were created, they would be loaded into their containers by one of three methods: cast load, press load or extrusion. Cast loading was the preferred method. In cast loading, the explosive substance is poured as a liquid into a container and left to solidify. Explosives that have no liquid form must be press-loaded or pressed into the container. When certain explosives are combined in plastic mixes they can only be loaded by extrusion. Extrusion employs a pressure system for forcing the plastic mixtures into the various types of projectiles and bomb casings (The Ordnance Shop 2004). During the life of the HE Plant it is probable that Picatinny employed all these production techniques.

In a 1973 report, Picatinny reported as one of its major achievement in the area of production technology base the piloting of a new Melt Pour Facility in the HE area. This process was developed for use on 33 production lines located at Government Owned, Company Operated (GOCO) facilities. All of the facilities were slated to replace existing batch HE melting systems for TNT and Composition B. The new system was designed to: more effectively produce high explosives; reduce personnel exposure because of remote operations; operate remotely; and eliminate multi-story buildings by use of new concepts including HE pumping and in-line detonation tarps (PICA 1973; Mason & Hanger-Silas 2003; Sargent, Webster, Crenshaw & Folley 1955).

Constructed at the end of World War II, the Haleite Plant is located within the HE plant off Robinson Road. The Chemical Engineering Section of the Technical Division at Picatinny Arsenal 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 (also called EDNA), named for PICA's chief chemist Dr. George C. Hale.

At the beginning of World War II, the two most important explosives with a high brisance (shattering effect) in the Allies' arsenal were cyclonite (or RDX) and PETN (see Section 4.1.1, above). Too sensitive to be used in a pure state in a shell. the two compounds were mixed with a variety of other compositions to stabilize them. Since the 1920s the chemists at PICA had been working on a compound with the brisance of RDX without its sensitivity to impact and

friction. Research on this explosive led to the discovery of ethylenedinitramine, or EDNA, later named haleite. Haleite was the first entirely American high explosive. The new explosive could be press-loaded into small shells without a desensitizing agent and its derivative, ednatol, could be melt-loaded into large shells. By 1943 haleite was ready to be tested, but manufacturing problems precluded it from use in combat (Green et al. 1990).

Haleite, as noted above, has an alternate nomenclature of EDNA, Ethylenedinitrine, and Dinitroethylenediamine. Its chemical composition, $(CH_2)_2(NH)_2(NO_2)_2$ or $C_2H_6N_4O_4$, makes it useful as a bursting charge, but its primary use is in the making of Ednatol, a more stable, less sensitive explosive. Haleite is created when ethyleneurea is mixed or reacts with concentrated nitric acid, which yields dinitroethyleneurea. The dinitroethyleneurea is filtered out of the liquid, washed, and then mixed with seven times its weight of water. This liquid is then boiled until the evolution of carbon gas stops. The resulting haleite is gathered by filtration, washed again and dried (Ordnance Liaison Group-Durham nd:52-3). White to buff in color, haleite is press-loaded after its manufacture.

While the plant was constructed for the production haleite, it was, of course, used for numerous other production activities throughout its life. During the late 1960s it was used for the pilot production of CBU 34/A (TFD and BLU 42/B) (PICA DPW ndb). CBU (Cluster Bomb Units) 34A was an antipersonnel mine cluster. The cluster was composed of 54 BLU (Bomb Life Units) 42B bomblets (Parsch 2004). In the early 1970s the plant also pilot produced some type of 60mm ammunition (PICA DPW ndb).

Building 1090 was originally constructed in 1944 as a Haleite Screening and Packing Building. Designed by PICA's Technical Division, the building was constructed of hollow clay tiles. It was a typical three-story industrial building looking very much like all the other buildings in the complex. However, in 1968, this building and its neighbor, Building 1089, were significantly modified for the production of CBUs. When these modifications were made to the structures, the Haleite Plant became the Special Weapons Plant (PICA DPW ndb). It is interesting to note that the term "special weapons" generally is a euphemism for nuclear weapons, but it does not appear that this area was ever used for the production of such weapons. If nuclear weapons were ever produced at Picatinny, they would have been prepared within the carefully controlled environment of the Special Weapons Plant at Building 95, the William L. Bell Building (Nolte and Steinback 2004a).

When Panamerican first viewed this building in 2004, it had been completely stripped of original equipment and was left standing to the elements. It was then determined to not have integrity and, therefore, was not eligible for the NRHP (Nolte and Steinback 2004b). At the time of the present investigation, Building 1090 has been completely refurbished (see Figure 4.56). This building is the sole remaining element of the former Haleite Plant and has been altered numerous times. As a result of these alterations, it no longer has integrity and cannot be eligible for listing on the NRHP. There is no associated landscape.

1300 Area Nitroglycerine and Rocket Propellant Powder Area. The 1300 Area is located immediately off Farley Avenue in a triangle formed by Upper H.X.E. Road roughly to the west, N.G. and S.N.G. roads to the east, and Ford Avenue to the south on Nitro Hill (Figure 4.57). Panamerican surveyed three buildings in this area:

1310 (1956)	Air Storage Tank (Figure 4.58)
1352 (1948)	Blending Building (Figure 4.59)
1380 (1949)	Weight House (Figure 4.60)

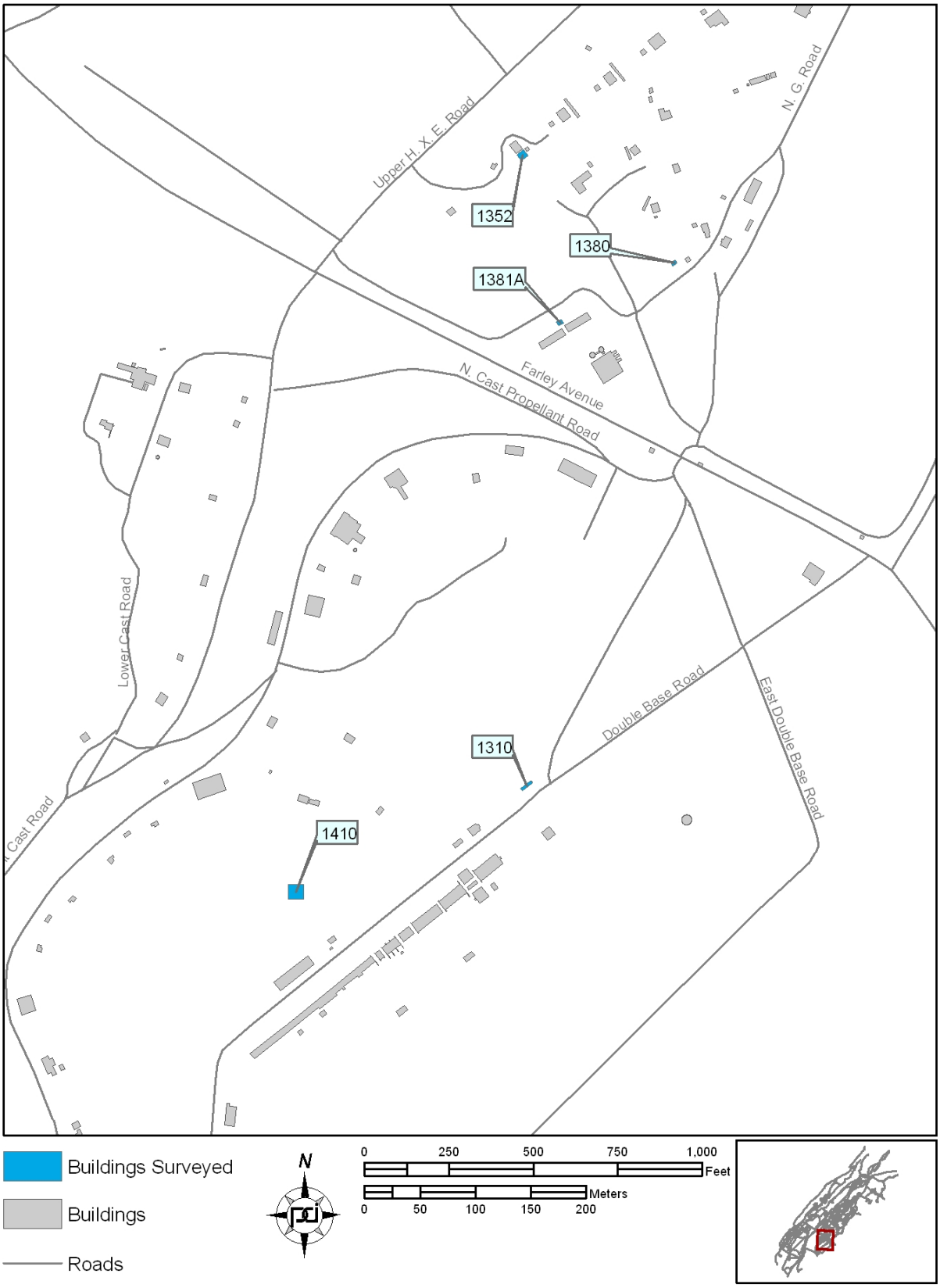

Figure 4.57. Locations of Buildings 1310, 1352, 1380, 1381A, and 1410, Picatinny Arsenal, NJ *(base map: Chugach Industries 2007).*

Figure 4.58. Building 1310, Air Storage Tank, Nitroglycerine Plant/Rocket Propellant Powder Plant, Picatinny Arsenal, NJ (*Panamerican 2007*).

Figure 4.59. Building 1352, Blending Building, which is wedged in between two large, earthen blast barriers, Nitroglycerine Plant/Rocket Propellant Powder Plant, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.60. Building 1380, Weight House, Nitroglycerine Plant/Rocket Propellant Powder Plant, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 1310 (1956), an air storage tank, is found off Double Base Road and is a cylinder-shaped tank. It sits on concrete cradles, the dimensions of which are 12 inches thick, 8.9 inches long and 3.6 inches high on centers (see Figure 4.58).

Building 1352 (1948), use unknown, is a rectangular, gable-roofed structure with interior blast walls extending above the main roof line. Surrounded by a concrete-and-railroad-tie blast wall, the building sits on a concrete foundation, has asbestos walls, and a roll roof (see Figure 4.59).

Building 1380 (1949), previously used as an ordnance facility, propellant plant and weigh house, is a small, square, gable-roofed structure with central double doors. The building sits on a concrete foundation, has asbestos walls, and a roll roof. The interior floors are covered with lead; derelict (see Figure 4.60).

The creation, testing and production of smokeless powders were an important chapter in Picatinny's manufacturing history. Smoking powders, such as black powder, billow across battlefields and hang as a pall, obscuring the vision of soldiers, sailors and their commanding officers. Less smoke covering the action meant a greater capability of directing forces and winning the battle. By the mid-nineteenth century, the quest for nonsmoking powders was on.

At the heart of nonsmoking powders is nitroglycerine. Nitroglycerine, $4C_3H_5N_3O_9$, also known as nitroglycerine, trinitroglycerine or glycerol trinitrate, is an oily, heavy, clear to yellow, poisonous liquid used to make explosives. It is also used medically to make a vasodilator to treat heart conditions. Nevertheless, Picatinny Arsenal's creation, testing, and production of nitroglycerine were related only to battlefield uses. Nitroglycerine is so unstable that the slightest jolt, impact or friction can cause it to spontaneously detonate. Since the molecule contains oxygen, nitrogen

and carbon, it explodes with a lot of energy as the atoms rearrange to form new molecules with stronger more stable bonds (Imperial College 2004). One of the great advantages that nitroglycerine has over other high explosives, like TNT, is that no solid forms of carbon (soot or smoke) is produced when it is detonated. This allows for the creation of “smokeless powders.”

Because of its unstable nature, nitroglycerine must be stabilized in order to use it on the battlefield. Alfred Nobel, throughout the mid-nineteenth century, experimented with developing nitroglycerine as an explosive for use in mining operations. Several factory explosions occurred during his pursuit, one of which killed his brother, Emil. To make the handling of nitroglycerine safer, Nobel experimented with different additives, finally settling on a type of clay, kieselguhr, that turned the liquid into paste that then could be shaped into rods suitable for insertion into drilling holes. In 1867, he patented this new explosive under the name “dynamite.”

Dynamite quickly found many industrial uses, but, with the start of World War I, it was adapted to the engines of war. Nobel, a pacifist, was appalled by its battlefield use and quickly began developing weapons so powerfully destructive that no one would use them, thereby eliminating war. This endeavor did not work out as Nobel planned.

Early in the use of nitroglycerine, it was discovered that liquid nitroglycerine could be desensitized by cooling it to between 40° and 50° Fahrenheit, the temperature at which it freezes. However, the warming up period proved problematical, leading to the discovery that the explosive could be made extremely sensitized. Modern HE formulations are made by adding approximately 10 to 30 percent ethanol, acetone or dinitrotoluene, depending upon the desensitizing agent used (Encyclopedia4U 2004).

The industrial manufacture of nitroglycerine uses a 50:50 mixture of fuming (concentrated) sulfuric acid and red fuming nitric acid. This produces nitornium ions that attack glycerin (glycerol) at its negatively charged oxygen atoms. The functional group NO_2 is added giving extra oxygen atoms to the flammable substance glycerin (Encyclopedia4U 2004). The use of strong acids results in an exothermic (heat-producing) reaction. If the mixture is too hot it will explode, therefore, the acid mixture is slowly added to the reaction vessel containing the glycerin. The holding vessel is cooled with ice water or some other coolant mixture at about 0° Celsius. The vessel has a trap door at the bottom, which hangs over a pool of very cold water. If sensors in the mixture detect the temperature rising too rapidly, then the whole mixture can be dumped into the ice-cold water thus preventing an explosion (Encyclopedia4U 2004).

In 1973, PICA introduced an Automated Continuous Nitroglycerine Plant in this area. The new line was based on the Biazzi Process and replaced the antiquated “Batch Process” that had been employed for the previous 30 years. This new method was representative of the most modern methodology in the manufacture of nitroglycerine. It permitted the arsenal to operate with greater safety, attain greater consistency, and reduce the number of operating personnel. The new production method was important to the whole Army since it allowed greater surveillance and evaluation of procedures and methodology for the modernization of GOCO, Government-Owned, Government-Operated (GOGO), and private industrial plants. In addition, this pilot plant served as a study for the continuous processing of nitratable esters, thereby enhancing overall R&D capabilities and to quicken the response posture in this critical field (PICA 1973).

In that same year PICA developed and established a reliable, safe, economical production scale module for the production of guanidine nitrate, an intermediate for making nitroguanidine, a very stable primary explosive. Guanidine Nitrate, $CH_6N_4O_3$, is both an explosive and a precursor to

other explosives. Guanidine, also called carbamidine, is formed by the oxidation of guanine. It is also a normal product of protein metabolism found in urine (SB Organics LTD 2004).

As a result of the disappearance of commercial sources of nitroguanidine, PICA needed to develop readily available source. By 1930 PICA had scaled up from bench to pilot to scale module with a capacity of 35,000 pounds/month. The process technology was scheduled for use in the design and erection of a major plant at Sunflower Army Ammunition Plant, DeSoto, Kansas, in 1974. PICA believed their nitroguanidine was superior to that which was previously commercially available (PICA 1973). Picatinny Arsenal continued to make nitroglycerine and work with its manufacture well into the 1980s. Although this area was also called the Rocket Powder Propellant Plant, most of the propellant work actually was conducted across Farley Road in the 1400 Area.

In 2004, Panamerican assessed that the Nitroglycerine Plant/Rocket Propellant Powder Plant had lost its integrity and, therefore, none of its buildings were eligible. The New Jersey Historic Preservation Office (HPO) concurred (Nolte and Steinback 2004a; Guzzo 2004a). The three buildings surveyed are the last remnants of the plant that has now completely fallen into disrepair and disuse. They shed no light on the workings of the plant and they still lack integrity. The buildings, therefore, are not eligible for the NRHP. There is no associated landscape.

1400 Area Rocket Powder Propellant Plant and Cast High Explosives Plant. The 1400 Area is located on a hill at the eastern-most end of Farley Avenue (see Figure 4.57). Like all of Nitro Hill, the Rocket Powder Propellant Plant is highly contaminated with black powder, nitroglycerine, and rocket propellant. Panamerican surveyed one building in this plant:

1410 (1948) Acetone Storage Tank (Figure 4.61)

Building 1410 (1948) comprises two metal tanks on concrete tank stands covered by a dilapidated wooden structure; derelict (see Figure 4.61).

After the devastating 1926 explosion at the Lake Denmark Naval Depot, the Army decided to rebuild Picatinny Arsenal. The decision reached by the Army's Special Board of Enquiry added recommendations for the rearrangement of certain facilities with a view toward greater safety and economy of operation (PICA 1942; see Rogers 1931). These recommendations included geographically dividing the reservation into specific use categories. The three main use categories were: 1) the manufacturing area in which explosives were handled; 2) storage areas in which propellants and high explosives were kept; and 3) manufacturing activities where non-hazardous materials were handled and where administrative, engineering and research activities were carried out (PICA 1942). In general, the central section of the post was designated for explosives manufacturing, and a small tetryl plant was built on the eastern slope (i.e., Nitro Hill) of the arsenal.

The tetryl plant did not stay small for very long. Beginning with the Protective Mobilization in 1939, all of Picatinny's activities were accelerated, and plants were enlarged and rearranged to accommodate full production capabilities. This condition was especially true for the tetryl plant, which after its expansion was able to supply all the needs of the arsenal for fuze-loading, the loading of boosters in the Renovation Plant, and some of the new loading plants as they began production (PICA 1942).

As the war continued and new items, such as rockets, were employed. It became clear that research and production related to rocket fuels and related explosives were becoming an area of additional scrutiny. Some time toward the end of World War II, a new experimental explosives plant was designed and constructed on the south side of Nitro Hill. The construction of this new plant conformed to the location requirements of Picatinny's geographic use plan for explosives plants.

The new experimental explosives plant was 96 percent complete in January 1946, when all work was stopped (Picatinny News 1946). It is unclear why the work was suspended (although the high costs associated with demobilization after the war may be surmised) or when the work was finally completed. However, the plant was completed and called the Rocket and JATO (Jet-Assisted Take Off) Plant when it opened (PICA 1956). The plant's use was reflected in the surrounding street names: Rocket Production Road, Double Cast Road, Lower Cast Road, and Double Base Road (see Figure 4.57).

A 1956 booklet (PICA 1956:48-49) described Rocket and JATO Plant activities as involving the production of propellants in sheets or by extrusion in any geometric shape. The largest press in the United States was located within the plant. The 21-inch, horizontal press could extrude grains up to 9 inches in diameter (PICA ca. 1961). The plant could produce both experimental and semi-production propellants as well as a wide range of experimental extruded grains, which could be produced at about 1,500 pounds per day. The fully equipped cast-propellant lines were adequate for manufacturing cast grains, 36 inches in diameter and up to 150 inches long. The various casting molds required for this process were manufactured in the arsenal machine shops. In addition to solid propellant activities, the pilot and semi-production facilities were flexible enough to permit the employment of practically every conceivable chemical process associated with the manufacture of explosives and propellants.

Figure 4.61. Building 1410, Acetone Tanks, Rocket Powder Propellant Plant and Cast HE Plant, Nitro Hill, Picatinny Arsenal, NJ *(Panamerican 2007).*

Although it would seem to be a logical connection, the Rocket and JATO Plant apparently did not have a direct connection to the work of NARTS and RMI/RMD just a few miles away (Siminski 2003). It is unclear when the Rocket and JATO Plant became the Rocket Powder Propellant and Cast High Explosives (RPP and CHE) plants, its current designation.

The plants are laid out in typical World War II military-industrial style with a multiplicity of buildings performing a discrete function (with many of the buildings being redundant), all of which were connected by a series of covered walkways. At the time of the investigation, most of the buildings and structures in RPP and CHE plants were vacant and a number of them were derelict or demolished. Many of the covered walkways still exist on Rocket Production Road, but almost none exist in the other areas of the production plant. A few buildings are still in use for propellant-related research and production.

With the exception of a handful of buildings, the RPP and CHE plants were conceived and designed by the Industrial Division and/or Engineering Division of PICA. Certainly many of these buildings were based on standardized industrial plans that had been created previously at Picatinny and were subsequently used throughout the military.

During the early 1970s, a number of new buildings were constructed on Lower Cast Road. Buildings 1462 and 1464, a process and loading plant, were redesigned by Ballinger and Co., Architects and Engineers, of Philadelphia (now, simply Ballinger). Ballinger considers itself the oldest architectural firm in the United States, with more than 125 years of experience. Ballinger established its early reputation on its technical qualifications and the ability to meet the needs of a manufacturing-based economy. It was the first American firm to integrate the disciplines of architecture and engineering, securing patents in the early 1920s for Super-Span, saw-tooth roof trusses that helped illuminate industrial plants with natural light. Its designers pioneered designs in reinforced concrete and other new materials (Bottemly 2000; Ballinger 2007).

By the early 1900s, Ballinger was one of the largest commercial and industrial firms in the United States. Its architects designed landmark projects for the Victor Talking Machine Corporation (later, RCA) and the first facility for the Joseph M. Campbell Company (Campbell Soup Co.). By the mid-1930s Ballinger had completed 16 new hospitals. Technical innovations continued to follow with the creation of the vertically expandable Robert Morris Hotel and Office Building and the TWA hangar at the Philadelphia Airport that featured a cable-suspended, 150-foot cantilevered roof. One of their most innovative creations during the 1950s was one of the first ever “computer rooms” for the ENIAC computer. This led to the creation of related facilities at IBM and the Rand Corporation (Ballinger 2007).

Ballinger and Co. was the architectural and engineering group responsible for the creation of NARTS Area E, the X-15 rocket-engine test site located off Snake Hill Road, now within PICA. It also designed a number of special use buildings for Fort Monmouth (New Jersey) and the Soldier Systems Center (Natick, Massachusetts). Ballinger has had a long and profitable career with the U.S. military. Still located in Philadelphia, Ballinger continues to design research facilities, medical facilities and industrial structures (Ballinger 2007).

Because the majority of the buildings in the RPP and CHE plant were built at the end of World War II, when construction materials were in short supply, the materials used throughout these plants were almost the same. Simple wood-frame, one-story buildings have walls covered in transite, while asbestos or other cheap types of shingles covered the roofs and simple concrete slabs formed the foundations. Many buildings featured concrete interior blast walls or special

concrete chambers, although concrete walls that would have required some form of metal rebar were kept to a minimum. Later additions to the line included concrete block and poured concrete, but the World War II buildings were built of the filmiest materials. Inexpensive construction materials coupled with little ongoing maintenance practically insured that the production lines' buildings were in very poor condition.

Every building within the RPP and CHE plants is essentially the same building, constructed out of the same materials with the only variance size. A number of buildings within the Rocket and JATO plant have been recorded at HABS/HAER Level 4 (Thurber and Norman 1983). Building 1301, the Mortar Powder Building, was recorded as possessing significance. However, this building, after going through the proper review process, was being partially demolished and completely rebuilt at the time of the investigation. Building 1408B, Weight House, Building 1412A, Dry House, and Building 1418, Shipping and Storage (now demolished), were all recorded with notations indicating that they were of "limited significance" (Thurber and Norman 1983). When the HABS/HAER cards were recorded in the early 1980s, most of the buildings within the RPP and CHE plants were not yet 50 years of age, therefore, the other buildings within the complex were not recorded.

The remaining buildings of the Cast High Explosives area of the RPP and CHE plants were built in the late 1960s and 1970s and obviously replaced a number of older structures. Maps of this area for earlier years are few and it is difficult to tell how many earlier buildings were on Lower Cast Road. However, a few completely collapsed buildings in the area suggest that the original buildings in the area were like those on Rocket Propellant Road.

In 2004, Panamerican found that the RPP and CHE plants had lost their integrity because of the poor condition of the buildings, the large number of buildings missing from the lines, the construction of new buildings, and the demolition of key buildings. As a result of that loss it is virtually impossible to trace the production sequence. Because of this significant loss of integrity, the plants were recommended not eligible for the NRHP (Nolte and Steinback 2004a). The New Jersey HPO concurred (Guzzo 2004a). The recordation of one more structure, the acetone tanks, does not shed any light on the production sequence of the plants and since the plant has lost integrity, Building 1410 is not eligible for the NRHP. There are no associated landscapes.

1600 Area "Little Picatinny." The 1600 Area is located on a steep hillside between Phipps Road and a fork off Berkshire Hill Road known as Little Picatinny Road (Figure 4.62). It is purported that the name "Little Picatinny" derives from the fact that this pyrotechnic area was a microcosm of the work and research conducted at the installation as a whole. As late as 2004, a testing area, the Detonation Facility, was still extant, but is now gone (Nolte and Steinback 2004a). At the time of the investigation, only four buildings were left from this once large and thriving production/test line. Panamerican survey one building in Little Picatinny:

1609A (1963) Disassembly Building (Figure 4.63).

Building 1609A (1963), now a storehouse but originally a disassembly building, is a small rectangular, flat roofed structure located along a covered walkway that is associated with Building 1609. Situated along Phipps Road, the building sits on a concrete pier foundation, has corrugated asbestos walls and a corrugated asbestos roof (see Figure 4.63).

Figure 4.62. Locations of Buildings 67, 68, 70, 71, 80, 81, 83, 92, 92A, 94, 1102 and 1609A, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.63. Building 1609A, Disassembly Building, Little Picatinny Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

In 2004 it was recommended that the Little Picatinny production area had no integrity and its structures were not eligible for listing to the NRHP; to which the New Jersey HPO concurred (Nolte and Steinback 2004a; Guzzo 2004a). The Disassembly Building, 1609A, does not shed any light on the work of Little Picatinny and is cut-off from its original production sequence. As a result, it retains no integrity and is, therefore, not eligible for the NRHP.

4.2 TESTING ASSOCIATED WITH MANUFACTURNG AND PRODUCT QUALITY ASSURANCE

Although testing is not generally thought of as a part of the manufacturing process, all aspects of material production at PICA were investigated and codified. Testing was vital to understanding the nature of new chemicals, shell casings, and shelf life of any new creation. 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 propellants and explosives. The Lake Denmark explosion was a brief interruption in PICA's role of preserving armament knowledge, as the arsenal's facilities continued to serve both the Army and private industry during the inter-war years. When the United States entered the war, Picatinny was producing smokeless powder, high explosives, fuzes and primers, assembled rounds of artillery ammunition, bombs and grenades, and pyrotechnics (i.e., airplane flares and signal smokes), all at experimental or peace-time levels (Thurber and Norman 1983).

As noted previously, Picatinny 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 during the interwar years. The arsenal also improved and redesigned artillery primers, trench mortars

and rounds of chemical and tracer ammunition. Fuze powders, primer mixtures, pyrotechnic compositions, propellant 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, important advances, new products or simplified methods of production were made at the arsenal. PICA's accomplishments included: 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. 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, PICA also conducted a significant number of testing operations. The M1 and M3 flashless, non-hygroscopic cannon powders were tested at the arsenal both for composition and specific weapons (3-inch and 90mm). Long delay and aboveground 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 of the arsenal. All of these tests were critical in developing explosives that would best meet the Army's needs.

After the 1926 explosion, PICA 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, which included 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 focused on the powder and explosives manufacturing area. A new Nitrocellulose Smokeless Powder Plant (500 Area; built on the original site), the Complete Rounds/Melt Loading Plant (800 Area), and a High Explosives Plant (1000 Area) were all 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 (Building 151) and a chemical laboratory complex also were 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 the research was being conducted. Such impromptu testing caused numerous accidents and fires in the production areas. After the 1926 explosion, most of the testing activities were shifted to a small peninsula on the south shore of Picatinny Lake. Another fire and explosion in 1928, limited on this occasion only to 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 relocation 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 shores 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 (PICA ca. 1945).

The structures in the 600 Explosives Test Area 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, as all construction features were dictated by the testing intended for them. Building materials included: wood, brick, concrete, galvanized steel, and tile. Framing styles and materials also differed with the structure's testing intent. The area at the time of the investigation looked very much as it probably did during the World War II years. Large, well-lit open areas surrounded oddly configured buildings that stand in stark simplicity. No attempt has ever been made to landscape this almost surreal grouping of buildings, which are still used 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 Corps and outside contractors (PICA ca. 1945). Several structures in the 600 Area were specifically designed for explicit purposes and are considered one-of-a-kind buildings. A survey of the facilities at the other old line Army arsenals—Edgewood Arsenal (Aberdeen), Maryland; Rock Island Arsenal, Illinois; and Watervliet Arsenal, New York—reveal no grouping of testing-related structures like those at Picatinny.

This World War II testing area has been well documented. HAER documentation was completed on the area in the early 1980s (Thurber and Norman 1983). On 2 July 1999, the New Jersey HPO ruled that the 600 Ordnance Test District was eligible for listing to the NRHP under Criteria A and C (Guzzo 1999). The Ordnance Test District comprises approximately 29 buildings all located in southern portion of the 600 Area. The historic context for the district was: the interwar years, World War II mobilization, and World War II. Although the district itself is closely associated with those periods, the area continues to be used.

During the Cold War, the area was used for a number of different testing activities. Aside from conventional explosives, some nuclear testing was conducted in the area. By the late 1950s PICA was a major player in the nuclear field, so it is not surprising that some testing was conducted at this site. Nevertheless, conventional weapons held sway within the test area. The Ordnance Test Historic District is only a very small part of the entire ordnance test area that stretches across the mountain ridge.

4.2.1 600 Area Buildings Surveyed. As expected, this large area has been divided into several "ranges" or areas. This section discusses the 600 Area test buildings within their ranges or as a miscellaneous group of buildings.

600 Area Miscellaneous Buildings (see Figure 4.31).

602C (1967)	Change House (Figure 4.64)
603E (1938)	Storehouse (Figure 4.65)

Building 602C (1967) previously used as a change house, is located off Twentieth Avenue. It is a long, rectangular, gable-roofed structure with the gable end extending and sheltering a covered walkway. The building sits on a concrete foundation, has masonry block walls, and an asphalt shingle roof (see Figure 4.64).

Figure 4.64. Building 602C, Change House, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.65. Building 603E, Storehouse, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 603E (1938), a garage, is found off Twentieth Avenue. It is a rectangular, gable-roofed structure with a single garage bay at the gable end. The building sits on a concrete foundation, has galvanized iron walls, and a galvanized iron roof (see Figure 4.65).

The connection of these miscellaneous buildings to other buildings and their purpose is not clear. A number of fallen buildings (ruins) can be seen along this stretch of Twentieth Avenue, so it can be assumed that they might be associated somehow with them. These two buildings, however, are mundane, daily operations buildings without historical or architectural significance and as such are not eligible for the NRHP.

Unnamed Test Area near James, Deavy and Greenberg Roads (see Figure 4.31).

606 (1960)	Experimental Test Facility (Figure 4.66)
614 (1958)	Warehouse (Figure 4.67)
615 (1958)	Turret; derelict (Figure 4.68)
616 (1963)	Test and Evaluation Facility (Figure 4.69)
S634 (1930)	Slug Butt, derelict (Figure 4.70)

Building 606 (1960), previously used as an ordnance facility and experimental testing facility, is situated off James and Deavy roads. It is a rectangular, two-story, flat roof building with a one-story gable wing. The building sits on a concrete foundation, has 12-inch concrete and corrugated walls, and a metal and build-up roof (see Figure 4.66).

Building 614 (1958) was previously used as a general purpose warehouse. Located off Greenberg Road, the building is a small rectangular, shed-roofed structure with central hinged double doors. It sits on a railroad tie foundation, has frame on wood walls, and a roll on roof (see Figure 4.67).

Building 615 (1958), previously used as an ordnance facility and fire control barricade turret, is a gun turret located on the firing field off Twentieth Avenue. Derelict, the turret sits on a concrete foundation, and is constructed of ¼-inch steel (see Figure 4.68).

Building 616 (1963) was previously used as an ordnance facility, and is on the test-firing field off James Road. It is a rectangular, flat roofed structure with six firing bays. The building sits on a concrete foundation, has concrete walls, and a concrete slab roof (see Figure 4.69).

Building S634 (1930), previously used as a slug butt, is found off Greenberg Road. It is the concrete-with-rebar remains of the structure, and sits on a reinforced-concrete foundation, has reinforced-concrete walls, and no roof (see Figure 4.70).

The buildings surveyed were erected in support of an open test range off James, Deavy and Greenberg roads (Figure 4.71). A typical firing range is a large open area, usually a gravel covered lot, surrounded by any number of buildings for observation, storage of various types of materials and materiel, and magazines. In addition, the field itself contain firing stands, vertical and horizontal sheets of iron, and targets of various types, such as vehicles, and earthen berms. Many times the back of the firing range is formed into a large slug butt, a place to capture fired ammunition.

At Picatinny, the buildings surrounding these test areas are in a variety of conditions, ranging from totally derelict to almost new. By and large, the buildings are fairly dilapidated, probably a

Figure 4.66. Building 606, Experimental Test facility, Unnamed Test Area near James and Greenburg Roads, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.67. Building 614, Warehouse, Unnamed Test Area near James and Greenburg Roads, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.68. Building 615, Gun Turret used as a Fire Control Barricade, derelict, Unnamed Test Area, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.69. Building 616, Test and Evaluation Facility, Unnamed Test Area near James and Greenburg Roads, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.70. Building S634, Slug Butt, derelict, Unnamed Test Area near James and Greenburg Roads, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.71. Explosives Testing Field at Unnamed Test Area near James and Greenburg Roads, Ordnance Test Area, Picatinny Arsenal, NJ. Note various pieces of iron used as shields within the field *(Panamerican 2007).*

result of the buildings on the ranges only being used during the times of testing. Offices and some types of warehouses tend to be in better condition since they are used on a daily or regular basis. While testing is an ongoing activity at Picatinny, the actual explosion of ordnance on the test fields is not necessarily a daily activity.

This test area is typical of those within the Ordnance Test Area at Picatinny. These mundane, daily operations buildings are without architectural or historical significance and are, therefore, not significant. There is an associated landscape with this test area, the test range itself (see Figure 4.71). The range, however, is typical of type, and has no architectural or historical significance. The Unnamed Test Area off James, Deavy and Greenberg roads range and associated buildings are not eligible for the NRHP.

Bear Swamp Testing Facility (see Figure 4.31).

619 (1965)	Hypervelocity Test Facility, Magazine (Figure 4.72)
621A (1947)	Ammunition Testing Facility (Figure 4.72A)
622 (1945/1964)	Pyrotechnics Magazine (Figure 4.73)
623F (1957)	Valve House (Figure 4.74)
627 (1954/1958)	Shaped-charge Test Facility Observation (Figure 4.75)
630 (1957)	Administration Office (Figure 4.76)
631 (1953/1957)	Environmental Chamber (Figure 4.77)
632 (1953/1957)	Propellant Conditioning, derelict (Figure 4.78)

Building 619 (1965) was previously used as a high explosive magazine, a test facility, and a hypervelocity test chamber. Located off Stickle Road, it is a rectangular, flat-roofed structure with open side, covered storage at one end. The building sits on a concrete foundation, has concrete-block walls, and a concrete roof (see Figure 4.72).

Building 621A (1947), previously used as a small arms pyrotechnics magazine, is located off Stickle Road. It is an almost square, shed-roof building that sits on a concrete foundation, has tile walls, and a metal roof (see Figure 4.72A). This building appears to be in the 600 Area Ordnance Test Historic District. However, it is not individually eligible for listing to the NRHP, and is a non-contributing element to the district.

Building 622 (1945/1964), previously used as an ordnance facility, metallurgy lab, firing chamber, and an explosive metal forming facility, is found near Stickle and Hance roads. It is a rectangular, flat-roofed structure with a garage bay at one end. The building sits on a concrete foundation, has concrete block walls, and a build-up on fiberboard roof. An addition was made to it in 1964 (see Figure 4.73).

Building 623F (1957), a water pump, NP 1-400 GPM valve house, is located along Twentieth Avenue. It is a small, square, shed-roofed structure with a side entrance door on the north end. The building sits on a concrete foundation, has transite walls, and a transite roof (see Figure 4.74). This building appears to be in the 600 Area Ordnance Test Historic District. However, it is not individually eligible for listing to the NRHP, and is a non-contributing element to the district.

Building 627 (1954/1958) was previously used as a high explosive magazine, explosive test firing building, observation building, and a shape-charged test facility. Situated along Stickle Road, the building is a rectangular, flat-roofed structure with a central steel entrance door. The building sits on a concrete foundation, has concrete walls, and a concrete roof (see Figure 4.75).

Figure 4.72. Building 619, Hypervelocity Test Facility, Magazine, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.72A. Building 621A, Ammunition Testing Facility, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.73. Building 622, Pyrotechnic Magazine, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.74. Building 623F, Valve House, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.75. Building 627, Shaped-charge Test Facility Observation, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.76. Building 630, Administration Office, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.77. Building 631, Environmental Chamber, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.78. Building 632, Propellant Conditioning, derelict, Bear Swamp Testing Facility, Ordnance Test Area, Picatinny Arsenal *(Panamerican 2007).*

Building 630 (1957), an administration building off Bear Swamp Road, is a rectangular, gable-roofed structure constructed on a hill with an exposed cement basement. The second story has with cement-board vertical siding. The building sits on a concrete foundation, has 2-inch AFC board walls, and 5-ply, build-up roof (see Figure 4.76).

Building 631 (1953/1957), previously used as an ordnance facility, conditioning building, and an environmental chambers powder conditions and service building, is located between Twentieth Avenue and Bear Swamp Road. It is a rectangular, gable-roofed structure with three garage bays, three entrance doors, and a cement loading dock. The building sits on a concrete foundation, has Cemesto walls, and a build-up roof (see Figure 4.77).

Building 632 (1953/1957), previously used as propellant conditioning, magazine service, chemistry laboratory, loading building, and constant temperature service building, is found along Bear Swamp Road. It is a rectangular, flat-roofed shell of a structure with an intact loading dock. The building sits on a concrete foundation, has framed walls, and a corrugated build-up roof (see Figure 4.78).

This test area is typical of those within the Ordnance Test Area at Picatinny. These mundane, daily operations buildings are without architectural or historical significance and are, therefore, not significant. Bear Swamp Testing Facility has no associated landscapes. The associated buildings are not eligible for the NRHP.

Bear Swamp Testing Area #1 (see Figure 4.31).

633 (1957)	Storage/Loading (Figure 4.79)
636 (1957)	Gun Service Building (Figure 4.80)
637 (1953/1957)	Ordnance Observation (Figure 4.81)
637A (1957)	Emplacement Pad (Figure 4.82)

Building 633 (1957), previously used as an ordnance facility propellant storage and a loading facility, is found off Bear Swamp Road. It is a rectangular, gable-roofed structure with three sets of double entrance doors, and a cement loading dock. The building sits on a concrete foundation, has Cemesto walls, and a five-ply build-up roof (see Figure 4.79).

Building 636 (1957), previously used as a gun-service ordnance facility, is situated off Hance Road. It is a rectangular, gable-roofed structure with a garage bay on the gable end and four hopper windows on the end without a gable. There is a cement, flat roof addition at the rear. The building sits on a concrete foundation, has Cemesto walls, and a five-ply build-up roof (see Figure 4.80).

Building 637 (1953/1957) was previously used as an ordnance facility and for observation. Located off Hance Road, the building is a small, square, shed-roofed structure with three long narrow bays. It sits on a concrete foundation, has concrete and steel walls, and a concrete roof (see Figure 4.81).

Building 637A (1957) was previously used as an emplacement pad and ordnance facility. It is located off Hance Road, and is a concrete pad with irregular pattern concrete walls (see Figure 4.82).

Figure 4.79. Building 633, Storage and Loading, Bear Swamp Testing Area #1, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.80. Building 636, Gun Service Building, Bear Swamp Testing Area #1, Ordnance Test Area, Picatinny Arsenal, NJ (*Panamerican 2007).*

Figure 4.81. Building 637, Ordnance Observation, Bear Swamp Testing Area #1, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.82. Building 637A, Emplacement Pad, Bear Swamp Testing Area #1, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.83. Firing Range Associated with Bear Swamp Testing Area #1, Ordnance Test Area, 600 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

This test area is typical of those within the Ordnance Test Area at Picatinny. These mundane, daily operations buildings are without architectural or historical significance and are, therefore, not significant. Bear Swamp Testing Area #1 has an associated landscape, an open firing range (Figure 4.83). The range, however, is typical of type, and is not historically or architecturally significant. The range and the associated buildings are not eligible for the NRHP.

Bear Swamp Testing Area #3 (see Figure 4.31).

644 (1964)	HE Magazine (Figure 4.84)
646 (1958)	Pump House (Figure 4.85)
647 (1957)	Electronic Equipment Facility (Figure 4.86)
650 (1957)	Personnel Building (Figure 4.87)
651 (1957)	Barricade (Figure 4.88)
654 (1963)	Control Bunker (Figure 4.89)

Building 644 (1964) was previously used as a high explosive magazine. Off Twentieth Avenue, the building is a rectangular, gable-roofed structure with a steel double door entry. It sits on a concrete foundation, has 8-inch, cinder-block walls, and a corrugated aluminum roof (see Figure 4.84).

Building 646 (1958), a pump house, is situated off Bell Road and is a circular, cone-roofed structure far back on a hill. The building sits on a concrete foundation, has steel walls, and a steel roof (see Figure 4.85).

Figure 4.84. Building 644, HE Magazine, Bear Swamp Test Area #3, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.85. Building 646, Pump House, Bear Swamp Test Area #3, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.86. Building 647, Electronic Equipment Facility, Bear Swamp Test Area #3, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.87. Building 650, Personnel Building, Bear Swamp Test Area #3, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.88. Building 651, Barricade, Bear Swamp Test Area #3, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.89. Building 654, Control Bunker, Bear Swamp Test Area #3, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 647 (1957), previously used as an electronic equipment facility, is found off Seavy Road is an irregular-shaped, flat-roofed structure with periscope bays. The building sits on a concrete foundation, has concrete walls, and a concrete roof (see Figure 4.86).

Building 650 (1957) was previously used as an electronic equipment facility and personnel building. It is off Bear Swamp Road, and is an L-shaped, flat-roofed structure with open side, covered storage at one end. The building sits on a concrete foundation, has concrete walls, and a concrete roof (see Figure 4.87).

Building 651 (1957) was previously used as an ordnance facility barricade. It is located off Bear Swamp Road and is an octagonal, flat-roofed structure. The building sits on a concrete foundation, has concrete and steel walls, and a concrete roof (see Figure 4.88).

Building 654 (1963), previously used as an ordnance facility, control bunker, is situated off Bear Swamp Road. It is a rectangular, shed-roofed structure with six sliding bays and a rear-framed addition. The building sits on a concrete foundation, has concrete walls, and a concrete slab roof (see Figure 4.89).

This test area is typical of those in the Ordnance Test Area at Picatinny. These mundane, daily operations buildings are without architectural or historical significance and are, therefore, not eligible for listing to the NRHP. Bear Swamp Testing Area #3 has an associated landscape, an open firing range (Figure 4.90). The firing range is typical of the type and has no architectural or historical significance. The open range and its associated buildings are not eligible for the NRHP.

Figure 4.90. Firing Range, Bear Swamp Test Area #3, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Unnamed Grouping at End of Bear Swamp Road (see Figure 4.31).

670 (1955/58)	Firing Stand with Dark Room (Figure 4.91)
671 (1958)	Magazine (Figure 4.92)
672 (1956/1961)	Storage; derelict (Figure 4.93)
673 (1963)	Electronic Equipment Facilities (Figure 4.94)

Building 670 (1955/1958), a firing stand off Bear Swamp Road, is a concrete and steel-framed structure. This structure sits on a concrete foundation (see Figure 4.91).

Building 670 (1968), a dark room, is located off Bear Swamp Road is a rectangular, flat-roofed structure with a side, steel entrance door and a sliding bay just below the roof line. The building sits on a concrete foundation, has concrete and armor plate walls and a concrete and armor plate roof (see Figure 4.92).

Building 671 (1958) a general purpose magazine, off Bear Swamp Road is a rectangular, shed roofed structure single interior blast wall dividing the structure. The building sits on a concrete foundation, has plywood and metal walls, and an asbestos and metal roof (see Figure 4.93).

Building 672 (1956/1961), a storage facility off Bear Swamp Road, is a rectangular, gable-roofed structure with a single bay. The building sits on a concrete foundation, has frame walls, and a collapsed roof (see Figure 4.94).

Figure 4.91. Building 670, Firing Stand with Dark Room, unnamed test area at end of Bear Swamp Road, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.92. Building 671, Magazine, unnamed test area at end of Bear Swamp Road, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.93. Building 672, Storage, derelict, unnamed test area at end of Bear Swamp Road, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.94. Building 673, Electronic Equipment Facility, unnamed test area at end of Bear Swamp Road, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 673 (1963), previously used as an electronic equipment facility, id located off Bear Swamp Road and is a square, flat-roofed structure with central double doors. The building sits on a concrete foundation, has steel walls, and a steel roof (see Figure 4.94).

This test area is typical of those within the Ordnance Test Area at Picatinny. These mundane, daily operations buildings are without architectural or historical significance and are, therefore, not eligible for the listing in the NRHP. The unnamed test grouping at end of Bear Swamp Road has an associated landscape, an open firing range (Figure 4.95). The range is typical of the type, and has no architectural or historical significance. The range and its associated buildings are not eligible for the NRHP.

4.3 TESTING ASSOCIATED WITH ROCKET AND MISSILE SYSTEMS AND COMPONENTS

Both the U.S. Army and Navy tested rocket and missile systems and components at locations now part of Picatinny Arsenal. Scientists and engineers working in these areas participated in the development of some of the most important rockets of the Cold War (1946-1989) and made significant contributions to the science at what was then the Naval Air Rocket Test Station (NARTS), the former Lake Denmark Navy Ammunition Depot, and Picatinny Arsenal. This section discusses both the Army and Navy work at Picatinny Arsenal in separate sections.

4.3.1 Army Rocket Testing at Picatinny.

1500 Area Former Rocket Test Area. The 1500 Area is located off Lake Denmark and Hart roads and off the installation proper, within a chain-link fence enclosure. It is currently used for storage, assembly, research, development and testing of high explosives, propellants, and projectiles (Picatinny Arsenal 2006; Figure 4.96). Buildings surveyed in this area include:

1501 (1948)	Office
1502 (1948)	Ordnance Facility
1503 (1948/1956)	Conditioning Building
1504 (1956)	Storage
1504A (1948)	Conditioning Building
1505 (1948/1956)	Test Cell
1505A (1948)	Test Cell
1505B (1948)	Test Cell
1505C (1958)	Control House
1505D (1951)	Test Cell
1505E (1966)	Control Spin Room
1505F (1959)	Storage
1505J (1960)	Storage
1505K (found on post)	Storage
1505N (1948)	Open Blast Area
1506 (1954)	Loading Facility

Figure 4.95. Firing Range, unnamed test area at end of Bear Swamp Road, Ordnance Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

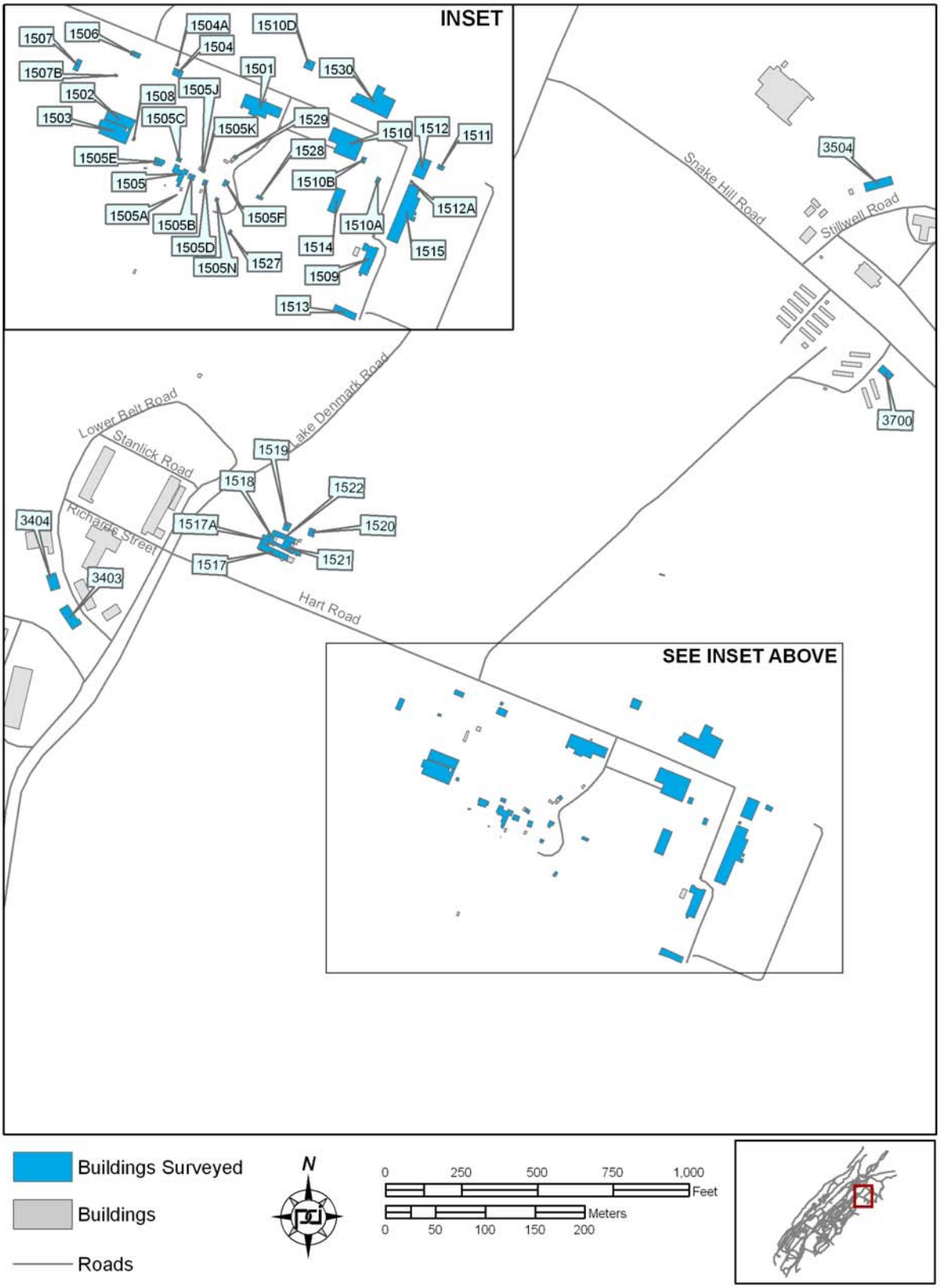

Figure 4.96. Location of 1500 Area, former Rocket Test Area, and buildings 3403, 3404, 3504, and 3700, Picatinny Arsenal, NJ *(base map: Chugach Industries 2007).*

1507 (1946)	HE Magazine
1507B (1959)	Storage
1508 (1955)	HE Magazine
1509 (1950)	Test Facility
1510 (1950/1956)	Pyrotechnic Building
1510A (1947)	Storage
1510B (1948)	General Storage
1510D (1947)	Water Tower
1511 (1952)	Neutralizing and Pump Station
1512 (1956)	Chemistry Laboratory
1512A (1958)	Flammable Material Storage
1513 (1968)	Pyrotechnic R&D Laboratories
1514 (1968)	Pyrotechnic R&D Laboratories
1515 (1961)	Physics laboratory
1517 (1956)	High Altitude Test
1517A (1963)	Electric Equipment Facility
1518 (1958)	General Purpose Instrument Storage; derelict
1519 (1956)	HE Magazine
1520 (1956)	HE Magazine
1521 (1960)	Component Propellant Building
1522 (1970)	Ordnance Facility
1527 (1960)	Barricade; derelict
1528 (1963)	Barricade; derelict
1529 (1964)	Warehouse

The early rocket and missile activities at Picatinny generally have been associated with the Reaction Motors Inc. (RMI) and the Navy conducted primarily in the areas off Snake Hill Road in the Lake Denmark section of the installation. It is here that RMI and the Navy tested the XLR-99 rocket engine (also known as the “Pioneer”)—the engine that eventually powered the X-15 plane, an experimental hypersonic aircraft that served as the test bed for the Space Shuttle (Jenkins 1996). The XLR 99 proved to be the workhorse of rocket engines because of its exceptional reliability and extraordinary safety record (Nolte et al. 1999c). Nevertheless, the Army also was actively engaged in rocket research and development during this period, and Picatinny was one of its research centers (Bjork et al. 1957; Bullard 1965; Cagle 1973; Combat Air Museum 2007a. 2007b, 2007c; Silber 1958).

