

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

Department of the Army
Installation Management Command
HEADQUARTERS, UNITED STATES ARMY GARRISON, PICATINNY
Picatinny Arsenal, New Jersey 07806-5000

PICATINNY ARSENAL
Morris County, New Jersey

Revision Coordinated through Picatinny Arsenal Garrison

with Picatinny Arsenal Stakeholders;
United States Fish and Wildlife Service;
New Jersey Division of Fish and Wildlife;
and IMCOM Atlantic Region.

April 2022

Previously approved
April 2015

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

April, 2022

Picatinny Arsenal Picatinny Arsenal, New Jersey

Signature Page

This Integrated Natural Resources Management Plan (INRMP) was developed in accordance with Army Regulation (AR) 200-1, Environmental Protection and Enhancement, paragraph 4-3d.(1)(a), and meets the requirements for INRMPs listed in the *Sikes Act* (16 U.S.C. sec 670a et seq.) as amended. It sets appropriate guidelines for conserving and protecting the natural resources of Picatinny Arsenal.

APPROVED BY:

PICATINNY ARSENAL REVIEWING OFFICIALS

Adam Woytowich
Lieutenant Colonel, U.S. Army, Commanding

Date

Prepared by:

Bradley Garie
Natural Resources Manager, Picatinny Arsenal

Date

Reviewed by:

Jason Huggan
Chief, Environmental Affairs Division

Date

US Fish and Wildlife Service Review

Reviewed by: Rebecca J. Klee, via email (see next page)-Annual Review Approval

2-22-2022

Date

Reviewed by:

Date

Reviewed by:

Date

Reviewed by:

Date

This page added for Verification of Concurrence of Annual Review by USFWS

From Subject Received Size Categories
Klee, Rebecca J [Non-DoD Source] Re: [EXTERNAL] Sikes Act Formal Review--REQUEST
3/22/2022 124 KB

Hi Brad,

I have reviewed the document and agree with the changes. The Service agrees changes were minor and can be considered an Update (per Department of Defense manual DoDM 4715.03). Additionally, this review meets the annual review requirements. Thank you!

PS. A proposed rule to reclassify the listed status of the northern long-eared bat (NLEB) from threatened to endangered is on file today at the Office of the Federal Register and will be published in the Federal Register tomorrow, March 23. Per a court order, a final listing determination is due by the end of November 2022. If the final determination is to reclassify to endangered, that would go into effect 30 days later – sometime during December 2022. We should find a time to chat about any changes we may want to make to consulting on NLEB---possibly adding the buffers I discussed in my previous email to you about PICA consultation procedures. Between now and the final rule, NLEB is still classified as endangered and the 4(d) rule will still apply, but it may be best to start planning early for a change. Thank you!

Rebecca Klee
Fish and Wildlife Biologist

New Jersey Ecological Services Field Office
US Fish and Wildlife Service
4 E. Jimmie Leeds Road, Suite 4
Galloway, New Jersey 08205

Cell: 908-930-1878

Email: rebecca_klee@fws.gov
<https://www.fws.gov/office/new-jersey-ecological-services>

From: Garie, Bradley CIV USARMY ID-SUSTAINMENT (USA) <bradley.garie2.civ@army.mil>
Sent: Thursday, March 17, 2022 12:48 PM
To: Klee, Rebecca J <rebecca_klee@fws.gov>
Cc: Garie, Bradley CIV USARMY ID-SUSTAINMENT (USA) <bradley.garie2.civ@army.mil>; Huggan, Jason CIV USARMY ID-SUSTAINMENT (USA) <jason.huggan.civ@army.mil>
Subject: RE: [EXTERNAL] Sikes Act Formal Review--REQUEST

Rebecca,

This morning's discussion was certainly a big help, and now we have a path forward.

I have attached the INRMP with requested changes provided to me, for your review. More changes may be required in the future, pending uplifting of the Federally pending status of the NLEB status from threatened to endangered.

As discussed, we are considering this review to be an Update (per Department of Defense manual DoDM 4715.03), as simple updates that do not require substantial changes in the way natural resources on the base are to be managed.

Please get back to me with any comments or changes, as our goal at this time is to meet the annual review requirement. Also, indicating to me in writing that this review meets our annual review requirements, would be appreciated.

Thanks again for your assistance and professional handling of tis.

Bradley Garie
Environmental Scientist/Natural Resource Manager
IMPI/Environmental
Building 3002
USAG Picatinny Arsenal, NJ
973-724-3594
We are the Army's Home

This page added for Concurrence letter of USFWS

Note: Signed Approval of INRMP provided in 2015 (2/23/15)

**This page added for Concurrence signature sheet of
NJDFW**

Note: Signed Approval of INRMP provided in 2015 (2/24/2015)

Table of Contents

INTRODUCTION	1
CHAPTER 1 - POLICIES AND GOALS	4
1.1 Policy	4
1.2 Goals	4
CHAPTER 2 - LOCATION AND ACREAGE.....	5
2.1 Location.....	5
2.2 Acreage.....	5
2.3 Installation History and Acquisition.....	6
2.4 Neighbors	8
CHAPTER 3 - MILITARY MISSION.....	9
3.1 Overview of the Current Mission.....	9
3.2 Natural Resources Needed to Support the Military Mission.....	9
3.3 Military Mission and Natural Resources Impacts	10
3.4 Environmental Stewardship and Compliance Oversight	10
CHAPTER 4 - FACILITIES.....	11
4.1 Improved Areas.....	11
4.2 Partnership Program.....	12
4.3 Landscaped Areas	12
4.4 Urban Wildlife	13
CHAPTER 5 - RESPONSIBLE AND INTERESTED PARTIES.....	14
5.1 Installation Organizations.....	14
5.2 Other Defense Organizations	14
5.3 Federal and State Agencies.....	14
5.4 Contractors and Other Interested Parties	15
5.5 Indian Nations and Tribes.....	16
CHAPTER 6 - NATURAL RESOURCES AND CLIMATE.....	17
6.1 Setting	17
6.2 Topography and Relief	17
6.3 Geology	18
6.4 Climate and Climate Change	18
6.4.1 Temperature.....	18
6.4.2 Precipitation.....	19
6.4.3 Frost Dates, Growing Season, and Ice Formation	19
6.5 Petroleum and Minerals.....	19
6.6 Soils.....	19
6.7 Water Resources	20
6.7.1 Lakes and Ponds	22
6.7.2 Streams.....	22
6.7.3 Storm Drainage	22
6.7.4 Wetlands.....	22

6.8 Flora	23
6.8.1 Grasslands and Shrublands	24
6.8.2 Forest Types.....	25
6.9 New Jersey Highlands Ecosystem Context.....	26
6.10 Fauna	31
6.10.1 Invertebrates.....	31
6.10.2 Fish.....	31
6.10.3 Amphibians and Reptiles	32
6.10.4 Birds	32
6.10.5 Mammals	33
6.10.6 Game Species	35
6.11 Threatened and Endangered Species (TES)/ Species At Risk (SAR)	36
6.11.1 Bog Turtles	38
6.11.2 Indiana Bats	38
6.11.2.1 Northern Long Eared Bats	39
6.11.3 State-Listed Species (SAR).....	40
6.12 Insects, Disease, and Invasive Species.....	42
6.12.1 - Insects.....	42
6.12.2 - Diseases.....	43
6.12.3 Invasive (Non-Native) Plants	44
 CHAPTER 7 - LAND USE AND MANAGEMENT UNITS	 46