At Picatinny, the Army appears to have conducted rocket and missile work in two areas: the 1400 Area and the 1500 Area. Some missile and rocket work was also conducted in the 800, 900, and 1300 areas, but these activities were incidental and these areas were not dedicated to that work alone. The 1400 and 1500 areas, however, were dedicated to missile and rocket work for much of their existence. The 1400 Area is known as the Rocket Powder Propellant and Cast High Explosives Plant and is located on a hill at the eastern-most end of Farley Avenue (see Section 4.1 Industrial/Factory Complexes). The hill is referred to as “Nitro Hill” by most Picatinny old-timers in honor of the explosives work conducted in the area, particularly on the north side were the oldest explosives plants were located. Sometime in the late 1950s new facilities were constructed for the creation of rocket and JATO (Jet Assisted Take Off) solid propellant research and development, including pilot and semi-production facilities (Nolte and Steinback 2004a). As is true for all Picatinny’s production and industrial facilities, the Rocket Powder Propellant area has changed significantly through time as the needs of various projects and

research activities changed (for a more detailed discussion of the 1400 Area see Nolte and Steinback 2004a).

The 1500 Area of Picatinny, located off Lake Denmark Road, apparently served as the Rocket Engine Test Facility, where such endeavors occurred as spin testing, launcher recoil, static hot firing, pressure and thrust measurements, altitude testing, hot and cold testing, salt water spray testing, and explosives detonation, including primers, detonators, fuzes, flares, mines, warheads projectiles, and igniters. Most of the tests involved propellant burning, but were non-ballistic in nature since free flight of the test item was limited to a few feet (PICA 2007). This area tested various components of the following rockets: the REDSTONE, HONEST JOHN (the first U.S. tactical nuclear weapon [Redstone Arsenal 2000a]), LOKI, NIKE AJAX, SHILLELAGH, PERSHING I and the SAGE (Semi-Automatic Ground Environment) system (Bjork et al. 1957; Bullard 1965; Cagle 1973; Combat Air Museum 2007a, 2007c; Delong et al. 1984; Directorate of Public Works nd; Facilities Engineering Division ndb; Loeber 2002; Silber 1958). Given Picatinny's research expertise in explosives it is probable that they were involved in other rocket/missile programs that have not yet been identified.

The Army In Space. After World War II, the U.S. military became a leader in the development and use of space for weapons and communications. The U.S. Army played a significant role in the early stages of the U.S. space program developing rockets and satellites, many of which were transferred to the National Aeronautics and Space Administration (NASA) after it was created in 1958. The first U.S. satellite was launched into orbit by an Army Redstone rocket. (Space Division, HQ 1993). The first U.S. tactical nuclear weapon, the HONEST JOHN rocket, was developed by the Army (Redstone Arsenal 2000a), and world's first operational, guided, surface-to-air missile system, the NIKE AJAX was deployed by the Army (Combat Air Museum 2007a). In all of these "firsts" Picatinny played a role.

Although theoretical work had been laid down by others before them, primarily by Konstantin Eduardovich Tsiolkovsky, a Russian pioneer in rocket and space science development, and Robert Hutchings Goddard, father of U.S. rocketry, German scientists and engineers were the first to develop and use guided missiles. Throughout the 1920s and 1930s, Walter Hohmann, an engineer who defined the principles of rocket travel in space, guided the German rocket program, which launched its first successful liquid propellant rocket in the early 1930s (Space Division, HQ 1993).

In 1932, Dr. Wernher von Braun has hired by the German Army to develop liquid propellant rockets, which led to the creation of the Aggregate or "A" series of successful rockets that achieved an altitude of 1.5 miles. In 1937, von Braun and his colleagues moved to an area off the Baltic coast near the small town of Peenemünde in northern Germany to escalate their rocket work for war weaponry. Von Braun and his team created larger rockets and began working on the first A4 rocket (Space Division, HQ 1993).

In October 1942, after a number of failures, the first A4 rocket was successfully launched, flying a programmed trajectory and impacting 120 miles down range. This is considered the beginning of the space age because the A4 is the ancestor of practically all U.S. and Soviet space launchers after World War II. The A4 was originally intended to attack the rear battlefield area beyond the range of conventional artillery, but it evolved into something entirely different. The A4 became the V-2 (*Vergeltungswaffe zwei*, "Vengeance Weapon 2"), a ballistic missile weapon that had a range of 200 miles and carried a one-ton explosive warhead (Space Division, HQ 1993).

In 1943, Hitler authorized the full-scale development of the V-2, with mass production of the weapon beginning later that year in an underground factory in the Harz Mountains. On 7 September 1944, the first V-2 was launched against England. Before the war was over, 4,300 V-2s were launched against Great Britain, Belgium and other Allied targets. The Allies were powerless against the rockets since they did not have any weapons able to intercept them. The V-2 fell silently on its target at about 5,200 feet per second (3,600 miles per hour); it was the most sophisticated and capable rocket that had ever been developed (Space Division, HQ 1993).

As the war was coming to an end, von Braun and his team were in a small town near the Austrian border with elements of the advancing U.S. Seventh Army only a few miles away. Von Braun and his men surrendered to the U.S. Army. When the war in Europe ended on 7 May 1945, the U.S. Army began to collect all the V-2s, V-2 components, technical documents, and all German technical personnel they could in order to outflank the Russians. The Russians did manage to capture a considerable amount of V-2 hardware, including the actual Peenemünde launch complex and several remaining scientists and technicians (Space Division, HQ 1993).

During World War II, the U.S. military had not been standing still on the development of rockets and missiles. In 1943, the Army established the Ordnance Rocket Branch (ORB) to centrally mange to development of rockets. In 1944, the ORB contracted with the California Institute of Technology's (CIT) Jet Propulsion Laboratory (JPL) to study rocket propulsion and develop long-range surface-to-surface rockets (Project ORDCIT). A total of 24 solid propellant rockets were tested at Fort Irwin, California, under this program, leading to the development of the PRIVATE, CORPORAL and BUMPER rockets. These development systems never reached operational testing (Space Division, HQ 1993).

Also in 1944, the Army developed White Sands Proving Ground (WSPG), New Mexico, north of Fort Bliss, Texas, to provide more area for longer range testing. Between 1945 and 1948, Fort Bliss was the involved in "Operation PAPERCLIP," the relocation of 492 German and Austrian rocket scientists, their equipment, and documents to the United States. The Army received 177 of these individuals, including Wernher von Braun, and was responsible for another 38 working for the Commerce Department. Fort Bliss became the U.S. Army Ordnance Research and Development Rocket Sub Office (Space Division, HQ 1993; Hughes 1990).

After the war, military funding decreased dramatically and many in the War Department were reluctant to fund what they considered experimental programs, such as large rocket weapons. The need to modernize conventional weaponry, such as jet airplanes, tanks, and submarines, seemed to take precedence. Nevertheless, people within the military establishment continued to push for rocket development and extended space exploration. The concept of artificial synchronous communication satellites seized the imagination of the public and some in the military viewed it as a virtual communications certainty for which they sought funding (Space Division, HQ 1993).

In January 1946, scientists at the Army Signal Corps at Fort Monmouth, New Jersey, bounced radio signals off the moon and received the reflected signals back proving that radio transmissions could penetrate the atmosphere and return to earth. About the same time, studies and proposals were prepared urging the development of artificial satellites. Despite the potential utility of the project, development of a satellite was not immediately pursued (Space Division, HQ 1993).

On 16 April 1946, the Army launched its first reconstructed V-2 from WSPG, which carried instruments in the nosecone that were recovered by parachute. In January 1947, the Navy asked the Joint Aeronautical Research and Development Board, an oversight committed composed of the Navy and Army Air Forces personnel, for authority over U.S. satellite development. In June of that year, the board asked the War Department for authority to fund studies related to satellites. However, in 1947, the National Security Act established the National Military Establishment (NME; the Department of Defense was not created as such until August 1949), reorganizing the U.S. military establishment and creating the Air Force as a separate service with resources primarily from the Army Air Corps. In September, the NME assigned responsibility for the development and control of defense satellites to the Joint Aeronautical R&D Board (Space Division, HQ 1993; Hall 1992).

Nevertheless, by 1948, the first Secretary of Defense James V. Forrestal felt it necessary to specify the roles and missions of each of the services in relationship to rockets and space, especially during a period of limited budgetary expenditures. The Army could develop tactical and Intermediate Range Ballistic Missiles (IRBM), including responsibility for antiaircraft guided missiles and ground-launched, short-range, surface-to-surface guided missiles supporting or extending conventional artillery capabilities; the Air Force was responsible for Intercontinental Ballistic Missiles (ICBM); and the Navy would develop ship or Submarine Launched Ballistic Missiles (SLBM). The struggle among the services for funding was exacerbated when the Air Force claimed the rights to satellite development as an extension of strategic air power. The Navy dropped its claims for satellite oversight (Redstone Arsenal 2000b; Space Division, HQ 1993; Hall 1992).

Regardless of the funding and maneuvering ploys, the Army moved forward in its rocket program. On 24 February 1949, Bumper Round 5, fired at WSPG under the direction of von Braun, marked the first penetration of outer space by a U.S. missile (Redstone Arsenal 2000b). In that same year the Secretary of the Army transferred the Ordnance Research and Development Division Sub Office from Fort Bliss to Redstone Arsenal. Von Braun and his team moved to Huntsville, Alabama. In addition, safety restrictions at WSPG became a problem for testing large rockets and the testing range was relocated to an isolated place on the east coast of Florida, later developing into Cape Canaveral (Space Division, HQ 1993). More ominously, an American weather plane over the Pacific Ocean detected radioactive particles in the atmosphere in September 1949, indicating that Soviets had tested their own atomic bomb. This development set off an atomic weapons race that lasted almost 50 years, adding more chill to the Cold War.

During the early 1950s, the sharp-elbowed rivalry among the military services over their respective roles during the Cold War carried over into the efforts to develop rockets and missiles. Changing roles after World War II brought about by new technology (e.g., airplanes, atomic bomb) compounded by budgetary priorities raised the Air Force's stature at the expense of the Army's. This shift was enhanced by the policies of the administration of President Dwight Eisenhower, beginning in 1953. His "New Look" budget for the Army for Fiscal Year 1955 was barely half of its allocation in FY 1953, and it would receive the smallest allocations of the three services during the 1950s (Bacevich 1986:20). The intellectual environment of the period reinforced policy decisions that emphasized high technology applications to military problems and was seasoned by reports published by RAND. These reports speculated on the use of commercial television technology for military satellites to gather intelligence and weather data (1951) and advocated Air Force use of imaging satellites to gather strategic intelligence (1954) (Space Division, HQ 1993).

To rebut the charges that conventional warfare was obsolete in the Atomic Age, Army policymakers emphasized their lead in missile development, and promoted its high technology endeavors, such as the space program, to capture public imagination. In its efforts to assert control over the development of rockets and missiles, the Army supported three missile programs, each focused on a different problem: air-defense weapons, including surface-to-air missiles (SAMs); tactical surface-to-surface missiles (SSMs); and space exploration with the goal of orbiting a satellite. However, the Air Force and the Navy were also eager to obtain this technological responsibility (Bacevich 1986:16-21, 74-75; Gaither 1997:14, 23-24).

In its rivalry to develop SAMs, the Air Force argued that the Army was intruding into areas of Air Force responsibility, abrogating the 1948 Key West agreement, which outlined the functions of the armed services in the new NME. At that time, the Air Force was assigned the task of developing long-range missiles, however, the Army was allowed to continue its research on the Skysweeper, a radar-directed automatic cannon. By the early 1950s, the Air Force was working with the private sector on the BOMARC missile and the Army was testing the NIKE AJAX. The NIKE won the bureaucratic battle over the BOMARC and was fielded in 1954, but its lack of range and firepower made it quickly obsolete. By 1956, the more nuclear-capable NIKE HERCULES was under development in competition with Air Force-Navy TALOS. To quell the debate, the DoD, in November 1956, assigned the Army jurisdiction of SAMs with range up to 100 miles. By 1960, the Army had two more missiles under development: the HAWK and NIKE ZEUS (Bacevich 1986:77-80; Gaither 1997:23-24; Combat Air Museum 2007a).

The Army's work on SSMs lead to the creation of the 280-mm Atomic Cannon, which was developed at PICA, but its obese size and lack of range made it obsolete immediately. Also, in 1953 the Army fielded the CORPORAL missile, first operational guided missile of the Army and the first guided missile approved for a nuclear warhead. It had a range of 75 miles. During the 1950s, the Army was developing the Redstone rocket as a tactical ballistic missile; the Navy was working on the VANGUARD rocket; and the Air Force was developing the ATLAS rocket as an ICBM (Combat Air Museum 2007b; Space Division, HQ 1993).

The development of rockets and missiles had dual implications; one path involved tactical weapons and focused on battlefield developments and defense against attacks, while the other involved more strategic goals of space exploration and research, communication and intelligence-gathering satellites. In 1950, the Army consolidated it rocket and missile development program, relocating von Braun's scientists and engineers from Fort Bliss to Redstone Arsenal. As a result, Redstone's mission was expanded to include "antiaircraft missiles, rocket launchers, and solid propellants, the latter two programs to be carried out in cooperation with Rock Island and Picatinny Arsenals" (Hughes ca. 1995). During the period between 1950 and 1958, Army personnel at Redstone Arsenal directed the REDSTONE, CORPORAL, NIKE, HAWK, LACROSSE, HONEST JOHN, SERGEANT, LITTLE JOHN, and REDEYE missile/rocket development programs. PICA scientists played a prominent role in the development of warhead sections (including the explosive payload, fuzing devices, and the arming and safety mechanisms) for all of these programs as well as the PERSHING, SAM-D, LANCE, and SAFEGUARD systems (Gaither 1997:94, 102; Kaye 1978).

The revelations that the Soviet Union had not only produced a hydrogen bomb in 1953 but were developing a ballistic missile delivery system capable of reaching the United States enlivened the American effort to develop a ballistic missile. A 69-ft tall Redstone rocket was successfully launched from Cape Canaveral, Florida, in August 1953. The Redstone would serve initially as a space launcher and, by 1956, as a tactical ballistic missile (deployed in Germany). Despite the success of the Redstone, the president elevated development of the ATLAS ICBM project as

the government's number one priority in 1955. (The ATLAS would not become operational until the late summer of 1959.) The Army Ballistic Missile Agency (ABMA) was established in 1956 at Redstone "to oversee the Army's ballistic missile program, the first agency devoted exclusively to the development of ballistic missiles" (Gaither 1997:24). The agency was responsible for the REDSTONE, JUPITER, and PERSHING (Intermediate Range Ballistic Missile [IRBM]) missile programs (Hughes ca. 1995).

Closely related to the American missile-development program was its satellite-development program, since the rockets used to propel a warhead at an enemy were also the same ones that could be used to send a satellite into orbit. By the 1950s, manned reconnaissance over enemy territory was vulnerable to increasingly accurate air defense missiles, so development of reconnaissance satellites was essential to intelligence-gathering and monitoring activities in the Soviet interior. However, no international agreement had been negotiated on the right of free passage of satellites over another nation's territory. President Eisenhower advocated a policy of "Open Skies," which would permit the United States and Soviet Union to conduct aerial reconnaissance flights over each other's territory to verify that the other was not preparing to attack. Cold War suspicions led Soviet General Secretary Nikita Khruschev to reject Eisenhower's proposal. President George H.W. Bush reintroduced this concept 34 year later, in 1989, as a means to build confidence and security between NATO and Warsaw Pact countries (Space Division, HQ 1993; Hall 1992).

The inter-service rivalry that was characteristic of the period was also fierce in the field of launching satellites: the Army advocated the use of a modified REDSTONE rocket with a solid fuel upper stage; the Air Force proposed using an ATLAS ICBM, although it had yet to field one; and the Navy advanced its VANGUARD rocket, also in development. The administration, sensitive to the appearance that the launch of a military-sponsored satellite would destabilize the tense Cold War political environment, selected the Navy-National Science Foundation VANGUARD to launch the first U.S. satellite because it was more closely linked to the research community (Space Division, HQ 1993; Hughes 1990; Hall).

Although the Air Force's ATLAS received high priority for development as an ICBM and the Navy's VANGUARD was chosen to launch the first American satellite, the Army was allowed to continue research on its JUPITER rocket for use as an IRBM. By September 1956, the Army realized that its modifications to the JUPITER's motor as well as the use of solid propellant could allow the placement of a small satellite in orbit by the end of 1956, ahead of VANGUARD. Despite the capability, the Army was ordered not to launch such a satellite.

Nevertheless, in 1956, the Soviets announced their intention to place a satellite in orbit as part of the International Geophysical Year 1957-1958. Almost as a precursor to the satellite launch, the Soviets successfully conducted a launch of their first ICBM in August 1957. Several months later, in October, the Soviets launched Sputnik, the first artificial satellite, and ushered in the Space Age. The administration viewed the launch of Sputnik as advancing the "Open Skies" concept, since the Soviets couldn't protest American surveillance satellites flying over other nations if the Soviets did it first (Begley 2007; Hall 1992).

Despite the advanced warning and intelligence revealing the Soviets intension and ability to launch a satellite, administration critics and politicians pandering to fears of the general public played up the non-existent technology gap. With this, they argued, the Soviets demonstrated that they not only possessed nuclear weapons but also had the means to deliver them against targets in the continental United States for which the United States had no defense. On 3 November 1957, the Soviets launched Sputnik 2, which carried a live dog named Laika. The

Eisenhower Administration, unconcerned by the satellite launch, had miscalculated the blow to national pride and prestige. To counter the negative publicity after the launch of Sputnik 2, the VANGUARD program, which had endured delays and test failures, was accelerated and the Army was directed to orbit a satellite by March 1958. However, American technological prestige was wounded when a Vanguard launch in December 1957 fell back to the pad and erupted in flames (Begley 2007; Space Division, HQ 1993; Hall 1992).

By the end of 1950s, the initial fragmentation of the U.S. space program as a result of inter-service rivalries was replaced by a greater sense of organization with the creation of Advanced Research Projects Agency (ARPA) and National Aeronautics and Space Administration (NASA). Eisenhower created ARPA, a high-level DoD organization, to initially direct the U.S. space program and, in the summer of 1958, the National Aeronautics and Space Act was enacted which created the NASA. ARPA would maintain control of national defense space operations and focus on national defense R&D that would expand the frontiers of technology beyond the immediate and specific requirements of the military services, while NASA was responsible for non-military aeronautical and space research under civilian control. Initially, NASA's facilities came from the National Advisory Committee for Aeronautics (NACA), which was disbanded. The American space effort also began to achieve some success at this time when ABMA launched the first U.S. satellite—EXPLORER I—on January 31, 1958 using a JUPITER-C rocket (later, redesignated JUNO I). The data collected by this satellite led to the discovery of radiation belts in space around the Earth (i.e., the Van Allen belts). The successful satellite launch cemented the competence of Army missile developers in the American mind. A successful launch of a VANGUARD rocket finally occurred on 17 March 1958 (Space Division, HQ 1993; Hall 1992).

During this period, the Air Force continued development of ICBMs and the Navy continued its work on sea-launched rockets, although the Navy did transfer its VANGUARD project and part of the Naval Research Laboratory to NASA in November 1958. The Army continued research on IRBMs. Gradually, non-military space-related missions were transitioned to NASA, while weapons-related missions were transitioned to the Army Ordnance Missile Command at Redstone, including development of the solid propellant for the PERSHING rocket and the NIKE ZEUS program. By October 1959, ABMA engineers and scientists were transferred to NASA, including the development program for the SATURN rocket, the EXPLORER satellite program, and the JPL in California. Nevertheless, final approval of the Army-NASA transfer enabled ABMA personnel to work on military weapons systems for the Army as well as independent space vehicle R&D for NASA (Hughes 1990, ca. 1995; Space Division, HQ 1993). NASA established the George C. Marshall Space Flight Center at Redstone Arsenal, Alabama, in the spring of 1960, and by 1 July, with the transfer of ABMA responsibilities to the Marshall Space Flight Center, all of the Army’s space missions passed to NASA (Hughes 1990). Subsequent to the Army reorganization in 1962, missile R&D was subsumed under the Army Missile Command (MICOM), a subordinate command of the U.S. Army Materiel Command.

ARPA's initial emphasis included space, ballistic missile defense, and nuclear test detection. In 1960, all of its civilian space programs were transferred to NASA and the military space programs to the individual services. This allowed ARPA to concentrate its efforts on the DEFENDER (defense against ballistic missiles), Project Vela (nuclear test detection), and AGILE (counterinsurgency R&D) Programs, and to begin work on computer processing, behavioral sciences, and materials sciences. The DEFENDER and AGILE Programs formed the foundation of DARPA sensor, surveillance, and directed energy R&D, particularly in the study of radars, infrared sensing, and x-ray/gamma ray detection (Space Division, HQ 1993). The Army satellite program was directed by Signal Research and Development Laboratory (SRDL) at Fort

Monmouth, where ARPA was also located. SRDL developed the Signal Communications by Orbiting Relay Equipment (SCORE) satellite, which was launched in December 1958.

The Army's significant contributions to the U.S. space program during the last years of the 1950s included:

- successfully solving the problem of ballistic missile reentry (August 1957);
- placing four satellites into orbit between 1958 and 1960 (EXPLORER I, II, III, IV);
- launching the United States' first lunar probe (PIONEER III) and first solar satellite (PIONEER IV);
- launching three primates into space, although only two were recovered alive;
- beginning R&D for a 1.5-million-pound-thrust booster rocket for a lunar exploration vehicle (SATURN, an ARPA project);
- and initiating research on the launch vehicle that would carry the first men into space (Hughes 1990).

By the beginning of the 1960s, the NASA's manned space program had begun, which captured the public's imagination. As a precursor, Mercury 1, an unmanned capsule, was launched by a REDSTONE rocket on a suborbital flight on 9 December 1960. Despite advances in the US space program and the success of hypersonic flight by American test pilots, Soviet cosmonaut Yuri Gagarin became the first man in space on 12 April 1961. Less than one month later, American astronaut Alan Shepard became the first American to make a suborbital flight on 5 May 1961. His Mercury 3 capsule called Freedom 7 was launched by a REDSTONE. On 21 July 1961, astronaut Virgil Grissom made another suborbital Mercury mission launched by the Army's REDSTONE. John Glenn became the first American to orbit the earth on 20 February 1962, in the Mercury 6 capsule launched on an ATLAS D rocket (Space Division, HQ 1993).

In the field of space probes and satellites, ABMA launched the PIONEER III lunar probe (6 December 1958), which did not reach the moon, and EXPLORER VII for NASA (13 October 1958) using an Army-developed JUNO II rocket (a SERGEANT missile as top stage on a JUPITOR first stage). The technology applied in the JUNO II rocket was important in the subsequent deep space explorations by RANGER, MARINER, VIKING, and SURVEYOR spacecraft. Other Army satellites included VANGUARD 2 (launched 17 February 1959); DISCOVERED I, the first polar orbiting satellite (28 February 1959); PIONEER IV, launched by JUNO II to orbit the sun; TIROS (Television Infrared Observation Satellite) I (1 April 1960) and II (23 November 1960); COURIER 1B (4 October 1960) a. In 1961, the Department of Defense assigned the mission of managing and operating U.S. military space launch vehicles and satellites to the Air Force (Space Division, HQ 1993).

By the early 1960s, the Army's role as a developer of communication payloads in satellite systems was taken over by the Defense Communications Agency (DCA). And, in 1962, the U.S. Army Satellite Communications Agency was organized at Fort Monmouth, New Jersey, which was responsible for ground terminals and ground support for space systems (Space Division, HQ 1993).

The Rocket Test Area. This area, which has gone by a number of names including the Rocket Propellant Power Plant (late 1940s), the Liquid Rocket Propulsion Laboratory Test Area (early 1960s), and the 1500 Area, is a 20-acre site off Lake Denmark Road located off the installation proper (see Figure 4.96). The area is divided into two parts, the Western Explosives Area and

the Eastern Pyrotechnics Area. The western area was constructed from the late 1940s through the 1960s and the eastern section from the early 1950s to the late 1950s. The 1500 Area is currently used for storage, assembly, research, development, and testing of high explosives, propellants, and projectiles (Picatinny Arsenal 2006).

There has been speculation, and, in fact, it has appeared in print, that the 1500 Area was once a part of the Navy/RMI area. The *Army Defense Environmental Restoration Program Installation Action Plan* (Picatinny Arsenal 2006:76) identified the area as a "Former React Mtrs [Reaction Motors]" area. After discussions with Dr. Patrick Owens, ARDEC Historian, and Mr. Ken Klingaman, a long-time Picatinny employee working in the 1500 Area, it is questionable that RMI ever held this area.

When Navy and RMI areas were subsumed by the Army in 1960 and incorporated into Picatinny Arsenal, the number designations given to buildings and structures began with 3000. The buildings within the 1500 Area have never been renumbered. Moreover, the Navy and RMI traditionally identified their areas with letters of the alphabet (A area, B area, etc.), and the 1500 Area appears to have always had a name designation (e.g., Liquid Propellant Laboratory Test Area) or in later years a number designation (e.g., 1500 Area). All of the Navy/RMI-test facilities are located off Snake Hill Road with a smattering of laboratories off Belt Road on what is now the installation proper. The 1500 Area is located off Lake Denmark Road.

Finally, "grey" literature makes it clear that the Army was testing rockets with conventional, chemical, and nuclear warhead adaptations at Picatinny. According to historical maps of the installation, these activities probably occurred at one of two places, the 1400 Area, at the end of Farley Road, or the 1500 Area. Blueprints (Facilities Engineering Division nda) and Real Property files (Directorate of Public Works nd) indicate that the 1500 Area was involved in the testing of various components related to the REDSTONE, HONEST JOHN, LOKI, NIKE AJAX, and SHILLELAGH rockets, as well as the SAGE (Semi-Automatic Ground Environment) system. Photographs also documented that the 1500 Area tested PERSHING I rockets (PICA 2007). Other literature revealed that Picatinny also played a role in the warhead development of the following tactical missiles: NIKE HERCULES, HAWK, CORPORAL, LITTLEJOHN, LACROSSE, PERSHING II, SEARGENT, PATRIOT, and LANCE (Lonnquest and Winkler 1996; Montross 1964; Gorman and Tepper 1986; Parsch 2002a; Redstone Arsenal 2000d). The use of the 1500 Area as a testing area makes sense given the fact that the 1400 Area is generally a propellant production and loading area, not a place well suited to the testing of explosives or the hot firing of rocket/missile components.

In the early years of Army rocket development, the numerous research activities and undertakings, such as component creation, modification, and testing or procurement, loading, and servicing, were farmed out to the Army installation that could best handle the required activity. This diversification was prominent for the other service branches as well. In the early years, a single rocket might actually represent the physical labor of several installations, such as Picatinny Arsenal, which might have developed the fragmentation device in the warhead, Frankford Arsenal, which might have created the fuzing device, and Aberdeen Proving Ground, where a determination of the optimum shape of the warhead might have been made (Combat Air Museum 2007a). This division of labor often caused problems, but the need and lack of other resources necessitated the division.

Picatinny participated in creation of the following rocket/missile and systems (organized by first launch, first experimental firing, or first working date):

CORPORAL	1947	
LOKI	1951	(work known to have been conducted in 1500 Area)
SAGE	1951	(work known to have been conducted in 1500 Area)
HONEST JOHN	1952	(work known to have been conducted in 1500 Area)
REDSTONE	1953	(work known to have been conducted in 1500 Area)
NIKE AJAX	1954	(work known to have been conducted in 1500 Area)
LACROSSE	1954	
SHILLELAGH	1958	(work known to have been conducted in 1500 Area)
NIKE HERCULES	1958	
HAWK	1960	
PERSHING I	1960	(work known to have been conducted in 1500 Area)
LITTLEJOHN	1961	
SERGEANT	1962	
LANCE	1970	
PATRIOT	1976	
PERSHING II	1977	

It is probable that Picatinny also worked on other rocket/missile systems that have not yet been identified.

Rocket/Missile Systems. As noted above, blueprints (Facilities Engineering Division nda) and Real Property files (Directorate of Public Works nd) demonstrate that the 1500 Area was involved in the testing of various components related to numerous rocket systems. A brief explanation of the rocket/missile/system and the work performed in the 1500 Area provides an overview of the types of activities undertaken at the site.

LOKI. Beginning in 1946, the Army conducted research on anti-aircraft, free-flight, unguided, rocket systems based on the German *Taifun* rocket. LOKI was first flown in 1951, but never saw service in its original role; instead, the Navy acquired them in 1955 and used them successfully as sounding rockets to measure high-altitude wind speed and direction until the mid-1960s (Bjork et al. 1957; Parsch 2005; Wikipedia 2007).

The solid-fuel rocket development and tests were overseen by many eyes including: Picatinny Arsenal, Redstone Arsenal, Frankford Arsenal, Watertown Arsenal, JPL, Fort Monmouth's Evans Signal Laboratory, Bendix Aviation Corporation, R. Hoe and Co., Inc., Grand Central Aircraft Cp., Thiokol Chemical Corporation, East Coast Aeronautics, Inc., Steuart-Harner Corporations, Horning-Cooper Corp., Westinghouse Electric Corp., American Machine and Foundry Co., Whitin Machine Works, the Dawns-Ratterson Corp., United Can Co., Chaffee Brothers, Philadelphia Ordnance District, Boston Ordnance District, and the New York Ordnance District (Bjork et al. 1957). Despite the number of organizations involved, Picatinny had a significant role in the development, testing and creation of LOKI.

Picatinny's first responsibility was for the technical supervision of LOKI fuze development, which was designed and developed by Eastman Kodak under Picatinny's supervision. The rocket motors also underwent extensive surveillance. Most importantly Picatinny was given the responsibility of loading and assembling the warhead with conventional high explosives. Because of production problems, Picatinny actually wound up loading and fully producing 30,000 Loki rockets. Reports of the progress in the development of guided missiles, such as the HAWK and the NIKE AJAX, prompted the Ordnance Department to discontinue the LOKI program. It is not clear what happened to the 30,000 LOKI that had been loaded at Picatinny Arsenal (Bjork et al. 1957; FAS 1999).

Figure 4.97. Building 1506 (1954), Assembling Building, Rocket Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Despite the importance of the project, blueprints and Real Property records are not specific about which buildings were used for the LOKI project. In most cases, projects are mentioned casually, which is the case with LOKI. A notation written on Blueprint no. SK-5373 indicated that Building 1560 (1954), a former Assembling Building, was relocated from the LOKI area (Figures 4.97 and 4.98). Unfortunately, at the time of Panamerican's field investigation, the Technical Library at Picatinny had sent out all of its early historical records, such as monthly reports and grey literature (e.g., technical reports) to be digitized. It is not clear, however, that this literature would have been helpful in deciphering which activities were actually happening in particular buildings.

SAGE. The Semi-Automatic Ground Environment system began life in 1951 as the Lincoln Transition System, a U.S. Air Force project with the Massachusetts Institute of Technology (MIT). Completed in the early 1960s, it revolutionized air defense by integrating radar and computer technology in the aid of air defense and contributed to the development of civilian air traffic control systems. Under SAGE, incoming targets (i.e., long-range bombers, missiles) tracked by remote radar were displayed instantaneously at central SAGE command centers, along with the target's speed, direction and altitude. With this information, air defense commanders could efficiently allocate their fighters to engage enemy aircraft. The Air Force also intended to incorporate long-range, surface-to-air missiles into SAGE. The SAGE system was used to direct BOMARC missiles, which were direct competitors to the Army's NIKE program. The SAGE control centers would not be replaced until 1979 (Lonnquest and Winkler 1996).

Although blueprints mention the program within the context of the 1500 Area, it is unclear what Picatinny was doing with a rival service's missile-tracking system. It is true that in the early years of the space program all the "rocketeers" talked and shared research with each other. The field was new and workers were gleaned from many different disciplines, necessitating the transfer of ideas and knowledge. Perhaps Picatinny had expertise in an area that the Air Force needed. Nevertheless, it is not clear what buildings were involved in this activity, only that it occurred in the 1500 Area.

Figure 4.98. Historical photograph of Building 1506 (1954) taken in 1964. An assembling building, it was used as a loading building and office at the time Picatinny was working on the HAWK and PERSHING I, Rocket Test Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

HONEST JOHN. A simple, free-flight rocket capable of delivering a nuclear warhead, the HONEST JOHN was a highly mobile system designed to be fired like conventional artillery in battlefield areas. The HONEST JOHN was the United States' first tactical nuclear weapon and was considered a vital part of the Army's Pentomic battlefield. The system was first deployed in 1954 and was classified obsolete in 1982 (Redstone Arsenal 2000a; Silber 1958; Combat Air Museum 2007c; Cagle 1964).

Picatinny played a significant role in the research and creation of the HONEST JOHN. The installation's primary responsibility was for the warhead and fuzing system, including the adaptation kit. The Army was optimistic that the nosecone of the HONEST JOHN could also be

adapted to hold a chemical warhead, but Picatinny discounted the feasibility of a chemical warhead (Kobialka 1952; Silber 1958).

Photographs of the 1500 Area from 1953 showed an HONEST JOHN being moved and in test position in Static Firing Test Bay No. 2, Building 1505 (Figures 4.99 and 4.100). The rocket is being moved down a covered walkway, a typical Army industrial area feature, from Building 1503, a Conditioning Building (Figure 4.101), to the static firing area. The rocket was strapped to the stand in Static Firing Test Bay No. 2, Building 1505 (see Figure 4.100), where it was test fired. The squares on the wall are one-foot cubes that were used in conjunction with high-speed film to determine velocity.

Building 1505 was still extant at the time of the investigation and is a Test Cell (Figures 4.102 and 4.103).

Figure 4.99. An HONEST JOHN rocket is carried down a covered walkway from Building 1503 in 1953, Rocket Test Area, Picatinny Arsenal, NJ. The blast berm protecting Building 1503 can be seen in the right middle ground *(Courtesy Picatinny Arsenal, Building 1501).*

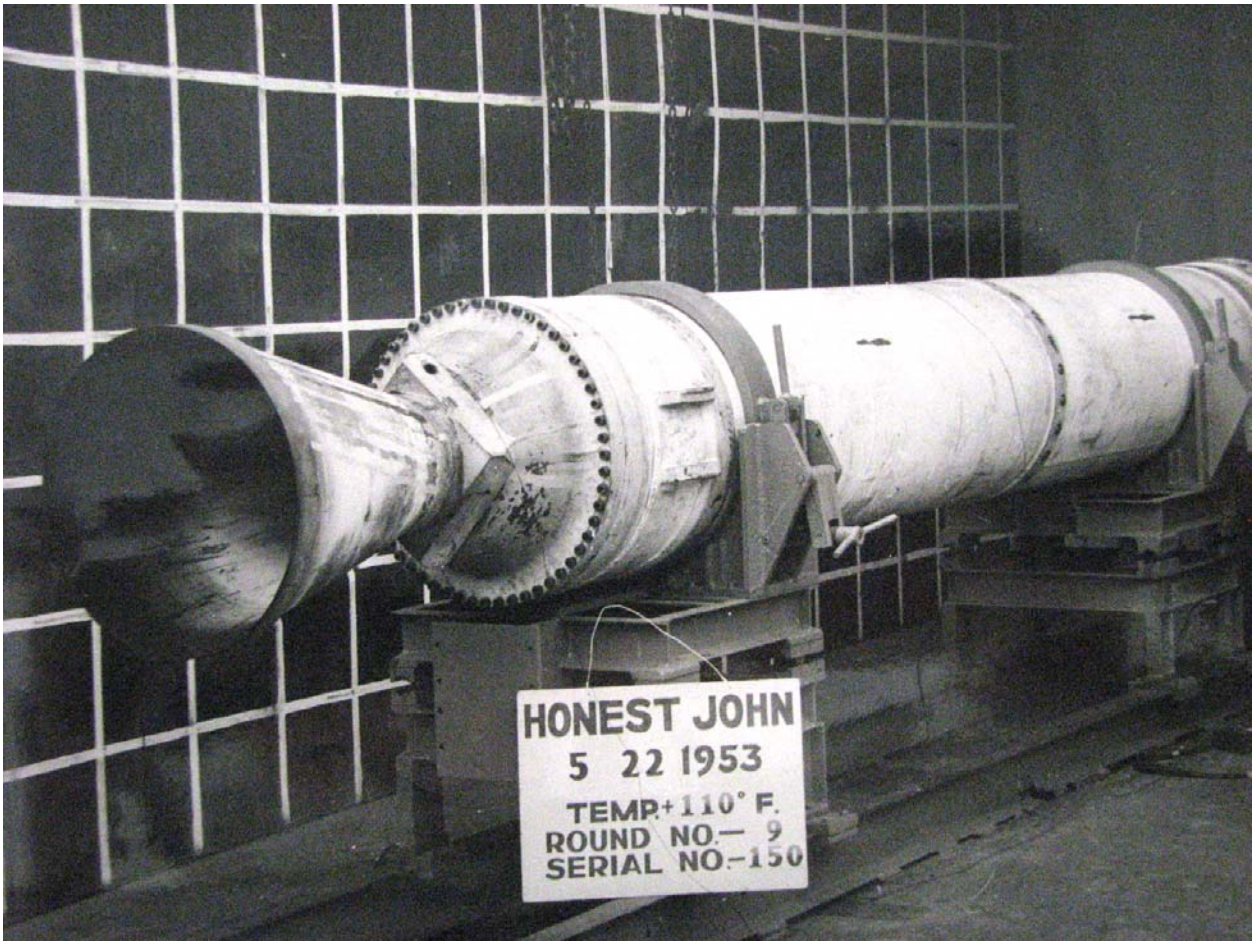

Figure 4.100. An HONEST JOHN rocket ready for static firing in Static Firing Test Bay No. 2, Building 1505, May 22, 1953, Rocket Test Area, Picatinny Arsenal, NJ. The squares on the wall are one-foot cubes that were used in conjunction with high-speed film to determine velocity *(Courtesy Picatinny Arsenal, Building 1501).*

REDSTONE. The year 1953 proved to be a banner year for Soviet achievement in space. In August, the Soviets tested their first hydrogen bomb and, later that year, U.S. intelligence sources revealed that the Soviet ICBM program was well on its way to becoming a reality. The assessment was that the Soviets were well ahead of the United States in the space race, resulting in a major shift in American policy toward the development of long-range ballistic missiles. Based on the experience of the V-2 and other rockets, the Army developed the REDSTONE rocket as both a tactical ballistic missile and a space launcher. The first launch of the REDSTONE was 20 August 1953 at the Army's Cape Canaveral (Space Division, HQ 1993). After the creation of NASA, the Army REDSTONE was modified for the MERCURY (MR-2 and MR-3) program and was used successfully to carry first a chimpanzee and then a man into space (Hughes 2007).

Picatinny Arsenal, Aberdeen Proving Grounds, Frankford Arsenal, and Watertown Arsenal all played a role in the development of the REDSTONE rocket. Picatinny's primary responsibilities were the development of the adaptation kit, the radio proximity fuze, and the safety and arming mechanisms. It delegated the responsibilities for developing the radio proximity fuze and safety and arming mechanisms to the Diamond Ordnance Facility (Bullard 1965). It is not clear what type of warhead Picatinny was adapting for the REDSTONE, but it could have run the gamut

Figure 4.101. Building 1503 (1948/1956), Conditioning Building, in 1964, Rocket Test Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

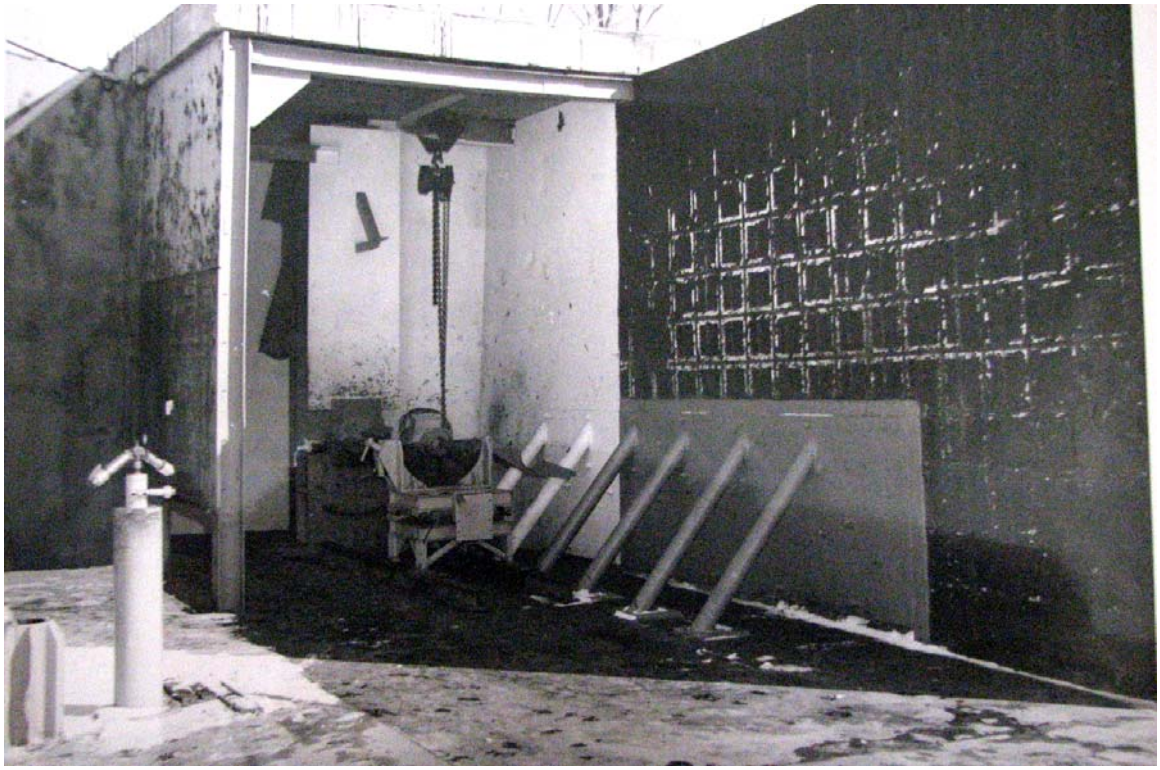

Figure 4.102. Building 1505 (1948/1956), Static Firing Test Cell, Bay No. 2, 1964, Rocket Test Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

Figure 4.103. Building 1505 (1948/1956), Test Cell, Rocket Test Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

from nuclear to chemical to some type of exotic hybrid HE. Although blueprints and Real Property files reveal that work on the REDSTONE was completed in the 1500 Area, it is not clear which specific buildings were involved.

NIKE AJAX. Developed by the Army as the world's first surface-to-air missile (SAM), the NIKE AJAX was rushed into production and deployed in battery systems around key urban, military, and industrial locations in 1954. By 1958, the Army had deployed nearly 200 NIKE AJAX batteries in these key locations. Soon after, they were deactivated and replaced with the next generation NIKE HERCULES missile, which had a longer range and was nuclear-capable (Combat Air Museum 2007a).

The key contractor for the NIKE AJAX project was Western Electric, but Picatinny played an essential role in its production. The arsenal was chosen to develop the HE fragmentation device that would be placed in the warhead. The warhead was actually three HE fragmentation warheads mounted in the nose, center and rear of the missile body. Although consideration was given to arming the NIKE AJAX with a nuclear warhead, this aspect of the project was canceled in favor of developing a new and improved missile, the NIKE HERCULES (Air Combat Museum 2007a; Bender 2004). The NIKE AJAX system is mentioned in the blueprints and Real Property files within the context of the 1500 Area, but not specifically related to any particular building.

SHILLELAGH. An antiarmor missile system, the SHILLELAGH evolved from a requirement in 1958 for the development of weapon systems for use in combat vehicles for the Pentomic and future armies. The complete, combat-vehicle weapon system consisted of a SHILLELAGH direct-fire guided missile, a 152mm gun/launcher, conventional ammunition, and guidance-fired control subsystems. The SHILLELAGH was the primary armament on the M551 Sheridan Armored Reconnaissance/Airbone Assault Vehicle and M60A2 Main Battle Tank. SHILLELAGH was first deployed in 1959 (Delong et al. 1984).

This Pentomic weapon system included work by Picatinny Arsenal, Frankford Arsenal, Redstone Arsenal, the Ballistic Research Laboratories, Watervliet Arsenal, White Sands Missile Range, the Signal Corps, Ford Motor Company, Aeronautic Division, and Raytheon. Picatinny was responsible for the warhead and fuze system development, the motor propellant and igniter development, and the gas generator propellant and igniter development.

Picatinny also was responsible for providing a propellant grain and igniter, which met the ballistic requirements for the missile within existing limitations and, most importantly, was compatible with the missile guidance system. The guidance component required that the exhaust plume of the rocket motor not interfere with the transmission of infrared signals within the plume. These specifications posed severe limitations on propellant composition. After a thorough analysis of the types of solid propellants available, Picatinny selected a double-base type that was essentially smokeless at relatively low flame temperatures, thus solving the problem (DeLong et al. 1984). Historical photographs reveal that various components of the SHILLELAGH were tested in the 1500 Area. In particular, the SHILLELAGH's closed, breach-launch simulator was tested in Building 1505A (Figure 4.104). Building 1505A, a Test Cell, is extant and still used for testing (Figure 4.105).

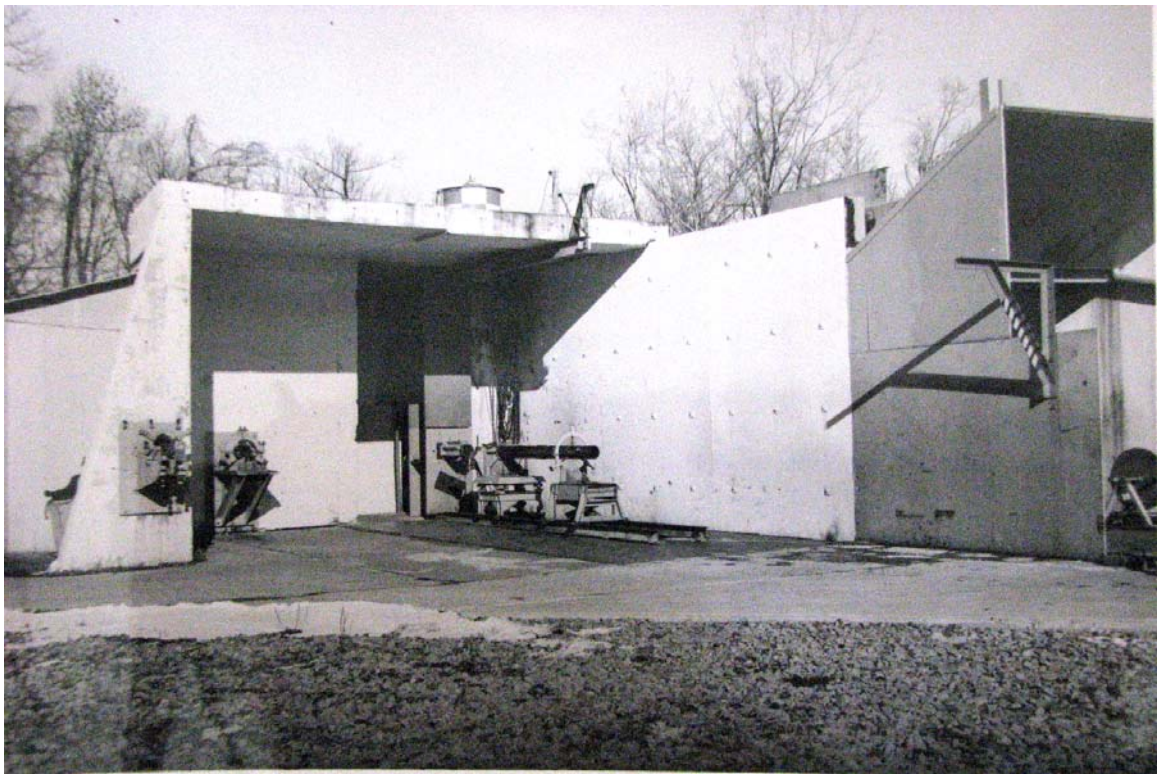

Figure 4.104. Building 1505A, Static Firing Test Bay No. 3, shown with tube for SHILLELAGH Closed Breach Launch Simulator and various test stands, in 1964, Rocket Test Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

Figure 4.105. Building 1505A (1948), Test Cell, Rocket Test Area, Picatinny Arsenal, NJ. Note the left side is the former Static Firing Test Bay 3 and the right side, now covered with a wooden addition, is the former Static Firing Test Bay 4 *(Panamerican 2007).*

PERSHING I. A solid-fuel, two-stage medium-range ballistic missile, the PERSHING I was designed and built by the Martin Marietta Company to replace the REDSTONE missile as the Army's primary theater-level weapon. It was named after General John J. Pershing and had its first test firing in 1960. The warhead could be a conventional explosive or a W50 nuclear warhead, yielding 400 kilotons of TNT. The PERSHING I firing platoon consisted of four M747 tracked-vehicles, while the REDSTONE needed twenty vehicles (Wikipedia 2007a).

The warhead for the PERSHING I was developed at Picatinny (Lonnquest and Winkler 1996) and components of the motor were tested there as well. In what is now Building 1505A (it was then identified as Static Firing Test Bay No. 4), the PERSHING underwent static spin testing (Figure 4.106). Building 1505A was extant at the time of the investigation and was used for testing (see Figure 4.105).

As noted, Picatinny also developed warheads for the CORPORAL, LACROSSE, NIKE HERCULES, HAWK, LITTLE JOHN, SERGEANT, PARTIOT, LANCE and PERSHING II missiles (Lonnquest and Winkler 1996). The LITTLE JOHN (also written as LITTLEJOHN) was the smallest nuclear-capable rocket the U.S. Army ever deployed. It was an air-transportable, unguided artillery rocket powered by an XM26 solid-fuel rocket motor and could be armed with either a conventional or nuclear warhead (Parsch 2002). The LANCE system was also a nuclear-capable system that could also be adapted with a conventional warhead. It was a field-mobile artillery missile system designed to attack key enemy targets beyond the range of cannon artillery and to reinforce the fire of other artillery units. The LANCE replaced the HONEST JOHN system. As can be surmised by the significant amount of nuclear work completed at Picatinny, the arsenal

Figure 4.106. "Static Firing Test Bay No. 4, shown with Artillery Primer Test Apparatus and PERSHING Static Spin Test Stand," in 1946, now 1505A, Rocket Test Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

was considered a part of the U.S. Nuclear Weapons Complex (NWC) until well into the 1970s (Loeber 2002).

1500 Area Buildings and Structures. Although the 1500 Area is traditionally divided into the east and the west divisions, the area really consists of three distinct building groupings. Within the enclosure, the first area approached is close to the intersection of Hart Road and Lake Denmark Road on the north side of Hart Road (see Figure 4.96). This area, which is no longer used, was the site of extreme altitude and hot and cold testing. The extreme environment testing area consists of the buildings listed below:

1517 (1956)	High Altitude Test (Figures 4.107 and 4.108)
1517A (1963)	Electric Equipment Facility (see Figure 4.108)
1518 (1958)	General Purpose Instrument Storage (derelict) (Figure 4.109)
1519 (1956)	HE Magazine (Figure 4.110)

Figure 4.107. Building 1517 (1956) is really two large connecting chambers and a number of associated, connected buildings, within which high altitude testing and extreme hot and cold environment testing was conducted. 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.108. Building 1517 (1956), two large connected chambers. Building 1517A is the small building between the two large chambers, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.109. Building 1518 (1958), now derelict, General Purpose Instrumentation Building associated with the extreme environment testing area, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.110. Building 1519 (1956), an HE Magazine, associated with the extreme environment testing area, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

1520 (1956)	HE Magazine (Figure 4.111)
1521 (1960)	Component Propellant Building (Figure 4.112)
1522 (1970)	Ordnance Facility (Figure 4.113)

Building 1517 (1956) was previously used as a laboratory and test building off Hart Road. It is a rectangular, shed- roofed structure flanked by a steel tank (environmental chamber). The building sits on a concrete foundation, has transite walls, and an aluminum and asbestos roof (see Figures 4.107 and 4.108).

Building 1517A (1963), an electrical equipment facility that also served as a pump house, is found off Hart Road. It is a rectangular, flat-roofed structure flanked on each side by steel tanks (environmental chambers). The building sits on a concert foundation, has concrete-block walls and rolled roofing (see Figure 4.108).

Building 1518 (1958) was previously used as a high altitude test chamber, laboratory and general purpose instrument storage facility. It is located off Hart Road and is a rectangular, flat-roofed structure attached to the rear of 1517. The building sits on a reinforced concrete foundation, has frame walls, and a build-up roof (see Figure 4.109).

Building 1519 (1956), previously used as high explosives magazine and a ready magazine, is found off Hart Road. It is a small, rectangular, shed-roofed structure. The building sits on a concrete foundation, has transite walls, and a corrugated asbestos roof (see figure 4.110).

Building 1520 (1956), previously used as high explosives magazine and a ready magazine, is situated off Hart Road. A small, rectangular, shed-roofed structure, the building sits on a cinder-block foundation, has plywood walls, and a corrugated asbestos roof (see Figure 4.111).

Figure 4.111. Building 1520 (1956), an HE Magazine, associated with the extreme environment testing area, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.112. Building 1521 (1960), Component Propellant Building, associated with the extreme environment testing area, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.113. Building 1522 (1970), Ordnance Facility, associated with the extreme environment testing area, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 1521 (1960) was previously used as a component propellant building and ordnance facility. Found off Hart Road, the building is a small, rectangular, shed-roofed structure. It sits on a railroad-tie foundation, has plywood walls, and an APM roof (see Figure 4.112).

Building 1522 (1970), previously used as an ordnance facility off Hart Road, is a small, rectangular, shed-roofed structure. The building sits on a railroad-tie foundation, has wood-frame walls clad in transite, and a roll-on wood roof (see Figure 4.113).

Not a great deal is known about this area except that the reaction of items and/or components to environmental extremes were tested here on a large scale. Extreme testing on a smaller scale also was conducted in other areas in the 1500 Area. It is probable that this area included a salt spray and various types of precipitation testing within the large chambers. It is not known when testing was suspended in this area. Buildings 1517, High Altitude Test Chamber, 1518, Instrumentation Storage (derelict), and 1519, HE Magazine are all scheduled for disposal.

The second grouping of buildings is the testing area, which is behind a chain-link fence within the already fenced 1500 Area (see Figure 4.96). During the 1950s and 1960s this area conducted fully instrumented tests on a wide variety of munitions systems and components, including gun and rocket propellants, projectile, warheads, igniters, primers, detonators, fuzes, flares, and mines. The test generally involved explosives detonations or propellant burning but were not ballistic in nature since free flight of the test item was limited to a few feet (Figure 4.114).

Figure 4.114. Overview of a portion of the 1500 Test Area, ca. 1960. Buildings 1505A is shown at left and 1505 at right with the soil berm in front. A covered walkway connects 1505 to 1503at left. The roof seen above 1505 is 1501; Building 1510D, Water Tower, at the upper right *(Courtesy of Picatinny Arsenal, Building 1501).*

Buildings in the test area include:

1501 (1948)	R&D Administration (Figure 4.115)
1502 (1948)	Ordnance Facility (Figure 4.116)
1503 (1948/1956)	Conditioning Building (see Figures 4.116 and 4.101)
1504 (1956)	Ordnance Facility (Figure 4.117)
1504A (1948)	Conditioning Building (Figure 4.118)
1505 (1948/1956)	Ordnance Facility (see Figures 4.102 and 4.103)
1505A (1948)	Test Cell (see Figures 4.105 and 4.106)
1505B (1948)	Test Cell (Figure 4.119)
1505C (1958)	Control House (Figure 4.120)
1505D (1951)	Test Cell (Figure 4.121)
1505E (1966)	Control Spin Room (Figure 4.122)
1505F (1959)	Test Facility (Figure 4.123)
1505J (1960)	Storage (Figure 4.124)
1505K (found on post)	Storage (Figure 4.125)
1505N (1948)	Open Blast Area (Figure 4.126)
1506 (1954)	Loading Facility (see Figure 4.97)
1507 (1946)	HE Magazine (Figure 4.127)
1507B (1959)	Storage (Figure 4.128)
1508 (1955)	HE Magazine (Figure 4.129)
1527 (1960)	Barricade (derelict) (Figure 4.130)
1528 (1963)	Barricade (derelict) (Figure 4.131)
1529 (1964)	Storage (Figure 4.132)

Building 1501 (1948), previously used as an electronic equipment, R&D administration building, CML Equipment Material facility service building and office, is found along Hart Road. It is a long, rectangular, gable-roofed structure with a covered walkway incorporated under the main roof line. The building sits on a concrete foundation, has concrete-block walls, and a roll roof (see Figure 4.115).

Building 1502 (1948) was previously used as powder conditioning service building, ordnance facility, AC plant compressor. Located off Hart Road, it is a long, rectangular, flat-roofed structure along a covered walkway. The building sits on a concrete foundation, has hollow tile walls, and build-up roof (see Figures 4.116).

Building 1503 (1948/1956), previously used as powder conditioning building and ordnance facility off Hart Road. A long, rectangular, flat-roofed structure with a covered walkway, the building sits on a concrete foundation, has concrete-block walls, and a roll roof (see Figures 4.116 and 4.101).

Building 1504 (1956) was previously used as an ordnance facility, and storage shed. Situated along Hart Road, it is a long, rectangular, gable-roofed structure. The building sits on a concrete foundation, has corrugated aluminum walls, and a corrugated aluminum roof (see Figure 4.117).

Building 1504A (1948), previously used as a test stand #3, HP storage bottle stand and manifold, general purpose warehouse, storage shed and ordnance facility, is found off Hart Road. A small, square, shed-roofed structure with double doors, the building sits on a concrete foundation, has APM walls, and an APM corrugated aluminum roof (see Figure 4.118).

Figure 4.115. Building 1501, R&D Administration Building, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.116. Building 1502, Ordnance Facility (at the end of Building 1503), and Building 1503, Powder Conditioning Building, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.117. Building 1504, Ordnance Facility, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.118. Building 1504A, Storage, Test Area, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.119. Building 1505B, Test Cell, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.120. Building 1505C, Control House, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.121. Building 1505D, Test Cell, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.122. Building 1505E, Control Spin Room, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.123. Building 1505F, Test Facility, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.124. Building 1505J, Storage, Truck Trailer, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.125. Building 1505K, Storage, Truck Trailer, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.126. Building 1505N, Blast Area with open rear, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.127. Building 1507 (1946), HE Earth-barricaded Magazine, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.128. Building 1507B, Storage, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.129. Building 1508, HE Magazine, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.130. Building 1527, Barricade, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.131. Building 1528, Barricade, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.132. Building 1529, Storage, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 1505 (1948/1956) was previously used as an ordnance facility, and rocket static test building, and is located off Hart Road. It is a rectangular, flat-roofed structure along a covered walkway. The building sits on a concrete foundation, has concrete walls, and a build-up roof. To the rear of the building is a rocket-test bay with concrete walls (see Figures 4.102 and 4.103).

Building 1505A (1948), a test cell off Hart Road, is a rectangular, flat-roofed structure located along a covered walkway. The building sits on a reinforced-concrete foundation, has reinforced-concrete and steel, open back wall and a reinforced-concrete and steel roof. To the rear of the building is a rocket-test bay with concrete walls (see Figures 4.105 and 4.106).

Building 1505B (1948), a test cell off Hart Road, is a rectangular, flat-roofed structure supported by two I-beams. The building sits on a reinforced-concrete foundation, has reinforced-concrete and steel, open back wall and a reinforced-concrete and steel roof. To the rear of the building is a rocket-test bay with concrete walls (see Figure 4.119).

Building 1505C (1958) is a control house off Hart Road. It is a rectangular, shed-roofed structure with a central entry flanked by two one-over-one windows. The building sits on a concrete foundation, has wood walls, and a rolled roof (see Figure 4.120).

Building 1505D (1951), a test cell off Hart Road, is a rectangular, flat-roofed structure supported by two I-beams. The building sits on a reinforced-concrete foundation, has a reinforced-concrete and steel, open back wall and a reinforced-concrete and steel roof. To the rear of the building is a rocket-test bay with concrete walls (see Figure 4.121).

Building 1505E (1966), a control spin room, is found off Hart Road. It is a long, rectangular, gable-roofed structure. The building sits on a concrete foundation, has corrugated aluminum walls, and a corrugated aluminum roof (see Figure 4.122).

Building 1505F (1959), a storage facility, is situated off Hart Road. A rectangular, shed-roofed structure along a concrete blast wall, the building sits on a dirt foundation, has wood walls, and a wood and asbestos roof (see Figure 4.123).

Building 1505J (1960), a storage facility off Hart Road, is a rectangular, truck trailer. It sits on a railroad-tie foundation, has steel walls, and a steel roof (see Figure 4.124).

Building 1505K (found on post) is a storage facility located off Hart Road. It is a rectangular, truck trailer that sits on a railroad-tie foundation, has steel walls, and a steel roof (see Figure 4.125).

Building 1505N (1948), an open top and back-blast area, is found off Hart Road. It is a three-sided structure with a reinforced-concrete foundation, reinforced-concrete walls, and an open roof (see Figure 4.126).

Building 1506 (1954) was previously used as an ordnance facility and a loading and assembly building. Located along Hart Road, it is a rectangular, gable-roofed structure that sits on a concrete foundation, has corrugated aluminum walls, and a corrugated aluminum roof (see Figure 4.97).

Building 1507 (1946) was previously used as an HE and general purpose magazine along Hart Road. It is a rectangular, flat-roofed structure with interior blast walls extending above the main roof line. The building sits on a concrete foundation, has transite walls, and a tar paper on wood roof (see Figure 4.127).

Building 1507B (1959) was previously used as an inert and general storehouse. Found off Hart Road, it is a small, rectangular, shed-roofed structure with two entrance doors on the west façade, and located along a covered walkway. The building sits on an earth foundation, has transite walls, and a roll roof (see Figure 4.128).

Building 1508 (1955) was previously used as an HE magazine, a general purpose magazine, and a boiler house. Situated off Hart Road, the building is a rectangular, shed-roofed structure that sits on a concrete foundation, has transite walls, and a transite roof (see Figure 4.129).

Building 1527 (1960) is a barricade located off Hart Road that is constructed of railroad ties (see Figure 4.130).

Building 1528 (1963), a wooden barricade found off Hart Road, has an earth foundation, transite walls, and a transite roof (see Figure 4.131).

Building 1529 (1964), a general purpose warehouse, is located off Hart Road and is a small, rectangular, shed-roofed structure. The building sits on a concrete foundation, has AMP walls, and a sheet-metal roof (see Figure 4.132).

This area is known to have tested both the PERSHING I and SHILLELAGH missile systems. Because of historical maps and photographs, more is known about this area than the other areas within the 1500 Area. The buildings in this part of the test area are generally connected through a series of covered walkways, which was typical of an Army industrial facility or plant area active during the World War II era (Figure 4.133). These walkways offer cover from the elements and also provide an auxiliary working space.

As can be expected in an area where testing of propellants of all types is conducted, the test cells, where the propellant is actually exploded, and the cell's associated buildings are constructed of materials that can withstand such daily wear and tear. They are in turn surrounded by barricades of earth or other materials that ensure an explosion will go up and not out (Figures 4.134 and 4.135). In this warren of walkways and buildings, looks can be deceiving; often, innocuous buildings will be loaded with special equipment and essentially become rooms within rooms. Building 1503, a powder conditioning building, is one such example. In the 1950s and 1960s, this building housed a number of important activities including a high-low temperature conditioning chamber (Figure 4.136) and an attached small altitude chamber and salt-spray room (Figure 4.137). Assessing powder brisance in all temperatures and under all conditions was an important part of the testing regimen.

The purpose of this test area is to test explosives under all types of conditions and in all types of configurations. The business of the test area was and is still performed in the numerous test cells, which have three enclosed sides and an open back. These cells could be outfitted with any number of machines to aid in the testing procedure. For example, in the 1960s, Test Cell 1505F was utilized as a spin test cubical and short-range rocket flight test barricade (Figure 4.138). The spin test fixture can be seen in shadows of the cubical and a close-up provides a different view of the fixture that simulates spin conditions in fuzes or rounds and measures pressure and thrust during spin (Figure 4.139). Any type of rocket/missile explosives testing, including initiators, fuzes, arming mechanisms, propellant types, and HE fragmentation, would have been done in this area. Two barricades, 1527 and 1528 (see Figures 4.130 and 4.131) that protected an observation area are located to the south of the test cells and are in poor to derelict condition.

Figure 4.133. Covered walkways at the test area, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.134. Open-back test cells were constructed with heavy steel beams and thick, reinforced-concrete walls to ensure that they could withstand the rigors of daily explosives testing, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.135. The extreme environmental test area takes advantage of a natural low spot in the 1500 Area, which serves as a natural berm that will help funnel an explosion up and not out, Picatinny Arsenal, NJ *(Panamerican 2007).*

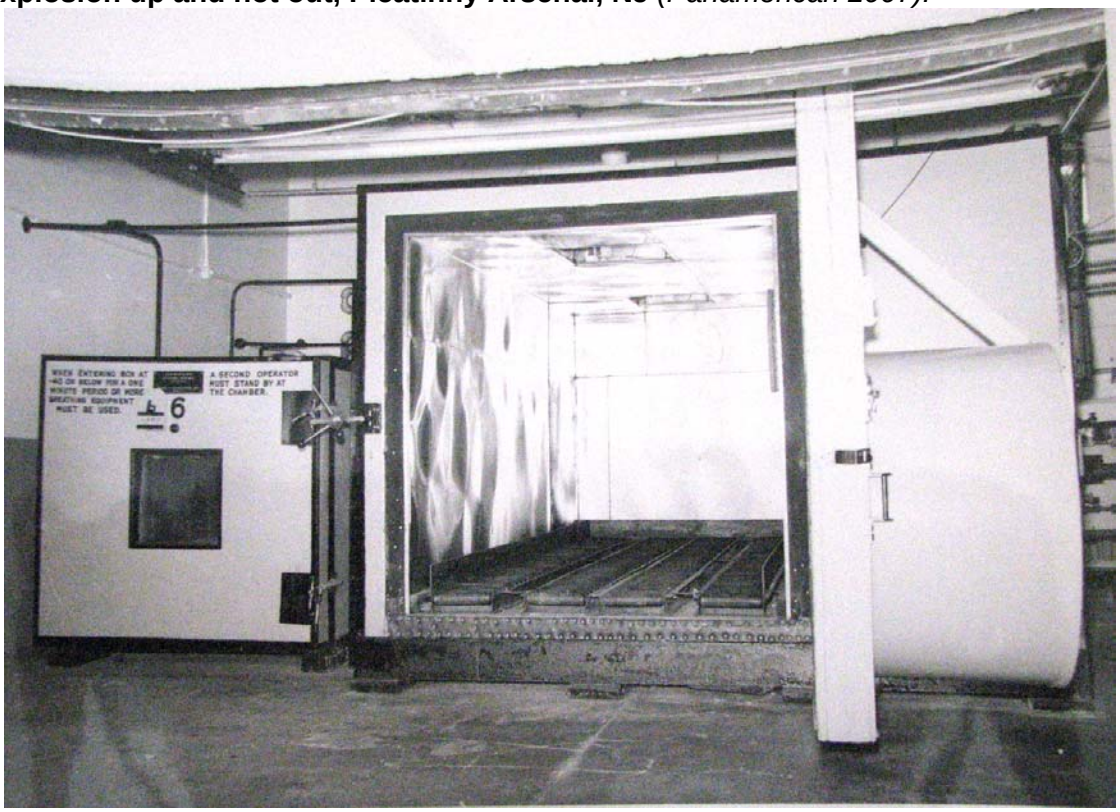

Figure 4.136. Building 1503, High-Low Conditioning Chamber, Room 1, in 1964, 1500 Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

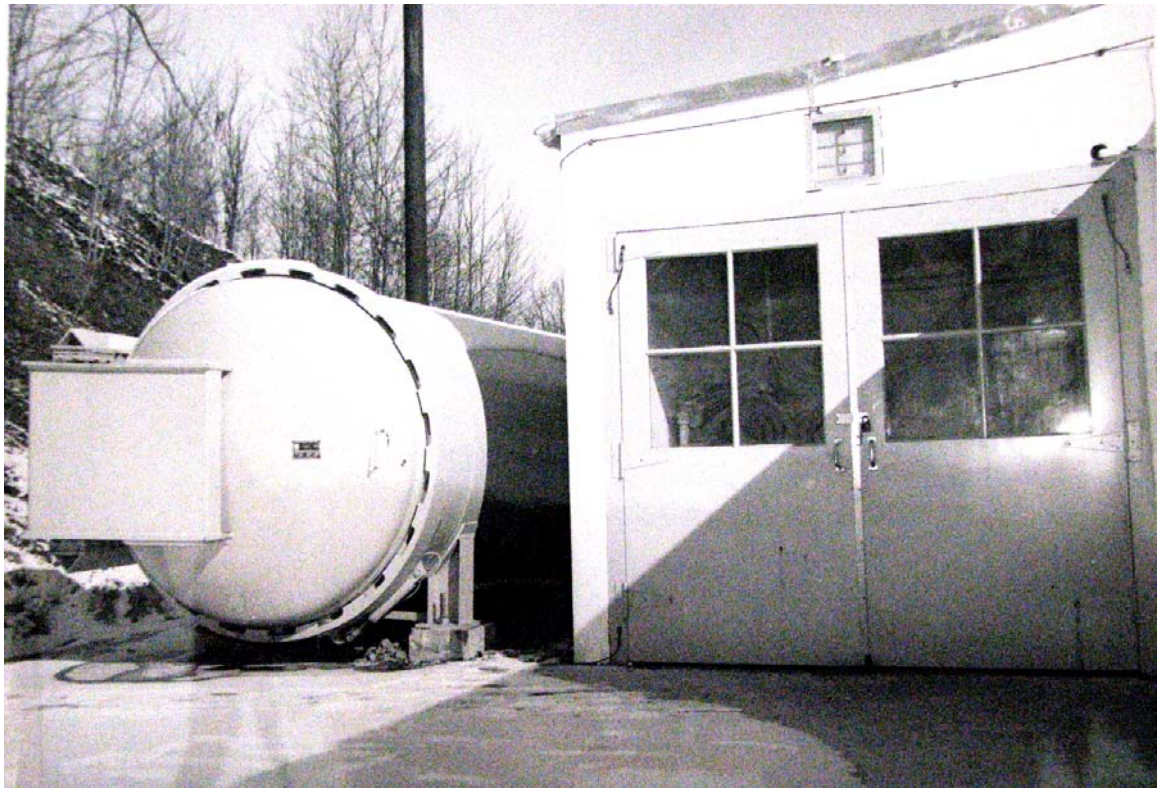

Figure 4.137. Building 1503, Altitude Test Chamber and Salt Spray Room, in 1964, 1500 Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

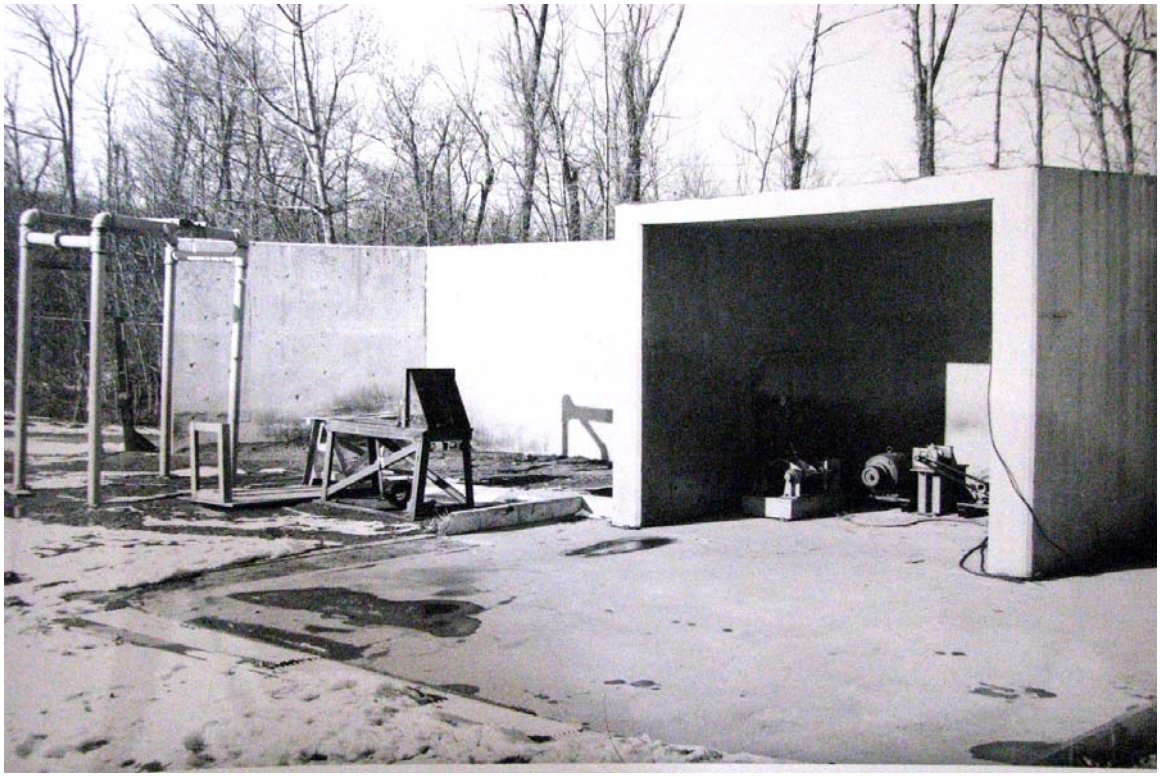

Figure 4.138. Building 1505F, Static Spin Test Cubicle and Short-range Rocket Flight Test Barricade, 1500 Area, Picatinny Arsenal, NJ *(Courtesy Picatinny Arsenal, Building 1501).*

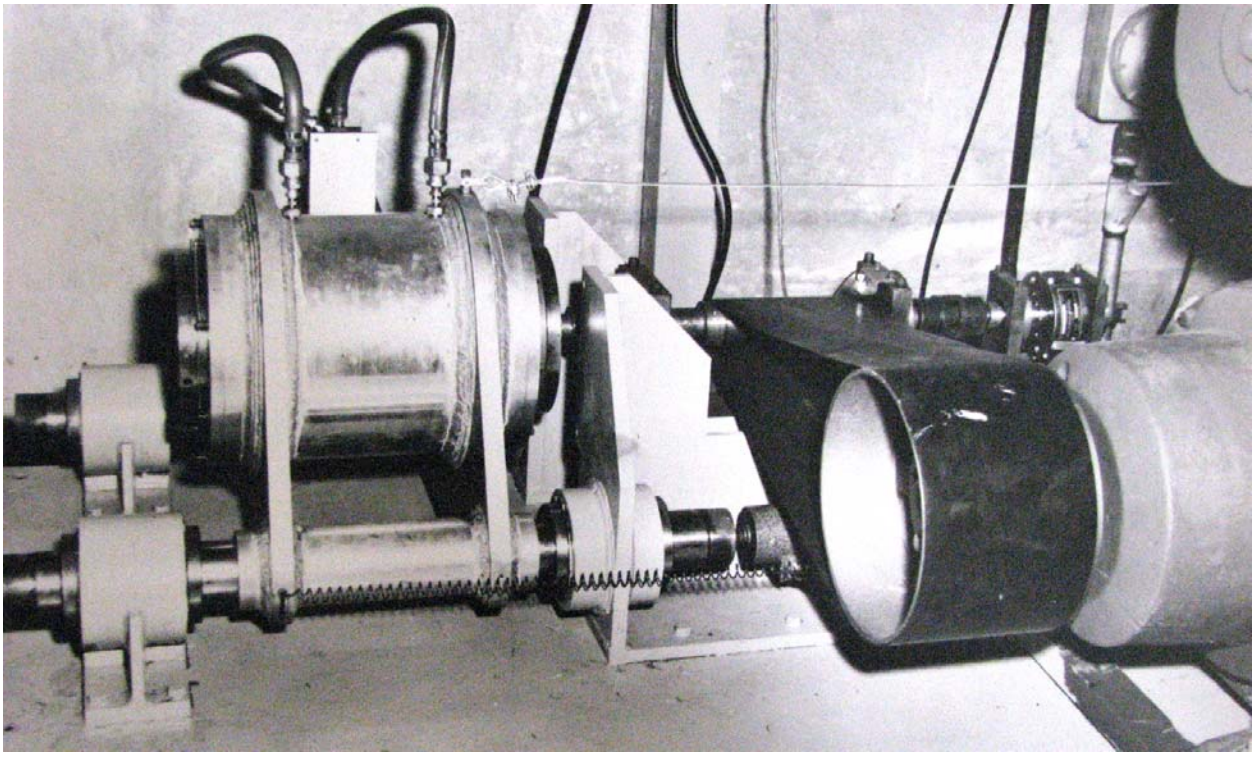

Figure 4.139. Spin test fixture in Building 1505F measures pressure and thrust during spin testing, 1500 Area, Picatinny Arsenal, NJ *(Courtesy of Picatinny Arsenal, Building 1501).*

Also found in the test area are earth-barricaded propellant magazines, Building 1507 (Figure 4.140; see Figure 4.127). The propellant held in these magazines would have been for immediate testing in this area, since long-term storage was located in other places in the 1500 Area and the installation.

The third grouping of buildings in the 1500 Area is the storage and laboratory area. The buildings in this area include:

1509 (1950)	Ordnance Facility (Figure 4.141)
1510 (1950/1956)	Pyrotechnic R&D Laboratory (Figure 4.142)
1510A (1947)	Storage (Figure 4.143)
1510B (1948)	General Storage (Figure 4.144)
1510D (1947)	Water Tower (Figure 4.145)
1511 (1952)	Conditioning Building (Figure 4.146)
1512 (1956)	Chemistry Laboratory (Figure 4.147)
1512A (1958)	Flammable Material Storehouse (Figure 4.148)
1513 (1968)	Pyrotechnic R&D Laboratories (Figure 4.149)
1514 (1968)	Pyrotechnic R&D Laboratories (Figure 4.150)
1515 (1961)	Physics Laboratory (Figure 4.151)

Building 1509 (1950) was previously used as an ordnance facility and a pyrotechnic pressing building and laboratory off Sage Place. It has a rectangular, flat-roofed structure, and two one-story bays with exterior stairs flank the main two-story entrance. A series of blast bays with the blast walls extending above the one-story roofline is south of the building. The building sits on a reinforced-concrete foundation, has reinforced-concrete walls, and a build-up reinforced-concrete roof (see Figure 4.141).

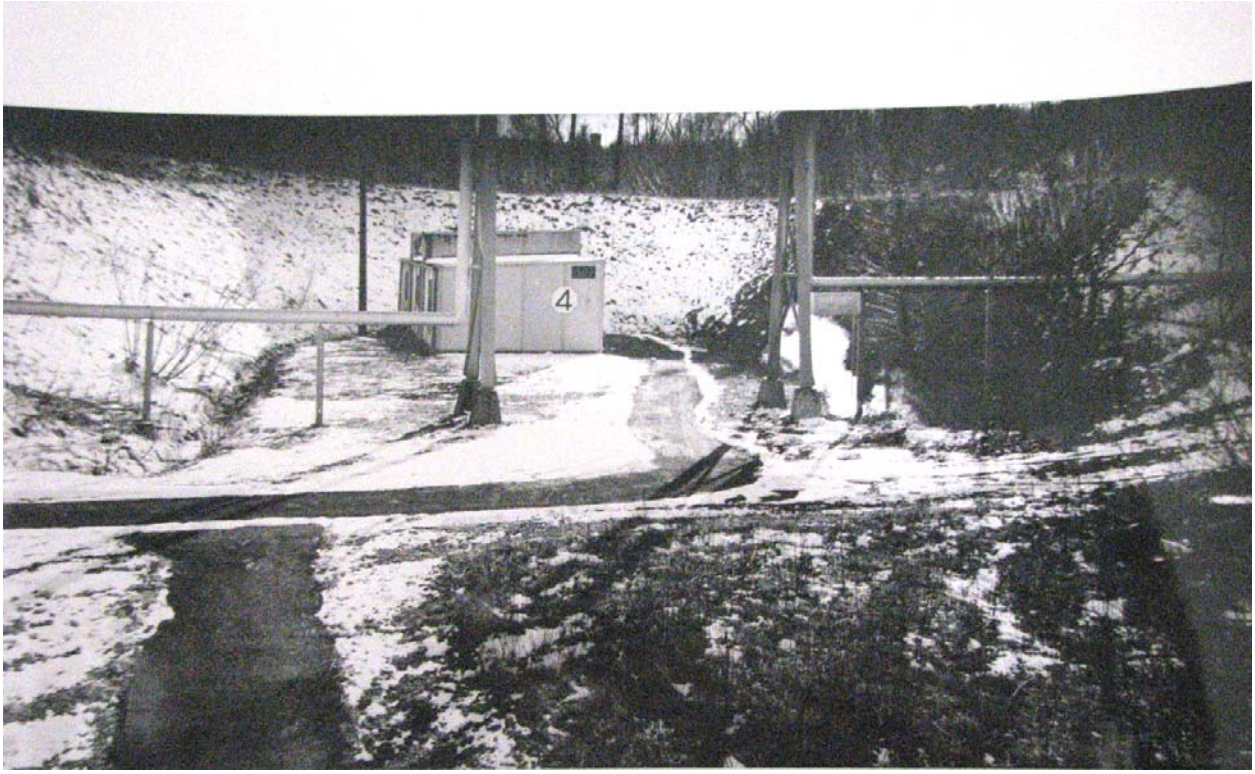

Figure 4.140. Overview of Building 1507, Earth-barricaded Propellant Magazine, in 1964, 1500 Area, Picatinny Arsenal, NJ *(Courtesy of Picatinny Arsenal, Building 1501).*

Figure 4.141. Building 1509, Ordnance Test Facility, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.142. Building 1510, Pyrotechnic R&D Building, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.143. Building 1510A, Storage, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.144. Building 1510B, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.145. Building 1510D, Water Tower, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.146. Building 1511, Conditioning Building, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.147. Building 1512, Chemistry Laboratory, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.148. Building 1512A, Flammable Material Storehouse, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.149. Building 1513, Pyrotechnic R&D Laboratories, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.150. Building 1514, Pyrotechnic R&D Laboratories, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.151. Building 1515, Physics Laboratory, 1500 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 1510 (1950/1956) was previously used as a pyrotechnic administration building, R&D office and engineering laboratory/machine shop. Located off Hart Road, it is a long, rectangular, gable-roofed structure with overhanging eaves and band windows. The building sits on a concrete foundation, has 8-inch, glazed tile walls, and a build-up roof (see Figure 4.142).

Building 1510A (1947), a storage facility found off Hart Road and Sage Place, is a rectangular, gable-roofed structure with two square buildings incorporated one roof. The building sits on a concrete foundation, has hollow tile walls, and a corrugated asbestos roof (see Figure 4.143).

Building 1510B (1948) was previously used as a general storehouse and a storage magazine for buildings 1512 and 1518. Located off Hart Road, it is a rectangular, shed-roofed structure with central double doors. The building sits on a concrete foundation, has framed walls faced with aluminum siding, and a rubberoid surface on wood-base roof (see Figure 4.144).

Building 1510D (1947) is a water tower off Hart Road that is set on a steel frame with a steel tank (see Figure 4.145).

Building 1511 (1952) was previously used as a conditioning general purpose storehouse and an inert storehouse neutralizing and pump station. Situated off Sage Place, it is a small, square, flat-roofed structure with a high garage bay for unloading and a side entrance. The building sits on a concrete foundation, has glazed tile walls, and a build-up roof (see Figure 4.146).

Building 1512 (1956), previously used as a chemistry laboratory, physics laboratory, basic chemistry research laboratory, and a laser laboratory. The building is situated off Sage Place and Hart Road and is a rectangular, gable-roofed structure with overhanging eaves. It sits on a concrete foundation, has 8-inch, glazed tiles walls, and a build-up concrete roof (see Figure 4.147).

Building 1512A (1958), previously used as a flammable materials storehouse off Sage Place, is a small, rectangular, shed-roofed structure with a central entrance. The building sits on a concrete foundation, has transite walls, and a corrugated metal roof (see Figure 4.148).

Building 1513 (1968) was previously used as a general purpose magazine, pyrotechnic R&D laboratory and an engineering laboratory. Found off Sage Place, it is a long, rectangular, flat-roofed structure with interior blast walls extending above the main roof line. The building sits on a reinforced-concrete foundation, has concrete-block walls, and a build-up on wood roof (see Figure 4.149).

Building 1514 (1968) was previously used as a liquid storage non-propellant flame and incendiary trajectory dissemination facility, pyrotechnic R&D laboratories, and flammable materials storehouse. It is a long, rectangular, flat-roofed structure with interior blast walls extending above the main roof line, situated off Hart Road. The building sits on a reinforced-concrete foundation, has concrete-block walls, and a build-up on wood roof. An addition was made in 1968 by Rouse, Dublin & Ventura Architect and Engineers of New York (see Figure 4.150).

Building 1515 (1961), previously used as a laboratory, propellant mixing station and electrical equipment facility, is located along Sage Place. It is a long, rectangular, flat-roofed structure with a central smokestack. The building sits on a reinforced-concrete foundation, has concrete-block walls, and a build-up on wood roof. An addition was made in 1968 by Rouse, Dublin & Ventura Architect and Engineers of New York (see Figure 151).

This area, well away from the active test firing of propellants, was set aside for laboratories and longer term storage of explosives and other materials. Chemistry, physics and pyrotechnics laboratories were found in this area as were flammable, HE, and general storage facilities.

Buildings in this area scheduled for disposal include: Buildings 1514 (1968), pyrotechnic R&D laboratories; 1515 (1961), physics laboratory; 1511 (1952), conditioning building; and 1510A (1947), storage facility.

Activities occurring in the 1500 Area, also known as the Rocket Test Area, played a significant part of the United States' and the Army's initial forays into space. Picatinny served in key roles in some of the most important rocket programs and missile systems that were ever devised, including those programs that involved the adaptation of rockets to accommodate nuclear warheads. These rockets include the HONEST JOHN, REDSTONE, LITTLE JOHN and NIKE AJAX.

The construction dates of the buildings within the Rocket Test Area span a broad spectrum from 1946 to 1980, all of which falling within the Cold War period, 1946-1989. According to Army Cold War Guidelines (USACE, Fort Worth 1997) for deciding building/structure significance, the determination of significance is made only after a resource is shown to be important to one or more of the Army Cold war Themes (see Section 2.2). The Rocket Test Area meets two of the Army's broad themes—Technological Imperative, and Survival and Preparation for a Hot War. Specific Army themes that the area meets include: Mission Focus, Technology, and Militarization of Space.

These buildings were used to meet a perceived Soviet military threat and to influence Soviet objectives and policy through the development of rockets and missile systems that could and would militarize space or change the traditional battlefield into a nuclear one. The implied or actual use of nuclear war materiel is considered one of the most significant aspects of the Cold War (USACE, Fort Worth 1997). Certainly, the Rocket Test Area meets these criteria.

The Rocket Test Area, now the 1500 Area, is eligible as a district for the National Register of Historic Places under Criterion A, contributing the broad patterns of history and Criterion C, architectural/engineering features, as well as satisfying Criterion Consideration G. The buildings contributing to this district are:

1501 (1948)	Office
1502 (1948)	Ordnance Facility
1503 (1948/1956)	Conditioning Building
1504 (1956)	Storage
1504A (1948)	Conditioning Building
1505 (1948/1956)	Test Cell
1505A (1948)	Test Cell
1505B (1948)	Test Cell
1505C (1958)	Control House
1505D (1951	Test Cell
1505E (1966)	Control Spin Room
1505F (1959)	Storage
1505N (1948)	Open Blast Area
1506 (1954)	Loading Facility
1507 (1946)	HE Magazine
1507B (1959)	Storage

1508 (1955)	HE Magazine
1509 (1950)	Test Facility
1510 (1950/1956)	Pyrotechnic Building
1510A (1947)	Storage
1510B (1948)	General Storage
1510D (1947)	Water Tower
1511 (1952)	Neutralizing and Pump Station
1512 (1956)	Chemistry Laboratory
1512A (1958)	Flammable Material Storage
1513 (1968)	Pyrotechnic R&D Laboratories
1514 (1968)	Pyrotechnic R&D Laboratories
1515 (1961)	Physics Laboratory
1517 (1956)	High Altitude Test
1517A (1963)	Electric Equipment Facility
1519 (1956)	HE Magazine
1520 (1956)	HE Magazine
1521 (1960)	Component Propellant Building
1522 (1970)	Ordnance Facility

On the whole, these buildings have integrity and it is clear that they form testing/plant areas. The period of significance is 1946-1989, the Cold War.

Non-contributing buildings include:

1505J (1960)	Storage (truck trailer)
1505K (found on post)	Storage (truck trailer)
1518 (1958)	General Purpose Instrument Storage (derelict, has no integrity)
1527 (1960)	Barricade (derelict, has no integrity)
1528 (1963)	Barricade (derelict, has no integrity)
1529 (1964)	Warehouse
1530 (1990s)	Administration Building (constructed after period of significance)

The boundaries of the 1500 Rocket Test Area Historic District begin at Lake Denmark Road at the west and extend easterly behind Buildings 1519 and 1520 to Building 1530 north of Hart Road and turning and extending to the south to encompass Buildings 1511, 1515 and 1513 east of Sage Place. From Building 1513, the boundary turns west and runs behind the buildings along the south side of Hart Road to the end of the chain-link fence, where the boundary turns north and extends to Hart Road. The boundary continues westerly along Hart Road to Lake Denmark Road (Figure 4.152).

4.3.2 Navy Rocket Activities at Picatinny. The Naval Air Rocket Test Station (NARTS), a Cold War (1946-1989) activity of the U.S. Navy, was located on the site of the former Lake Denmark Navy Ammunition Depot. While most of the rocket-testing activities occurred off Lake Denmark Road on Snake Hill Road, many other support activities occurred throughout the Navy base. These activities were as varied as storage, research, laboratory work, and personnel activities. However, the most important activity at NARTS was the design and testing of rocket engines, their propellants, and other related endeavors, such as the testing of fire-resistant clothing. This testing work was done in one area off Snake Hill Road.

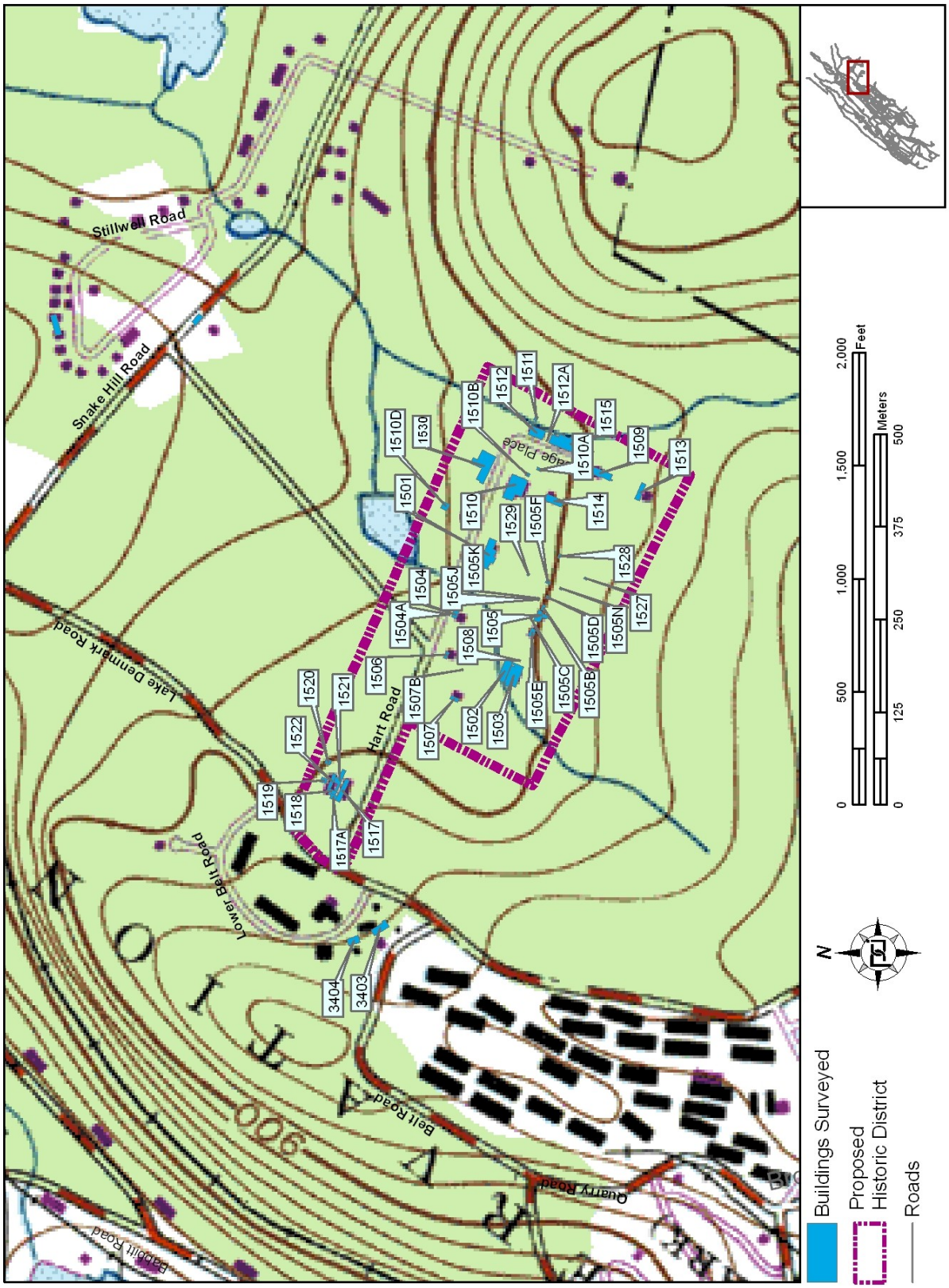

Figure 4.152. Boundaries of the proposed 1500 Rocket Test Area Historic District, Picatinny Arsenal, NJ *(Base map: USGS 1981; Chugach Industries, Inc. 2007).*

The test facilities were generally grouped into six test areas off Snake Hill Road, two were used especially by and for NARTS projects, and the others were leased to the private rocket company, Reaction Motors, Inc.. Test Areas A, B, and C, which were completed in 1947, and G were leased by RMI. NARTS used Test Areas D, E, and sometimes G. Areas R and S, which occupied 263 acres immediately north of the Navy test areas, were owned by RMI but were connected to areas A, B, C, and E by Lake Denmark Road (Redmond 1957; Figure 4.153). Navy Test Areas D and E have been determined eligible for the NRHP as districts by the New Jersey HPO (Guzzo 1999, 2004a).

Panamerican evaluated several buildings/structures associated with the Navy's rocket activities at Picatinny, including:

NARTS Area A (see Figure 4.96).

3504 (1945) Stored Rocket Fuel, Oxidizer, and Mono-propellant (Figure 4.154)

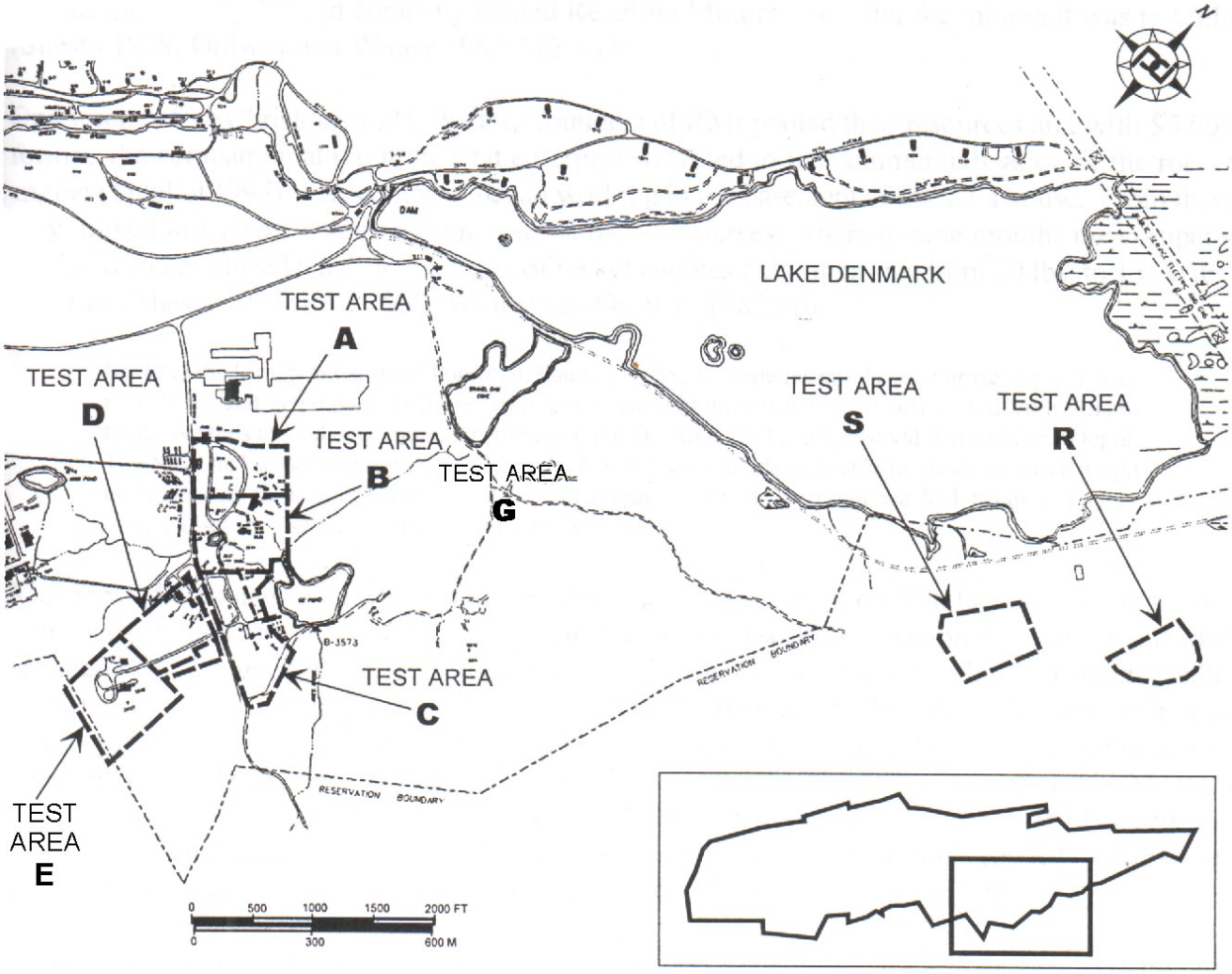

Figure 4.153. Former Test Areas A, B, C, D, E, G, R, and S, of NARTS (boundaries are general), Picatinny Arsenal, NJ *(base figure Picatinny DPW nd).*

Figure 4.154. Building 3504, Storage for Rocket Fuel, Oxidizer and Mono-propellant, RMI Area A, Picatinny Arsenal, NJ *(Panamerican 2007).*

Associated NARTS Buildings on Lower Belt Road (see Figure 4.96)

3403 (1944/1951)	W.M. Kellogg Laboratory (Figure 4.155)
3404 (1960)	Navy Laboratory 5 (Figure 4.156)

Associated NARTS Buildings on Snake Hill Road (see Figure 4.96)

3700 (1965)	Office/Storage (Figure 4.157)

Building 3403 (1944/1951), previously used as a chemistry laboratory, is found off Lower Belt Road. It is a rectangular, gable-roofed structure with a gable, entry portico at the northwest corner of the building. The building sits on a concrete foundation, has concrete-block walls, and a built-up roof. An addition was made in 1951 (see Figure 4.155).

Building 3404 (1960), previously used as a Navy laboratory, is situated off Lower Belt Road, and is a rectangular, gable-roofed structure. The building sits on a concrete foundation, has concrete-block walls, and a built-up roof (see Figure 4.156).

Building 3504 (1945), previously used as a maintenance building and originally as storage for rocket fuel, oxidizer, and mono-propellant, is found off Stillwell and Snake Hill roads. It is a rectangular, gable-roofed structure that sits on a concrete foundation, has metal walls, and a metal roof (see Figure 4.154).

Figure 4.155. Building 3403, W.M. Kellogg Laboratory, Navy laboratory associated with NARTS, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.156. Building 3404, Navy Laboratory 5, Navy laboratory associated with NARTS, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.157. Building 3700, the CSM Theodore R. Moran Recreational Area Office/Storage Building, Snake Hill Road, Former NARTS Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 3700 (1965), a storage facility and office off Snake Hill Road, is a rectangular, gable-roofed structure that sits on a concrete foundation, has transite walls, and a corrugated metal roof (see Figure 4.157).

4.3.3 History of NARTS. Although Picatinny Arsenal had long been involved in cutting edge military R&D projects, its sister installation, Lake Denmark Naval Ammunition Depot (NAD), had served the Navy simply as a storage facility since its inception on 24 February 1891. While the pace of its activities ebbed and flowed with peace and war, the depot was never involved in any special research until after World War II, 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 conducted in this small area would in many ways rival the best work ever done at PICA (Durant 1951:76; Baranowski 1959).

At the end of World War II, the Department of the Navy Bureau of Ordnance determined that Lake Denmark NAD, at one time the Navy's largest storage depot, was excess for then current needs, and started to deactivate the facility. However, the Bureau of Aeronautics (BuAer) recognized the opportunity to establish a centralized, East Coast rocket-engine test center with applications for naval aviation, and initiated steps to receive management control. After modifications to existing facilities, the U.S. Naval Aeronautical Rocket Laboratory (NARL) was established at Lake Denmark on 1 July 1948 with functions similar those of the Air Force's Rocket Test Facility at Muroc, California (now, Edwards Air Force Base). The Officer-in-Charge (OIC) of NARL reported to the Commanding Officer of NAD for command and BuAer for management. Its mission was the "evaluation and development of rocket engines and their

components" (NARTS 1950: Progress Report for January; Baranowski 1959). The first (and only) OIC of NARL was Commander Dayton A. Seiler, who served from 12 July 1948 to 1 April 1950.

Lake Denmark was selected as the site for the laboratory because the depot met the necessary criteria for a successful testing facility. The Navy had occupied the site since 1890s (as an ordnance depot) and had already invested in the facility's infrastructure for such items as roads, utilities, barracks, and potentially convertible warehouses. Lake Denmark 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 made the hiring of specialized personnel and the procurement of materials easier. Empty buildings could be easily adapted to rocket-testing functions, and the Navy had already leased a number of them to Reaction Motors Inc., the pioneer firm for the commercialization of rockets. Moreover, propellant-storage facilities, high-pressure inert gas storage, and test stands had been constructed by the Navy for the company. The site was close enough to Washington, D.C., for liaison with the Bureau of Naval Weapons (BuWeps) and the newly organized Department of Defense (DoD), as well as other East Coast rocket manufacturers (Seiler 1949; NARTS 1950: Project Report for January; Durant 1951:76).

Reaction Motors, Inc. (RMI), initially incorporated at Pompton Plains, New Jersey, in December 1941, worked closely with the Navy during the war, but required additional facilities to meet the accelerated demands of post-war jet engine development. The Navy offered the use of buildings and land formerly associated with the NAD ordnance battalion area for manufacturing shops and offices.

> The RMI administration area at the Naval Ammunition Depot's main gateway features two large buildings where research and development engineers and manufacturers produce rocket engines; in one building the engines are designed and models made; in the other, the approved designs are put in production. Nearby are separate buildings for the administration offices, cafeteria, security section and other facilities. The testing area, gleaming with the huge new power and supply plants, illustrates the rapid growth of [the] organization ... [RMI 1948:2-3].

By the middle of 1946 all of RMI's activities had been transferred to Lake Denmark, where a construction program for rocket test stands was underway (*The RMI Rocket* December 1951).

Scheduled for completion in December 1949, the construction of additional test facilities included one booster test stand of 100,000-lb. thrust capacity (Area D), and two test stands of 20,000-lb. thrust capacity. Plans for the renovation and expansion of the facility were included in the budget for the following year (Seiler 1949). NARL personnel comprised seven officers, 36 enlisted men, and 123 civilian employees. The earliest projects assigned to NARL, most of which were restricted or confidential, included the development of methods and equipment for testing liquid propellant rocket engines (project no. ARL PP-201); various applications as related to the LARK guided-missile rocket engine (ARL PP-202 and ARL PP-202.1); and the acceptance tests and evaluation of the XLR-18-K-2 booster assembly rocket (ARL PP-203 and ARL PP-203.1) (Seiler 1949; NARTS 1950: Progress Report for January).

In addition to testing and evaluation activities, the Navy found it desirable to actually provide test facilities at NARL for rocket engine contractors or other governmental agencies with inadequate or insufficient test facilities of their own. This was particularly true for engines with more than 10,000 lbs of thrust. As the thrust capacity of engines grew, the costs of construction for the test stand, tankage and instrumentation, which were costly to begin with, increased significantly making the

creation of large stands cost prohibitive for many companies. In addition, some companies were located so close to general habitation areas that the firing of very large engines was precluded because they were a public nuisance (Durant 1951). Prior to 1950, NARL had a number of temporary test stands that were made from Quonset huts. At these temporary stands the Navy had tested the rocket engines for the Douglas SKYROCKET, the Bell X-1 and the LARK. It also had a large test stand for the development of the 20,000-lb thrust VIKING engine, the Consolidated-Vultee MX-774, and for certain tests on the SKYROCKET. The large stand, called the Viking Stand, was originally built in 1946 for engines with a capacity of 6,000 lbs thrust and was later converted for 20,000 lbs thrust (NARTS 1950: Progress Report for January). These facilities would not be suitable for the testing rocket engines with larger thrust capacities.

On 1 April 1950, NAD was officially disestablished and NARL was redesignated the Naval Air Rocket Test Station (NARTS) under the command and coordination control of the Commandant, Third Naval District, and management control under BuAer. Its purpose was to test and evaluate rocket engines, components and propellants as well train service personnel in the handling, servicing and operation of rocket engines. All physical facilities of the former Lake Denmark depot were made a part of NARTS, but as a result of the large amount of ordnance still stored on site, a number of buildings were retained by the Bureau of Ordnance and the facility received the additional task of acting as an ordnance reserve stock point (Baranowski 1959).

In the early 1950s, the Navy undertook an extensive engineering study to create a master plan for the facility. The Navy requested $7,500,000 for the expansion and modernization of the existing test facilities; to purchase more land to better integrate their current holdings; to improve and standardize instrumentation; to provide for an underground propellant storage system; to create more housing; and to outfit specialized shops and laboratories (NARTS 1950: Progress Report for January; Durant 1951). NARTS began an expansion program that included the construction of Test Area E, a site for the testing of rocket engines up to 350,000 lbs thrust and which undertook a number of important research and design projects (NARTS 1951, 1952: various Monthly Progress Reports).

By 1952 RMI had constructed its main rocket engine test area at NARTS, operated under permit. The area contained an administration building, storage buildings as well as 17 test cells, which had maximum thrust operation ranging from 10,000 lbs to 50,000 lbs. Adjacent to RMI's test area, NARTS maintained four test cells and was planning what would become Test Area E. RMI also owned 237 acres adjacent to NARTS (RMI ca. 1953:15-16). At this time the Naval installation consisted of 760 acres and represented a multimillion-dollar investment. It was anticipated that the staff would double in the next decade. The facility's earliest work had been devoted primarily to liquid propulsion, but was beginning to include 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 these functions were 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" (NARTS ca. 1959).

As it evolved, NARTS had three major work categories: qualification tests, preliminary investigations, and technical services, all of which were included in its assigned mission (Durant 1951:76-77; Department of the Navy 1999a, 1999c; NARTS ca. 1959:np). 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 XLR 44-RM-2) and the engines on the Air Force SIDEWINDER. NARTS worked on a number of major preliminary investigations including: damage control of propellant oxidizers; variable thrust engine for spacecraft application; ultra high-density propellant systems; and the investigation of monopropellants as gas generates. Technical services were provided by the Rocket Propulsion Laboratory for the BuWeps, other government agencies and private contractors. These services included the development of specifications and procedures for mixed amines (i.e., 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, Inc., to name a few (NARTS ca. 1959, 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: Propellant, Rocket Engine, Engineering Services, and a more loosely organized Project Group. The Propellant Division was responsible for analytical chemistry and propellant evaluation as well as physical chemistry and propellant 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 (NARTS ca. 1959).

The military and civilian personnel who staffed NARTS in the mid-1950s held impressive credentials. Dr. John D. Clark, NARTS chief chemist from 1949 to mid-1950s, headed the Propellants Division. Clark, a Stanford Ph.D., is best known for the creation of new family of monopropellants 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. The Rocket Engine Division, which encompassed the Design, Shops, Test and Instrumentation Branches, was directed 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 Laboratory's technical director 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) (NARTS ca. 1959; Astronautix 2007).

The NARTS facilities began as a small liquid propellant 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 (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 RMI. Test Areas A, B, and C—completed in 1947— and G were leased by RMI. NARTS used Test Areas D, E and sometimes G. Test Area E, completed in 1953, was considered the "elite" among the many facilities at NARTS (NARTS ca. 1959; see Figure 4.153). 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 (NARTS ca. 1959). Areas

R and S, which occupied 263 acres immediately north of the Navy test areas, were owned by RMI but were connected to areas A, B, C, and E by Lake Denmark Road (Redmond 1957; see Figure 4.153).

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 (i.e., one that cooled its combustion chamber by the circulation of its propellants). 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 rocket (Ordway and Winter 1983:542-544; Shesta 1978).

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 BuAer of the Navy Department. After several successful test runs of the Wyld engine—and the bombing of Pearl Harbor—a contract was awarded to the newly formed company named Reaction Motors, Inc. after the motors it was to build (Shesta 1978; Ordway and Winter 1983:542-544).

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 1997). The company began working 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 lbs to 1,000 lbs of thrust (Shesta 1978; RMI 1957; Winter and Ordway 1982:np).

> By 1946 the local population of Pompton Plains, N.J. had become resentful of the noise made by our rockets, as well as the noxious fumes from our nitric acid motors which we also tested from time to time. We thus moved once more, this time to Lake Denmark, N.J., to the Naval Ammunition Depot. The Navy had some unoccupied buildings there which were made available to us. This move might be looked upon as a milestone in RMI's progress. Almost overnight we had become a large concern—at least in our estimation [Shesta 1978:np].

RMI located their new engine design and model construction and production facilities to the former ordnance battalion area at NAD. Engine testing occurred at a secluded location on a narrow dirt road between Hibernia and NAD. The new RMI site was situated "in a natural 'bowl' of surrounding hills, insulated by thousands of acres of Government property acquired specifically for ammunition storage and testing [and] provides one of the best areas on the Eastern seaboard for rocket engine testing" (Winter and Ordway 1982:np). Shortly after the company's relocation, it purchased 237 acres adjacent to the Navy-owned test area. By 1951, the Navy was in the process of planning and designing a new area at the renamed NARTS to test engines with a larger thrust capacity—Test Area E (Winter and Ordway 1982).

In November 1953, Mathieson Chemical Corp purchased a controlling interest in RMI, and merged with Olin Industries, Inc. in May 1954, forming the Olin Mathieson Chemical Corp. By the end of 1954 RMI had sales of $4.7 million and a work backlog of more than $7.5 million (Ordway and Winter 1983:549, 1985). By 1957, one year before it merged with Thiokol Chemical Corporation, RMI was organized into six divisions—Applications Engineering and Contracts, Project Engineering, Component Development, Production, Finance, and Administration—had sales of about $24.5 million dollars and employed 1,639 workers. Quality

control was conducted by a military inspector, while an in-plant BuAer representative served as RMI-DoD liaison (Thiokol 1997; Ordway and Winter 1983:549; RMI 1957). With a major interest in Flight Refueling, Inc., RMI had offices in Denville, New Jersey, Washington, D.C., Dayton, Ohio, and Los Angeles.

The principal work of RMI was the development and production of solid and liquid propellant rocket power plant (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 Reaction Motors 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 that was one of the most modern and complete rocket facilities in the United States. The 200,000-sq.ft. plant featured administrative offices, research activities and pilot production facilities. In addition, it maintained 150,000 sq. ft. of engineering, manufacturing and test facilities at the Lake Denmark Rocket Test Station (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 area 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 three large stands with capacities from 50,000 lbs 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; Redmond 1957).

The many engine test stands could hold complete rocket engine systems for simulated flight trials. Engine, propellant 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, and control rooms all constructed to permit the visual observation of items under test. The instrumentation areas operated under 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 playback system facilitated the analysis and evaluation of data (RMI 1957). The activities of RMI dovetailed with the mission of NARTS, which as stated in December 1956 was to "conduct tests and evaluation of rocket engines, their components and propellants," performed in support of technical research and development for BuAer (NARTS 1956). NARTS still served as a technical ordnance reserve stock point, an assignment, the document noted, not devoted to its R&D mission (NARTS 1956).

On 30 April 1958, RMI and Thiokol Chemical Corporation merged and RMI became a division within the company (i.e., Reaction Motors Division [RMD]). Thiokol had its beginning in 1926, when a serendipitous laboratory experiment created the world's first synthetic rubber. Three years later, in 1929, the Thiokol Chemical Corporation was formally created, 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 gun turrets, fuel tanks, and seams of all kinds. Scientists at Cal Tech's Jet Propulsion Laboratory discovered that Thiokol's polymer sealant made the best solid propellant fuel binder available at the time. Thiokol was suddenly in the rocket business (Thiokol 1997; Winter and Ordway 1982).

Thiokol opened its first small scale rocket operations in Elkton, Maryland, and by 1950 it had opened facilities at the U.S. Army's Redstone Arsenal, Huntsville, Alabama, in the old Redstone Ordnance Plant's production lines. In 1952, it won a contract to refurbish and operate the Longhorn Army Ammunition Plant in Marshall, Texas. By 1958, Thiokol had a contract with the

U.S. Air Force to build the first stage rocket motor for the revolutionary Minuteman ICBM at their Brigham City, Utah, rocket motor plant (Thiokol 1997).

On 14 October 1947, Chuck Yeager became the first human to break the sound barrier, flying the Bell X-1, powered by RMI's 6000C-4 engine (also known as the XLR-11 [its U.S. Air Force designation] and "Black Betsy") (Winter 1988:83-84; Winter 1994a, 1994b). In 1956, RMI was awarded the contract to develop the XLR-99 liquid rocket engine for eventual use in the X-15, the experimental hypersonic aircraft. Building on the knowledge gained from the XLR-11, the XLR-99 (also known as "the Pioneer") was the most powerful, most complex, and safest man-rated (i.e., 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 initial testing, including test firings, of that engine was conducted at Lake Denmark, much to the displeasure of the local residents (*The Citizen* 1958-1960; NARTS ca. 1959; Winter 1987:410). Tested in NARTS Test Area E, which RMI leased from the Navy, the XLR-99 was used for the X-15, a joint NACA, Navy, and Air Force project (Thiokol 1997; 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).

Conceptualized and constructed between 1951 and 1953, Test Area E was considered by the Navy to be its premier rocket-engine testing area upon its completion. NARTS engineers completely designed the original plan for the test area in consultation with RMI. 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, which also had offices in Washington, D.C. The development of Test Area E project was considered one of the major accomplishments of the NARTS engineering staff. When the test stand was first put into use it was one of the largest static test stands on the East Coast (NARTS ca. 1959).

Aside from the testing of the XLR-99 motor, NARTS had already established an impressive record of notable contributions to rocket engine and propellant 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 propellant performance calculation

The brochure advertising these accomplishments quickly added that these were just the ones "that can be named" publicly (NARTS ca. 1957). Further research would probably uncover a host of then highly classified NARTS achievements.

Despite the success of RMI/RMD and the accomplishments of NARTS, the Naval Air Rocket Test Station, Lake Denmark was disestablished on 1 August 1960, and the facilities reverted to the U.S. Army for incorporation into Picatinny Arsenal. Navy liquid propellant rocket development projects were transferred to the Naval Ordnance Test Station, China Lake, California, the Naval Propellant Plant, Indian Head, Maryland, and the Naval Weapons Laboratory, Dahlgren, Virginia (Department of the Navy 1999c). The Thiokol Chemical Corporation later leased the entire Lake Denmark Test Area. A *Test Facilities Data Book* prepared by Thiokol (Edson 1962) provides an excellent overview of all of the facilities there at that time. This volume was intended for use by the test area operating personnel, engineering and management personnel of RMD, other divisions of Thiokol, and industrial companies interested in using the facilities (Edson 1962).

During the mid-to-late 1960s, the Denville RMD plant experienced declining business as a result of changes in the rocket industry, especially the switch from liquid to solid propellants. Efforts were made to retool the plant and to undertake new, more profitable projects. However, by 1970, the Denville office was phased out and with a complete shutdown of all activities occurring by 1972 (Walker 1970). RMD's location undermined its ability to attract clients, such as NASA, which sought to build larger and more powerful rocket engines. Although the Lake Denmark area was secluded and isolated in 1949, population trends of the period (i.e., suburban sprawl) less than ten years later produced the same problems for RMD that afflicted RMI at Pompton Plains during World War II: complaints from area residents about noise and damage from shock waves. Moreover, the New Jersey State Supreme Court ruled that Thiokol Chemical Corporation, as RMD's parent, was liable for property damage caused by the testing of the X-15 engine (Winter 1987:415). The company that began by developing JATO engines and motors for America's first missiles (the LARK and GORGON) and engines or propulsion systems for the VIKING rocket, the Bell X-1, the MX-774, the Republic XF-91, the Rocket-on-Rotor (ROR) for the HRS-2 helicopter, the North American X-15, the BULLPUP, CORVUS, and CONDOR missiles, and the SURVEYOR spacecraft control system, discontinued work in the liquid propulsion field by 1970 and ceased operations less than two years later (Shesta 1978; Ordway 1985, 1987). The rocket test areas of the Lake Denmark site were abandoned to the Army and have been largely unused since.

Test Area A. Practically from its inception, the Navy rocket program was tied to Reaction Motors, one of the Navy's earliest rocket contractors. When the Navy decided to open the NARL, later NARTS, facility, it was a given that RMI would be intimately involved in the Navy's rocket program on the East Coast. Therefore, it is no surprise that NARTS leased property to RMI from the beginning. The former leased testing areas are located on the north side of Snake Hill Road in a relatively isolated part of the former Lake Denmark Depot. While the Navy retained exclusive control of Area D, and Areas E and G were essentially Navy sites that could be used by private-sector companies, Areas A, B and C were, from the beginning, associated almost exclusively with RMI/RMD (see Figure 4.153).

Test Area A was essentially a grouping of eight test stands, designed primarily for testing liquid propellant rocket engines up to 10,000 lbs thrust (NARTS ca. 1959). Area A comprised approximately 26 buildings and structures that, aside from the eight test stands, included a photography laboratory, welding shop, maintenance shop, magazines, a boiler house, and a number of other offices and laboratories (PICA 1969). At the time of the investigation, only five of those structures remain. The building surveyed for this report was 3504, a storage building for rocket fuel, oxidizer and mono-propellant (see Figure 4.154).

Although the work of RMI/RMD was essential to the creation of the military's current rocket program and much of that early work was performed in Area A, the area is now a jumble of concrete foundation pads and a few remaining, poorly maintained buildings scattered along a number of ill-defined dirt roads. Area A has lost it integrity and its few remaining buildings, therefore, cannot be eligible for the NRHP. Building 3504 is not individually eligible for the NRHP, and there are no landscapes associated with this building.

NARTS Area along Snake Hill Road. One building was surveyed in the NARTS area along Snake Hill Road but not in clearly defined test area: Building 3700 (see Figure 4.157). This is a solitary building now associated with a trailer park. It has no architectural or historical significance and as a consequence is not eligible for the NRHP.

NARTS Buildings off Lower Belt Road. Building 3403 and Building 3404, old Navy #706, were erected by the Navy in 1944 as a Station Brig and Laundry Maintenance Shop, respectively (see Figures 4.155 and 4.156). They were part of a cluster of five buildings, numbered 3401 through 3405, which served as service and support buildings for the Marine Barracks Area, located in the 3400 area off Lower Belt Road. These service buildings were constructed on concrete slabs, have concrete-block walls and front gable roofs covered in strip shingles. They are typical of World War II base operations buildings that every installation needs in order to complete its mission and, as such, have no particular military significance. Since they were associated with support of a barracks area, they were probably built using standardized plans.

During the 1950s and 1960s, Building 3404 served as a Propellants Test Laboratory for RMI/RMD and was also known as the W.M. Kellogg Laboratory for special projects. It was surrounded by a "Plastecs" (sic) Tech Evaluation Center (Building 3401), a Liquid Propellants Laboratory (Building 3402), a Rocket Propulsion Laboratory (Building 3403), and a Boiler House and Bunker (Building 3405) (PICA 1969). Building 3403, known as Navy Laboratory 5, also served as a chemistry laboratory. It is unclear exactly what activities occurred within these buildings, but the most important work of RMI/RMD was conducted in Test Areas A, B, C, G, and later R and S. Since Building 3404 and 3403 have no military significance and were most likely built using standardized plans, they fail to meet the NRHP criteria and are, therefore, not eligible for the NRHP. There are no landscapes associated with any of these former NARTS buildings.

4.4 MISCELLANEOUS TESTING BUILDINGS

On an installation such as Picatinny, there are various testing facilities that are not associated with particular industrial complexes or projects. These facilities can be extremely simple or highly complex; nevertheless, they are used across the board for a large number of activities and program components. Miscellaneous testing buildings at Picatinny include:

72 (1962)	Safe Shelter (Figures 4.158 and 4.159)
92 (1964)	Ramsey Building, Quality Evaluation Laboratory (see Figure 4.62; Figure 4.160)
178 (1956)	Chemistry Laboratory (Figures 4.161 and 4.162)
1222 (1946)	Electronic Equipment Shelter (Figures 4.163 and 4.164)
3109 (1945)	Environmental Testing Building, former Navy building (Figures 4.165 and 4.166)
3144 (1968)	Drop Tower (Figure 4.167)

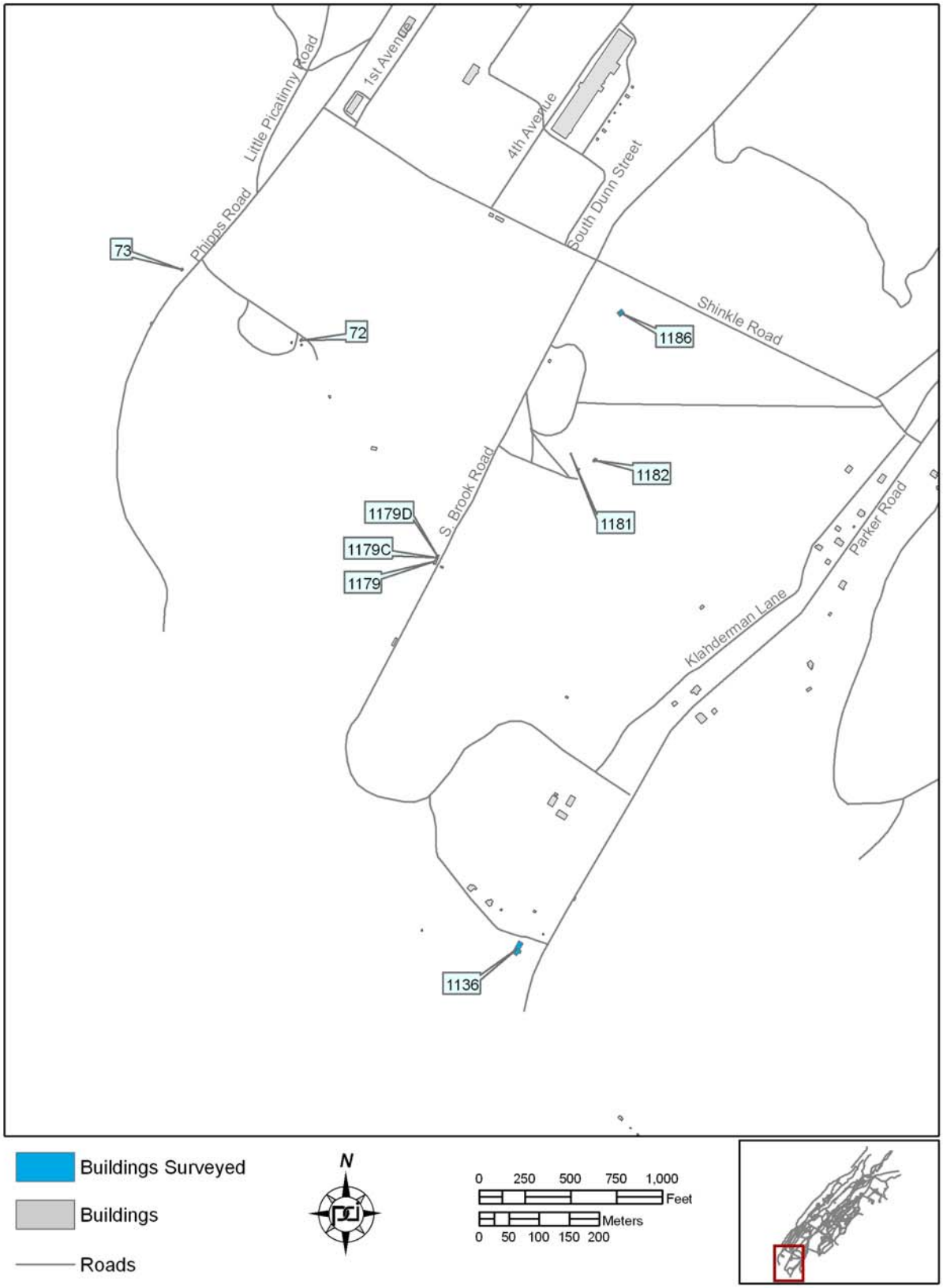

Figure 4.158. Locations of Buildings 72, 73, 1136, 1179, 1179C, 1179D, 1181, 1182, and 1186, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.159. Building 72, Safe Shelter, Pyrotechnic Test Range, off Horney Road, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.160. Building 92, the Ramsey Building, Quality Evaluation Laboratory, 90 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

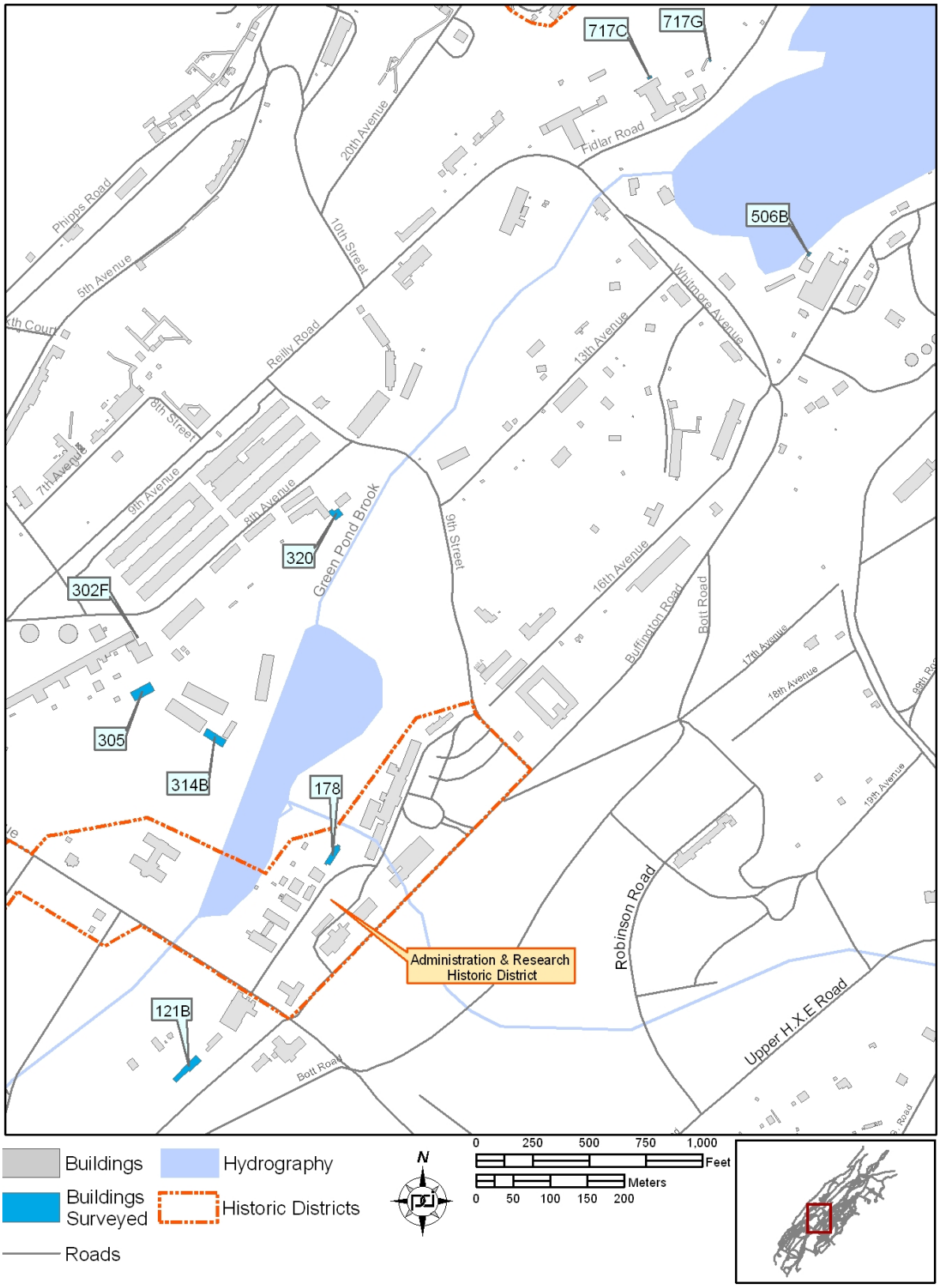

Figure 4.161. Locations of Buildings 121B, 178, 302F, 305, 314B, 320, 506B, 717C, and 717G, and the Administration & Research Historic District, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.162. Building 178, Chemistry Laboratory, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.163. Building 1222, Electronic Equipment Facility, Gorge Testing Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

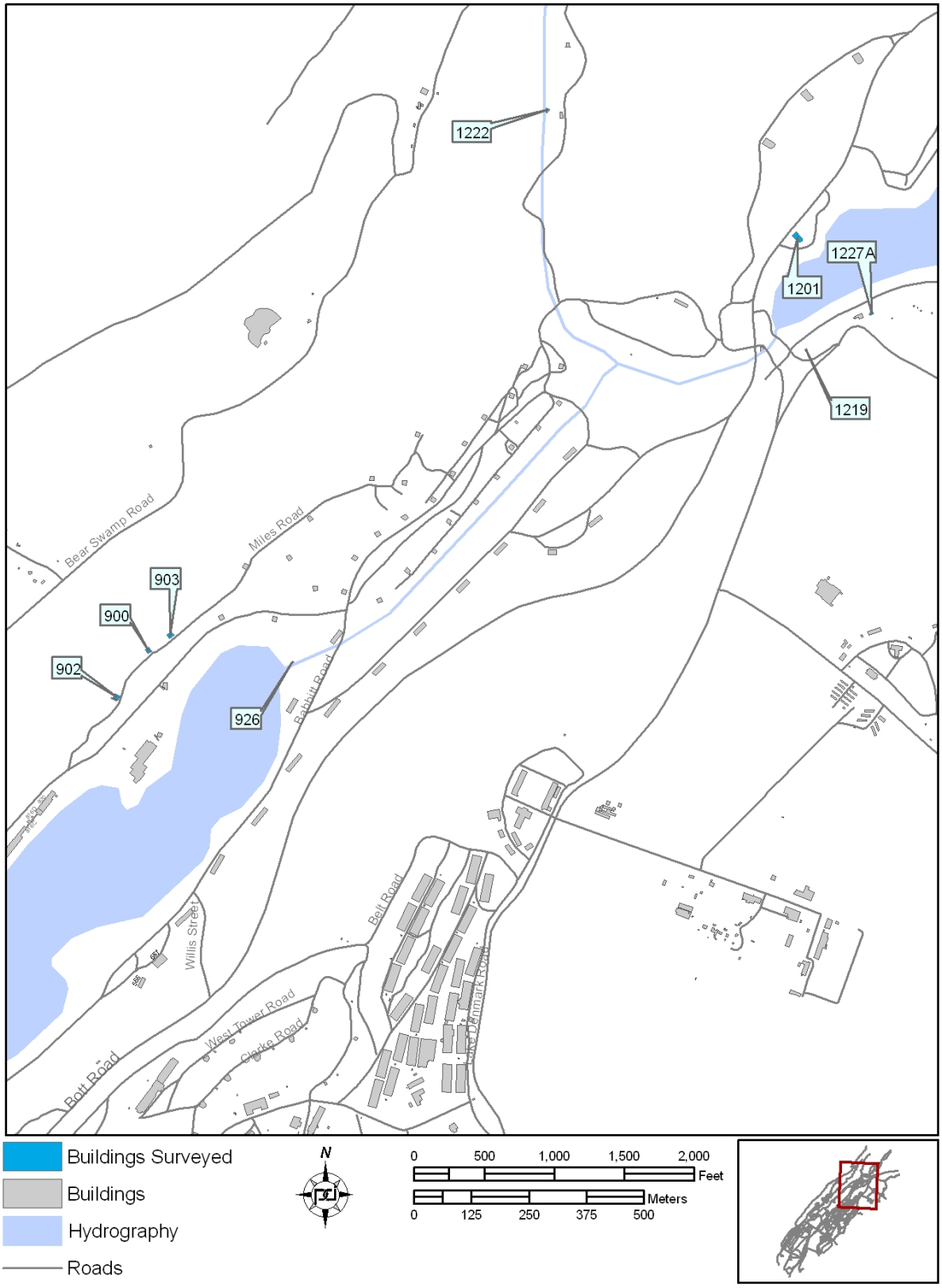

Figure 4.164. Locations of buildings surveyed in the 900 Area and 1200 Area, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

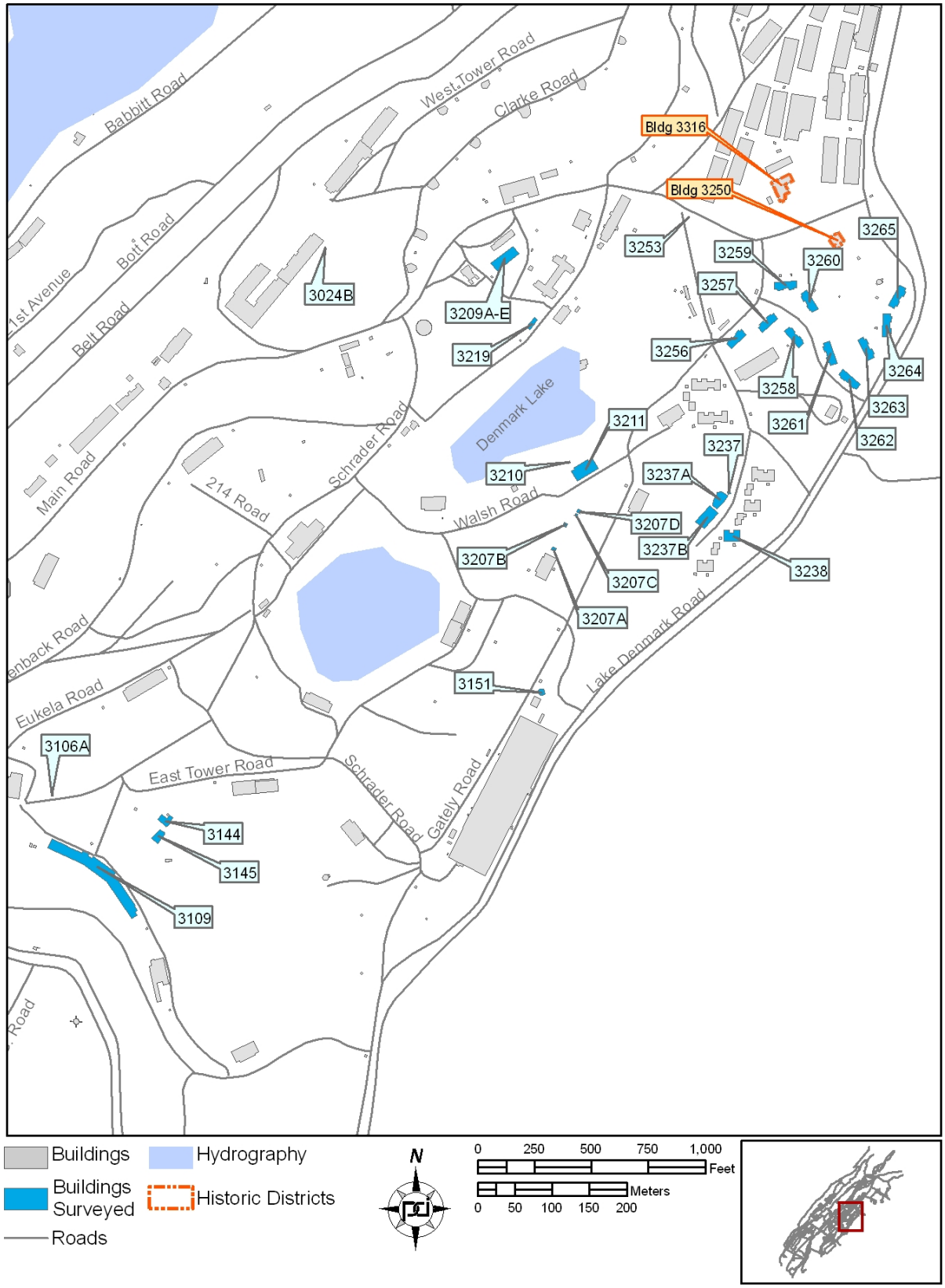

Figure 4.165. Locations of buildings surveyed in the 3100 Area and 3200 Area, and NRHP-listed Buildings 3250 and 3316, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.166. Building 3109, Environmental Testing, former Navy Facility, 3100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.167. Building 3144, Drop Tower, 3100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.168. Buildings 3145, Drop Tower Ordnance Complex, 3100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

3145 (1968)	Drop Tower Ordnance Facility (Figure 4.168)
3145A (1968)	Drop Tower HE Magazine
3207A (unknown)	E3, Fuze Division Storage (see Figure 4.165; Figure 4.169)
3207B (unknown)	E3, Fuze Division Storage (Figure 4.170)
3207C (unknown)	E3, Fuze Division Storage, derelict (Figure 4.171)
3207D (unknown)	E3, Fuze Division Storage (see Figure 4.171)

Building 72 (1962), a safe shelter off Horney Road at the southwestern end of the installation, is a rectangular, shed-roofed structure with a shelter bay. It sits on an earth foundation, has railroad-tie walls, and a ¼-inch thick steel roof. Building 72 is associated with a derelict firing range on the main post. It is a fairly typical structure, created from found materials and used to shelter individuals firing munitions on the range. The range looks seldom used, especially since it is located so near a sentry point on the main installation. The safe shelter has no historical or architectural significance and, therefore, is not eligible for the NRHP (see Figures 4.158 and 4.159).

Building 92 (1964), a multifunction building housing a physics laboratory, administration offices and R&D product assurance, is located off Ramsey Avenue. Identified as the Ramsey Building, it is a two-story, long rectangular, International-style building with a stepped, flat roof with narrow band windows and an off center cantilever entry. The building sits on a concrete foundation, has concrete-block walls faced with stretcher bond yellow brick, and a build-up flat roof. The floors on the first floor and the lobby are vinyl asbestos (see Figure 4.160).

The test facilities were generally grouped into six test areas off Snake Hill Road, two were used especially by and for NARTS projects, and the others were leased to the private rocket company, Reaction Motors, Inc.. Test Areas A, B, and C, which were completed in 1947, and G were leased by RMI. NARTS used Test Areas D, E, and sometimes G. Areas R and S, which occupied 263 acres immediately north of the Navy test areas, were owned by RMI but were connected to areas A, B, C, and E by Lake Denmark Road (Redmond 1957; Figure 4.153). Navy Test Areas D and E have been determined eligible for the NRHP as districts by the New Jersey HPO (Guzzo 1999, 2004a).

Panamerican evaluated several buildings/structures associated with the Navy's rocket activities at Picatinny, including:

NARTS Area A (see Figure 4.96).

3504 (1945) Stored Rocket Fuel, Oxidizer, and Mono-propellant (Figure 4.154)

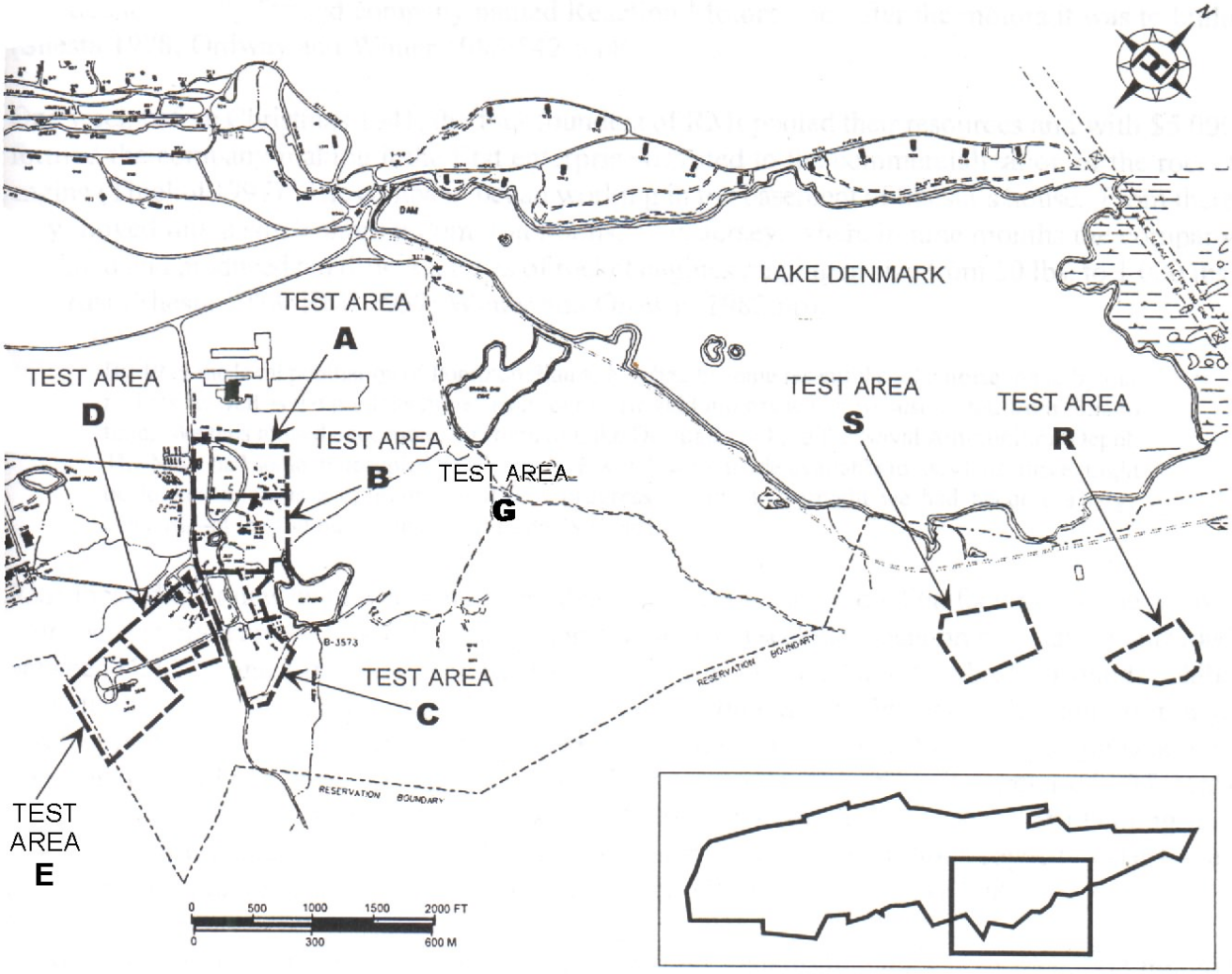

Figure 4.153. Former Test Areas A, B, C, D, E, G, R, and S, of NARTS (boundaries are general), Picatinny Arsenal, NJ *(base figure Picatinny DPW nd).*

Figure 4.154. Building 3504, Storage for Rocket Fuel, Oxidizer and Mono-propellant, RMI Area A, Picatinny Arsenal, NJ *(Panamerican 2007).*

Associated NARTS Buildings on Lower Belt Road (see Figure 4.96)

3403 (1944/1951)	W.M. Kellogg Laboratory (Figure 4.155)
3404 (1960)	Navy Laboratory 5 (Figure 4.156)

Associated NARTS Buildings on Snake Hill Road (see Figure 4.96)

3700 (1965)	Office/Storage (Figure 4.157)

Building 3403 (1944/1951), previously used as a chemistry laboratory, is found off Lower Belt Road. It is a rectangular, gable-roofed structure with a gable, entry portico at the northwest corner of the building. The building sits on a concrete foundation, has concrete-block walls, and a built-up roof. An addition was made in 1951 (see Figure 4.155).

Building 3404 (1960), previously used as a Navy laboratory, is situated off Lower Belt Road, and is a rectangular, gable-roofed structure. The building sits on a concrete foundation, has concrete-block walls, and a built-up roof (see Figure 4.156).

Building 3504 (1945), previously used as a maintenance building and originally as storage for rocket fuel, oxidizer, and mono-propellant, is found off Stillwell and Snake Hill roads. It is a rectangular, gable-roofed structure that sits on a concrete foundation, has metal walls, and a metal roof (see Figure 4.154).

Figure 4.155. Building 3403, W.M. Kellogg Laboratory, Navy laboratory associated with NARTS, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.156. Building 3404, Navy Laboratory 5, Navy laboratory associated with NARTS, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.157. Building 3700, the CSM Theodore R. Moran Recreational Area Office/Storage Building, Snake Hill Road, Former NARTS Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 3700 (1965), a storage facility and office off Snake Hill Road, is a rectangular, gable-roofed structure that sits on a concrete foundation, has transite walls, and a corrugated metal roof (see Figure 4.157).

4.3.3 History of NARTS. Although Picatinny Arsenal had long been involved in cutting edge military R&D projects, its sister installation, Lake Denmark Naval Ammunition Depot (NAD), had served the Navy simply as a storage facility since its inception on 24 February 1891. While the pace of its activities ebbed and flowed with peace and war, the depot was never involved in any special research until after World War II, 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 conducted in this small area would in many ways rival the best work ever done at PICA (Durant 1951:76; Baranowski 1959).

At the end of World War II, the Department of the Navy Bureau of Ordnance determined that Lake Denmark NAD, at one time the Navy's largest storage depot, was excess for then current needs, and started to deactivate the facility. However, the Bureau of Aeronautics (BuAer) recognized the opportunity to establish a centralized, East Coast rocket-engine test center with applications for naval aviation, and initiated steps to receive management control. After modifications to existing facilities, the U.S. Naval Aeronautical Rocket Laboratory (NARL) was established at Lake Denmark on 1 July 1948 with functions similar those of the Air Force's Rocket Test Facility at Muroc, California (now, Edwards Air Force Base). The Officer-in-Charge (OIC) of NARL reported to the Commanding Officer of NAD for command and BuAer for management. Its mission was the "evaluation and development of rocket engines and their

components" (NARTS 1950: Progress Report for January; Baranowski 1959). The first (and only) OIC of NARL was Commander Dayton A. Seiler, who served from 12 July 1948 to 1 April 1950.

Lake Denmark was selected as the site for the laboratory because the depot met the necessary criteria for a successful testing facility. The Navy had occupied the site since 1890s (as an ordnance depot) and had already invested in the facility's infrastructure for such items as roads, utilities, barracks, and potentially convertible warehouses. Lake Denmark 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 made the hiring of specialized personnel and the procurement of materials easier. Empty buildings could be easily adapted to rocket-testing functions, and the Navy had already leased a number of them to Reaction Motors Inc., the pioneer firm for the commercialization of rockets. Moreover, propellant-storage facilities, high-pressure inert gas storage, and test stands had been constructed by the Navy for the company. The site was close enough to Washington, D.C., for liaison with the Bureau of Naval Weapons (BuWeps) and the newly organized Department of Defense (DoD), as well as other East Coast rocket manufacturers (Seiler 1949; NARTS 1950: Project Report for January; Durant 1951:76).

Reaction Motors, Inc. (RMI), initially incorporated at Pompton Plains, New Jersey, in December 1941, worked closely with the Navy during the war, but required additional facilities to meet the accelerated demands of post-war jet engine development. The Navy offered the use of buildings and land formerly associated with the NAD ordnance battalion area for manufacturing shops and offices.

> The RMI administration area at the Naval Ammunition Depot's main gateway features two large buildings where research and development engineers and manufacturers produce rocket engines; in one building the engines are designed and models made; in the other, the approved designs are put in production. Nearby are separate buildings for the administration offices, cafeteria, security section and other facilities. The testing area, gleaming with the huge new power and supply plants, illustrates the rapid growth of [the] organization ... [RMI 1948:2-3].

By the middle of 1946 all of RMI's activities had been transferred to Lake Denmark, where a construction program for rocket test stands was underway (*The RMI Rocket* December 1951).

Scheduled for completion in December 1949, the construction of additional test facilities included one booster test stand of 100,000-lb. thrust capacity (Area D), and two test stands of 20,000-lb. thrust capacity. Plans for the renovation and expansion of the facility were included in the budget for the following year (Seiler 1949). NARL personnel comprised seven officers, 36 enlisted men, and 123 civilian employees. The earliest projects assigned to NARL, most of which were restricted or confidential, included the development of methods and equipment for testing liquid propellant rocket engines (project no. ARL PP-201); various applications as related to the LARK guided-missile rocket engine (ARL PP-202 and ARL PP-202.1); and the acceptance tests and evaluation of the XLR-18-K-2 booster assembly rocket (ARL PP-203 and ARL PP-203.1) (Seiler 1949; NARTS 1950: Progress Report for January).

In addition to testing and evaluation activities, the Navy found it desirable to actually provide test facilities at NARL for rocket engine contractors or other governmental agencies with inadequate or insufficient test facilities of their own. This was particularly true for engines with more than 10,000 lbs of thrust. As the thrust capacity of engines grew, the costs of construction for the test stand, tankage and instrumentation, which were costly to begin with, increased significantly making the

creation of large stands cost prohibitive for many companies. In addition, some companies were located so close to general habitation areas that the firing of very large engines was precluded because they were a public nuisance (Durant 1951). Prior to 1950, NARL had a number of temporary test stands that were made from Quonset huts. At these temporary stands the Navy had tested the rocket engines for the Douglas SKYROCKET, the Bell X-1 and the LARK. It also had a large test stand for the development of the 20,000-lb thrust VIKING engine, the Consolidated-Vultee MX-774, and for certain tests on the SKYROCKET. The large stand, called the Viking Stand, was originally built in 1946 for engines with a capacity of 6,000 lbs thrust and was later converted for 20,000 lbs thrust (NARTS 1950: Progress Report for January). These facilities would not be suitable for the testing rocket engines with larger thrust capacities.

On 1 April 1950, NAD was officially disestablished and NARL was redesignated the Naval Air Rocket Test Station (NARTS) under the command and coordination control of the Commandant, Third Naval District, and management control under BuAer. Its purpose was to test and evaluate rocket engines, components and propellants as well train service personnel in the handling, servicing and operation of rocket engines. All physical facilities of the former Lake Denmark depot were made a part of NARTS, but as a result of the large amount of ordnance still stored on site, a number of buildings were retained by the Bureau of Ordnance and the facility received the additional task of acting as an ordnance reserve stock point (Baranowski 1959).

In the early 1950s, the Navy undertook an extensive engineering study to create a master plan for the facility. The Navy requested $7,500,000 for the expansion and modernization of the existing test facilities; to purchase more land to better integrate their current holdings; to improve and standardize instrumentation; to provide for an underground propellant storage system; to create more housing; and to outfit specialized shops and laboratories (NARTS 1950: Progress Report for January; Durant 1951). NARTS began an expansion program that included the construction of Test Area E, a site for the testing of rocket engines up to 350,000 lbs thrust and which undertook a number of important research and design projects (NARTS 1951, 1952: various Monthly Progress Reports).

By 1952 RMI had constructed its main rocket engine test area at NARTS, operated under permit. The area contained an administration building, storage buildings as well as 17 test cells, which had maximum thrust operation ranging from 10,000 lbs to 50,000 lbs. Adjacent to RMI's test area, NARTS maintained four test cells and was planning what would become Test Area E. RMI also owned 237 acres adjacent to NARTS (RMI ca. 1953:15-16). At this time the Naval installation consisted of 760 acres and represented a multimillion-dollar investment. It was anticipated that the staff would double in the next decade. The facility's earliest work had been devoted primarily to liquid propulsion, but was beginning to include 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 these functions were 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" (NARTS ca. 1959).

As it evolved, NARTS had three major work categories: qualification tests, preliminary investigations, and technical services, all of which were included in its assigned mission (Durant 1951:76-77; Department of the Navy 1999a, 1999c; NARTS ca. 1959:np). 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 XLR 44-RM-2) and the engines on the Air Force SIDEWINDER. NARTS worked on a number of major preliminary investigations including: damage control of propellant oxidizers; variable thrust engine for spacecraft application; ultra high-density propellant systems; and the investigation of monopropellants as gas generates. Technical services were provided by the Rocket Propulsion Laboratory for the BuWeps, other government agencies and private contractors. These services included the development of specifications and procedures for mixed amines (i.e., 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, Inc., to name a few (NARTS ca. 1959, 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: Propellant, Rocket Engine, Engineering Services, and a more loosely organized Project Group. The Propellant Division was responsible for analytical chemistry and propellant evaluation as well as physical chemistry and propellant 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 (NARTS ca. 1959).

The military and civilian personnel who staffed NARTS in the mid-1950s held impressive credentials. Dr. John D. Clark, NARTS chief chemist from 1949 to mid-1950s, headed the Propellants Division. Clark, a Stanford Ph.D., is best known for the creation of new family of monopropellants 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. The Rocket Engine Division, which encompassed the Design, Shops, Test and Instrumentation Branches, was directed 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 Laboratory's technical director 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) (NARTS ca. 1959; Astronautix 2007).

The NARTS facilities began as a small liquid propellant 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 (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 RMI. Test Areas A, B, and C—completed in 1947— and G were leased by RMI. NARTS used Test Areas D, E and sometimes G. Test Area E, completed in 1953, was considered the "elite" among the many facilities at NARTS (NARTS ca. 1959; see Figure 4.153). 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 (NARTS ca. 1959). Areas

R and S, which occupied 263 acres immediately north of the Navy test areas, were owned by RMI but were connected to areas A, B, C, and E by Lake Denmark Road (Redmond 1957; see Figure 4.153).

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 (i.e., one that cooled its combustion chamber by the circulation of its propellants). 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 rocket (Ordway and Winter 1983:542-544; Shesta 1978).

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 BuAer of the Navy Department. After several successful test runs of the Wyld engine—and the bombing of Pearl Harbor—a contract was awarded to the newly formed company named Reaction Motors, Inc. after the motors it was to build (Shesta 1978; Ordway and Winter 1983:542-544).

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 1997). The company began working 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 lbs to 1,000 lbs of thrust (Shesta 1978; RMI 1957; Winter and Ordway 1982:np).

> By 1946 the local population of Pompton Plains, N.J. had become resentful of the noise made by our rockets, as well as the noxious fumes from our nitric acid motors which we also tested from time to time. We thus moved once more, this time to Lake Denmark, N.J., to the Naval Ammunition Depot. The Navy had some unoccupied buildings there which were made available to us. This move might be looked upon as a milestone in RMI's progress. Almost overnight we had become a large concern—at least in our estimation [Shesta 1978:np].

RMI located their new engine design and model construction and production facilities to the former ordnance battalion area at NAD. Engine testing occurred at a secluded location on a narrow dirt road between Hibernia and NAD. The new RMI site was situated "in a natural 'bowl' of surrounding hills, insulated by thousands of acres of Government property acquired specifically for ammunition storage and testing [and] provides one of the best areas on the Eastern seaboard for rocket engine testing" (Winter and Ordway 1982:np). Shortly after the company's relocation, it purchased 237 acres adjacent to the Navy-owned test area. By 1951, the Navy was in the process of planning and designing a new area at the renamed NARTS to test engines with a larger thrust capacity—Test Area E (Winter and Ordway 1982).

In November 1953, Mathieson Chemical Corp purchased a controlling interest in RMI, and merged with Olin Industries, Inc. in May 1954, forming the Olin Mathieson Chemical Corp. By the end of 1954 RMI had sales of $4.7 million and a work backlog of more than $7.5 million (Ordway and Winter 1983:549, 1985). By 1957, one year before it merged with Thiokol Chemical Corporation, RMI was organized into six divisions—Applications Engineering and Contracts, Project Engineering, Component Development, Production, Finance, and Administration—had sales of about $24.5 million dollars and employed 1,639 workers. Quality

control was conducted by a military inspector, while an in-plant BuAer representative served as RMI-DoD liaison (Thiokol 1997; Ordway and Winter 1983:549; RMI 1957). With a major interest in Flight Refueling, Inc., RMI had offices in Denville, New Jersey, Washington, D.C., Dayton, Ohio, and Los Angeles.

The principal work of RMI was the development and production of solid and liquid propellant rocket power plant (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 Reaction Motors 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 that was one of the most modern and complete rocket facilities in the United States. The 200,000-sq.ft. plant featured administrative offices, research activities and pilot production facilities. In addition, it maintained 150,000 sq. ft. of engineering, manufacturing and test facilities at the Lake Denmark Rocket Test Station (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 area 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 three large stands with capacities from 50,000 lbs 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; Redmond 1957).

The many engine test stands could hold complete rocket engine systems for simulated flight trials. Engine, propellant 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, and control rooms all constructed to permit the visual observation of items under test. The instrumentation areas operated under 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 playback system facilitated the analysis and evaluation of data (RMI 1957). The activities of RMI dovetailed with the mission of NARTS, which as stated in December 1956 was to "conduct tests and evaluation of rocket engines, their components and propellants," performed in support of technical research and development for BuAer (NARTS 1956). NARTS still served as a technical ordnance reserve stock point, an assignment, the document noted, not devoted to its R&D mission (NARTS 1956).

On 30 April 1958, RMI and Thiokol Chemical Corporation merged and RMI became a division within the company (i.e., Reaction Motors Division [RMD]). Thiokol had its beginning in 1926, when a serendipitous laboratory experiment created the world's first synthetic rubber. Three years later, in 1929, the Thiokol Chemical Corporation was formally created, 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 gun turrets, fuel tanks, and seams of all kinds. Scientists at Cal Tech's Jet Propulsion Laboratory discovered that Thiokol's polymer sealant made the best solid propellant fuel binder available at the time. Thiokol was suddenly in the rocket business (Thiokol 1997; Winter and Ordway 1982).

Thiokol opened its first small scale rocket operations in Elkton, Maryland, and by 1950 it had opened facilities at the U.S. Army's Redstone Arsenal, Huntsville, Alabama, in the old Redstone Ordnance Plant's production lines. In 1952, it won a contract to refurbish and operate the Longhorn Army Ammunition Plant in Marshall, Texas. By 1958, Thiokol had a contract with the

U.S. Air Force to build the first stage rocket motor for the revolutionary Minuteman ICBM at their Brigham City, Utah, rocket motor plant (Thiokol 1997).

On 14 October 1947, Chuck Yeager became the first human to break the sound barrier, flying the Bell X-1, powered by RMI's 6000C-4 engine (also known as the XLR-11 [its U.S. Air Force designation] and "Black Betsy") (Winter 1988:83-84; Winter 1994a, 1994b). In 1956, RMI was awarded the contract to develop the XLR-99 liquid rocket engine for eventual use in the X-15, the experimental hypersonic aircraft. Building on the knowledge gained from the XLR-11, the XLR-99 (also known as "the Pioneer") was the most powerful, most complex, and safest man-rated (i.e., 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 initial testing, including test firings, of that engine was conducted at Lake Denmark, much to the displeasure of the local residents (*The Citizen* 1958-1960; NARTS ca. 1959; Winter 1987:410). Tested in NARTS Test Area E, which RMI leased from the Navy, the XLR-99 was used for the X-15, a joint NACA, Navy, and Air Force project (Thiokol 1997; 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).

Conceptualized and constructed between 1951 and 1953, Test Area E was considered by the Navy to be its premier rocket-engine testing area upon its completion. NARTS engineers completely designed the original plan for the test area in consultation with RMI. 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, which also had offices in Washington, D.C. The development of Test Area E project was considered one of the major accomplishments of the NARTS engineering staff. When the test stand was first put into use it was one of the largest static test stands on the East Coast (NARTS ca. 1959).

Aside from the testing of the XLR-99 motor, NARTS had already established an impressive record of notable contributions to rocket engine and propellant 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 propellant performance calculation

The brochure advertising these accomplishments quickly added that these were just the ones "that can be named" publicly (NARTS ca. 1957). Further research would probably uncover a host of then highly classified NARTS achievements.

Despite the success of RMI/RMD and the accomplishments of NARTS, the Naval Air Rocket Test Station, Lake Denmark was disestablished on 1 August 1960, and the facilities reverted to the U.S. Army for incorporation into Picatinny Arsenal. Navy liquid propellant rocket development projects were transferred to the Naval Ordnance Test Station, China Lake, California, the Naval Propellant Plant, Indian Head, Maryland, and the Naval Weapons Laboratory, Dahlgren, Virginia (Department of the Navy 1999c). The Thiokol Chemical Corporation later leased the entire Lake Denmark Test Area. A *Test Facilities Data Book* prepared by Thiokol (Edson 1962) provides an excellent overview of all of the facilities there at that time. This volume was intended for use by the test area operating personnel, engineering and management personnel of RMD, other divisions of Thiokol, and industrial companies interested in using the facilities (Edson 1962).

During the mid-to-late 1960s, the Denville RMD plant experienced declining business as a result of changes in the rocket industry, especially the switch from liquid to solid propellants. Efforts were made to retool the plant and to undertake new, more profitable projects. However, by 1970, the Denville office was phased out and with a complete shutdown of all activities occurring by 1972 (Walker 1970). RMD's location undermined its ability to attract clients, such as NASA, which sought to build larger and more powerful rocket engines. Although the Lake Denmark area was secluded and isolated in 1949, population trends of the period (i.e., suburban sprawl) less than ten years later produced the same problems for RMD that afflicted RMI at Pompton Plains during World War II: complaints from area residents about noise and damage from shock waves. Moreover, the New Jersey State Supreme Court ruled that Thiokol Chemical Corporation, as RMD's parent, was liable for property damage caused by the testing of the X-15 engine (Winter 1987:415). The company that began by developing JATO engines and motors for America's first missiles (the LARK and GORGON) and engines or propulsion systems for the VIKING rocket, the Bell X-1, the MX-774, the Republic XF-91, the Rocket-on-Rotor (ROR) for the HRS-2 helicopter, the North American X-15, the BULLPUP, CORVUS, and CONDOR missiles, and the SURVEYOR spacecraft control system, discontinued work in the liquid propulsion field by 1970 and ceased operations less than two years later (Shesta 1978; Ordway 1985, 1987). The rocket test areas of the Lake Denmark site were abandoned to the Army and have been largely unused since.

Test Area A. Practically from its inception, the Navy rocket program was tied to Reaction Motors, one of the Navy's earliest rocket contractors. When the Navy decided to open the NARL, later NARTS, facility, it was a given that RMI would be intimately involved in the Navy's rocket program on the East Coast. Therefore, it is no surprise that NARTS leased property to RMI from the beginning. The former leased testing areas are located on the north side of Snake Hill Road in a relatively isolated part of the former Lake Denmark Depot. While the Navy retained exclusive control of Area D, and Areas E and G were essentially Navy sites that could be used by private-sector companies, Areas A, B and C were, from the beginning, associated almost exclusively with RMI/RMD (see Figure 4.153).

Test Area A was essentially a grouping of eight test stands, designed primarily for testing liquid propellant rocket engines up to 10,000 lbs thrust (NARTS ca. 1959). Area A comprised approximately 26 buildings and structures that, aside from the eight test stands, included a photography laboratory, welding shop, maintenance shop, magazines, a boiler house, and a number of other offices and laboratories (PICA 1969). At the time of the investigation, only five of those structures remain. The building surveyed for this report was 3504, a storage building for rocket fuel, oxidizer and mono-propellant (see Figure 4.154).

Although the work of RMI/RMD was essential to the creation of the military's current rocket program and much of that early work was performed in Area A, the area is now a jumble of concrete foundation pads and a few remaining, poorly maintained buildings scattered along a number of ill-defined dirt roads. Area A has lost it integrity and its few remaining buildings, therefore, cannot be eligible for the NRHP. Building 3504 is not individually eligible for the NRHP, and there are no landscapes associated with this building.

NARTS Area along Snake Hill Road. One building was surveyed in the NARTS area along Snake Hill Road but not in clearly defined test area: Building 3700 (see Figure 4.157). This is a solitary building now associated with a trailer park. It has no architectural or historical significance and as a consequence is not eligible for the NRHP.

NARTS Buildings off Lower Belt Road. Building 3403 and Building 3404, old Navy #706, were erected by the Navy in 1944 as a Station Brig and Laundry Maintenance Shop, respectively (see Figures 4.155 and 4.156). They were part of a cluster of five buildings, numbered 3401 through 3405, which served as service and support buildings for the Marine Barracks Area, located in the 3400 area off Lower Belt Road. These service buildings were constructed on concrete slabs, have concrete-block walls and front gable roofs covered in strip shingles. They are typical of World War II base operations buildings that every installation needs in order to complete its mission and, as such, have no particular military significance. Since they were associated with support of a barracks area, they were probably built using standardized plans.

During the 1950s and 1960s, Building 3404 served as a Propellants Test Laboratory for RMI/RMD and was also known as the W.M. Kellogg Laboratory for special projects. It was surrounded by a "Plastecs" (sic) Tech Evaluation Center (Building 3401), a Liquid Propellants Laboratory (Building 3402), a Rocket Propulsion Laboratory (Building 3403), and a Boiler House and Bunker (Building 3405) (PICA 1969). Building 3403, known as Navy Laboratory 5, also served as a chemistry laboratory. It is unclear exactly what activities occurred within these buildings, but the most important work of RMI/RMD was conducted in Test Areas A, B, C, G, and later R and S. Since Building 3404 and 3403 have no military significance and were most likely built using standardized plans, they fail to meet the NRHP criteria and are, therefore, not eligible for the NRHP. There are no landscapes associated with any of these former NARTS buildings.

4.4 MISCELLANEOUS TESTING BUILDINGS

On an installation such as Picatinny, there are various testing facilities that are not associated with particular industrial complexes or projects. These facilities can be extremely simple or highly complex; nevertheless, they are used across the board for a large number of activities and program components. Miscellaneous testing buildings at Picatinny include:

72 (1962)	Safe Shelter (Figures 4.158 and 4.159)
92 (1964)	Ramsey Building, Quality Evaluation Laboratory (see Figure 4.62; Figure 4.160)
178 (1956)	Chemistry Laboratory (Figures 4.161 and 4.162)
1222 (1946)	Electronic Equipment Shelter (Figures 4.163 and 4.164)
3109 (1945)	Environmental Testing Building, former Navy building (Figures 4.165 and 4.166)
3144 (1968)	Drop Tower (Figure 4.167)

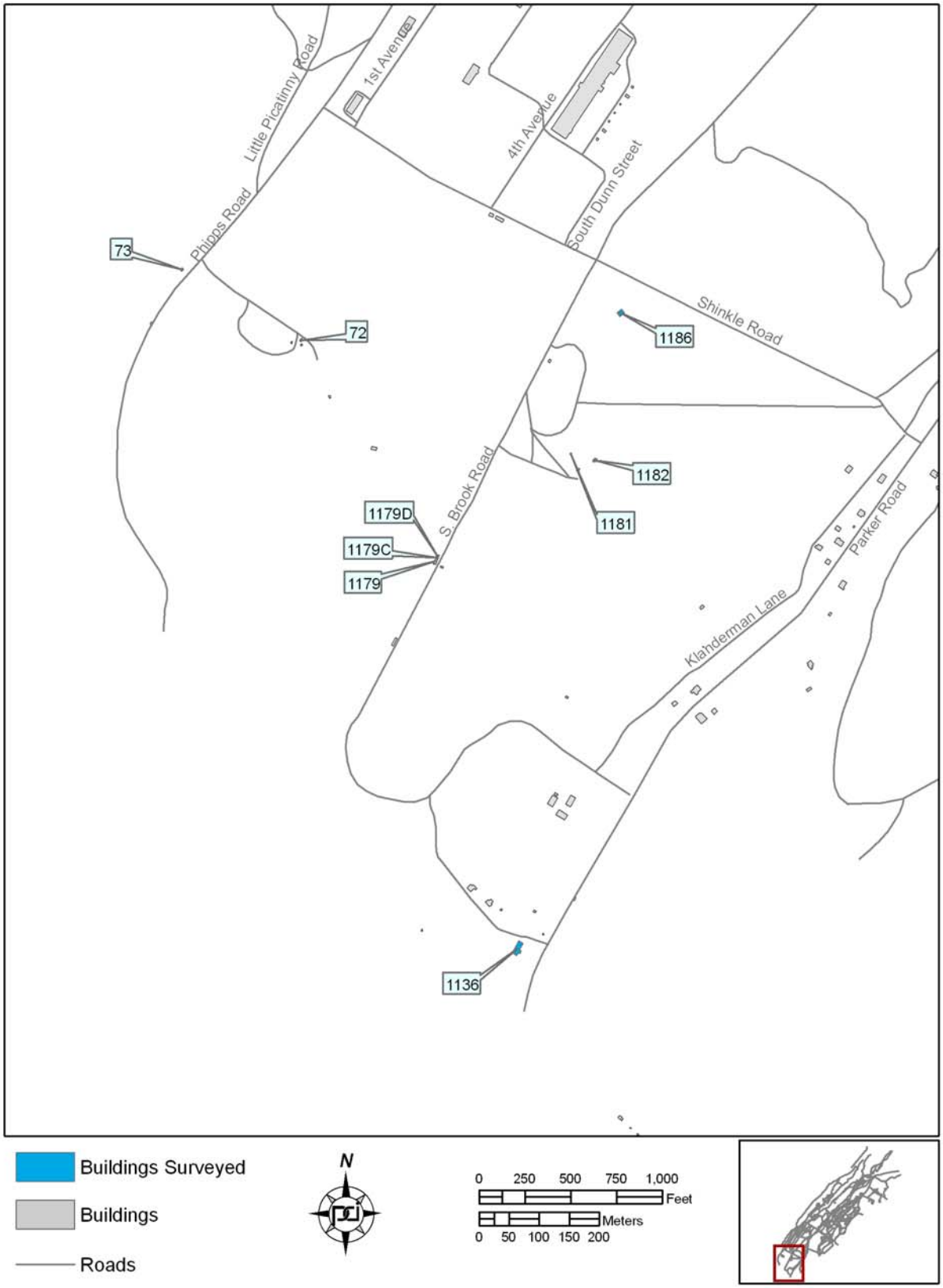

Figure 4.158. Locations of Buildings 72, 73, 1136, 1179, 1179C, 1179D, 1181, 1182, and 1186, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.159. Building 72, Safe Shelter, Pyrotechnic Test Range, off Horney Road, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.160. Building 92, the Ramsey Building, Quality Evaluation Laboratory, 90 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

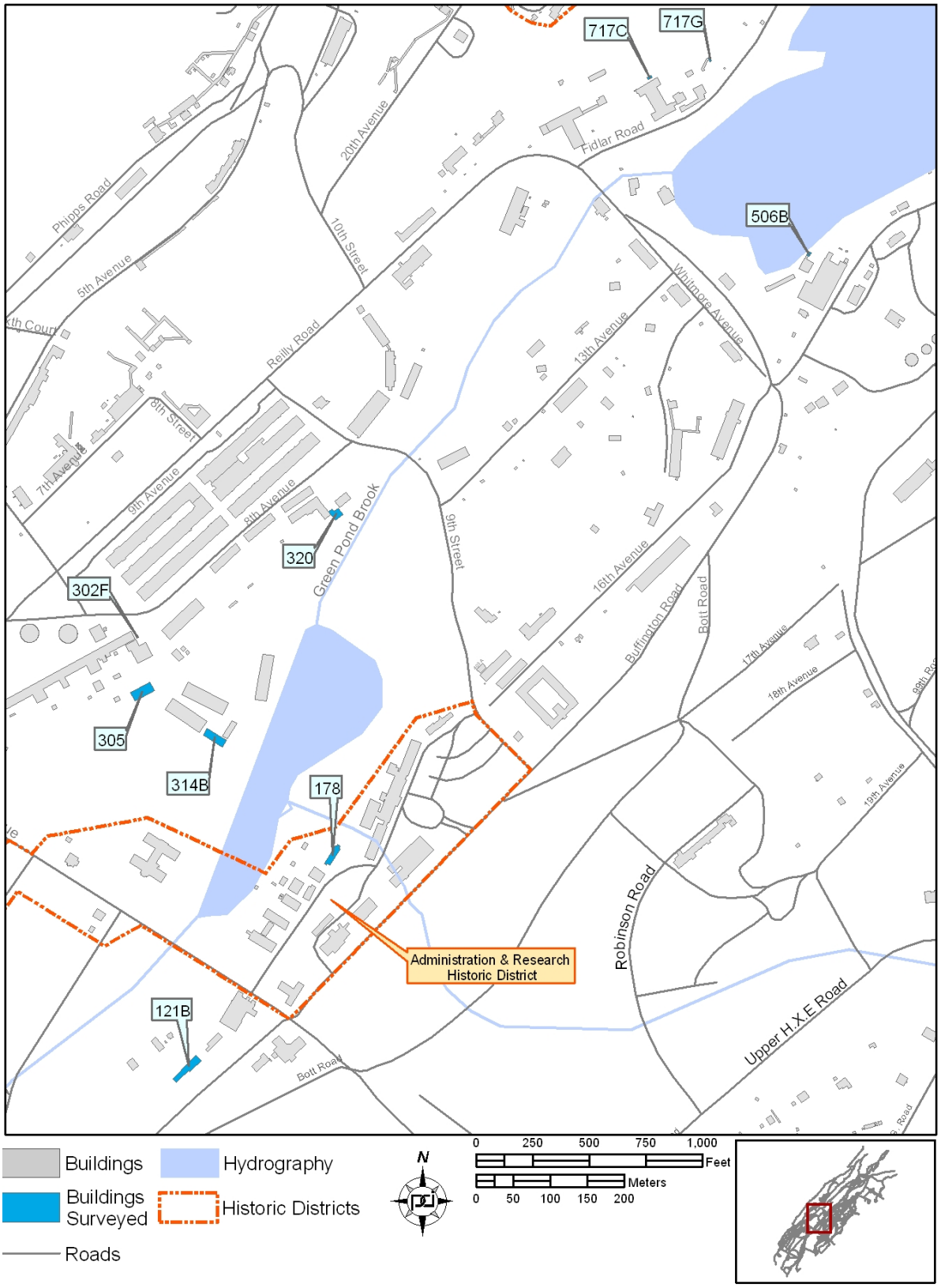

Figure 4.161. Locations of Buildings 121B, 178, 302F, 305, 314B, 320, 506B, 717C, and 717G, and the Administration & Research Historic District, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.162. Building 178, Chemistry Laboratory, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.163. Building 1222, Electronic Equipment Facility, Gorge Testing Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

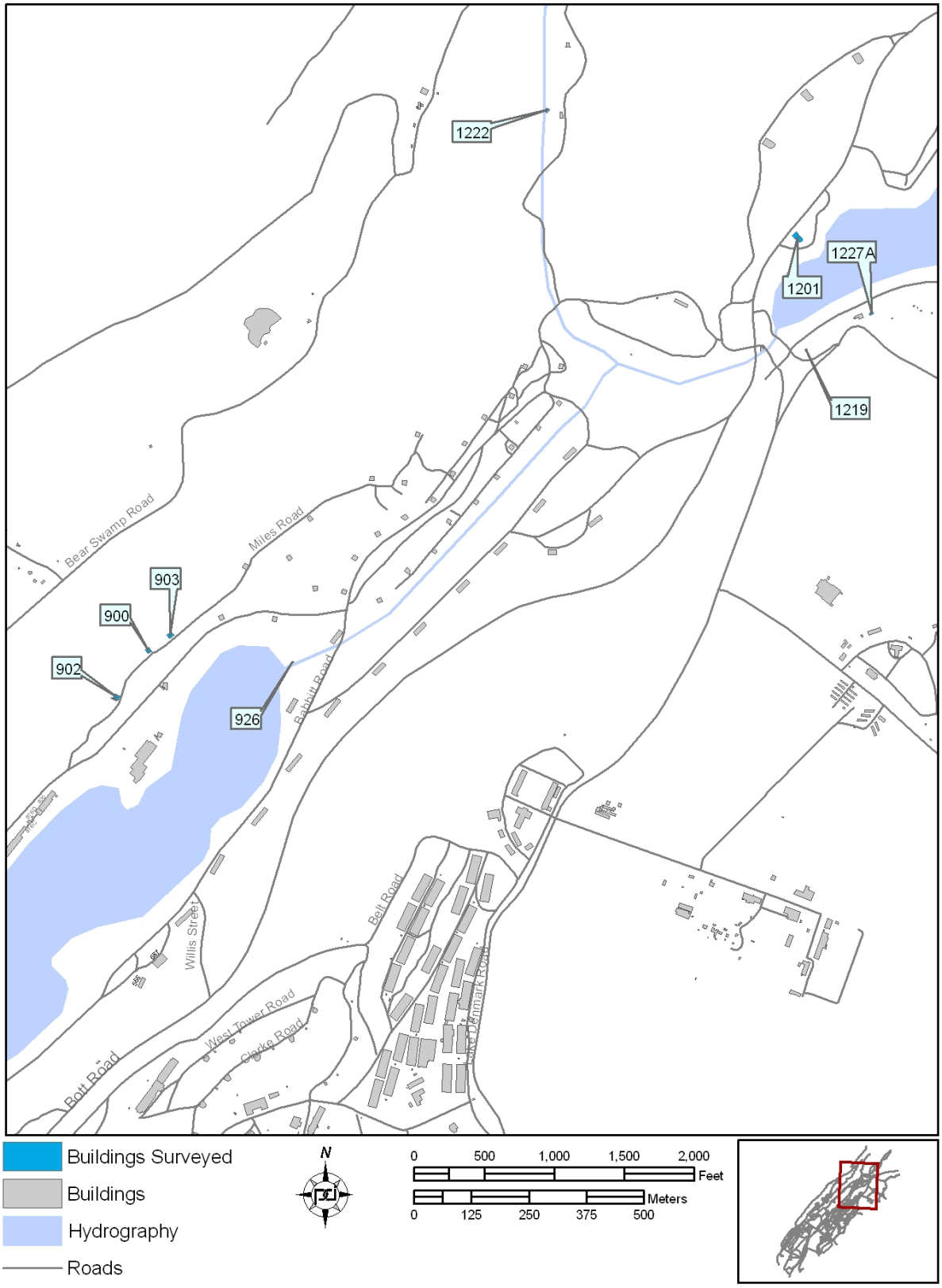

Figure 4.164. Locations of buildings surveyed in the 900 Area and 1200 Area, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

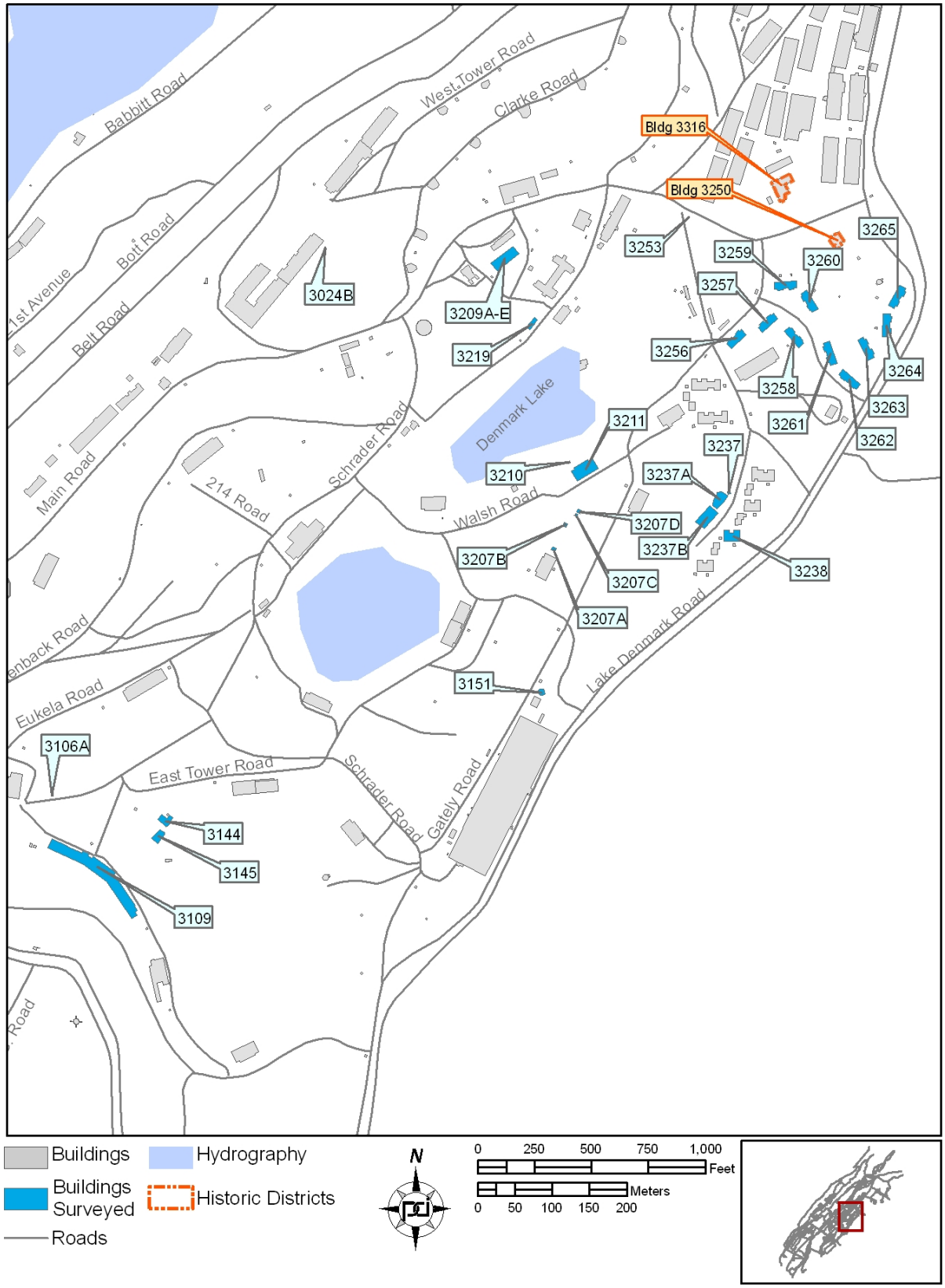

Figure 4.165. Locations of buildings surveyed in the 3100 Area and 3200 Area, and NRHP-listed Buildings 3250 and 3316, Picatinny Arsenal, NJ *(base map: Chugach Industries, Inc. 2007).*

Figure 4.166. Building 3109, Environmental Testing, former Navy Facility, 3100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.167. Building 3144, Drop Tower, 3100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.168. Buildings 3145, Drop Tower Ordnance Complex, 3100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

3145 (1968)	Drop Tower Ordnance Facility (Figure 4.168)
3145A (1968)	Drop Tower HE Magazine
3207A (unknown)	E3, Fuze Division Storage (see Figure 4.165; Figure 4.169)
3207B (unknown)	E3, Fuze Division Storage (Figure 4.170)
3207C (unknown)	E3, Fuze Division Storage, derelict (Figure 4.171)
3207D (unknown)	E3, Fuze Division Storage (see Figure 4.171)

Building 72 (1962), a safe shelter off Horney Road at the southwestern end of the installation, is a rectangular, shed-roofed structure with a shelter bay. It sits on an earth foundation, has railroad-tie walls, and a ¼-inch thick steel roof. Building 72 is associated with a derelict firing range on the main post. It is a fairly typical structure, created from found materials and used to shelter individuals firing munitions on the range. The range looks seldom used, especially since it is located so near a sentry point on the main installation. The safe shelter has no historical or architectural significance and, therefore, is not eligible for the NRHP (see Figures 4.158 and 4.159).

Building 92 (1964), a multifunction building housing a physics laboratory, administration offices and R&D product assurance, is located off Ramsey Avenue. Identified as the Ramsey Building, it is a two-story, long rectangular, International-style building with a stepped, flat roof with narrow band windows and an off center cantilever entry. The building sits on a concrete foundation, has concrete-block walls faced with stretcher bond yellow brick, and a build-up flat roof. The floors on the first floor and the lobby are vinyl asbestos (see Figure 4.160).

Figure 4.169. Building 3207A, E3, Fuze Division, Storage, 3200 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.170. Building 3207B, E3, Fuze Division, Storage, 3200 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.171. Building 3207C and 3207D, both derelict, E3, Fuze Division, Storage, 3200 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 178 (1956), previously used as a physics and chemistry laboratory, is found off of Kibler Road. It is a long, rectangular, gable-roofed structure with a shed-roof addition. Five sets of double doors adorn the eastern elevation. The building sits on a concrete foundation, has hollow tile walls, and a corrugated galvanized iron roof. Building 178 is situated on the edge of the Administration and Research Historic District, but is not a part of that district (Nolte et al. 1999b). The building style and materials are typical for the period and could have housed any number of activities. The Chemistry Laboratory is not architecturally or historically significant, and is not eligible for the NRHP (see Figures 4.161 and 4.162). It is, however, located in the Administration and Research Historic District, and a non-contributing element to that district.

Building 1222 (1946), previously used as an electrical equipment facility off Gorge Road Testing Area, is an L-shaped, flat-roofed structure with two sets of double doors on the south facade. The building sits on a concrete foundation, has concrete and steel walls, and a concrete roof. The building has a railroad-tie blast wall. Building 1222 a standard building found on most testing ranges, and can be found on most of Picatinny's test ranges (see Figure 4.163).

Building 3109 (1945), previously used as an ordnance facility, environmental testing facility, and ammunition packing building, is located off Woods Road. It is a long, rectangular, gable-roofed structure with several additions. The building sits on a concrete foundation, has concrete walls, and a corrugated asbestos build-up roof. The environmental testing building is left over from the Navy, and is a typical laboratory space like many on the installation. It has no architectural or historical significance, and is not, therefore, eligible for the NRHP (see Figure 4.166).

Building 3144 (1968) is a drop tower off Drop Tower Road. The structure is set on a concrete foundation with a steel frame (see Figure 4.167)

Building 3145 (1968), an ordnance facility off Drop Tower Road, is a T-shaped, flat-roofed structure with a garage bay and double entrance doors. The building sits on a concrete foundation, has concrete and AMP walls, and a build-up roof (see Figure 4.168)

Building 3145A (1968), a magazine and part of the drop tower complex off Drop Tower Road, is not visible from the road. According to Real Property records, the building sits on a concrete foundation, has frame walls, and a build-up roof.

Buildings 3144, 3145, and 3145A are located in an isolated section of the installation. The 100-foot tower (3144) is surrounded by at least two buildings (3145 and 3145A). Picatinny operates another drop tower in the 600 Historic District, which was used for testing ammunition. It is unclear exactly how Tower 3144 was used since it is on the main installation and explosives testing has generally moved to the 600 Area. Components and other parts of systems could be tested here and it is possible that small amounts of munitions are also tested here. The drop tower and its associated buildings have no architectural or historical significance, and are not, therefore, eligible for the NRHP.

Building 3207A (unknown), use unknown but probably storage, is located off Walsh and Black Swamp roads. It is a rectangular, gable-roofed structure with a shed-roof entry portico located behind a chain-link fence. The building sits on a wood foundation, has wood walls, and a shingle roof (see Figure 4.169).

Building 3207B (unknown), use unknown but probably storage, is found off Walsh and Black Swamp roads. It is a rectangular, gable-roofed structure located behind a chain-link fence. The building sits on a wood foundation, has wood walls, and a shingle roof (see Figure 4.170).

Building 3207C (unknown), use unknown but probably storage, is located off Walsh and Black Swamp roads. The building is a rectangular, shed-roofed structure that sits on a wood foundation, has wood walls, and a shingle roof (see Figure 4.171)

Building 3207D (unknown), use unknown but probably storage, is situated off Walsh and Black Swamp roads. Found behind a chain-link fence, the building is a rectangular, shed-roofed structure that sits on a wood foundation, has wood walls, and a shingle roof (see Figure 4.171).

Four buildings, 3207A through 3207D, are associated with the Electromagnetic Environmental Effect (E3) Facility, Fuze Facility. E3 provides full spectrum capabilities for the evaluation of electromagnetic effects susceptibility of munitions, weapon systems, subsystems, and engages in R&D, development and production. The E3 team works with the Army, Tri-Service, NATO, and industry organizations in developing standards for certifying the safety and reliability of weapons and installations from electromagnetic effects (E3, Fuze Division 2007). The facility itself provides a wide range of testing capabilities, including electromagnetic pulse tests, non-fire and all fire explosive Bruceton and Langley sensitivity tests, high voltage testing, and triboelectric or P-static test (ARDEC 2007).

Nevertheless, all of the buildings surveyed in the E3 Fuze Facility appear to be small wooden storage sheds, two of which are derelict. They hold no important machinery and are incidental to the actual work of the facility. They have no historical or architectural significance and as such are not eligible for the NRHP. None of the miscellaneous testing buildings are eligible for the NRHP.

4.5 AMMUNITION AND EXPLOSIVES/GENERAL STORAGE FACILITES

In 2007, the U.S. Army and the Advisory Council on Historic Preservation (ACHP) issued a Programmatic Comment covering the management of ammunition storage facilities based on the context developed in *Army Ammunition and Explosives Storage in the United States: 1775-1945* (Murphey et al. 2000). This programmatic approach to the National Historic Preservation Act, Section 106 compliance is allowed through a Program Alternative (36CFR 800.14), in this case a Programmatic Comment in the form of an ammunition and explosives storage context. Although the context dates range from 1775 to 1945, the context does discuss the Cold War and storage issues related to that period. Panamerican used this context during its evaluation of ammunition and explosives storage structures surveyed at PICA. In order to fully discuss certain aspects of ammunition and explosives storage, buildings are grouped together and discussed as a component of a particular aspect of storage.

The buildings surveyed, grouped by geographic location, are:

67 (1953/1956)	Flammable Materials Storehouse (see Figure 4.62; Figure 4.172)
70 (1949)	Igloo (see Figure 4.62; Figure 4.173)
71 (1948)	Igloo (see Figure 4.62; Figure 4.174)
302F (1956)	Post Engineer Storehouse (see Figure 4.161 and Figure 4.175)
305 (1945/1956)	Storehouse, derelict (see Figure 4.161 and Figure 4.176)
314B (1958)	Storage (see Figure 4.161 and Figure 4.177)
717C (1941)	Magazine (see Figure 4.161 and Figure 4.178)
717G (1943)	Magazine, derelict (see Figure 4.161 and Figure 4.179)
900 (1950)	Magazine/Rocket Propellant Surveillance Laboratory (see Figure 4.164; Figure 4.180)
902 (1950)	Magazine, High Temperature Test Facility, derelict (see Figure 4.164; Figure 4.181)
903 (1950)	Magazine (see Figure 4.164; Figure 4.182)
926 (1956)	Igloo (see Figure 4.164; Figure 4.183)
1186 (1966)	Open Storage Shed, derelict (see Figure 4.158; Figure 4.184)
1201 (1948)	Igloo with Nuclear Adaptations (see Figure 4.164; Figure 4.185)
3106A (1966)	HE Magazine (see Figure 4.165; Figure 4.186)
3211 (unknown)	Warehouse (see Figure 4.165; Figure 4.187)

Building 67 (1953/1956), a storage facility off First Avenue, is a rectangular, gable-roofed structure with open side, covered storage at one end. The building sits on a concrete foundation, has concrete-block walls, and a corrugated asbestos roof. An addition was made in 1966 (see Figure 4.172).

Building 70 (1948) is an igloo off Fourth Avenue. It sits on a concrete foundation, has concrete walls and roof that are earth fast (see Figure 4.173).

Building 71 (1948) is an igloo off Fourth Avenue. The building sits on a concrete foundation, has concrete walls and roof that are earth fast (see Figure 4.174).

Building 302F (1956), previously used as a post engineer storehouse, is found off Eleventh Avenue. It is a rectangular, gable-roofed structure with a sliding door bay and a side, double door entry. The building sits on a concrete foundation, has galvanized iron walls, and a corrugated asbestos roof (see Figure 4.175).

Figure 4.172. Building 67, Flammable Materials Warehouse, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.173. Building 70, Igloo, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.174. Building 71, Igloo, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.175. Building 302F, Post Engineer Storehouse, 300 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.176. Building 305, Storehouse, derelict, 300 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.177. Building 314B, Storage, 300 area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.178. Building 717C, Magazine, 700 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.179. Building 717G, Magazine, derelict, 700 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.180. Building 900, Magazine/Rocket Propellant Surveillance Laboratory, 900 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.181. Building 902, Magazine, High Temperature Laboratory, derelict, 900 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.182. Building 903, Magazine, 900 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.183. Building 926, HE Magazine, Igloo, 900 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.184. Building 1186, Open Storage Shed, derelict, 1100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.185. Building 1201, Igloo with possible nuclear adaptations, 1200 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.186. Building 3106A, HE Magazine, 3100 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.187. Building 3211, Warehouse, 3200 Area, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 305 (1945/1956), previously used as a maintenance shop, storehouse and ice-making building, is situated off Twelfth Avenue. It is a rectangular structure with a rectangular, side ell gable with a gabled roof. A shed-roof covered walkway extends from the main bay. The building sits on a concrete foundation, has framed walls, and a roll roof. An addition was added in 1956 (see Figures 4.161 and 4.176).

Building 314B (1958), a storage facility off Twelfth Avenue, is a long, rectangular, gable-roofed structure with a garage bay and entrance through the gable end. On the long end are double sliding doors. The building sits on a concrete foundation, has corrugated iron walls, and a corrugated metal roof (see Figures 4.161 and 4.177).

Building 717C (1941/1967), a general purpose magazine located off Fidlar Road, is a rectangular, shed-roofed structure. It sits on a concrete foundation, has concrete-corrugated galvanized walls, and a corrugated asbestos roof (see Figures 4.161 and 4.178).

Building 717G (1941) was previously used as a general purpose magazine. Located off Fidlar Road, it has been reduced to a rectangular concrete foundation (see Figures 4.161 and 4.179).

Building 900 (1950) was previously used as a general purpose laboratory, surveillance test conditioning chamber magazine, and a rocket and rocket propellant surveillance laboratory. Found off Miles Road, it is a one-story, rectangular, gable-roofed structure with a central interior blast wall extending above the roofline. The building sits on a concrete foundation, has 8-inch hollow tile walls, and a corrugated asbestos roof. Renovations occurred in 1955 (see Figures 4.164 and 4.180).

Building 902 (1950) was previously used as general purpose laboratory, surveillance test conditioning chamber magazine, and a high temperature test facility. Located off Miles Road, the building is a one-story, rectangular, gable-roofed structure with a cement side addition with blast walls. There is a covered walkway on the south façade. It sits on a concrete foundation, has hollow tile walls, and a corrugated galvanized roll roof. To the west of the structure is a railroad-tie and sandblast wall. Renovations occurred in 1955 (see Figures 4.164 and 4.181).

Building 903 (1950), previously used as a general purpose laboratory, surveillance test conditioning chamber and magazine, is situated off Miles Road. It is a one-story rectangular, gable-roofed structure with a central interior blast wall extending above the main roof line and a shed-roof covered walkway. The building sits on a concrete foundation, has 8-inch hollow tile walls, and a corrugated galvanized steel roof (see Figures 4.164 and 4.182).

Building 926 (1956) is an igloo off Cave Street. It sits on a concrete foundation, has concrete walls and roof that are earth fast (see Figures 4.164 and 4.183).

Building 1186 (1966), a storage building off Green Pond Brook Road, is a rectangular, shed-roofed structure with three open storage bays. The building sits on a dirt foundation, has wood walls, and a metal roof (see Figures 4.158 and 4.184).

Building 1201 (1948) is an igloo off Twenty-Fifth Avenue and is barricaded with a steel cage on a timing device. This structure may be a nuclear igloo. The building sits on a concrete foundation, has concrete walls and roof that are earth fast (see Figures 4.164 and 4.185).

Building 3106A (1966), a high explosives magazine off Battalion Road, is a small, rectangular, flat-roofed structure that sits on a concrete foundation, has frame walls, and a build-up roof (see Figures 4.165 and 4.186).

Building 3211 (unknown), a warehouse off Walsh Road, is a rectangular, gable-roofed structure that sits on a concrete foundation, has brick walls, and an asbestos shingle roof (see Figures 4.165 and 4.187).

Igloos. After the 1926 explosion at the Lake Denmark Naval Depot, now part of Picatinny Arsenal, both the Army and Navy began to seriously review ammunition storage practices. By 1931, the Army Ordnance Department issued a safety manual detailing five types of ammunition and explosives storage structures. Each type had size and distance requirements appropriate to the munitions it stored. These structures included:

- explosives magazines that stored up to 250,000 pounds of bulk explosives including black powder, TNT, tetryl, and explosive D;
- smokeless powder magazines that stored up to 500,000 pounds of powder in boxes, or a slightly less poundage of propelling charges, all of which required protection from moisture and high temperatures;
- primer and fuzes magazines for the storage of primers, primer detonators, adapters, boosters, and fuzes;
- ammunition magazines for the storage of loading shells and shrapnel; and
- ordnance warehouses, similar to commercial warehouses, for the storage of small arms ammunition, sodium nitrate, and other nonexplosive materiel (Murphey et al. 2000).

The most notable consequence of the Lake Denmark explosion was the creation of the “igloo,” so termed because of its likeness to Inuit housing. The igloo magazine is a low, barrel-arched structure made of reinforced concrete and covered in earth. The barrel-arch design directs an explosion up and not out and the berming of the structure dampens the explosion’s force. Although the floor of the igloo is at or slightly above natural grade, the igloo is considered underground because of the earthen berm (Murphey et al. 2000).

The Navy began testing the new igloo design in July 1928 and, by the end of that year, the first igloos were constructed at the Yorktown Naval Depot, Virginia. The first entirely modern ammunition depot to house twentieth-century explosives and propellants was the Naval Ammunition Depot, Hawthorne, Nevada, construction of which began in 1928 and was completed in 1931.

The Army, too, began testing and building igloo designs in 1928 with its first igloos constructed at the Savanna Ordnance Depot, Illinois. By the beginning of World War II, the Army settled on four igloo designs with the Standard Army Igloo (Underground Magazine Igloo, Type 49) being the progenitor of the other three variations, which included the triple barrel vault, the New Depot, and the Huntsville designs. The standard igloos typically feature fully reinforced arch and walls, a full concrete headwall, and vents. Different types of doors could be added (Murphey et al. 2000).

The igloo underwent a number of important modifications after World War II. By the late 1950s, Black and Veatch Constructing Engineers designed an igloo, the Stradley Magazine, for the

storage of special (nuclear) weapons. A few standard igloos were converted into Stradleys by modifying the front wall, and igloos were modified with refrigerators for chemical or biological weapons storage. Igloo-type magazines continued to be used and built through the 1980s. At that time, a revised plan for igloos was developed that called for less construction material and less land. The majority of the magazines currently in use in the United States are igloos or an igloo-derived type magazine (Murphey et al. 2000). Igloos at Picatinny surveyed included: Buildings 70 (1949), 71 (1948), 926 (1922), and 1201 (ca. 1944).

With the exception of Igloo 1201, the igloos at PICA are typical. However, Igloo 1201, according to blueprints, appears to have been modified for possible use with a proposed "swimming pool" nuclear reactor. A timed set of gates and other improvements were made to it (see Figure 4.185).

On 16 July 1945, the nature of warfare changed forever when the scientists working on the Manhattan Project exploded "Gadget," an atomic bomb, at the Trinity Site in Alamogordo, New Mexico. Just three weeks after the Trinity test, the Army Air Forces dropped two atomic bombs on Japan, one on Hiroshima and the other on Nagasaki, bringing an end to World War II. The United States had devised the most destructive means of war ever created (Gaither 1997). After the war and for the next half century, the Soviet Union and the United States raced to improve and stockpile nuclear weapons, menacing each other with the potential of nuclear warfare. The race expanded to include other countries and continues to threaten the world. Picatinny Arsenal was closely associated with the development nuclear weapons throughout the Cold War. "Nuclear weapons are perhaps generally thought of as the single most important, and the most defining element of the Cold War…making these weapons and the places associated with their development extremely significant" (Gaither 1997:100).

PICA was involved in early atomic-weapons development and its role continued to expand through the period into the 1980s. On 25 May 1953, the world's first atomic artillery shell was fired on the Las Vegas Proving Ground, and Picatinny Arsenal took pride in this accomplishment since its engineers and scientists had developed it. Picatinny received the mission to develop an artillery shell capable of carrying a nuclear payload in 1949. Basically, this meant scaling a 240mm shell, the Army's largest field artillery shell in World War II, up to 280mm (Owens 2003b).

The deployment and logistics of creating this shell were worked out by Bob Schwartz, a young ordnance-design engineer at PICA, who was locked in a Pentagon office until he came up with a plan (Diehl 1953). Development of this shell established Picatinny's nuclear credentials and led directly to PICA's designation in the 1970s as the commodity center for nuclear munitions. By 1974, the arsenal was home to the Large Caliber and Nuclear Munitions Center, which was responsible for research, development and engineering of nuclear munitions (Gaither 1997).

By the early 1970s many of PICA's major functions were related to nuclear weapons development. The first major function was to conduct research, development, testing, and evaluation with respect to assigned material, and to perform special research into the fields of nuclear weapons, energetic materials, munitions/ammunition, strafing, arming and fuzing, and non-metallic materials. It also was tasked with the performance of in-house fabrication and pilot-plant manufacture of prototypes and reproduction evaluation quantities, including nuclear weapons. Moreover, Picatinny was to provide technical support to, and membership in, the Army Nuclear Weapons System Safety Committee and to operate the Department of the Army's repository of drawings and information pertinent to nuclear components received from the Atomic Energy Commission and its contractors. PICA was tasked with national procurement of

nuclear weapons as well as the storage and the evaluation of the degradation of stored nuclear materiel (Kaye 1978).

Nuclear weapons ammunition, components, and devices (i.e., bombs) were developed and produced in a complex of buildings known as the Special Weapons Plant (Buildings 95, 18, 19, 20 and 21), which was overseen by the Nuclear Engineering Directorate (Kaye 1978; Owens 2003c). In 1960, PICA erected Building 95, the Bell Laboratory, to consolidate its many nuclear activities. The special weapons area was fenced and strict security measures were in place at all times. Remnants of the special turnstile gate through which employees entered this area are still extant near Building 18 (Owens 2003c). The heart of the arsenal's nuclear work was conducted within this area.

PICA was responsible for the development of a number of important shells and warheads during the Cold War. These included the 280mm atomic shell that led to the development of other sizes of nuclear shells, including an 8-inch shell capable of being fired by both Army and Navy guns. At the time, it was the smallest nuclear ammunition package ever created and was the first shell of any kind to use titanium, a super lightweight, high-strength metal (Kaye 1978).

Nuclear warheads were created at PICA for a wide range of missile systems including various members of the NIKE family, the country's first supersonic, air defense guided missile that was fired from the ground to intercept and destroy enemy planes. The creation of warheads included the explosive payload plus its fuzing, strafing, and arming devices. In addition, ancillary handling and checkout equipment was designed and developed. Warheads were created for: the HAWK, CORPORAL, HONEST JOHN, REDSTONE, and LANCE systems (Kaye 1978).

One of the most specialized applications of nuclear weaponry was ADM (Atomic Demolition Munitions), a nuclear demolition device. These devices were trunk-sized bombs that could be pre-positioned and linked to firing devices that set off the explosion at a set time, essentially a nuclear time bomb (Kaye 1978). These devices became much more refined through time, making them low-yield and portable on the battlefield by an individual soldier. One of Picatinny's chief contributions to ADM was the development of a Universal Firing Device (UFD). The UFD was more compact and rugged and could convert any of the Army's then present nuclear weapons into a nuclear demolition device (Kaye 1978).

The nuclear weapon created for infantryman, the Davy Crockett missile, was developed under the technical direction of Picatinny. This weapon could be hand-carried and fired from a tripod or could be mounted on a jeep or armored personnel carrier. In order to protect the using forces, friendly troops, and civilians from radioactive fallout, the Davy Crockett's effective radius was kept quite small without compromising its destructive force (Kaye 1978).

Other nuclear projects carried out by PICA included the development of the nuclear timer, a more accurate and rugged timer than other mechanical timers then in existence. Powered by a nuclear battery for pinpoint accuracy, the timer was used in missile research allowing technicians the capability of pinpointing the location of nose cones through sound tracking (Kaye 1978).

In the late 1950s, Picatinny entertained the idea of having its own nuclear reactor. Arsenal scientists had been using the reactor at Brookhaven on New York's Long Island. PICA commissioned Atomics, American Machine and Foundry Company (AMF), Greenwich, Connecticut, to weigh the options and determine whether a five-megawatt, light water (swimming pool) reactor was suitable for the installation. The reactor never came to pass for

reasons that remain unclear (Owens 2003c). Picatinny continued to use the Brookhaven reactor as needed.

At the end of the Cold War, the Army began reassessing its nuclear programs. A Presidential directive dated 23 September 1991 called for the retirement of all tactical nuclear weapons beginning 30 September 1991. The retirement of these weapons, especially from overseas, would take time. Nevertheless, the Nuclear Division in ARDEC's Fire Support Armaments Center at PICA, seeing a bleak future, began looking for other missions and trying to fit its people into other units. By mid-1992 there was no Nuclear Division (Owens 2003d).

The Project Manager for Nuclear Munitions, located at PICA but not part of ARDEC, endured a little longer, deactivating 30 September 1993. It is believed that this division's final assignment was the return of the PERSHING missile system from Europe. Nevertheless, Picatinny maintained some expertise in the nuclear area and remained in a position to support studies in the field. The Cold War was over and so was PICA's nuclear mission.

In 1957, Picatinny issued a large report on the possibility of siting a nuclear reactor facility at the arsenal (Pollock 1957), and included a number of study photographs illustrating possible locations for it at the arsenal. One study photograph showed the suggested reactor site in relation to explosive storage magazines, which would be used as necessary, New Jersey Public Service power lines, mountain ranges and Lake Demark (Figure 4.188). Igloo 1201 is located at the bottom left, outlined in a dotted square. While it is unclear if the igloo was actually prepared for use with a possible nuclear reactor, it is quite different from other igloos at PICA. Although Igloo 1201 may be a nuclear igloo, it does not appear to have ever been used as such.

All of the igloos at Picatinny are standard Army igloos with one, 1201, having modifications. They are typical of type and are not architecturally or historically significant. They are not eligible for the NRHP.

Magazines. Magazines for the storage of ammunition and explosives can be classified into two broad categories: aboveground magazines and underground igloos. The earliest military magazines were aboveground and followed no standardized plans. They varied in size, shape, construction material, and architectural/engineering features. By World War I, most aboveground magazines were rectangular in shape with gable or flat roofs. Construction material was generally masonry or corrugated asbestos on a wooden frame; however, some magazines were all wood. Floors were at grade or at railroad car level, and safety distances were sometimes reduced by installing a separation barricade (Murphey et al. 2000).

By the end of World War I, ammunition was stored in standardized aboveground magazines made from a variety of building materials depending on the classification of the ammunition and explosives stored. Class I, II, II, and IV ammunition and explosives were treated differently with the most explosive, Class IV, High Explosive, having the smallest magazines with the largest separation between buildings (Murphey et al. 2000).

During World War II and into the Cold War, the Army continued to build aboveground magazines, although igloos were preferred for all types of ammunition and explosives storage. In general, all magazines had to be adequately grounded and fireproof, have ventilators to regulate temperatures, have loading platforms with the floor at railroad car-floor height, have adequate drainage, and have tightly fitted doors placed opposite of the prevailing winds (Murphey et al. 2000).

In addition to the specifications regarding the actual building, the surrounding landscape was to have a mainline railroad track to each row of magazines with a spur at each magazine to allow railroad cars to be loaded and unloaded without blocking the main line. Well-maintained roads were present to facilitate fighting fires, if necessary, and to enhance security (Murphey et al. 2000).

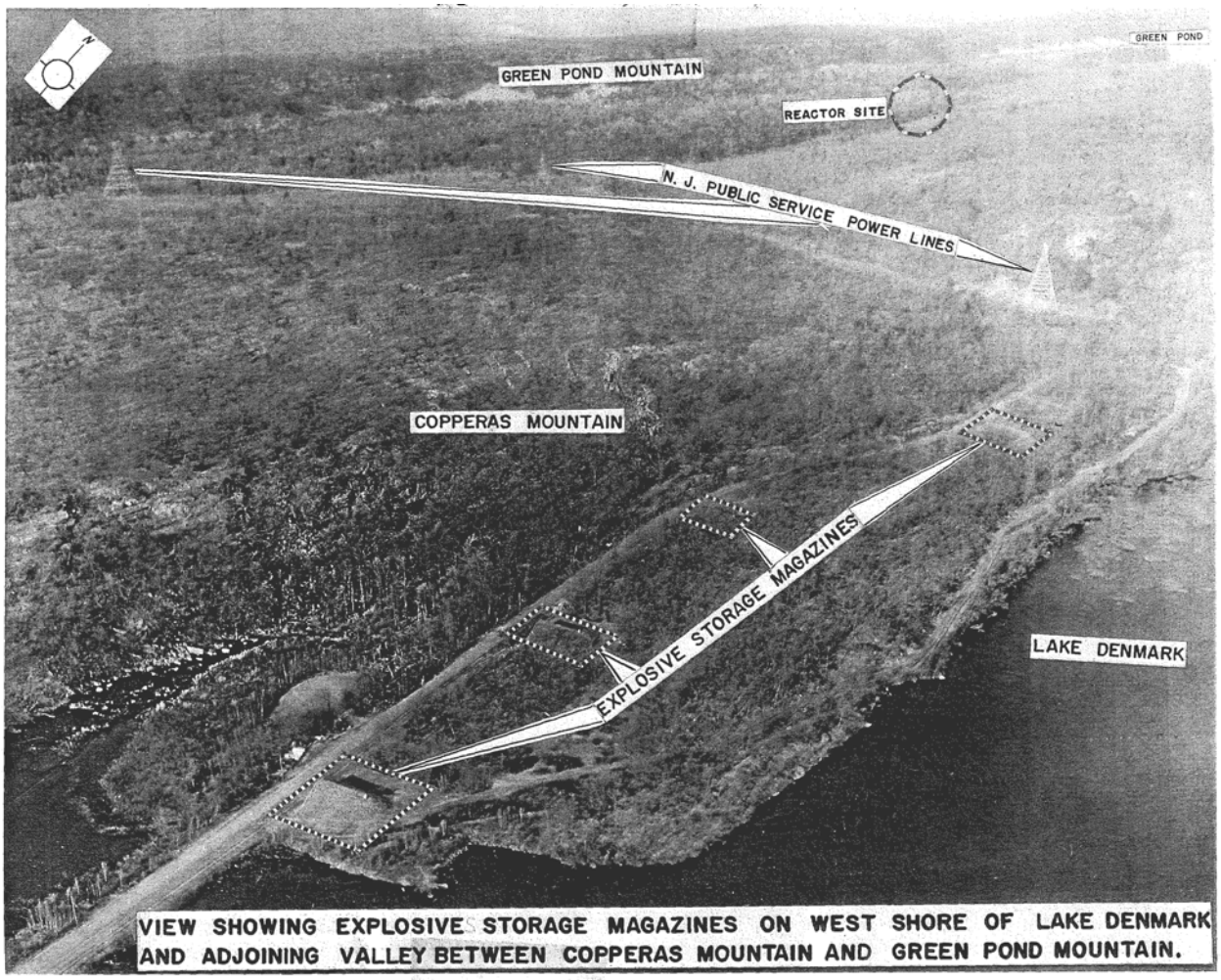

Figure 4.188. View Showing Explosive Storage Magazines on West Shore of Lake Denmark and Adjoining Valley Between Copperas Mountain and Green Pond Mountain, Picatinny Arsenal NJ. Note Building 1201 in lower left *(M.D. Pollock 1957).*

The aboveground magazines surveyed at Picatinny include:

67 (1953/1956)	Flammable Materials Storehouse (see Figure 4.172)
717C (1941)	Magazine (see Figure 4.178)
717G (1943)	Magazine, derelict (see Figure 4.179)
900 (1950)	Magazine/Rocket Propellant Surveillance Laboratory (see Figure 4.180)
902 (1950)	Magazine, High Temperature Test Facility, derelict(see Figure 4.181)
903 (1950)	Magazine (see Figure 4.182)
3106A (1966)	HE Magazine (see Figure 4.186)

The magazines at PICA are standardized structures that are now missing their railroad connections. In many cases, the roads connecting the magazines are as dilapidated as the magazines themselves. The magazines have no architectural or historical significance, and are not eligible for the NRHP.

General Storage. The Army historically provided troops with all necessary supplies, including food, clothing, and weapons. To control distribution of supplies, the Army developed a dual storage system during the nineteenth century. Each installation maintained a number of warehouses to store and distribute supplies on an as-needed basis, while the Quartermaster Corps operated central depots to store Quartermaster supplies for regional distribution. When railroad cars replaced pack mules, the Army distribution system became highly efficient and effective. The other technical services, including the Corps of Engineers and the Signal Corps, established their own supply systems, based on the Quartermaster model, to distribute equipment to their personnel. During the twentieth century, as troops required more equipment, the Quartermaster depots and warehouse system grew accordingly (Kuranda et al. 1995).

During World War I, the Quartermaster's system of distribution was sorely tested and found wanting. There were not enough warehouses, and the rail and shipyards were not adequately designed or prepared to process the massive amount of equipment the Quartermaster was trying to move. In 1918, the government took control of the railroad, the Army began to construct more storage space, and the Quartermaster Corps reorganized itself. At the conclusion of the war, the Quartermaster Corps was already planning for the next one (Kuranda 1995).

After World War I, the Army arranged for permanent storage of the massive amounts of military materiel that was returned from Europe. While Army construction in general was halted, construction for storage continued apace. Eventually the construction of storage facilities stopped and did not pick up again until the 1930s, when the Quartermaster Corps was given the responsibility for supplying the Civilian Conservation Corps (Kuranda et al. 1995).

During the limited national emergency in 1939, the Quartermaster Corps began to expand its storage capacity at installations and depots. During World War II, the Army adopted the one-story storehouse for new construction at its general storage and supply depots. World War II storehouses were long buildings with multiple loading doors and loading docks along side elevations. The loading docks and doors accommodated both trucks and trains. Often the storage complex was arranged to accommodate trains on one side and trucks on the other. High ceilings and wide floors allowed the use of forklift equipment and the stacking of supplies on pallets (Kuranda et al. 1995).

Although the Army constructed multi-story warehouses, the single-story warehouse dominated storehouse construction. Characterized by multiple doors on their long sides, these buildings were constructed from all types of materials and could be temporary or permanent. Roofs were typically low-pitched gable or monitor (Kuranda et al. 1995).

Storage buildings at Picatinny surveyed include:

302F (1956)	Post Engineer Storehouse (see Figure 4.175)
305 (1945/1956)	Storehouse, derelict (see Figure 4.176)
314B (1958)	Storage (see Figure 4.177)
1186 (1966)	Open Storage Shed, derelict (see Figure 4.184)
3211 (unknown)	Warehouse (see Figure 4.161 and Figure 4.187)

The warehouses and storage facilities at PICA are standardized plan storage facilities. They are not historically or architecturally significant, and are, therefore, not eligible for the NRHP. There are no associated landscapes.

4.6 INFRASTRUCTURE

Infrastructure is used here to indicate the large-scale public systems, services, and facilities of the installation that are necessary for the daily operation of the post. These include power and water supplies, telecommunications, roads, etc. In order to better discuss certain aspects of the installation's infrastructure, buildings are grouped together and presented as components of a particular part of the installation's infrastructure.

Buildings surveyed at Picatinny, grouped by geographic location, are:

80 (1944/1948)	Sewage Treatment Plant (see Figure 4.62; Figure 4.189)
81 (1975)	Monitoring Station (see Figure 4.62; Figure 4.190)
83 (1978)	Water Monitoring Station (see Figure 4.62; Figure 4.191)
92A (1964/1971)	Sewage Pump Station (see Figure 4.62; Figure 4.192)
506B (1958)	Pump House (see Figure 4.162; Figure 4.193)
320 (1956)	Former AC plant (see Figure 4.162; Figure 4.194)
1219 (1953)	Pump House (see Figure 4.164; Figure 4.195)
1381A (1948)	Pump House (see Figure 4.57; Figure 4.196)

Figure 4.189. Building 80, Sewage Treatment Plant, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.190. Building 81, Monitoring Station, Sewage Treatment Plant, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.191. Building 83, Water Monitoring Station, Sewage Treatment Plant, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.192. Building 92A, Sewage Pump Station, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.193. Building 506B, Pump House, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.194. Building 320, Former AC Plant, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.195. Building 1219, Pump House, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.196. Building 1381A, Pump House, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

3024B (1997)	Air Conditioning Unit on Concrete Foundation (see Figure 4.165; Figure 4.197)
3151 (1929)	Tank (see Figure 4.165; Figure 4.198)
3210 (unknown)	Pump House (see Figure 4.165; Figure 4.199)
3219 (1928)	Water Reservoir Pump Building (see Figure 4.165; Figure 4.200)

Sewage. The Army's need for clean drinking water to protect the health of the troops lead directly to the creation of installation sewage treatment facilities. During World War I, the Army generally used septic tank disposal system plants at its permanent installations. When the War Department began planning for the emergency mobilization in 1940, sewage treatment was one of the problems it immediately faced. Army policy was to locate sewage treatment plants as far as possible away from residential and administrative areas depending on the topography and location of the discharge stream. The plants were also located in areas where they would not interfere with military operations, especially artillery ranges (Kuranda et al. 1995).

Sewage buildings at Picatinny surveyed include:

80 (1944/1948)	Sewage Treatment Plant (see Figure 4.189)
81 (1975)	Monitoring Station (see Figure 4.190)
83 (1978)	Water Monitoring Station (see Figure 4.191)
92A (1964/1971)	Sewage Pump Station (see Figure 4.192)

Figure 4.197. Building 3024B, Air Conditioning Unit on Concrete Pad, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.198. Building 3151, Tank, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.199. Building 3210, Pump House, Main Post, Picatinny Arsenal, NJ. Note the original number still on building *(Panamerican 2007).*

Figure 4.200. Building 3219, Water Reservoir Pump Building, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Building 80 (1944/1948), a sewage treatment plant settling tank located off First Street, is a rectangular structure with open access to the tank from the roof. The building is constructed around a concrete Imhoff tank situated on a sprinkler filter bed of crushed stone on a sludge bed foundation, has concrete walls, and no roof. An addition was made in 1948 (see Figure 4.189).

Building 81 (1975), a monitoring facility off First Street, is a small, square, gable-roofed, prefabricated structure with a single entrance door. The building sits on a concrete foundation, has fiberglass walls, and a fiberglass roof (see Figure 4.190).

Building 83 (1978), a monitoring facility off First Street, is a small, square, gable-roofed, prefabricated structure with a single entrance door. It sits on a concrete foundation, has fiberglass walls, and a fiberglass roof (see Figure 4.191).

Building 92A (1964/1971), a sewage pump station, is found off Ramsey Avenue. It is a rectangular, gable-roofed structure with a central entry door. The building is built on a concrete construction foundation, has concrete-block walls, and a concrete roof faced with corrugated metal (see Figure 4.192).

Building 80, a settling tank, holds waste water to allow large particles to settle out of the water and is typical of buildings found at a sewage treatment plant. The pumping station, Building 92A, is constructed to pump sewage to and through the sewage treatment plant and to pump effluent to its final destination (Kuranda et al. 1995). The monitoring buildings are used as check points to ensure that the water released is pure.

These buildings are typical of sewage treatment plants found on installations and in municipalities throughout the United States. They are not architecturally or historically significant. As such, they are not eligible for the NRHP. The sewage treatment plant has no associated landscape.

Water. The Army became aware of the importance of a safe water supply during the Civil War, when contaminated drinking water contributed to massive outbreaks of typhoid fever. When the Army consolidated its troops into larger, more permanent installations during the 1880s and 1890s, the Quartermaster Department included plans for water supply systems. In the 1880s, the Army included indoor plumbing in housing, and by 1892 all company barracks had indoor plumbing (Kuranda et al. 1995).

During World War I, the Construction Division of the Quartermaster Corps estimated that each trainee at its 46 mobilization training institutions required a water supply of 55 gallons per man per day. This estimate calculated to a capacity of 2,250,000 gallons of water daily per each cantonment. When possible, the Army utilized water drawn from nearby municipal water mains. However, in some instances, the Army was forced to develop its own water supplies, drawn from local streams, rivers or wells. The water from these original sources was stored in reservoirs where it was filtered and quality tested; if needed, it was purified with chlorine (Kuranda et al. 1995).

During the interwar years, the Army continued to explore every avenue for obtaining pure water for its growing enterprises. It began to use chemical treatments during this period. Chlorination, carbon, copper sulfate, ammonia, sodium aluminate, caustic soda and activated carbon were all used depending on the chemical composition of the water source. Water treatment at Army

installations did not differ from municipal treatment plants, and was under the control of trained personnel applying proven water treatment methods (Kuranda et al. 1995).

The massive build-up for World War II led to the creation of many new water treatment plants on installations. New cantonments led to increased demand for water and the Army was constantly seeking new sources and expanding old systems. To store and distribute water the Army generally relied on riveter-steel, elevated water storage tanks. Often one tank served several cantonments. The elevated tanks served as effective storage structures and maintained sufficient water pressure. Also during this time the Army expanded its number of concrete reservoirs (Kuranda et al. 1995).

Buildings surveyed at Picatinny associated with water treatment include:

506B (1958)	Pump House
1219 (1953)	Pump House
1381A (1948)	Pump House
3151 (1929)	Tank
3210 (unknown)	Pump House
3219 (1928)	Water Reservoir Pump Building

Building 506B (1958), previously used as a pump house and originally built as a steam and power generating facility, is located off Babbitt Road. It is a large, rectangular, flat-roofed building with a rectangular, flat-roofed addition attached by a gable-roof hyphen. The building sits on a concrete foundation, has hollow tile walls, and a build-up roof (see Figure 4.193).

Building 1219 (1953), a pump house off Lake Denmark Road, is a rectangular, flat-roofed structure with central entry. The building sits on a concrete foundation, has hollow tile walls, and a roll roof. Building 1219 is located behind a chain-link fence (see Figure 4.195).

Building 1381A (1948), a pump house off South Nitroglycerine Road, is a small, rectangular, gable-roofed structure with central, steel double doors. It sits on a concrete foundation, has concrete-block walls, and a roll roof (see Figure 4.196).

Building 3151 (1929), a water tank, is located along Gately Road at the corner of Gately and Battalion roads. A large cylinder-shaped tank, it is set on a concrete foundation and is constructed of steel (see Figure 4.198).

Building 3210 (unknown), previously used as a pump house and storage shed, is situated along Walsh Road. It is a square, hipped-roofed structure with exposed rafters, side entry, and exterior chimney. The building sits on a concrete foundation, has brick walls, and a shingle roof. It was previously numbered building 86 (see Figure 4.199).

Building 3219 (1928), a water pump reservoir off Blacksmith Road, is a rectangular, gable-roofed structure with attached open side, covered storage at one end. The building sits on a concrete foundation, has sided walls, and a shingle roof (see Figure 4.200).

The majority of the buildings surveyed within this category are pump houses. Pump houses or stations were constructed to shelter pumping equipment located above wells or were used in the water distribution systems. These buildings are generally utilitarian in nature but, if they were located on the main installation, were designed to fit in with the surrounding architecture

(Kuranda et al. 1995). These pump houses are typical of buildings required for the operation of any water system and are not architecturally or historically significant. They are, therefore, not eligible for the NRHP. Building 3151, a steel water tank, is also a basic component of any water system. It is not architecturally or historically significant and is, therefore, not eligible for the NRHP. There are no landscapes associated with any of the water treatment buildings.

Incinerators. The Army produces solid wastes and has disposed of it in various ways through its history. Early on, waste was dumped on land or in water, fed to animals or burned. As early as the 1880s the Army was experimenting with incinerating its solid wastes. Early incinerators were not completely successful since they could not reach or maintain a temperature that would completely burn all waste products. During World War I, the Army, much like the rest of the United States, recycled as many materials as possible and fed as much garbage as possible to swine. By World War II, the Army was using a combination of incineration and sanitary landfills for refuse disposal, especially since there was growing concern about pollution from incineration (Kuranda et al. 1995).

Only one building associated with waste disposal was surveyed at PICA: Building 320 (1956) (see Figure 4.194), a former incinerator and health and sciences laboratory. Located off Eighth Avenue, the building is a rectangular, gable-roofed structure with a brick side tower that sits on a concrete, footer foundation, has brick walls, and a build-up roof. Additions were added in 1958 and 1988.

A prominent feature of an incinerator house is the smokestack, which releases heat from the furnaces located in the basement. Incinerators generally used forced draft fans to aid in the burning process. Many times, a loading platform was part of the structure (Kuranda et al. 1995). Obviously, the incinerator has changed drastically through time, losing its furnaces and other equipment, although the telltale smokestack still stands. The incinerator has no integrity and as such is not eligible for the NRHP. There is no landscape associated with the incinerator.

Miscellaneous Components of Infrastructure. Numerous components of infrastructure are scattered throughout the installation. They have little meaning in and of themselves, but are required as part of a larger system. This is true of Building 3024B, a large air conditioning unit. It has no historical or architectural significance and is not eligible for the NRHP. Nevertheless, it is essential for daily operations within a modern office/plant setting.

Building 3024B (unknown) is an air conditioning unit, off West Clarke Road. The metal unit sits on a concrete foundation (see Figure 4.197). No buildings or landscapes are eligible for the NRHP within the Infrastructure category.

4.7 BASE OPERATIONS BUILDINGS

Base operations buildings are those structures associated with the daily running of an installation, such as office buildings, chapels, hospitals, gyms, etc. These are the buildings where the daily, orderly administration of the installation is carried out. In order to better discuss aspects of base operations, buildings are grouped together and discussed as a component of a particular part of the installation's operations buildings.

Buildings surveyed are listed below in numerical order, but are grouped and discussed by geographic location:

68 (1957)	Ordnance Facilities (see Figure 4.62; Figure 4.201)
73 (1956)	Scale House (see Figure 4.158; Figure 4.202)
94 (1967)	Lerner Building, Administration Building (see Figure 4.62; Figure 4.203)
121B (1968)	Golf Cart Storage Building (see Figure 4.162; Figures 4.204)
1102 (unknown)	Golf Garage (see Figure 4.62; Figure 4.205)
1136 (unknown)	ARDEC Reception Center (see Figure 4.158; Figure 4.206)
1179C (1948)	Burning Ground Storage Building (see Figure 4.158; Figure 4.207)
1179D (1950)	Burning Ground Storage Building (see Figure 4.158; Figure 4.208)
1181 (1956)	Skeet Field Recreation House (see Figure 4.158; Figures 4.209)
1182 (1956)	Skeet Field Gas Cylinder Storage (see Figure 4.158; Figure 4.210)
1227A (1968)	Picnic Shelter (see Figure 4.164; Figure 4.211)
3237 (unknown)	Playground Shelter (see Figure 4.165; Figure 4.212)
3237A (1985)	Playground (see Figure 4.165; Figure 4.213)
3237B (1985)	Basketball court (see Figure 4.165; Figure 4.214)
3253 (1985)	Waiting Shelter (see Figure 4.165; Figure 4.215)

Figure 4.201. Building 68, Ordnance Facility, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.202. Building 73, Scale House, Picatinny Arsenal, NJ. Note scales in foreground *(Panamerican 2007).*

Figure 4.203. Building 94, Lerner Building, Administration Building, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.204. Building 121B, Golf Cart Storage, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.205. Building 1102, Golf Course Garage, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.206. Building 1136, ARDEC Reception Center, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.207. Building 1179C, Burning Ground Storage Building, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.208. Building 1179D, Burning Ground Storage Building, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.209. Building 1181, Skeet Field Recreation House, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.210. Building 1182, Skeet Field Gas Cylinder Storage, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.211. Building 1227A, Picnic Shelter, Lake Denmark Area, Picatinny Arsenal, NJ *(Panamerican 2007)*.

Figure 4.212. Building 3237, Playground Shelter, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.213. Building 3237A, Playground, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.214. Building 3237B, Basketball Court, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.215. Building 3253, Waiting Shelter, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Golf Course Buildings. On most installations, the largest planned landscape is the golf course. No research, however, has been completed on PICA's golf course, so the architect and date of construction is not known. Nevertheless, it is known that holes 16 and 17 were originally the site of the parade ground. It is beyond the scope of this survey to research the history and development of the actual golf course. The two buildings surveyed are associated with the golf course. They are:

Building 121B (1968) is a golf cart storage building located on the golf course off Buffington Road. It is a long, rectangular, gable-roofed structure with a garage bay at the gable end. The building sits on a concrete foundation, has frame walls, and a strip shingle roof (see Figure 4.204).

Building 1102 (unknown), a garage located in the golf course, is situated off Wooden Bridge Road and is a long, rectangular, gable-roofed structure with two garage bays. The building sits on a concrete foundation, has frame and cement walls, and a roll roof (see Figure 4.205).

These two buildings, while associated with the golf course, are not vital to the understanding of the historic or architectural significance of the golf course. They are not individually eligible for the NRHP. Nevertheless, the PICA golf course and its attendant buildings have never been surveyed. Panamerican recommends that the golf course itself should be evaluated for its eligibility for listing to the NRHP.

Burning Grounds Buildings. Picatinny has a designated area for the burning of certain designated items. A series of storage buildings are located in this area to that support this activity. They are:

Building 1179C (1948), a storage building off Green Pond Brook Road, is a rectangular, shed-roofed structure with an open storage bay that sits on a dirt foundation, has wood walls, and a metal roof (see Figure 4.207).

Building 1179D (1950), a storage building off Green Pond Brook Road, is a rectangular, shed-roofed structure with a central entry that sits on a dirt foundation, has wood walls, and a metal roof (see Figure 4.208).

These buildings are constructed of found materials and are not historically or architecturally significant. They are not eligible for the NRHP.

Recreation/Community-Related Buildings. All installations have numerous buildings related to recreational activities, such as ball fields and playgrounds, and community activities, such as transportation waiting shelters. These are typically found on installations in support of soldiers and their families. Recreation/Community-related buildings surveyed include:

Building 1181 (1956) is a Skeet Field high house located off Green Pond Brook Road. A small, square, shed-roofed high structure with access stairs on the east façade, the building sits on a dirt foundation, has wood walls, and a roll roof (see Figure 4.209).

Building 1182 (1956), a Skeet Field low house off Green Pond Brook Road, is a small, rectangular, shed-roofed structure that sits on a dirt foundation, has wood walls, and a roll roof (see Figure 4.210).

Building 1227A (1968) is a picnic shelter found off Lake Denmark Road. It is a rectangular and open gable-roofed structure that sits on a concrete foundation, has frame walls, and a wood shingle roof (see Figure 4.211).

Building 3237 (unknown), a playground shelter off Harris Court, is an open, square, hipped-roofed structure with a built-in bench seat at the northeast end of the structure. The building sits on a concrete-pier foundation with pressure-treated lumber framing, and a roll asphalt roof (see Figure 4.212).

Building 3237A (1985), a playground off Harris Court, is a rectangular layout with pressure-treated wooden playground equipment including a swing set and jungle gym. It sits on a rubber mulch bed (see Figure 4.213).

Building 3237B (1985), a basketball court off Harris Court, has a rectangular paved layout with basketball hoops supported by L-shaped metal piping at the east and west ends of the court (see Figure 4.214).

Building 3253 (1958), a waiting shelter on the corner of Brown Road and Maple Street, is a rectangular, flat-roofed structure with glass curtain walls and a side entrance. The building sits on a concrete foundation, has glass walls, and a steel joist roof (see Figure 4.215).

These buildings are typical of type and have no historical or architectural significance. They are, therefore, not eligible for the NRHP.

Administration/Offices. All installations have administrative and office facilities that are required for the daily operation of the installation as well as the smooth operation of the installation's mission. Many times, office facilities are created in building spaces that were originally designed for other purposes, as is the case with Building 68 (see Figure 4.201). In this case, a magazine was converted into an office space. Administration/offices at Picatinny surveyed include:

Building 68 (1957), an ordnance facility between Second and Third avenues, is a long, rectangular, gable-roofed structure with a garage bay at the gable end. The building sits on a concrete foundation, has corrugated metal walls, and a corrugated metal roof. Renovations occurred in 1989 (see Figure 4.201).

Building 94 (1967), the Learner Building, an administration building with R&D activities, is situated off Ramsey Avenue. It is a two-story, irregular-shaped International-style building with a flat roof. The building sits on a concrete foundation, has concrete-block walls faced with stretcher bond yellow brick in the main bay and flanked by two concrete-block wings, and a build-up flat roof (see Figure 4.203).

Building 1136 (unknown), the ARDEC Reception Center, is located at the main gate off Parker Road. It is a one-story, T-shape, flat-roofed structure that sits on a concrete foundation, has frame and cement walls, and a roll roof (see Figure 4.206).

None of these buildings are architecturally or historically significant and are, therefore, not eligible or the NRHP. They do not have associated landscapes.

Miscellaneous Base Operations Buildings. PICA has a truck scale house (Building 73) off Phipps Road at its truck entrance (see Figures 4.158 and 4.202). Building 73 (1956) is a square,

hipped-roofed structure with center slider windows. It sits on a concrete foundation, has ribbed, split-face concrete walls, and an asphalt shingle roof. An addition was made in 1966. The scale house is not historically or architecturally significant, and is therefore, not eligible for the NRHP. There is no associated landscape.

4.8 HOUSING

As part of RCI (Residential Communities Initiatives), the DoD no longer owns family housing, just the land upon which the housing sits. Housing is now owned and operated by civilian contractors who are responsible for its construction and upkeep. RCI was undertaken to create world-class quality residential communities, leverage assets and scarce funds, and obtain private-sector expertise, creativity, innovation and capital. The goal of RCI is to eliminate inadequate housing within the DoD by 2007 (RCI 2007).

PICA's housing is now owned by Gary Michael Holloway (GMH). GMH, in turn, employs John Cullinane Associates, LLC, of Annapolis, Maryland, a cultural resources management firm, to assist it in the management and maintenance of historic quarters. Part of the older housing (1965) at PICA, which was created using Military Construction, Army (MCA) funds, is currently being demolished.

Many of the quarters Panamerican was tasked to survey were identical in appearance, created using the same standard Army plan. As a result of this sameness, Panamerican and Picatinny agreed that only one set of houses per type would be photographed. In addition, a small storage shed associated with a house, now also part of RCI, which was in the backyard behind a privacy fence, also was not photographed.

Buildings surveyed and in the same geographic area (see Figure 4.165) include:

3205 (2002)	Housing (see Figure 4.216)
3209A (2002)	Housing (Figure 4.216)
3209B (2002)	Housing (see Figure 4.216)
3209C (2002)	Housing (see Figure 4.216)
3209D (2002)	Housing (see Figure 4.216)
3209E (2002)	Housing (see Figure 4.216)
3232A (2002)	Housing (see Figure 4.216)
3232B (2002)	Housing (see Figure 4.216)
3232C (2002)	Housing (see Figure 4.216)
3232D (2002)	Housing (see Figure 4.216)
3232E (2002)	Housing (see Figure 4.216)
3232F (2002)	Housing (see Figure 4.216)
3233A (2002)	Housing (see Figure 4.216)
3233B (2002)	Housing (see Figure 4.216)
3233C (2002)	Housing (see Figure 4.216)
3233D (2002)	Housing (see Figure 4.216)
3233E (2002)	Housing (see Figure 4.216)
3238 (1984)	Housing (Figure 4.217)
3249 (1984)	Housing Storage Shed (not photograph per agreement)
3256 (1965)	MCA Housing (Figure 4.218)
3257 (1965)	MCA Housing (Figure 4.219)
3258 (1965)	MCA Housing (Figure 4.220)

Figure 4.216. Building 3209A-E, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.217. Building 3238, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.218. Building 3256, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.219. Building 3257, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.220. Building 3258, MCA-funded housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

3259 (1965)	MCA Housing (Figure 4.221)
3260 (1965)	MCA Housing (Figure 4.222)
3261 (1965)	MCA Housing (Figure 4.223)
3262 (1965)	MCA Housing (Figure 4.224)
3263 (1965)	MCA Housing (Figure 4.225)
3264 (1965)	MCA Housing (Figure 4.226)
3265 (1965)	MCA Housing (Figure 4.227)

Figure 4.221. Building 3259, MCA-funded housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.222. Building 3260, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.223. Building 3261, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.224. Building 3262, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.225. Building 3263, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.226. Building 3264, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007).*

Figure 4.227. Building 3265, MCA-funded Housing, Family Housing, Main Post, Picatinny Arsenal, NJ *(Panamerican 2007)*.

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5.0 Summary

Picatinny Arsenal contracted Panamerican Consultants, Inc., under a cooperative agreement with the U.S. Army Medical Research Acquisition Activity, to evaluate 318 buildings and structures at Picatinny for eligibility for listing in the National Register of Historic Places. In addition to other mission-specific endeavors, PICA has proposed a number of construction activities (e.g., renovations and demolitions) that may affect these structures. PICA requested a determination of NRHP eligibility for all buildings that would be potentially affected in order to satisfy its cultural resources obligations as delineated by numerous federal statues and regulations, including National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et. seq.) through 2000 (which includes Section 106 compliance); National Environmental Policy Act of 1969 (42 U.S.C. 4371 et. seq.); Historic Preservation Act of 1974 (16 U.S.C. 469-469c); the Advisory Council on Historic Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800); as well as Army Regulation (AR) 200-4 "Cultural Resources Management."

During the evaluation, all 318 buildings and structures were inventoried, mapped, physically inspected, photographed, and a ground survey completed (see Appendix B). Buildings that Panamerican was unable to find were further investigated through the Real Property Manager's office to ensure that properties had not been missed. The buildings/structures surveyed were erected primarily between World War II and the middle of the Cold War. By and large, these buildings tended to be small, isolated, "lost" structures that had escaped previous surveys but were still appearing on various Real Property lists. Of the 318 buildings/structures survey, 109 had been demolished or were so deteriorated that they had fallen down. Of the remaining 209 buildings and structures, 29 were family housing and are no longer the property of the Army.

Three of the properties surveyed are located in two of the four historic districts at Picatinny. Building 621A, Ammunition Testing Facility, and Building 623F, Valve House, both found off 20th Avenue, are within the 600 Ordnance Testing District. Neither Building 621A nor 623F are individually eligible for listing to the NRHP, and both buildings are non-contributing elements to that district. Building 178, Chemistry Laboratory, situated off Kibler Road, is within the Administrative and Research District. It is also not individually eligible for the NRHP, and is a non-contributing element to that district.

During the investigation, Real Property files were consulted for pertinent information and the Real Property Manager answered questions and provided additional information on particular buildings, industrial complexes, or demolitions. Further, blueprints, which can provide a wealth of information about individual properties or building complexes, for all of the properties were consulted.

Buildings and structures surveyed, photographed and evaluated included:

> 67, 68, 70, 71, 72, 73, 80, 81, 83, 92, 92A, 94, 97, 121B, 178, 179, 215, 215A, 221A, 224, 225, 231, 232A, 232F, 234, 236, 237, 238, 240A, 242C, 247, 283D, 295, 296, 302F, 305, 314B, 317E, 320, 403A, 407B, 427A, 429A, 436, 452, 454B, 471, 471A, 471B, 472, 476, 477E, 501, 506B, 524, 540, 566, 567, 584, 602C, 603, 603E, 603F, 604H, 606, 606A, 606B, 612, 614, 615, 616, 619, 621A, 622, 623F, 625F, 627, 630, 631, 632, 633, 634, 636, 636B, 637, 637A, 642, 642A, 643, 644, 645, 645A, 646, 647, 649, 650, 651, 652, 652B, 653, 654, 655, 657, 658, 659, 670, 671, 672, 673, 717C, 717G, 717I, 717J, 717L, 732E, 800,

807B, 807C, 809, 810A, 813A, 813D, 816A, 816B, 816C, 816D, 820A, 822, 823, 824A, 825, 900, 902, 903, 926, 1033A, 1036B, 1037, 1038, 1052A, 1071C, 1071G, 1090, 1096, 1101, 1101B, 1102, 1109A, 1114, 1136, 1141, 1178, 1179C, 1179D, 1181, 1182, 1186, 1187, 1201, 1219, 1221, 1222, 1222A, 1227A, 1240, 1242A, 1304, 1308, 1309, 1310, 1350, 1352, 1355, 1366, 1368, 1369, 1370, 1370A, 1374, 1375, 1380, 1381A, 1382A, 1392, 1392A, 1393, 1393A, 1398A, 1501, 1502, 1503, 1504, 1504A, 1505, 1505N, 1505J, 1505K, 1506, 1507, 1507B, 1508, 1509, 1510, 1510A, 1510B, 1511, 1512, 1512A, 1513, 1514, 1515, 1517, 1517A, 1518, 1519, 1520, 1521, 1522, 1528, 1529, 1609A, 1615, 3011, 3023, 3024B, 3054, 3056, 3058, 3100B, 3104A, 3104B, 3104C, 3104D, 3106A, 3109, 3117, 3119, 3144, 3145, 3145A, 3151, 3205, 3206, 3207A, 3207B, 3207C, 3207D, 3209A, 3209B, 3209C, 3209D, 3209E, 3210, 3211A, 3211B, 3211C, 3219, 3225A, 3227, 3227B, 3227C, 3227D, 3229, 3232A, 3232B, 3232C, 3232D, 3232E, 3232F, 3233A, 3233B, 3233C, 3233D, 3233E, 3234, 3237, 3237A, 3237B, 3238, 3239, 3240, 3241, 3243, 3249K, 3251, 3253, 3256, 3257, 3258, 3259, 3260, 3261, 3262, 3263, 3264, 3265, 3403, 3404, 3504, 3531, 3939, 3700.

To facilitate the discussion of these buildings and structures, the architectural discussion was divided into six sections—Industrial/Factory Complexes, Testing Associated with Manufacturing and Quality Assurance, Ammunition and Explosives/General Storage, Infrastructure, Base Operations, and Housing. All 209 of the assessed buildings and structures were subsumed into one of these six broad categories (Appendix B).

Industrial/Factory Complexes. No buildings, structures, or landscapes evaluated at PICA within this category are recommended as eligible for listing to the National Register of Historic Places.

Testing Associated with Manufacturing and Quality Assurance. The Rocket Test Area, now the 1500 Area, is recommended as eligible as a district for listing to the NRHP under Criterion A, contributing the broad patterns of history, and Criterion C, architectural/engineering features, applying Criteria Consideration G. The 34 buildings contributing to this district are:

1501 (1948)	Office
1502 (1948)	Ordnance Facility
1503 (1948/1956)	Conditioning Building
1504 (1956)	Storage
1504A (1948)	Conditioning Building
1505 (1948/1956)	Test Cell
1505A (1948)	Test Cell
1505B (1948)	Test Cell
1505C (1958)	Control House
1505D (1951)	Test Cell
1505E (1966)	Control Spin Room
1505F (1959)	Storage
1505N (1948)	Open Blast Area
1506 (1954)	Loading Facility
1507 (1946)	HE Magazine
1507B (1959)	Storage
1508 (1955)	HE Magazine
1509 (1950)	Test Facility

1510 (1950/1956)	Pyrotechnic Building
1510A (1947)	Storage
1510B (1948)	General Storage
1510D (1947)	Water Tower
1511 (1952)	Neutralizing and Pump Station
1512 (1956)	Chemistry Laboratory
1512A (1958)	Flammable Material Storage
1513 (1968)	Pyrotechnic R&D Laboratories
1514 (1968)	Pyrotechnic R&D Laboratories
1515 (1961)	Physics Laboratory
1517 (1956)	High Altitude Test
1517A (1963)	Electric Equipment Facility
1519 (1956)	HE Magazine
1520 (1956)	HE Magazine
1521 (1960)	Component Propellant Building
1522 (1970)	Ordnance Facility

On the whole, these buildings have integrity and it is clear that they form testing/plant areas. The period of significance is the Cold War, 1946-1989.

Non-contributing buildings include:

1505J (1960)	Storage (truck trailer)
1505K (found on post)	Storage (truck trailer)
1518 (1958)	General Purpose Instrument Storage (derelict; no integrity)
1527 (unknown)	Barricade (derelict; no integrity)
1528 (1963)	Barricade (derelict; no integrity)
1529 (1964)	Warehouse
1530	Administration Building (constructed after the period of significance)

The boundaries of the Rocket Test Area (1500 Area) Historic District begin at Lake Denmark Road at the west and extend easterly behind Buildings 1519 and 1520 to Building 1530 north of Hart Road and turning and extending to the south to encompass Buildings 1511, 1515 and 1513 east of Sage Place. From Building 1513, the boundary turns west and runs behind the buildings along the south side of Hart Road to the end of the chain-link fence, where the boundary turns north and extends to Hart Road. The boundary continues westerly along Hart Road to Lake Denmark Road (see Figure 4.152).

Ammunition and Explosives/General Storage. No buildings, structures or landscapes evaluated at PICA within this category are recommended as eligible for listing to the National Register of Historic Places.

Infrastructure. No buildings, structures, or landscapes evaluated at PICA within this category are recommended as eligible for listing to the NRHP.

Base Operations. No buildings, structures, or landscapes evaluated at PICA within this category are recommended as eligible for listing to the NRHP. However, the Golf Course and its

attendant buildings have never been evaluated as a group. Therefore, Panamerican recommends that it and its attendant buildings undergo an NRHP evaluation before more golf course-related structures are reviewed independent of their landscape for their NRHP status.

Housing. No buildings, structures, or landscapes evaluated at PICA within this category are recommended as eligible for listing to the NRHP since the DoD no longer owns them.

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APPENDIX A

SCOPE OF WORK

APPENDIX B

BUILDING INVENTORY

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
58A	**Not Found**		Demolished	**1956**			General Storehouse	**Foundation:** Wood on Crushed Stone **Walls:** Metal/Wood **Roof:** Corrugated Asbestos	**NO**	Not Applicable [NA]	First listed as Building 7A until 1983. Appears to have been demolished; previously located in parking lot adjacent to Building 59, next to Building 58N; concrete pad found.
67	**Off 1st Avenue**			**1953/1956**		Storage	Oil Storage Special Weapons Storehouse Flammable Materials Storehouse	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Corrugated Asbestos	**NO**	4.172	***Blueprints:*** Plans for Minor M.C.A. Program FY 1966-Building 61 Conversion and Addition; 17 June 1953
68	**Between 2nd and 3rd Avenues**			**1957**		Ordnance Facility	Unknown	**Foundation:** Concrete **Walls:** Concrete **Roof:** Corrugated Metal Prefabricated Building	**NO**	4.201	***Real Property File:*** Building renovated in 1980
70	**Off 4th Avenue**			**1948**	**Construction Division of the Quartermaster General**	Arms Building	Igloo Storage	**Foundation:** Concrete **Walls:** Earth **Roof:** Earth	**NO**	4.173	***Blueprints:*** Underground Magazine Plan-Igloo Type (Magazine Type No. 49) with Alternative plan 652T330--23 July 1937
71	**Off 4th Avenue**			**1948**	**Construction Division of the Quartermaster General**	Arms Building	Igloo Storage High Explosive Magazine	**Foundation:** Concrete **Walls:** Earth **Roof:** Earth	**NO**	4.174	
72	**Off Horney Road**	Testing Pyrotechnic Range		**1962**		Safe Shelter	Safe Shelter	**Foundation:** Dirt Floors **Walls:** Railroad Ties **Roof:** Steel, 1/4" Thick	**NO**	4.159	
73	**Off Phipps Road**			**1956**		Scale House	Scale House	**Foundation:** Concrete **Walls:** Concrete **Roof:** Asphalt Shingle	**NO**	4.202	***Real Property File:*** One scale, motor truck, Howe Model No 5964. 1966--addition to building
80	**Off 1st Street**	Sewage Treatment Plant Area		**1944/1948**		Sewage Treatment Plant (Settling Tank)	Sewage Treatment Plant (Settling Tank)	**Foundation:** Inhoff Tank Concrete construction sprinkler filter bed with crushed stone, sludge bed **Walls:** Concrete	**NO**	4.189	***Blueprints:*** Plan Notes: "Salvaged Material to be Used Whenever Possible." Chain-link fence added in 1974.
81	**Off 1st Street**	Sewage Treatment Plant Area		**1975**		Monitoring Station	Water Monitoring Facility Environ Test Water Monitoring Facility	**Foundation:** Concrete **Walls:** Fiberglass **Roof:** Fiberglass	**NO**	4.190	***Real Property File:*** Photograph of building in file; Category change 24 July 1978. Houses industrial waste monitoring equipment station #10
83	**Off 1st Street**	Sewage Treatment Plant Area		**1978**		Monitoring Station	Water Monitoring Station	**Foundation:** Concrete **Walls:** Fiberglass **Roof:** Fiberglass	**NO**	4.191	***Real Property File:*** Photograph of building in file. Category change 24 July 1978; houses Industrial waste-monitoring equipment, station #7.
92	**Off Ramsey Avenue**		**Ramsey Building**	**1964**	**Croheim & Kuo**	Physics Lab Administration R&D Product Assurance	Ordnance Facility Quality Evaluation Lab	**Foundation:** Concrete **Walls:** Concrete Block 8" **Roof:** Build-up Flat *Floors in lobby and offices are vinyl asbestos	**NO**	4.160	***Real Property File:*** Two cards and two folders for the building in file. Notation of top card: 31040 (6600SF)/61060 (28,7750 SQ) Admin R&D; Card #2 Quality Assurance Facility Built 1983 (June 23) ***PICA 1968:*** Ordnance Facility, Qual Eval Bldg (29,221 SQ FT)
92A	**Off Ramsey Avenue**			**1964/1971**		Sewage Pump Station	Sewage Pump Station	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	4.192	
94	**Off Ramsey Avenue**		**Lerner Building**	**1967**	**Nathan Conheim Architect and Engineer, Philadelphia PA.**	Administration Building, R&D Activities	Administration Building Research and Design	**Foundation:** Concrete **Walls:** CMU and Brick **Roof:** Built up	**NO**	4.203	***PICA 1968:*** Originally part of Ordnance Facility
97	**Not Found**		**Demolished or Deteriorated**	**1955**		Sewage Pump Station	Sewage Pump Station	**Foundation:** Concrete **Walls:** Frame Asbestos Board **Roof:** Roll on 1" Sheathing	**NO**	NA	***PICA 1968:*** Originally part of Ordnance Facility

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
121B	**Golf Course Off Bluffington Road**	Golf Course		**1968**		Golf Cart Storage Building	Golf Cart Storage Building	**Foundation:** Concrete **Walls:** Wood **Roof:** Strip Shingle	**NO**	4.204	Constructed with non-appropriated funds
178	**Off Kibler Road**			**1956**			Chemistry Lab Physics Lab	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** 20 BA Corrugated Galvanized Iron	**In District, non-contributing**	4.162	***Real Property File*** : Category change 1969 and 1982; checklist 1 July 1997
179	**Not Found**		**Demolished or Deteriorated**	**1978**			Water Monitoring Station #9 Water Maintenance Facility	**Foundation:** Concrete **Walls:** Fiberglass **Roof:** Fiberglass	**NO**	NA	
209	**Off Phipps Road**	Shell Component Area	**derelict**	**1956**			General Storehouse	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.2	Building is deteriorated
210	**Off Phipps Road**	Shell Component Area	**derelict**	**1956**			Ordnance Facility Major Caliber Propellant Loading	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos and Built up	**NO**	4.3	Building is deteriorated and slated for burning/demolition. **HAER 1983**
210E	**Off Phipps Road**	Shell Component Area	**Demolished or Deteriorated**	**1956**			Ready Magazine	**Foundation:** Concrete **Walls:** Reinforced Concrete **Roof:** Corrugated Asbestos **Spark-proof Floors**	**NO**	4.4	Building is deteriorated and slated for burning/demolition.
215	**Not Found**	Shell Component Area	**Demolished or Deteriorated**	**1956**		Ordnance Facility	Cast High Explosives Filling Plant Ordnance Facility	**Foundation:** Concrete **Walls:** 8" HT Mastic **Roof:** Corrugated Asbestos Roll Roofing and Wood	**NO**	NA	***Real Property File:*** Category change 1966 and 1982
215A	**Not Found**	Shell Component Area	**Demolished or Deteriorated**	**1966**		General Storehouse	General Storehouse	**Foundation:** Concrete **Walls:** Wood **Roof:** Sheet Metal	**NO**	NA	
221A	**Not Found**	Shell Component Area	**Demolished or Deteriorated**	**1959**		General Storehouse	General Storehouse	**Foundation:** Wood **Walls:** Wood **Roof:** Tar Paper	**NO**	NA	***PICA 1994:*** Located in the back of 200 line on Phipps Road, just north of Building 221, presently used as an inert material (decontaminated equipment) storehouse; no production-related activity occurred in Building 221A. Use has remained essentially the same. **Blueprints:** Conversion of building; Alterations to Storage Shed Building 221 (31 July 1957) for Lens Area Heating and Illumination.
224	**Off Phipps Road**	Shell Component Area/ Propellant Powder Plant		**1962**			Electric Equipment Facility Control Bunker for explosive machining performed in Building 225	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	4.5	***Blueprints, McKinney 2006 Form:*** Building Unutilized--Restricted area *possible explosive residue from prior operations and potential UXO; Surrounding land use: Military Weapons ROT &E, JB-2 Propellant Powder Plant Mill House No. 225 + Mill Control House (No. 224) Floor Plans--10 January 1947. ***PICA 1994:*** Located in back of 200 line on Phipps Road--No production-related activities occurred in 224; use has remained essentially the same. Restricted area due to explosives residue. **HAER 1983**
225	**Off Phipps Road**	Shell Component Area/ Propellant Powder Plant		**1946/1956**			Ordnance Facility Operating Machine Shop	**Foundation:** Concrete **Walls:** 8" Hot Tar Asbestos Board **Roof:** Corrugated Asbestos, Roll on Wood	**NO**	4.6	***Real Property File:*** Addition (2) 30'X20'X20', 1983 Dumpster Pad. JB-2 Propellant Powder Plant Mill House No. 225 + Mill Control House (No. 224) Floor Plans- 10 January 1947 ***Blueprints:*** JB-2 Propellant Powder Plant Bldgs. 225,230H,230B,323 Alterations-Ramp III. 13 May 1950 **HAER 1983**
231	**Off 10th Street**	Shell Component Area		**1959**		Cast High Explosive Filling Plant, Electronic equipment for central bunker, control bunker	Electronic Equipment Facility	**Foundation:** Concrete **Walls:** Concrete Slab, 6" **Roof:** Concrete	**NO**	4.7	***Real Property File:*** Description and category change 26 October 1965, ***McKinney Act:*** Contaminated **HAER 1983**

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
232A	**Off 10th Street**	Shell Component Area	**derelict**	**1956**			Flammable Material Storehouse	**Foundation:** Concrete base **Walls:** Wood/metal **Roof:** Roll Roofing	**NO**	4.8	***1994 Real Property File:*** Located in the back of 200 line and used as a flammable materials storehouse building. Decontaminated in the late 1960s for layaway but was used through the mid-1990s. Paint and related solvents were used in the building.
232F	**Not Found**	Shell Component Area	**Demolished or Deteriorated**	**1954**			Wood Barricade	**Foundation:** Concrete Piers **Walls:** Wood **Roof:** Rolled Roofing	**NO**	NA	
234	**Off 10th Street**	Shell Component Area		**1959**		Metallurgy Lab	Cast High Explosives Filling Plant Curing and Annealing Building	**Foundation:** Concrete **Walls:** 8" Concrete Block **Roof:** 5-Ply Built up	**NO**	4.9	***PICA 1994:*** Description and Category Change: October 1965 and April 1985. Building was decontaminated (rocket propellant) for layaway in 1969. Process equipment included: ovens, vacuum traps and presses. **HAER 1983** **Scheduled for Demolition**
236	**Off 10th Street**	Shell Component Area		**1959**		Ordnance Facility	Cast High Explosives Filling Plant Press Barricade	**Foundation:** Concrete **Walls:** Concrete **Roof:** Built up and Corrugated Aluminum	**NO**	4.10	***Real Property File:*** Description and Category Change October 1965 and July 1982 ***PICA 1994:*** Located on the north end of 200 back line off Phipps Road; used as a control room. All utilities connected to this building. No production-related activities in Building 236. **Scheduled for Demolition**
237	**Off 10th Street**	Shell Component Area		**1959**		Ordnance Facility	Press Barricade	**Foundation:** Concrete **Walls:** Concrete **Roof:** Frame and Aluminum	**NO**	4.11	***PICA 1994:*** On north side of back 200 line on Phipps Road; used for explosive pressing + PBX mixing. Operations here are done remotely. Process equipment includes a mixer and a hydraulic press. The building was decontaminated (pyrotechnic contamination) for layaway in 1969 using water and solvents. All utilities are connected to building, chemicals/materials used: Explosives and propellants, small quantities of solvents and press oils. **Scheduled for Demolition**
238	**Off 10th Street**	Shell Component Area		**1942**		Indoor Firing Range	Archery Range Press Facilities	**Foundation:** Concrete **Walls:** Tar **Roof:** Corrugated Asbestos	**NO**	4.12	***PICA 1994 :*** Located on the north end of back of 200 line on Phipps Road, used for explosive pressing facility. Includes vacuum pumps, a hydraulic press, and a 90 day hazardous waste storage area. Decontaminated (Pyrotechnic Contamination) for layaway in 1969 using water and solvents. All utilities are connected to this building, chemicals/materials used: Explosives, solvents, and press oils. **HAER 1983** **Scheduled for Demolition**
240A	**6th Street; across from Check-in Gate**	Shell Component Area		**1957**			Sentry Station	**Foundation:** Concrete **Walls:** Steel **Roof:** Build up	**NO**	4.13	
242C	**Not Found**	Shell Component Area	**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
247	**Off 10 Street**	Shell Component Area		**1962**			Hydrostatic Isostatic Press Building Barricades Explosives	**Foundation:** Concrete **Walls:** Steel Insulated Wall Panel **Roof:** Build-up Concrete Barricade with Steel. TV Tower to Center Section and 2 Double Wings	**NO**	4.14	***PICA 1994:*** Located at the end of Phipps Road. Constructed in 1962 as a hydrostatic (isotatic) press facility. The building was never used for this purpose. It was renovated in the mid-1990s for use as a control room for the High Speed Windstream Test Facility. A test stand (247A) was scheduled to be on a concrete pad immediately adjacent. **HAER 1983**
283D	**Not Found**	Shell Loading Area	**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
295	**Off Reilly Avenue**	Shell Loading Area	**derelict**	**1941**			Operating Lead Azide Primer Mix Blending and Pelleting Building, Composition "K" plant	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.16	***PICA 1994:*** Located west of the junction of Reilly Road and Whittemore Avenue. Constructed as a Lead Azide and Primer Mixing House--the chemical compounds of initiators were weighted and mixed here before being taken over to the 200 Area Initiator-Loading Facility. Also used as Medium and Large Caliber Projectile Loading and Pelleting Facility (reportedly inactive since 1979). Yellow smoke compound caught on fire in 1962 and burned Room 3. Numerous chemicals/ materials were used. **HAER 1983**

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
296	**Off Reilly Avenue**	Shell Loading Area	**derelict**	**1941**	**War Plans Division**		Operating Building Tracer Composition	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.17	***PICA 1994:*** Located west of the junction of Reilly Road and Whittemore Avenue; it is connected to Building 295 by covered walkway. Constructed as Operating Building, wooden addition completed in 1956. In 1964 a flash fire occurred during the blending of real phosphorous and magnesium, no explosive damage. **HAER 1983**
302F	**Off 11th Avenue**			**1956**			Post Engineer Storehouse	**Foundation:** Concrete **Walls:** Galvanized Iron **Roof:** Corrugated Asbestos	**NO**	4.175	Enclosed shed construction
305	**Off 12th Avenue**		**derelict**	**1945/1956**			Post Engineer Maintained Shop Facility Engineer Storehouse Ice Making Building	**Foundation:** Concrete **Walls:** Frame Siding **Roof:** Roll Roofing	**NO**	4.176	
314B	**Off Fast Street**			**1958**		Storage	Salvage and Surplus Property Storage	**Foundation:** Concrete **Walls:** Corrugated Iron/Metal **Roof:** Corrugated Metal	**NO**	4.177	
317E	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
320	**Off 8th Avenue; behind #318**		**ARDEC Rehab Protection OFC Health and Physics Lab**	**1956**		**ARDEC Rehab Protection OFC Health and Physics Lab**	Incinerator Health and Science Lab AC Plant	**Foundation:** Piles, Concrete Footings **Walls:** Brick **Roof:** Built-up Roof	**NO**	4.194	***Real Property File:*** Addition in 1958, Addition in 1988 ***Blueprints:*** Renovation of Building 320 Health Physics Lab Plumbing "Haul Plans; 21 February 1980 ***Blueprints:*** Building 320 Addition Site Plan, Section and Details; 1 June 1984
403A	**Off 9th Street**	Gun Bag Loading Area	**derelict**	**1947/1956**		General storage	Storage Barrier Materials Storage	**Foundation:** Concrete **Walls:** Roll Roofing on Wood **Roof:** Rubberoid on Wood	**NO**	4.20	***Blueprints:*** Building No. 403A Alterations and Connection to Building 338- Access Road; 7 April 1953
407B	**Not Found**	Gun Bag Loading Area	**Demolished or Deteriorated**	**1947**		Storage	Chemistry Lab Flammable Material Storehouse Plastics Specimens Storage	**Foundation:** Concrete **Walls:** Transite **Roof:** Roll Roofing	**NO**	NA	***Real Property File:*** Category change 1982, category change 1987; new computer room 1992
427A	**Off 13th Avenue**	Gun Bag Loading Area		**1949**		Flammable Material Storehouse	Flammable Material Storehouse	**Foundation:** Concrete **Walls:** Frame Wood, Tar Paper **Roof:** Roll Roofing on Sheathing	**NO**	4.21	***Real Property File, McKinney Act:*** Land Use: Military RDT&E ***Blueprints:*** No. 427A, New Truck Loading Dock; 18 April 1956
429A	**Off 13th Avenue**	Gun Bag Loading Area	**derelict**	**1954**			High Explosive Magazine	**Foundation:** Concrete **Walls:** Transite **Roof:** Roll	**NO**	4.22	
436	**Off 13th Avenue**	Gun Bag Loading Area		**1948/1956**			Propellant Processing Plant Mix and Dry Propulsion Systems Facility	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated APM	**NO**	4.23	***Real Property File, McKinney Act:*** Possible explosives residue from prior operations and potential UXO
452	**Not Found**	Gun Bag Loading Area	**Demolished or Deteriorated**	**1929/1956**	**Office of the Quartermaster General, Picatinny Arsenal; Rehabilitation Project**		General Purpose Magazine Bag Charge Filling P1 Operations Igniter Loading Building	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** AMP	**NO**	NA	***1994 Real Property*:** Northwest of Whittemore Avenue on 16th Street. One-story with two story tower for bag unloading operations. Completed in 1942 but the building appears on the installation map from the late 1920s. Engineering drawings predating 1942. Had toilet facilities prior to 1940s. Likely built in the early 1930s along with other loading facilities in 400 Area. Bag Filling and Igniter Loading and Sewing; until 1970s. Also used for storage of propellants. Equipment: Presses and shakers. Slated for demolition under TECUP-1985 contaminated buildings. ***Blueprints:*** Was Building T-866; changed to 453; 18 February 1929

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
454B	**Off 16th Avenue**	Gun Bag Loading Area	**derelict**	**1942**			Magazine	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** AMP	**NO**	4.24	**HAER 1983**
471	**Off 13th Avenue**	Gun Bag Loading Area		**1944/1966**			Administration General Purpose Office New Change House for No. 427	**Foundation:** Concrete **Walls:** Metal **Roof:** Metal (Pre-Fab Metal Building)	**NO**	4.25	Built as Change House for Building 427.
471A	**Off 13th Avenue**	Gun Bag Loading Area		**1962**		Flammable Material Storehouse	Flammable Material Storehouse	**Foundation:** Concrete **Walls:** Corrugated Metal **Roof:** Corrugated Asbestos	**NO**	4.26	
471B	**Off 13th Avenue**	Gun Bag Loading Area		**1962**		Flammable Material Storehouse	Flammable Material Storehouse	**Foundation:** Concrete **Walls:** Corrugated Metal **Roof:** Corrugated Asbestos	**NO**	4.27	***Real Property File, McKinney Act (9 June 2006):*** Unutilized; Surrounding Land Use: Military Weapons RDT&E inactive explosive operating area. Possible explosive reside
472	**The Corner of 16th Avenue and 11th Street**	Gun Bag Loading Area		**1942/1967**	**Tectonic Associates Architect-Engineers; Somerville NJ 1965 Plan**	Storehouse	Chemistry Lab Change House Flammable Materials Storehouse Storehouse	**Foundation:** Reinforced Concrete **Walls:** Masonry **Roof:** Asphalt Shingle	**NO**	4.28	***Blueprints:*** Rehab and Expansion of Industrial Facilities AMC 59072 As Built; 9 September 1965 **HAER 1983**
476	**Off Ninth Street**	Gun Bag Loading Area		**1978**			Environmental Pollution Monitoring Test Facility Water Monitoring Station	**Foundation:** Concrete **Walls:** Fiberglass **Roof:** Fiberglass	**NO**	4.29	***Real Property File:*** Houses industrial waste monitoring equipment Station #3. Photographs in Real Property File
477E	**Not Found**	Gun Bag Loading Area	**Demolished or Deteriorated**	**1945**			Magazine	**Foundation:** Wood Post **Walls:** Frame **Roof:** Corrugated Asbestos	**NO**	NA	
501	**Off Babbitt Road**	Powder Factory		**1928/1945**			General Purpose Magazine P.E. Maintenance Shop Measuring Equipment and Repair Building	**Foundation:** Wood Post **Walls:** Frame Plywood **Roof:** Corrugated Asbestos	**NO**	4.32	***Blueprints:*** Rehabilitation Project Annex to Surveillance Magazine 119 (Crossed out with 501); 14 July 1928 (Hollow Tile) ***Blueprints:*** Scale Shop Environmental Control; 29 August 1967 **HAER 1983**
506B	**Off Babbitt Road**			**1958**	**Burns and Bege, Inc., New York 1953**		Electric Power CF2-1000 GPM Pump house	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Built up	**NO**	4.193	***PICA 1994 :*** On the western boundary of Picatinny Lake, built in the late 1950s as pump house. Built as Steam and Power Generating Facility; 21 August 1953
524	**Off Waters Road**	Powder Plant, Smokeless Powder Line		**1955**	**Drake & Tuthill Associates**		Change House Administration General Purpose	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Asbestos Shingles	**NO**	4.33	***PICA 1994:*** Northeast of junction of Whittemore Avenue and Babbitt Road (28'X28' building); change house and field office for Powder Factory Area. Presently used as a security office for ISA (1994). Building located on formerly developed plot of land. **HAER 1983**
540	**21st Avenue**	Powder Plant, Smokeless Powder Line	**Demolished February 6, 2007**	**1942**			Load/Unload Dock/Ramp	**Foundation:** Concrete **Walls:** N/A **Roof:** Corrugated Iron	**NO**	NA	***PICA 1994:*** Before it was **demolished**, located on 21st Avenue, northeast of Whittemore Avenue and Babbitt Road. Built as a Loading and Unloading Dock to store carts used in 500 Area Nitrocellulose Powder Production Lines. (Storage tank aboveground next to foundation.)
566	**Off Babbitt Road**	Powder Plant, Smokeless Powder Line	**derelict**	**1954/1958**			Ordnance Facility Propellant Plant Screening Building	**Foundation:** Concrete **Walls:** Transite **Roof:** Asbestos Roll **Floors:** Lead lined over concrete	**NO**	4.34	***PICA 1994:*** On Babbitt Road northeast of Whittemore Avenue (16'X25'). Screening House in support of Gun Propellant Manufacturing Operations, also used for finishing operations in the production of IMR Propellant and Bottle Washing. **HAER 1983**
567	**Off Babbitt Road**	Powder Plant, Smokeless Powder Line	**derelict**	**1954/1956**			Propellant Plant Ordnance Facility Storehouse Rest House	**Foundation:** Concrete **Walls:** Concrete and Transite **Roof:** Asbestos Roll	**NO**	4.35	***PICA 1994:*** Babbitt Road northeast of Whittemore Avenue (39'X97"). Constructed in 1956 as a Propellant Rest House (i.e., process M17 composition propellants)

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
584	**Demolished**	Powder Plant, Smokeless Powder Line	**Demolished or Deteriorated**	**1944**				**No Real Property Info**	**NO**	NA	
602C	**Off 20th Avenue**			**1967**			Change House Engineering Field Office	**Foundation:** Reinforced Concrete **Walls:** Masonry Block **Roof:** Asphalt Shingle	**NO**	4.64	
603	**Not Found**		**Demolished or Deteriorated**	**1941**			Ordnance Facility Black Powder Drying	**Foundation:** Concrete **Floors:** Lead Covered **Walls:** 8" Hollow Tiles **Roof:** Asbestos	**NO**	NA	***PICA 1994:*** Located on 20th Avenue, constructed for use as a dry house for initiators and black powder. Building was decontaminated (black powder contamination) for layaway in 1969 using water wash; presently inactive and under consideration for disposal. Chemical materials used: black powder, potassium nitrate, sodium nitrate, and solvents)
603E	**Off 20th Avenue**			**1938**		Garage/Storage	Flammable Material Storehouse	**Foundation:** Concrete **Walls:** Galvanized Iron **Roof:** Corrugated Galvanized Iron Butler Building	**NO**	4.65	***Real Property File:*** Request for **Approval of Disposal of Buildings** and Improvements; 25 March 1994. Building and accompanying 190-linear-foot covered walkway was used by the now extinct Technical Support Directorate, originally built for the production and storage of energetic materials. *****Attached NJ SHPO MOA dated 1 April 1991 (not in folder)
603F	**Not Found**		**Demolished**	**1923**			Magazine	**Foundation:** Concrete **Walls:** Galvanized Iron **Roof:** Corrugated Galvanized Iron	**NO**	NA	***PICA 1994:*** Before it was **demolished**, Building 603F was located on 20th Avenue. It was rectangular (21'X18") and served as a General Purpose Magazine. Explosives would have been stored here.
604H	**Not Found**		**Demolished or Deteriorated**	**1963**			Ordnance Facility	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	NA	***Real Property File:*** Category change: 1982
606	**Off James and Deavy Roads**			**1960**			Ordnance Facility Experimental Test	**Foundation:** Concrete **Walls:** 12" Concrete and Corrugated **Roof:** Metal and Build up	**NO**	4.66	***Real Property File:*** Category change: 1982
606A	**Not Found**		**Demolished or Deteriorated**	**1980**			General Purpose Storage Shed	**Foundation:** Wood **Walls:** Steel **Roof:** Steel Temporary building	**NO**	NA	***Real Property File:*** Commercially available reloadable building (temporary)
606B	**Not Found**		**Demolished or Deteriorated**	**1980**			General Purpose Storage Shed	**Foundation:** Wood **Walls:** Steel **Roof:** Steel Temporary building	**NO**	NA	***Real Property File:*** Commercially available reloadable building (temporary)
612	**Not Found**		**Demolished or Deteriorated**	**1958**			High Explosive Storage Magazine Storage *Blueprints: Rate of Detonation Building; 24 October 1942	**Foundation:** Railroad Ties **Walls:** Sheet Metal **Roof:** Corrugated Asbestos	**NO**	NA	
614	**Off Greenberg Road**			**1958**			General Purpose Warehouse	**Foundation:** Railroad Ties **Walls:** Frame on Plywood **Roof:** Roll On	**NO**	4.67	
615	**Test Firing Field Off 20th Avenue**			**1958**			Ordnance Facility Fire Control Barricade Turret	**Foundation:** Concrete **Walls:** 1/4" Steel **Roof:** 1/4" Steel **Turret**	**NO**	4.68	***Blueprints:*** Picatinny Arsenal USA Rehabilitation Project Gun Shed (Originally Building T-828, changed to No. 615
616	**Test Firing Field Off Deavy Road**			**1963**	**Tectonic Associates Architect-Engineers; Somerville NJ 1963 Plan**		Ordnance Facility Test and Evaluation Facilities	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete Slab	**NO**	4.69	

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619	**Off Stickle Road**	Ammo Testing Facility Bear Swamp Area		**1965**	**Tectonic Associates Architect-Engineers; Somerville NJ 1964 Plan**		High Explosive Magazine Test Facility Ordnance Facility Hypervelocity Test Facility	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Concrete	**NO**	4.72	***Real Property File:*** Category change:1977 & 1981 ***Blueprints:*** RDT&E Minor Construction Program FY 1964
621A	**Off Stickle Road**	Ammo Testing Facility Bear Swamp Area		**1947**			Small Arms Pyrotechnics Magazine	**Foundation:** Concrete **Walls:** Transite **Roof:** Roll	**In District, non-contributing**	4.72A	
622	**Off Stickle and Hance Roads**	Ammo Testing Facility Bear Swamp Area		**1945/1964**	**Tectonic Associates Architect-Engineers; Somerville NJ 1962 Plan**		Ordnance Facility Metallurgy Lab Firing Chamber for Testing Projectile Explosive Metal Forming Facility	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Built up on Fiberboard	**NO**	4.73	***Real Property File:*** Category change:1977 & 1982
623F	**Off 20th Avenue**	Ammo Testing Facility Bear Swamp Area		**1957**			Water Pump NP 1-400 GPM Valve House	**Foundation:** Concrete **Walls:** Transite **Roof:** Transite	**In District, non-contributing**	4.74	
625F	**Not Found**	Ammo Testing Facility Bear Swamp Area	**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
627	**Off Stickle Avenue**	Ammo Testing Facility Bear Swamp Area		**1954/1958**			High Explosive Magazine Explosive Test Firing Observation Building Shaped-Charge Test Facility Observation	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	4.75	***Real Property File:*** Category change:1981
630	**Off Bear Swamp Road**	Ammo Testing Facility Bear Swamp Area	**William C. Sweny Building**	**1957**	**Plant Engineering Section Picatinny Arsenal**	Administration Building/Office	Office Administration Building General Building Change House	**Foundation:** Concrete **Walls:** 2" AFC Board **Roof:** 5-ply Built up	**NO**	4.76	
631	**Between 20th Avenue and Bear Swamp Road**	Ammo Testing Facility Bear Swamp Area		**1953/1957**	**Plant Engineering Section Picatinny Arsenal**		Ordnance Facility Conditioning Building Environmental Chambers Powder Conditions and Service Building	**Foundation:** Concrete **Walls:** Cemesto **Roof:** Built up	**NO**	4.77	***Real Property File:*** Powder and Conditioning adjacent to Service Building
632	**Off Bear Swamp Road**	Ammo Testing Facility Bear Swamp Area	**derelict**	**1953/1957**			Propellant Conditioning Magazine Service Chemistry Lab Loading Building Constant Temperature Service Building	**Foundation:** Concrete **Walls:** Cemesto **Roof:** Built up *Asbestos Cement-Faced Fiberboard	**NO**	4.78	***Real Property File:*** Category change: 1983
633	**Off 20th Avenue**	Ammo Testing Facility Bear Swamp Area #1		**1957**			Ordnance Facility Propellant Storage Storage/Loading	**Foundation:** Concrete **Walls:** Cemesto **Roof:** 5-ply Built up	**NO**	4.79	***Real Property File:*** Category change: 1977 & 1982
S634	**Off Greenberg Road**	Ammo Testing Facility Bear Swamp Area #1	**derelict**	**1930**			Ordnance Facility Slug Butt	**Foundation:** Dirt/Sand Floor **Walls:** Plank **Roof:** Open Roof	**NO**	4.70	***RPF, McKinney Act Demo Checklist:*** Utilized, ordnance test stand restricted area, possible explosive residue. Surrounding Land Use: Military Weapons RDT&E
636	**Off Hance Road**	Ammo Testing Facility Bear Swamp Area #1		**1957**			Gun Service Ordnance Facility	**Foundation:** Concrete **Walls:** Cemesto **Roof:** 5-ply Built up	**NO**	4.80	***Blueprints:*** Ammunition Testing Facilities Bear Swamp Area #1 Gun Service Building 636, Observation Building 637 and Emplacement Pad Site Plan and Cross Sections 15 January 1953.

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
636B	**Not Found**		**Demolished or Deteriorated**	**Found on Post**			Storage Shed General Purpose Storage	**Foundation:** Piers **Walls:** Wood **Roof:** Composite Surface	**NO**	NA	
637	**Off Hance Road**	Ammo Testing Facility Bear Swamp Area #1		**1953/1957**			Ordnance Facility Observation	**Foundation:** Concrete **Walls:** Concrete and Steel **Roof:** Concrete	**NO**	4.81	***Real Property File:*** Possible UXO Area ***Blueprints:*** Device for Remote Lanyard Firing of Weapons; 26 February 1957
637A	**Off Hance Road**			**1957**			Emplacement Pad Ordnance Facility	**Concrete Pad**	**NO**	4.82	
642	**Not Found**		**Demolished or Deteriorated**	**1957**			Electric Equipment Facility Observation	**Foundation:** Concrete **Walls:** Cemesto **Roof:** Built up	**NO**	NA	
642A	**Not Found**		**Demolished or Deteriorated**	**1957**			Latrine Public Toilet	**Foundation:** Wood **Walls:** Frame **Roof:** Roll Roofing	**NO**	NA	
643	**Not Found**	Bear Swamp Area #3	**Demolished or Deteriorated**	**1957**			High Explosive Magazine (Magazine #1)	**Foundation:** Concrete **Walls:** 2" Cinder block **Roof:** Built Up	**NO**	NA	***Real Property File:*** Card dated 9 May 1959 ***Blueprints:*** 8'x8' Magazine
644	**Off 20th Avenue**	Bear Swamp Area #3		**1964**			High Explosive Magazine	**Foundation:** Concrete **Walls:** 8" Cinder block **Roof:** Corrugated Aluminum	**NO**	4.84	***Blueprints:*** Magazine 16'x20'
645	**Not Found**	Bear Swamp Area #2	**Demolished or Deteriorated**	**1952/1957**			Ordnance Facility Barricade Shaped Charge Barricade Instrumentation	**Foundation:** Concrete **Walls:** Concrete and Steel **Roof:** Steel	**NO**	NA	***Real Property File:*** No Card, Transfer and Acceptance of Military Real Property (20070206)
645A	**Not Found**	Bear Swamp Area #3	**Demolished or Deteriorated**	**1962**				**No Real Property Info**	**NO**	NA	**Real Property File:** Purchased in 1962 (9-16-68); 11 December 1974 Relocated formerly reported missing 2/2007. Transfer and Acceptance of Military Real Property. 20070206 Facility numbers, 645, 645A, 645B, 655, 659, 640 were found to be missing upon inspection.
646	**Off Bell Road**	Photoflash Area; Bear Swamp Area #3		**1958**			Pump House	**Foundation:** Concrete **Walls:** Steel **Roof:** Steel	**NO**	4.85	
647	**Off Seavy Road**	Bear Swamp Area #3		**1957**			Electronic Equipment Facility	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	4.86	***Blueprints:*** Ammo Testing Facilities Bear Swamp Area 2-3. Instrumentation Building 647, Personnel Building 650, and Shaped-Charge Barricades 645-644-651 Heating Power Illumination 15 January 1953, 24 March 1955
649	**Not Found**	Bear Swamp Area #3	**Demolished or Deteriorated**	**1953/1957**			Ordnance Facility Barricade	**Foundation:** Concrete **Walls:** Concrete Steel **Roof:** Concrete	**NO**	NA	***Blueprints:*** Spin Test Machine in Building
650	**Off Bear Swamp Road**	Bear Swamp Area #3		**1957**			Electronic Equipment Facility Personnel Building	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	4.87	***Real Property File:*** Renovations 1994
651	**Off Bear Swamp Road**	Bear Swamp Area #3		**1957**			Ordnance Facility Barricade	**Foundation:** Concrete **Walls:** Concrete & Steel **Roof:** Concrete	**NO**	4.88	
652	**Not Found**		**Demolished or Deteriorated**	**1960**			Rocket Test Stand (from photo) Ordnance Facility (PICA 1968) Observation Barricade	**Foundation:** Reinforced Concrete **Walls:** Steel **Roof:** Steel	**NO**	NA	Historic photograph shows Test Stand; ***PICA 1968*** says Observation Barricade
652A	**Not Found**		**Demolished or Deteriorated**	**1960**			Ordnance Facility Fuze Test Tunnels	**Foundation:** Concrete **Walls:** Concrete **Roof:** No Roof	**NO**	NA	Building could not be located and has probably been demolished.

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
652B	**Not Found**		**Demolished or Deteriorated**	**ca. 1960**			Ordnance Facility Fuze Test	**Foundation:** Reinforced Concrete **Walls:** Reinforced Concrete **Roof:** Reinforced Concrete	**NO**	NA	***PICA 1968:*** Fuze Test Tunnels were associated with this
653	**Not Found**		**Demolished or Deteriorated**	**1963**			Ordnance Facility Firing Pad	**Foundation:** Concrete	**NO**	NA	
654	**Off Bear Swamp Road**			**1963**			Ordnance Facility Control Bunker	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete Slab	**NO**	4.89	
655	**Not Found**		**Demolished**	**Found on Post**			Ordnance Facility	**Steel Cage**	**NO**	NA	**Demolished 6 July 2007**
657	**Not Found**		**Demolished or Deteriorated**	**1964**			General Purpose Warehouse	**Foundation:** Railroad Ties **Walls:** Wood **Roof:** Rolled Roofing	**NO**	NA	***Real Property File:*** Semi-permanent
658	**Not Found**		**Demolished or Deteriorated**	**1983**			Lightning Detection System	**No Real Property Info**	**NO**	NA	
659	**Not Found**		**Demolished or Deteriorated**	**WWII**			Turret Ordnance Facility	**Foundation:** No Foundation **Walls:** 1/4" Steel **Roof:** 1/4" Steel **Turret**	**NO**	NA	***Real Property File:*** Card dated 18 July 1918 F.O.P. Transfer and Acceptance of Military Real Property 2 July 2006; ***McKinney Act Checklist (11 January 2005):*** Unutilized, Ordnance Test Stand, Surrounding Land Use: Military Weapons RDT&E
670	**Off Bear Swamp Road**			**1955/1958**		Firing Stand with Dark Room (1968)	Electronic Equipment Facility Experimental Test Facility Firing Stand with Dark Room	**Foundation:** Concrete **Walls:** Concrete Armor Plate **Roof:** Concrete Armor Plate	**NO**	4.91	***Real Property File:*** Includes Firing Test Stand, concrete and steel 10'X24', dark room addition 1965
671	**Off Bear Swamp Road**			**1958**		General Purpose Magazine	General Purpose Magazine	**Foundation:** Concrete **Walls:** Plywood with Metal **Roof:** Asbestos with Metal	**NO**	4.92	***Real Property File:*** 19 July 1963--Renumbered
672	**Off Bear Swamp Road**		**derelict**	**1956/1961**		Storage	General Storehouse	**Foundation:** Concrete **Walls:** Frame (wood) **Roof:** Roll Roofing	**NO**	4.93	***Real Property File:*** 27 February 1961--Remodeled
673	**Off Bear Swamp Road**			**1963**			Electronic Equipment Facility	**Foundation:** Concrete Slab **Walls:** Steel **Roof:** Steel	**NO**	4.94	
717C	**Off Fidlar Road**		**Fire Support ARMTCEN Electric Armaments Research Center**	**1941/1963**		General Purpose Magazine	General Purpose Magazine Storage Magazine for Building #717	**Foundation:** Concrete **Walls:** Concrete-Corrugated Galvanized Iron **Roof:** Corrugated Asbestos	**NO**	4.178	***PICA 1994:*** Active through 1984, Chemical/Materials: HE, pressed pyrotechnics, acetone.
717G	**Off Fidlar Road**			**1941**		Foundation Only	General Purpose Magazine	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.179	***1994 Real Property:*** Stored explosives and acetone
717I	**Not Found**		**Demolished or Deteriorated**	**1943**			General Purpose Magazine	**Foundation:** Concrete **Walls:** Galvanized Iron, Steel **Roof:** Corrugated Asbestos	**NO**	NA	***1994 Real Property:*** Stored H.E., black powder, loaded fuzes, and acetone

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
717J	**Not Found**		**Demolished or Deteriorated**	**1917**			General Purpose Magazine	**Foundation:** Wood Planks **Walls:** Sheet Iron **Roof:** Corrugated Asbestos	**NO**	NA	***1994 Real Property:*** Constructed in two phases, the first in 1917, the second in 1957. There is a room labeled "pit" at one end of building, it stored smokeless powder, H.E., sulfur, propellant, and acetone.
717L	**Not Found**		**Demolished or Deteriorated**	**1956**			General Purpose Magazine	**Foundation:** Railroad Ties **Walls:** Transite **Roof:** Asbestos Roll	**NO**	NA	***1994 Real Property:*** Box of flares caught fire in 1963 and burned this building. In 1967 the building was completely destroyed by fire. It was reconstructed after the fire for use as a storage magazine. Stored pressed pyrotechnics and flares.
732E	**Not Found**		**Demolished or Deteriorated**	**1938**			Pyrotechnic Unit Magazine	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Corrugated Galvanized Iron	**NO**	NA	
800	**Off Crain Road**	Project Jackstraw, Complete Rounds Melt Loading		**1925/1957**	**PA Plant Engineering & Maintenance**		Special Projects Operating Loading Building Ammo Teardown Electric Motor Plant	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Corrugated Asbestos	**NO**	4.41	**HAER 1983**
807B	**Not Found**	Project Jackstraw Melt Loading	**Demolished or Deteriorated**	**1941**			Special Projects Vacuum House	**Foundation:** Concrete **Walls:** Galvanized Iron **Roof:** Galvanized Iron	**NO**	NA	**HAER 1983**
807C	**Not Found**	Melt Loading	**Demolished or Deteriorated**	**1958**			Guard Station Sentry Station	**Foundation:** Railroad Ties **Walls:** Frame **Roof:** Roll Roofing	**NO**	NA	
808	**Off Fidlar Road**	Melt Loading		**ND**			Equipment Shed	**Foundation:** concrete **Walls:** metal **Roof:** metal	**NO**	4.42	
809	**Off Fidlar Road**	Melt Loading		**1925/1930**			Ordnance Facility Conveyor Drive and Motor House	**Foundation:** Reinforced Concrete **Walls:** 8" Hollow Title and Metal **Roof:** Corrugated Asbestos	**NO**	4.43	Addition unknown date-metal siding and roof **HAER 1983**
810	**Off Fidlar Road**	Melt Loading	**derelict**	**1930**			Ordnance Facility Explosives Building	**Foundation:** Concrete **Walls:** HT **Roof:** Corrugated Asbestos	**NO**	4.44	**HAER 1983**
810A	**Off Fidlar Road**	Melt Loading		**1944**			Ordnance Facility Major Caliber Projectile Loading Plant Vacuum Pump House	**Foundation:** Reinforced Concrete **Walls:** Concrete **Roof:** Corrugated Asbestos	**NO**	4.45	**HAER 1983**
813A	**Off Fidlar Road**	Melt Loading		**1941**			General Purpose Magazine	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.46	
813D	**Off Fidlar Road**	Melt Loading	**Deteriorated**	**1948**			Ordnance Facility Major Caliber Projectile Loading Plant Vacuum Pump House	**Foundation:** Reinforced Concrete **Walls:** Hollow Tile and Wood **Roof:** Concrete	**NO**	NA	**Scheduled for Demolition, has already deteriorated**
816A	**Off Fidlar Road**	Melt Loading		**1930/1944**			Ordnance Facility Major Caliber Projectile Loading Plant Vacuum Pump House	**Foundation:** Reinforced Concrete **Walls:** Concrete **Roof:** Corrugated Asbestos	**NO**	4.47	**HAER 1983**

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
816B	**Off Fidlar Road**	Melt Loading		**1941**			Ordnance Facility Major Caliber Projectile Loading Plant Compressor House	**Foundation:** Reinforced Concrete **Walls:** 8" Hollow Tile **Roof:** Concrete	**NO**	4.48	**HAER 1983**
816C	**Off Fidlar Road**	Melt Loading		**1930**			Magazine General Purpose Magazine	**Foundation:** Concrete Piers **Walls:** 8" Hollow Tile **Roof:** APM	**NO**	4.49	***PICA 1994:*** 12'X12' building, contaminated with propellants, decontaminated with hot water. Stored explosives, propellant and smokeless powder
816D	**Off Fidlar Road**	Melt Loading		**1930**			Magazine General Purpose Magazine	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** APM	**NO**	4.50	***PICA 1994:*** 18'X22' one-story used as magazine, decontaminated with steam/hot water. Stored explosives
820	**Off Fidlar Road**			**1930**			Haz Waste Storage Complete Rounds Building		**NO**	4.51	New roof added unknown date **HAER 1983**
820A	**Not Found**	Melt Loading	**Demolished or Deteriorated**	**1930**			Flammable Material Storage	**Foundation:** Concrete **Walls:** APM **Roof:** APM	**NO**	NA	***PICA 1994:*** 6'X6' building, considered decontaminated by steam/hot water. Stored paint and related solvent solutions
822	**Not Found**	Project Jackstraw Melt Loading	**Demolished or Deteriorated**	**1930**			Magazine General Purpose Magazine	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** APM	**NO**	NA	***PICA 1994:*** Also used as a Drying House. Decontaminated by steam/hot water with explosives
823	**Off Fidlar Road**	Melt Loading	**derelict**	**1925/1930**			Major Caliber Projectile Loading Plant Ordnance Facility Ammonium Nitrate Building	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** APM	**NO**	4.52	***Real Property File:*** Card dated 1 June 1956. Industrial waste to Lake: 8" PVC-150CF. ***PICA 1968:*** Major Caliber Propellant Loading Plant Operating **HAER 1983**
824A	**Off Fidlar Road**	Melt Loading	**derelict**	**1938**			Ordnance Facility Major Caliber Projectile Loading Plant Dust Collector	**Foundation:** Cinder Block **Walls:** Transite **Roof:** White Roll	**NO**	4.53	***PICA 1994:*** Building 824A housed a rotoclone which removed dust from the Building 824 during explosives screening. Decontamination of the rotoclone occurred daily while it was operating. It is a wet scrubber, the building is considered contaminated with H.E. and may be decontaminated with steam/hot water. It is believed that there was some water seepage into Lake Picatinny.
825	**Off Fidlar Road**	Melt Loading		**1930**			General Purpose Magazine Barricade, TNT Service Building	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** APM	**NO**	4.54	***PICA 1994:*** Building is considered to be decontaminated using steam/hot water. Contaminated with HE. **HAER 1983**
900	**Off Miles Road**			**1950**			General Purpose Lab Surveillance Test Conditioning Chamber Magazine Rocket and Rocket Propellant Surveillance Lab	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.180	***PICA 1994:*** The building was renovated in 1955 for use as a research lab for the testing of liquid and solid propellants and explosives. The building is considered decontaminated by steam/hot water. It stored or used explosives, lead copper, salicylate, lead beta resorcylate, monobasic salicylate, and propellants (liquid and solid)
902	**Off Miles Road**		**derelict**	**1950**			General Purpose Lab Surveillance Test Conditioning Chamber Magazine High Temp Test Facility	**Foundation:** Concrete **Walls:** Hollow Tile and Transite **Roof:** Corrugated Galvanized Roll *Railroad Tie/Sand Blast Wall	**NO**	4.181	***PICA 1994:*** Renovated in 1947. Maintains contamination in pressurizing chambers with Freon stored here. The building is considered contaminated with H.E. and rocket propellant.
903	**Off Miles Road**			**1950**			General Purpose Lab Surveillance Test Conditioning Chamber Magazine, Igloo	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Galvanized Steel	**NO**	4.182	***PICA 1994:*** 30'x30' one-story building renovated in 1947. In 1985 the building was converted for use as an inert storage building.
926	**Off Cave Road**			**1956**			High Explosive Magazine	**Foundation:** Concrete **Walls:** Concrete/Earth **Roof:** Concrete/Earth	**NO**	4.183	

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
1033A	**Not Found**		**Demolished or Deteriorated**	**ND**			Incorporation Building	**No Real Property Info**	**NO**	NA	***PICA 1968:*** 1033 was an Incorporation Building
1036B	**Not Found**		**Demolished or Deteriorated**	**ND**			Pump House	**Foundation:** Concrete Piers **Walls:** Frame **Roof:** Roll Roofing	**NO**	NA	
1037	**Not Found**		**Demolished or Deteriorated**	**1954**	**Alexander Potter Associates**		Vertical Incinerator Waste Water Incinerator Experimental HE Plant	**No Real Property Info**	**NO**	NA	***Blueprints:*** Fluid Bed Incinerator
1038	**Not Found**		**Demolished or Deteriorated**	**1956**			Flammable Material Storehouse Solvent Storage	**Foundation:** Concrete **Walls:** Frame **Roof:** Roll Roofing	**NO**	NA	
1052A	**Not Found**		**Demolished or Deteriorated**	**1941**			Rest House	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	Building 1052 was a Nitration Building
1071C	**Not Found**		**Demolished or Deteriorated**	**1943**			Flammable Materials Storehouse Mine Loading Plant Storehouse	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	***Blueprints:*** 1071--Tetryl Crystalling Building; 5 August 1941 (date 25 January 1952)…1071 Tetryl Recrystallation (Wannamaker Process) Note: 1071A, B, D & E Demolished 15 August 1986
1071G	**Not Found**		**Demolished or Deteriorated**	**1941**			Ordnance Facility, Tetryl Dry House	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	
1090	**Off Robinson Road**			**1948**			Haleite Screening and Packing, Special Weapons Plant Lab General Purpose	**Foundation:** Reinforced Concrete **Walls:** CMU/Plaster Covered SCR **Roof:** Corrugated Asbestos Cem	**NO**	4.56	***Real Property File:*** Men's and Women's Toilets; attached card for 1084 crossed out 1090 written in. Mine Loading House 1948.11 September 1963 enclosed existing ramp.
1096	**Not Found**		**Demolished**	**1943**				**No Real Property Info**	**NO**	NA	**Demolished 5 February 2007**
1101	**Not Found**		**Demolished or Deteriorated**	**1965**			Recreation Building Golf Shelter	**Foundation:** Wood **Walls:** Wood **Roof:** Roll Roofing	**NO**	NA	
1101B	**Not Found**		**Demolished or Deteriorated**	**1963**				**No Real Property Info**	**NO**	NA	
1102	**Off Wooden Bridge Road**	Golf Course		**1960**			Garage	**Foundation:** Concrete **Walls:** Frame/ Cement board **Roof:** Rolled Roofing	**NO**	4.205	Number reissued. Blueprints for living quarters.
1109A	**Not Found**		**Demolished or Deteriorated**	**1956**				**No Real Property Info**	**NO**	NA	
1114	**Not Found**		**Demolished or Deteriorated**	**1941**			Garage (Vehicles)	**No Real Property Info**	**NO**	NA	**Demolished with 16 other garages 17 December 1998**
1136	**Off Parker Road**	Main Gate	**ARDEC Reception Center**	**ND**		ARDEC Reception Center	ARDEC Reception Center	**Foundation:** Concrete **Walls:** Frame/Cement board **Roof:** Rolled Roof	**NO**	4.206	
1140A	**Not Found**		**Demolished or Deteriorated**	**1952**					**NO**	NA	Building has been demolished and was located along Old Post Road Housing/ Residential Quarters Area that is currently wooded. Structural debris and roof shingles were noticed in surrounding areas.

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
1141	**Not Found**		**Demolished or Deteriorated**	**1941**				**No Real Property Info**	**NO**	NA	
1178	**Not Found**		**Demolished or Deteriorated**	**1961**			Change House	**Foundation:** Dirt **Walls:** Steel **Roof:** Steel	**NO**	NA	
1179C	**Off Green Pond Brook Road**	Burning Ground		**1948**			Storage Building	**Foundation: D**irt **Walls**: Wood **Roof:** Metal	**NO**	4.207	Semi-permanent building
1179D	**Off Green Pond Brook Road**	Burning Ground		**1950**			Storage Building	**Foundation: D**irt **Walls**: Wood **Roof:** Metal	**NO**	4.208	
1181	**Off Green Pond Brook Road**	Skeet Field		**1956**		Recreation Center/High House	Recreation Center	**Foundation: D**irt **Walls**: Wood **Roof:** Rolled	**NO**	4.209	
1182	**Off Green Pond Brook Road**	Skeet Field		**1956**		Recreation Center/Low House	Gas Cylinder Storage-Blueprints	**Foundation: C**oncrete **Walls**: Wood **Roof:** Rolled	**NO**	4.210	
1186	**Off Green Pond Brook Road**		**derelict**	**1966**		Open Storage Shed		**Foundation: D**irt **Walls**: Wood R**oof:** Metal	**NO**	4.184	
1187	**Not Found**		**Demolished or Deteriorated**	**1956**				**No Real Property Info**	**NO**	NA	
1201	**Off 25th Avenue**			**1948**				**Earth Igloo with Steel Cage**	**NO**	4.185	1200: H.E. Research Annex 12 August 1944; possibly nuclear igloo
1219	**Off Lake Denmark Road**			**1953**		Pump House	Pump House	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Roll Roofing	**NO**	4.195	
1221	**Not Found**		**Demolished or Deteriorated**	**1952**			Changing and Control Building	**Foundation:** Concrete **Walls:** Steel **Roof:** Steel	**NO**	NA	
1222	**Off Gorge Road**	Gorge Testing Area		**1946**			Electrical Equipment Facility	**Foundation:** Concrete **Walls:** Concrete and Steel **Roof:** Concrete	**NO**	4.163	
1222A	**Not Found**	Gorge Testing Area	**Demolished or Deteriorated**	**1956**			Storehouse	**Foundation:** Concrete **Walls:** Concrete & Steel **Roof:** Concrete	**NO**	NA	
1227A	**Off Lake Denmark Road**			**1968**			Picnic Shelter BBQ Picnic Area Shelter Lake Denmark Area	**Foundation:** Concrete **Walls:** No Sides **Roof:** Wood Shingles	**NO**	4.211	Number was reissued, earlier plans show 1219 as a pump house.
1240	**Not Found**		**Demolished or Deteriorated**	**1964**			Ordnance Facility Barricade Explosive	**Foundation:** Concrete **Walls:** Steel **Roof:** Steel **Turret**	**NO**	NA	
1242A	**Not Found**	Flight Ballistics Test Range	**Demolished or Deteriorated**	**1967/1970**		Slug Butt	Slug Butt Ordnance Facility	**Foundation:** Concrete **Walls:** Steel Pipe **Roof:** Earth Covered	**NO**	NA	
1304	**Not Found**		**Demolished**	**1945**			Propellant Plant Fan House	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	
1308	**Foundation only**	Nitroglycerine Plant/ Rocket Propellant Powder Plant	**Demolished**	**1948**			Propellant Plant Poaching Building	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	

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1309	**Foundation only**	Nitroglycerine Plant/ Rocket Propellant Powder Plant	**Demolished**	**1945**			Propellant Plant Shipping Building	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	
1310	**Off Double Base Road**	Nitroglycerine Plant/ Rocket Propellant Powder Plant		**1956**	**US Army Ordnance Department**	Air Storage Tank	Air Storage Tank	3 Concrete Cradles 12" Thick X 8.9" Long X 3.6" High on Centers	**NO**	4.58	
1350	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Powder Plant	**Demolished**	**1948**			Propellant Plant Blending	**Foundation:** Concrete **Walls:** Transite **Roof:** Roll Roofing	**NO**	NA	
1352	**Off Upper X.H.E. Road**	Nitroglycerine Plant/ Rocket Propellant Plant		**1948**			Propellant Plant Blending, Paste Building Nitroglycerine Plant Blending Building	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.59	
1355	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1948**			Storage Tanks Acid Loading Station	Steel and Wood Supports	**NO**	NA	
1366	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1956**			Propellant Plant Refrigeration	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	***Real Property File:*** Building X-1366, Barricades Explosives--concrete base 12"x8" wood sides, roll roofing on wood, dirt filled.
1368	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1945**			Ordnance Facility Propellant Plant Weight House	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	
1369	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1956**			Ordnance Facility Propellant Plant Heater House	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	
1370	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1947**			General Storage	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	
1370A	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1949**			Air Tank	Concrete Piers	**NO**	NA	
1374	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1948**			Ordnance Facility Propellant Plant N G Blending Plant	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Roll Roofing	**NO**	NA	
1375	**Not Found**	Nitroglycerine Plant/ Rocket Propellant Plant	**Demolished**	**1948**			Flammable Materials Warehouse	**Foundation:** Concrete **Walls:** 8" Hollow Tile **Roof:** Corrugated Asbestos	**NO**	NA	
1380	**Off South N. G. Road**	Nitroglycerine Plant/ Rocket Propellant Plant	**derelict**	**1949**			Ordnance Facility Propellant Plant Weight House	**Foundation:** Concrete **Walls:** Asbestos **Roof:** Roll Roofing Concrete floors covered with lead	**NO**	4.60	
1381A	**Off South N. G. Road**	Water Treatment Plant		**1948**			Water Pump House Double Base Rolled Powder Plant Building Pump House	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Corrugated Asbestos	**NO**	4.196	***Real Property File:*** No card on file; associated with Reservoir #1381
1382A	**Not Found**		**Demolished**	**1948**				**No Real Property Info**	**NO**	NA	
1392	**Not Found**	off Lake Denmark Road	**Demolished**	**1957**			Family Housing	**Foundation:** Concrete **Walls:** Wood Shingles **Roof:** Asbestos Shingles 30 June 1988-Vinyl Sided	**NO**	NA	***Real Property File:*** 1957 Acquisition of Land Tract A-88

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
1392A	**Not Found**	off Lake Denmark Road	**Demolished**	**1957**			Three-Car Garage	**Foundation:** Concrete **Walls:** Cinder Block, Frame Asbestos **Roof:** Asbestos Shingle	**NO**	NA	
1393	**Not Found**	off Lake Denmark Road	**Demolished**	**1957**			Family Housing	**Foundation:** Stone **Walls:** Frame **Roof:** Shingle Vinyl Sided in 1988	**NO**	NA	
1393A	**Not Found**	off Lake Denmark Road	**Demolished**	**1957**			Detached Garage	**Foundation:** Concrete **Walls:** Frame **Roof:** Shingle	**NO**	NA	
1398A	**Not Found**	off Lake Denmark Road	**Demolished**	**1956**			Detached Garage	**Foundation:** Wood Post **Walls:** Roll on Frame **Roof:** Roll on Frame	**NO**	NA	
1406A	**Not Found**	Rocket Powder Propellant	**Demolished or Deteriorated**	**1954**					**NO**	NA	Building 1406, 1407, and 1403 are still standing in the 1400 Area, while the concrete pad remains for Building 1404 and 1405. Building 1406A could not be located and has probably been demolished per new construction activities occurring in the 1400 Area.
1410	**Off Rocket Production Avenue**	Rocket Powder Propellant	**derelict**	**1948**			Ordnance Facility Storage Tank Shed Acetone	2 Tanks on concrete piers, covered with wood, roll roofing on 6"X6" post	**NO**	4.61	Tanks contain Freon & Genetron Fluorocarbon Solvents
1501	**Off Lake Denmark Road**	Army Rocket Test Area		**1948**			Electronic Equipment R&D Administration Building CML Equipment Material Facility Service Building, Office	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Roll Roofing	**YES, contributing to district**	4.115	
1502	**Off Lake Denmark Road**	Army Rocket Test Area		**1948**			Powder conditioning Service Building Ordnance Facility AC Plant, Compressor	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Built up	**YES, contributing to district**	4.116	Has explosives barricade made of concrete, wood-dirt filled
1503	**Off Lake Denmark Road**	Army Rocket Test Area		**1948/1956**			Powder Conditioning Building Ordnance Facility Conditioning Building	**Foundation:** Concrete **Walls:** Hollow Tile **Roof:** Built up	**YES, contributing to district**	4.101 4.136 4.137	***Real Property File:*** Card 13 August 1956. ***Blueprints:*** Held altitude chamber and salt spray facility (1959), high and low temperature test cabinets (1947), test ovens and Cold Test Chamber #5.
1504	**Off Lake Denmark Road**	Army Rocket Test Area		**1956**			Ordnance Facility Storage Shed Repair and Storage	**Foundation:** Concrete **Walls:** Corrugated Aluminum **Roof:** Corrugated Aluminum	**YES, contributing to district**	4.117	
1504A	**Off Lake Denmark Road**	Army Rocket Test Area		**1948**			Test Stand #3 HP Storage Bottle Stand and Manifold General Purpose Warehouse Storage Shed Ordnance Facility Conditioning Building	**Foundation:** Concrete **Walls:** APM **Roof:** APM-Corrugated Aluminum	**YES, contributing to district**	4.118	***Real Property File:*** #1504--Ordnance Facility Repair and Storage
1505	**Off Lake Denmark Road**	Army Rocket Test Area		**1948/1956**			Ordnance Facility Rocket Static Test Building	**Foundation:** Concrete **Walls:** Concrete **Roof:** Built Up	**YES, contributing to district**	4.102 4.103	***Real Property File:*** Card 13 August 1956 ***Blueprints:*** Drop Testing (1951), Recovery Chamber for atomic munitions branch tests (1954)

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
1505A	**Off Lake Denmark Road**	Army Rocket Test Area		**1948**		Test Cell	Test Cell	**Foundation:** Reinforced Concrete **Walls:** Reinforced Concrete and Steel, open back wall **Roof:** Reinforced Concrete and Steel	**YES, contributing to district**	4.104 4.105	
1505B	**Off Lake Denmark Road**	Army Rocket Test Area		**1948**		Test Cell	Test Cell	**Foundation:** Reinforced Concrete **Walls:** Reinforced Concrete and Steel, open back wall **Roof:** Reinforced Concrete and Steel	**YES, contributing to district**	4.119	
1505C	**Off Lake Denmark Road**	Army Rocket Test Area		**1958**		Control House	Control House	**Foundation:** Concrete **Walls:** Wood **Roof:** Rolled	**YES, contributing to district**	4.120	
1505D	**Off Lake Denmark Road**	Army Rocket Test Area		**1951**		Test Cell	Test Cell	**Foundation:** Reinforced Concrete **Walls:** Reinforced Concrete and Steel, open back wall **Roof:** Reinforced Concrete and Steel	**YES, contributing to district**	4.121	
1505E	**Off Lake Denmark Road**	Army Rocket Test Area		**1966**		Control Spin Room	Control Spin Room		**YES, contributing to district**	4.122	
1505F	**Off Lake Denmark Road**	Army Rocket Test Area		**1959**		Storage	Storage	**Foundation:** Dirt **Walls:** Wood **Roof:** Wood and Asbestos	**YES, contributing to district**	4.123 4.138	
1505N	**Off Lake Denmark Road**	Army Rocket Test Area		**1948**		Open Back Blast Area	Open Back Blast Area	**Foundation:** Reinforced Concrete **Walls**: Reinforced Concrete **Roof:** None, open	**YES, contributing to district**	4.126	
1505J	**Off Lake Denmark Road**	Army Rocket Test Area		**1960**			Inert Storehouse Storage Shed General Purpose Truck Trailer	**Foundation:** Railroad Ties **Walls:** Steel **Roof:** Steel	**NO**	4.124	
1505K	**Off Lake Denmark Road**	Army Rocket Test Area		**Found on Post**			Inert Storehouse Storage Shed General Purpose Truck Trailer	**Foundation:** Railroad Ties **Walls:** Steel **Roof:** Steel	**NO**	4.125	
1506	**Off Lake Denmark Road**	Army Rocket Test Area		**1954**			Ordnance Facility Loading, Assembling Building	**Foundation:** Concrete **Walls:** Corrugated Aluminum **Roof:** Corrugated Aluminum	**YES, contributing to district**	4.97	***Blueprints:*** Static test machine with jib crane and 2 firing stands, building relocated from LOKI area.
1507	**Off Lake Denmark Road**	Army Rocket Test Area		**1946**			High Explosives Magazine General Purpose Magazine	**Foundation:** Concrete **Walls:** Transite **Roof:** Tar Paper on Wood	**YES, contributing to district**	4.127 4.140	***Blueprints:*** Associated Berm X-1507 (Earth), building modification and addition 1957

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
1507B	**Off Lake Denmark Road**	Army Rocket Test Area		**1959**			Inert Storehouse General Purpose Storehouse	**Foundation:** Dirt **Walls:** Transite **Roof:** Roll Roof	**YES, contributing to district**	4.128	
1508	**Off Lake Denmark Road**	Army Rocket Test Area		**1955**			High Explosives Magazine General Purpose Magazine Boiler House	**Foundation:** Concrete **Walls:** Transite **Roof:** Transite	**YES, contributing to district**	4.129	***Blueprints:*** Boiler House for Building 1505
1509	**Off Lake Denmark Road**	Army Rocket Test Area		**1950**			Ordnance Facility Test Pyrotechnic pressing Building and Lab	**Foundation:** Reinforced Concrete **Walls:** Reinforced Concrete and Concrete **Roof:** Built up Reinforced Concrete	**YES, contributing to district**	4.141	***Real Property File:*** Corrugated Fiberglass blowout panels on exterior bay walls, 11 ea safety showers. 4-16-1968-Alterations and addition 1875 SqFt; ***McKinney Act (9 June 2006):*** Unutilized (5,911 Square Feet) Surrounding Land use: Military Weapons RDT&E; Recent Use: Propulsion testing,pPossible explosive residue. ***Blueprints:*** had ingredient dry and weighing room, sizing room, inspection and tool room, press (50 ton) room, grinding room, press (15 ton) room, wet blending, photoflash loading, composition dry room, assembly room, classification room, held conventional chemicals, general chemicals such as organics and dyes, inerts, held loaded items such as flares, flashes, tracers, chlorates, perchlorates and oxidants, pyro compositions, alkali, pyrophoric metals ZN and Ti and initiators. **Scheduled for Demolition as are 1509A, and 1529, which are not covered in this report.**
1510	**Off Lake Denmark Road**	Army Rocket Test Area		**1950/1956**			Pyrotechnic Administration Building R&D Office Engineering Lab and Machine Shop	**Foundation:** Concrete **Walls:** Glazed 8" Tiles **Roof:** Built up	**YES, contributing to district**	4.142	***Real Property File:*** Card date: 14 August 1956; ***McKinney Act (9 June 2006):*** Unutilized (6,062 Square Feet) Surrounding Land use: Military Weapons RDT&E, Recent Use: Propulsion Testing, Possible explosive residue **Scheduled for Demolition as are 1509A, 1517A, 1520 and 1529, which are not covered in this report.**
1510A	**Off Lake Denmark Road**	Army Rocket Test Area		**1947**			Storage	**Foundation:** Concrete **Walls:** Tile **Roof:** Corrugated Asbestos	**YES, contributing to district**	4.143	***Real Property File:*** Card date: 8 November 1956; ***McKinney Act (9 June 2006):*** Unutilized (240 Square Feet) Surrounding Land use: Military Weapons RDT&E, Recent Use: Propulsion Testing, Possible explosive residue ***Blueprints:*** Original 1510A was removed and replaced with current hollow tile building that was relocated from near #924. **Scheduled for Demolition as are 1509A, and 1529 which are not covered in this report.**
1510B	**Off Lake Denmark Road**	Army Rocket Test Area		**1948**			General Storehouse storage magazine for 1512 and 1518	**Foundation:** Concrete **Walls:** Aluminum on Wood **Roof:** Ruberoid surface on Wood Base	**YES, contributing to district**	4.144	***Real Property File:*** Category change and renumbered (was 588A), 9 September 1964
1510D	**Off Lake Denmark Road**	Army Rocket Test Area		**1947**			Water Tower	Steel	**YES, contributing to district**	4.145	
1511	**Off Lake Denmark Road**	Part of Naval Air Rocket Test Station; Army Rocket Test Area		**1952**			Conditioning General Purpose Storehouse Inert Storehouse Neutralizing and Pump Station	**Foundation:** Concrete **Walls:** Concrete and Glazed Tiles **Roof:** Built up	**YES, contributing to district**	4.146	***Real Property File:*** Card date: 31 July 1956 **Scheduled for Demolition as are 1509A, and 1529 which are not covered in this report.**
1512	**Off Lake Denmark Road**	Army Rocket Test Area		**1956**			Chemistry Lab Physics Lab Hyd Inj Caliber Stand Basic Chemistry Research Lab Laser Lab	**Foundation:** Concrete **Walls:** 8" Tile and Concrete Block **Roof:** Built up Concrete	**YES, contributing to district**	4.147	***Real Property File:*** Addition to Building: 1965; Category change: 1980 ***Blueprints:*** Interim spectroscopy lab (1977)

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
1512A	**Off Lake Denmark Road**	Army Rocket Test Area		**1958**			Flammable Material Storehouse General Purpose	**Foundation:** Concrete **Walls:** Transite **Roof:** Corrugated Metal	**YES, contributing to district**	4.148	***Real Property File:*** Category change: 1965; Category change: 1980
1513	**Off Lake Denmark Road**	Army Rocket Test Area		**1968**			General Purpose Magazine Pyrotechnic R&D Labs Engineering Labs	**Foundation:** Reinforced Concrete **Walls:** Concrete Block **Roof:** Built up Roofing Wood	**YES, contributing to district**	4.149	***Real Property File:*** Local Description: Pyrotechnic R&D Labs. Bond all metal work to ground and counter-poise; Category change: 1980 ***McKinney Act (9 June 2006):*** Surrounding Land Use: Military Explosives, Contaminated **Scheduled for Demolition as are 1509A, and 1529 which are not covered in this report.**
1514	**Off Lake Denmark Road**	Army Rocket Test Area		**1968**	**1968 alterations and additions by Rouse, Dubin & Ventura, Architect and Engineers, New York**		Liquid STR Non-Prp Flame and Incendiary Reactory Dissemination Facility Pyrotechnic R&D Labs Flammable Material Storehouse	**Foundation:** Reinforced Concrete **Walls:** Concrete Block **Roof:** Built up Roofing Wood	**YES, contributing to district**	4.150	***Real Property File:*** Local Description: Pyrotechnic R&D Labs Class I and Inerts Chemical Storage Bond all metal work to ground and counterpoise; Category change: 1980 ***McKinney Act (9 June 2006):*** Surrounding Land Use: Military Explosives ***Blueprints:*** Hot and Cold conditioning pits were added in 1953 **Scheduled for Demolition as are 1509A and 1529 which are not covered in this report.**
1515	**Off Lake Denmark Road**	Part of Naval Air Rocket Test Station; Army Rocket Test Area		**1961**	**1968 alterations and additions by Rouse, Dubin & Ventura, Architect and Engineers, New York**		Radiation Lab Electronic Lab Physics Lab Propellants Mixing Station Electrical Equipment Facility	**Foundation:** Concrete **Walls:** Glazed Tile and Concrete Block **Roof:** Built up Concrete	**YES, contributing to district**	4.151	***Blueprints:*** Flare tunnel (1964), HE test chamber, chemical storage, cooling area. Excess to Picatinny needs **Scheduled for Demolition as are 1509A and 1529 which are not covered in this report.**
1517	**Off Lake Denmark Road**	Army Rocket Test Area		**1956**			High Altitude Test Chamber Lab and Test Building Pump House	**Foundation:** Concrete **Walls:** Transite **Roof:** Aluminum and Asbestos	**YES, contributing to district**	4.107 4.108	Excess to Picatinny needs **Scheduled for Demolition as are 1509A and 1529 which are not covered in this report.**
1517A	**Off Lake Denmark Road**	Army Rocket Test Area	**Demolished or Deteriorated**	**1963**			Electric Equipment Facility	**Foundation:** Concrete **Walls:** Transite **Roof:** Rolled Roofing	**YES, contributing to district**	NA	***Blueprints:*** installation of high altitude chamber **Scheduled for Demolition as are 1509A and 1529 which are not covered in this report.**
1518	**Off Lake Denmark Road**	Army Rocket Test Area	**derelict**	**1958**			High Altitude Test Chamber Lab General Purpose Instrumental Storage	**Foundation:** Concrete **Walls:** Wood **Roof:** Built up	**NO**	4.109	***Real Property File:*** Associated Building 1518X Septic Tank, Drain Field (1966). Addition unknown date--concrete. Excess to Picatinny needs ***Blueprints:*** High altitude test chamber dome installed **Scheduled for Demolition as are 1509A and 1529 which are not covered in this report.**
1519	**Off Lake Denmark Road**	Army Rocket Test Area		**1956**			High Explosives Magazine Ready Magazine	**Foundation:** Concrete **Walls:** Transite **Roof:** Corrugated Asbestos	**YES, contributing to district**	4.110	**Scheduled for Demolition as are 1509A and 1529 which are not covered in this report.**
1520	**Off Lake Denmark Road**	Army Rocket Test Area		**1956**			Ready Magazine High Explosives Magazine	**Foundation:** Cinders **Walls:** Plywood **Roof:** Corrugated Asbestos	**YES, contributing to district**	4.111	***Real Property File:*** Category change: 1980 **Scheduled for Demolition as are 1509A, and 1529 which are not covered in this report.**
1521	**Off Lake Denmark Road**	Army Rocket Test Area		**1960**			Component Propellant Building Ordnance Facility	**Foundation:** Railroad Ties **Walls:** Plywood **Roof:** APM	**YES, contributing to district**	4.112	***Real Property File:*** Category change: 1970; Category change: 1982
1522	**Off Lake Denmark Road**	Army Rocket Test Area		**1970**			Ordnance Facility	**Foundation:** Railroad Ties **Walls:** Wood Frame/ Transite **Roof:** Rolled on Wood	**YES, contributing to district**	4.113	***Real Property File:*** Category change: 1982
1527	**Off Lake Denmark Road**	Army Rocket Test Area	**derelict**	**1960**			Barricade	**Foundation:** Dirt **Walls:** Dirt filled **Roof:** None	**NO**	4.130	Semi-permanent

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
1528	**Off Lake Denmark Road**	Army Rocket Test Area	**derelict**	**1963**			Wood Barricade, Barricade, Explosives Flammable Material Storehouse	**Foundation:** Earth **Walls:** Transite **Roof:** Transite	**NO**	4.131	
1529	**Off Lake Denmark Road**	Army Rocket Test Area		**1964**			General Purpose Warehouse	**Foundation:** Concrete **Walls:** APM **Roof:** Sheet Metal	**NO**	4.132	**RPF, McKinney Act:** Contaminated UXO
1609A	**Off Phipps Road**	Little Picatinny		**1963**		Storehouse	Storehouse Disassembly Building	**Foundation:** Concrete Piers **Walls:** Corrugated Asbestos **Roof:** Corrugated Asbestos	**NO**	4.63	***Real Property File:*** Excess to Picatinny needs-declared 9 June 2006 ***Blueprints:*** 1609 Armament Development Center Facility (1A) Physical Sciences Facility Building 1609, Buildings 1609, 1608 + 1609A Mark III Disassembly Building + Auxiliary Magazines at Detonation Pit Illumination and Power; 9 October 1941
1615	**Not Found**	Little Picatinny	**Demolished or Deteriorated**	**ND**			Seasoning Facility Screening	**Foundation:** Concrete **Walls:** Frame **Roof:** Roll Roofing	**NO**	NA	
3011	**Not Found**		**Demolished or Deteriorated**	**1940**			Tank Shed Fuel Storage	**Foundation:** Concrete **Walls:** Brick **Roof:** Metal on Wood	**NO**	NA	***PICA 1994:*** West of Building 3013 off South Office Road, constructed as Fuel Tank Shed in 1940 with two 20,000-gallon oil tanks that supplied Building 3013, 180 SqFt, it was active until demolished when two tanks were removed in 1990.
3023	**Not Found**		**Demolished or Deteriorated**	**1982**			Sewage Pump	**No Real Property Info**	**NO**	NA	
3024B	**Off West Clarke Road**			**1997**		Air Conditioning Unit		**Air Conditioning Unit on Concrete Foundation**	**NO**	4.197	
3054	**Not Found**	Pistol Range	**Demolished or Deteriorated**	**1951**				**No Real Property Info**	**NO**	NA	***PICA 1994:*** A wooden shack adjacent to an abandoned pistol range at Belt and Quarry Roads. Pistol Range active, 1936-1960. Range approved for pistol shot gun fire and tear gas rounds. There were two shacks on this site, 3054 and the second not numbered. Presently storing debris. NOTE: Near Building 3054, landfill strewn debris over an acre.
3056	**Not Found**	Pistol Range	**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3058	**Not Found**		**Demolished or Deteriorated**	**1963**				**No Real Property Info**	**NO**	NA	
3100B	**Not Found**		**Demolished or Deteriorated**	**1966**			High Explosive Magazine	**Foundation:** Concrete **Walls:** Frame **Roof:** Built-up	**NO**	NA	
3104A	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3104B	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3104C	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3104D	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3106A	**Off Battalion Road**			**1966**		High Explosives Magazine	High Explosive Magazine	**Foundation:** Concrete **Walls:** Frame **Roof:** Built-up	**NO**	4.186	Enclosed in chain-link fence

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3109	**Off Woods Road**			**1945**	**Navy Plans: Naval Ammunition Depot, Lake Denmark**		Ordnance Facility Environmental Testing Facility Ammo Packing Building	**Foundation:** Concrete **Walls:** Concrete **Roof:** Corrugated Asbestos, Built-up	**NO**	4.166	Transferred from Navy ***Blueprints:*** Navy Plans: US Naval Ammunition Depot-Lake Denmark NJ, Magazines, Ammo Packing Building 3136, 3111, 3109; 16 April 1945
3117	**Not Found**		**Demolished or Deteriorated**	**1965**				**No Real Property Info**	**NO**	NA	
3144	**Off Drop Tower Road**	Drop Tower Complex		**1968**		Drop Tower Complex	Ordnance Facility Drop Tower	**Foundation:** Concrete **Walls:** Steel **Roof:** No Roof	**NO**	4.167	***Blueprints:*** Drop Tower Machine Room--modification of electrical heating system, 18 January 1968; Drop Tower installation of receptacle power, 17 October 1972
3145	**Off Drop Tower Road**	Drop Tower Complex		**1968**		Drop Tower Complex	Ordnance Facility	**Foundation:** Concrete **Walls:** Concrete & APM **Roof:** Built-up	**NO**	4.168	***Blueprints:*** Building 3145 Observation and Utility Installation of Jib Crane Plan, Section and Details, ND; Building 3145 Impact Slab for Drop Tower, February 1973
3145A	**Off Drop Tower Road**	Drop Tower Complex		**1968**		Drop Tower Complex	High Explosives Magazine	**Foundation:** Concrete **Walls:** Frame, Asbestos Siding **Roof:** Built-up	**NO**	NA	
3151	**Corner of Gately and Battalion Roads**			**1929**		Tank		**Foundation:** Concrete **Tank:** Steel	**NO**	4.198	
3205	**Off Brown Road**	Housing		**2002**				**Foundation:** Concrete **Walls:** Frame/Brick-faced /Vinyl **Roof:** Shingles	**NO**	see 4.216	
3206	**Not Found**		**Demolished or Deteriorated**	**1936**				**No Real Property Info**	**NO**	NA	
3207A	**Off Walsh Road**	Electromagnetic Environmental Effects (E3) Team CCAC-Fuse Division		**ND**				**Foundation:** Wood **Walls:** Wood **Roof:** Shingles	**NO**	4.169	
3207B	**Off Walsh Road**	Electromagnetic Environmental Effects (E3) Team CCAC-Fuse Division		**ND**				**Foundation:** Wood **Walls:** Wood **Roof:** Shingles	**NO**	4.170	
3207C	**Off Walsh Road**	Electromagnetic Environmental Effects (E3) Team CCAC-Fuse Division	**derelict**	**ND**				**Foundation:** Wood **Walls:** Wood **Roof:** Shingles	**NO**	4.171	
3207D	**Off Walsh Road**	Electromagnetic Environmental Effects (E3) Team CCAC-Fuse Division	**derelict**	**ND**				**Foundation:** Wood **Walls:** Wood **Roof:** Shingles	**NO**	4.171	
3209A	**Off Caisson Road**	Housing		**2002**		Family Housing		**Foundation:** Concrete **Walls:** Frame/Brick-faced /Vinyl **Roof:** Shingles	**NO**	4.216	
3209B	**Off Caisson Road**	Housing		**2002**		Family Housing		**Foundation:** Concrete **Walls:** Frame/Brick-faced /Vinyl **Roof:** Shingles	**NO**	4.216	
3209C	**Off Caisson Road**	Housing		**2002**		Family Housing		**Foundation:** Concrete **Walls:** Frame/Brick-faced /Vinyl **Roof:** Shingles	**NO**	4.216	

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3209D	**Off Caisson Road**	Housing		**2002**		Family Housing		**Foundation:** Concrete **Walls:** Frame/Brick-faced /Vinyl **Roof:** Shingles	**NO**	4.216	
3209E	**Off Caisson Road**	Housing		**2002**		Family Housing		**Foundation:** Concrete **Walls:** Frame/Brick-faced /Vinyl **Roof:** Shingles	**NO**	4.216	
3210	**Off Walsh Road**			**ND**			Pump House	**Foundation:** Concrete **Walls:** Brick **Roof:** Shingles	**NO**	4.199	***Field Investigation:*** Formerly Building 86 (marked as such)
3211	**Off Walsh Road**			**1929**		Warehouse	Warehouse	**Foundation:** Concrete **Walls:** Brick **Roof:** Asbestos Shingles	**NO**	4.187	
3211B	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3211C	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3215	**Not Found**		**Demolished or Deteriorated**	**ND**					**NO**	NA	Surrounding area was visually inspected between Building 3050 and Walsh Road, but 3215 could not be located. It appears that as a result of the new residential and quarters development in this area Building 3215 may have been either demolished or deteriorated upon relocation.
3219	**Off Blacksmith Road**			**1928**			Water Reservoir Pump Building	**Foundation:** Concrete **Walls:** Siding **Roof:** Shingles	**NO**	4.200	Part of Reservoir System
3225A	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3227	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3227B	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3227C	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3227D	**Not Found**		**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3229	**Not Found**		**Demolished or Deteriorated**	**ND**			Personnel Shelter	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	NA	
3232A	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3232B	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3232C	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3232D	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
3232E	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3232F	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3233A	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3233B	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3233C	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3233D	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3233E	**Off Main Road**	Housing		**2002**				**No Real Property Info**	**NO**	see 4.216	
3234	**Not Found**		**Demolished or Deteriorated**	**Found on Post**			Playground	**Foundation:** Concrete **Walls:** Concrete **Roof:** Concrete	**NO**	NA	
3237	**Off Harris Court**			**ND**		Playground Shelter	Playground Shelter	**Foundation:** Concrete **Walls:** Frame **Roof:** Shingles	**NO**	4.212	
3237A	**Off Harris Court**			**1985**		Playground	Playground	**N/A**	**NO**	4.213	***Field Investigation:*** Swings, slide, climbing ladders, twirl-a-bout
3237B	**Off Harris Court**			**1985**		Basketball Court	Basketball Court	**N/A**	**NO**	4.214	
3238	**Off Harris Court**			**1984**		Family Housing CG & WO	Family Housing	**Foundation:** Concrete **Walls:** Brick **Roof:** Shingles	**NO**	4.217	
3243	**Not Found**		**Demolished or Deteriorated**	**1987**			Waiting Shelter	**Foundation:** No Foundation **Walls:** Wood **Roof:** Strip Shingles	**NO**	NA	
3249	**Off Main Road**	Housing		**1984**		Storage Shed	Storage Shed	**No Real Property Info**	**NO**	none	no photograph per agreement
3251	**Not Found**		**Demolished or Deteriorated**	**Found on Post**			Waiting Shelter	**Foundation:** Wood **Walls:** Wood **Roof:** Wood	**NO**	NA	
3253	**Corner of Brown Road and Main Street**			**1985**		Waiting Shelter	Waiting Shelter	**Foundation:** Concrete **Walls:** Glass **Roof:** STJ	**NO**	4.215	
3256	**Off Brown Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ NCO Quarters	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.218	Privately held housing, undergoing renovation
3257	**Off Gately Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ NCO Quarters	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.219	Privately held housing, undergoing renovation
3258	**Off Coughlin Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ NCO Quarters	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles	**NO**	4.220	Privately held housing, undergoing renovation
3259	**Off Coughlin Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ NCO Quarters	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.221	Privately held housing, undergoing renovation
3260	**Off Coughlin Road**	MCA Housing		**1965**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ NCO Quarters	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.222	Privately held housing, undergoing renovation

#	LOCATION	AREA	NAME	DATE	ARCH/BLDR	CURRENT USE	PAST USE	CONSTRUCTION MATERIALS	NRE	PHOTO #	ADDITIONAL INFORMATION
3261	**Off Coughlin Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ Company Grade and Warrant Officers	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.223	Privately held housing, undergoing renovation
3262	**Off Coughlin Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ Company Grade and Warrant Officers	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.224	Privately held housing, undergoing renovation
3263	**Off Belt Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ Company Grade and Warrant Officers	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.225	Privately held housing, undergoing renovation
3264	**Off Belt Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ Company Grade and Warrant Officers	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.226	Privately held housing, undergoing renovation
3265	**Off Belt Road**	MCA Housing		**1964**		Family Housing: 4 Apartments/ (2) 2-BDRM/ (2) 4-BDRM	Family Housing/ Company Grade and Warrant Officers	**Foundation:** Concrete **Walls:** Frame **Roof:** Asphalt Shingles *Vinyl Sided 1988	**NO**	4.227	Privately held housing, undergoing renovation
3403	**Off Lower Belt Road**	Navy Hill		**1944/1951**	**Hugh A. Kelly-B. Summer Gruzen Architects-Engineers Bergen Ave, Jersey City, NJ**		Chemistry Lab Station Brig The M.W. Kellogg Lab Special Projects	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Bit. Built-up	**NO**	4.155	***Real Property File:*** Card Dated: 3 September 1960; Transferred from Navy 18 May 1962 ***PICA 1994:*** Liquid Propellant Rocket Lab for the NARTS Ammo Group. Experiments on small quantities of liquid fluids, oxidizers and monopropellants were conducted. Two beehive-shaped storage structures were associated with this building with stored class 9 propellant and primers. Beehive structures demolished in 1975. In 1977 building was used as a lubricant testing lab.
3404	**Off Lower Belt Road**	Navy Hill		**1960**			Navy Lab 5 Chemistry Lab Administration and Supply Building	**Foundation:** Concrete **Walls:** Concrete Block **Roof:** Bit. Built-up	**NO**	4.156	***Real Property File:*** Transferred from Navy 1960; Category change: 1982; Category change: 1987; Part of a later Navy Lab ***PICA 1994:*** Stored rocket fuel, oxidizer and monopropellant. Large quantities of "poorly" stored oxidizer and fuel cylinders were identified in a 1967 safety report. In 1975 the building was closed and decontaminated;+L323 energetics were reduced to none
3504	**Stillwell Road and Snake Hill Road**	NARTS Area A		**1945**			Maintenance Building Area A RMI Stored Rocket Fuel, Oxidizer, and Mono Propellant	**Foundation:** Concrete **Walls:** Metal **Roof:** Metal	**NO**	4.154	***PICA 1994:*** Stored rocket fuel, oxidizer and monopropellant.
3531	**Not Found**	NARTS Area A	**Demolished or Deteriorated**	**ND**				**No Real Property Info**	**NO**	NA	
3700	**Off Snake Hill Road**	Trailer Park Area	**CSM Theodore R Moran Recreational Loading Area Building**	**1965**	**Tectonic Associates, Somerville, NJ**	Office/Storage	Office/Storage	**Foundation:** Concrete **Walls:** Transite **Roof:** Corrugated Metal	**NO**	4.157	***Blueprints:*** RDT&E Minor Construction Program 1964 Phase II Plans Elevations for Building 3700; 31 March 1964
3939	**Not Found**			**1918**				**No Real Property Info**	**NO**	NA	

APPENDIX C

VITA OF PRINCIPAL INVESTIGATOR

Panamerican Consultants, Inc.

Kelly Nolte, M.A.
Senior Architectural Historian

EDUCATION

M.A.; Humanities, Old Dominion University, Norfolk, VA (1989)
Emphasis: Architectural History

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

EXPERIENCE

Ms. Kelly Nolte is Senior Architectural Historian with Panamerican Consultants, Inc. and Director of Panamerican's Architectural History Group. She 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. Ms. Nolte's duties include serving as Principal Investigator, conducting fieldwork and research, writing reports related to historic architecture, as well as aiding in the development of proposals and budgets for projects and managing Panamerican's staff of architectural historians. She 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 Buildings 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

Under contract to Fort Benning Military Reservation and the Department of Defense (DoD) Legacy Resources Management Program, Ms. Nolte served as Panamerican's Senior Architectural Historian in the development of a Cold War military historic context for 13 DoD installations in the state of Georgia. The report and context are intended to streamline the identification and assessment of aboveground cultural resources at these installations in order to reduce or eliminate delays to training or other mission-related activities. As co-author, her responsibilities included extensive archival and documentary research at each of the installations, and writing pertinent report sections. The report presented a multi-service Cold War context to aid in cross-branch assessment of aboveground cultural resources. Also included were individual installation histories and bibliographies, and a general annotated bibliography of existing monographs, reports and contexts that may be useful in the evaluation of military cultural resources.

Ms. Nolte served as Senior Architectural Historian for the Phase I and Phase II cultural resources investigations of 17 sites as part of the Hudson River PCB Superfund Site project along the Upper Hudson River (NY), conducted for U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE), Kansas City District, under contract to Ecology & Environment. For each site and its surrounding viewshed, Panamerican performed an historic structures and landscape evaluation and detailed visual impact assessment. The investigation included archival, documentary and cartographic research, a complete architectural field investigation, interviews with knowledgeable informants, and photographic documentation of all structures and viewsheds in the project area.

She served as Panamerican's principal architectural historian for the historic structures survey and Cold War evaluation, Kelley Hill Cantonment for the Environmental Programs Branch, Directorate Facilities Engineering and Logistics, Fort Benning (GA). The project included standing structure identification, evaluation, and NRHP eligibility determination of 167 structures and planned landscapes. She also created updated, user-friendly Cultural Resources Survey and NRHP Evaluation forms for general use at Fort Benning, and Cold War-specific historic context for Kelley Hill Cantonment (site of Army's Air Assault concept).

She was Panamerican's Senior Architectural Historian for the cultural resources investigation for the Federal Energy Regulatory Commission (FERC) recertification of the New York Power Authority's (NYPA) Niagara Power Project. Panamerican's investigation, under contract to URS Corporation, covers the American side of the Niagara River corridor, including the cities of Niagara Falls and North Tonawanda, the towns of Porter, Lewiston, Wheatfield, and Niagara, Niagara County, and the cities of Buffalo and Tonawanda, the towns of Grand Island, and Tonawanda, Erie County, New York. She is conducting the architectural assessments and evaluations of NRHP eligibility for buildings and structures within the FERC boundary and determined buffer zone.

For the New York District, USACE (under subcontract to Northern Ecological Associates, Inc.), Ms. Nolte served as Panamerican's architectural historian and principal investigator for the assessment and development of Maintenance Plans for Redoubts Nos. 1 and 2 and their Associated Batteries at the U.S. Military Academy (USMA) at West Point, Orange County, New York, and for the preparation of the architectural evaluation of the proposed Thomas Jefferson Library on the Plain at the USMA. In addition, she has conducted at least eight investigations at the USMA (under subcontract to Northern Ecological Associates, Inc. or Barry A. Vittor & Associates, Inc.). These investigations include: an assessment and evaluation of 34 bridges within the USMA for eligibility for the NRHP as either individual properties or contributing elements to the existing West Point National Historic Landmark District and to determine treatment plans for them (Bridge inventory forms were completed for each bridge in the survey.); an analysis of 16 proposed exterior lighting upgrade impacts on structures eligible for or listed in the NRHP; and, a HABS recordation of Building 124, Married Junior Officers' Quarters; the NRHP Eligibility Evaluation and Impact Analysis Master Plan, New Brick Housing Area at the USMA; and the Review and Impact Assessment of the Master Plan for the West Point Elementary and Middle Schools. Each project involved intensive archival research, interviews with knowledgeable sources, photodocumentation of structures and site conditions, and report writing.

For the New York District, USACE (under subcontract to Barry A. Vittor & Associates, Inc.), Ms. Nolte served as Panamerican's architectural historian for the research and review of the 1984 HABS inventory for the USMA, West Point, NY. A total of 1,546 buildings, structures, and

monuments were inventoried. A total of 41 monuments were identified. Of the remaining 1,505 structures, 486 are located at Stewart Army Subpost, and 1,019 are located at the USMA, which includes all the outlying areas, Lady Cliff College and Constitution Island. Of the 1,019 structures, 611 are within the National Historic Landmark District.

As Panamerican's senior architectural historian, she prepared the architectural inventory, assessments and evaluations of Cold War buildings and structures for the architectural inventory and National Register evaluation of historic structures at Fort Monmouth (New Jersey), Pine Bluff Arsenal (Arkansas), Umatilla Chemical Depot (Oregon), and the Soldier System Center (Natick, Massachusetts) under contract to the U.S. Army Medical Research and Materiel Command. For each installation, she conducted a site visit and prepared an installation-specific inventory of all buildings and structures with special attention to Cold War (1946-1989) structures and evaluated these using NRHP criteria and guidance and contexts prepared by the DoD. Also, for U.S. Army Medical Research and Materiel Command, she prepared a HABS/HAER documentation project at Rock Island Arsenal, IL, comprising the documentation of four structures at the installation.

Ms. Nolte served as Panamerican's principal investigator and senior architectural historian for the determination of eligibility of select buildings at Picatinny Arsenal for inclusion on the National Register. Picatinny Arsenal (PICA) is located in Rockaway and Jefferson Townships, Morris County, New Jersey. Conducted for U.S. Army Medical Research and Materiel Command, the investigation evaluated the eligibility of 59 buildings and structures scattered across PICA for the NRHP. Panamerican conducted background and historic research, which included a thorough review of existing cultural resources studies of PICA, local histories, historic maps, real property records, blueprints, and regional/state histories. In addition, a careful review of NRHP criteria, especially those areas dealing with Criteria Consideration G, exceptional importance, as well as pertinent military contexts and guidance was completed. A total of 59 buildings and structures were surveyed, photographed and evaluated. In order to best discuss the various buildings and structures included within this survey, the architectural discussion was divided into three sections: Industrial/Factory Complexes, Naval Air Rocket Test Station (NARTS) Cold War and Non-NARTS Cold War. All 59 of the assessed buildings/structures fit into one of these three categories: 33 of them were included in the Industrial/Factory Complexes category; 23 were in the NARTS Cold War category, and three were in the Non-NARTS Cold War category.

For the Atlantic Division Naval Facilities Engineering Command, Norfolk, Virginia (under subcontract to AllenHoshall, Memphis, TN), Ms. Nolte served as Panamerican's principal investigator and architectural historian for a HABS, Level III-type Documentation of Selected Buildings at Naval Air Station Norfolk Historic District at the Naval Station Norfolk, Virginia. The buildings included the Air Operations-Control Tower, LP-1; Hangars, LP-2, LP-3, LP-4, LP-12, LP-13, LP-14; Ammunition Magazines, LP-6, LP-7, LP-8, LP-9, LP-10, LP-11, LP-28, LP-30, LP-32; Seaplane Hangars, SP-1, SP-2, SP-31; Squadron Storehouse, SP-9; Torpedo Shop, SP-10; Operations/Radio Building, SP-65; Ammunition Magazines, SP-5, SP-6, SP-7, SP-8; Seaplane Ramps, SP-3; SP-4; SP-32 and SP-33; Transformer Vault, SP-11. The purpose of the study was to implement a mitigation strategy designed to document the historic structures at the decommissioned facility through an in-depth historical and archival background search combined with a detailed photographic and architectural recordation process.

She served as Panamerican's architectural historian for Phase I cultural resources investigations for the Joseph G. Minish Passaic River Waterfront Park and Historic Area in the City of Newark,

New Jersey. The projects were conducted for the USACE, New York District, under contract to Northern Ecological Associates, Inc. The purpose of these investigations included the investigation and recordation of several industrial elements and structures that were components of properties eligible for listing in the National Register, the enhancement of previously existing documentation conducted during earlier project phases, and the development of an archaeological sensitivity assessment of an area which may contain buried or submerge cultural resources. The investigation included extensive documentary and background research pertinent to the historic development of this portion of the Passaic River in Newark; on-site inspection of the entire project area, with specific attention paid to the impacted cultural resources; review of earlier reports and soil borings addressing cultural resources affected during the first phase of the proposed project; and an architectural assessment and photographic documentation of numerous structures within the project area also will be conducted.

Ms. Nolte was Panamerican's co-principal Investigator and architectural historian for the Phase IA cultural resources investigation for the proposed restoration of vehicular traffic on Main Street, Buffalo, NY. Prepared for ERM, the investigation was conducted in support of the preparation of an environment assessment for the proposed restoration of vehicular traffic to 6,600 linear feet of Main Street in the city. The project area was Main Street between Tupper Street at the north end and Scott Street at the south. She conducted a site walkover reconnaissance, reviewed and assessed all structures along the project area, and prepared recommendation.

For the Niagara Mohawk Power Corp., Ms. Nolte served as Panamerican's 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.

Ms. Nolte served as Panamerican's 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. Each bridge requires intensive background research, interviews with knowledgeable sources, photodocumentation of structures and site conditions, and report writing.

Ms. Nolte served as Panamerican's 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 USACE, New York District in 1997. The project involved intensive background research, preparation of an inventory form for each structure, photodocumentation of structures and site conditions, and report writing.

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.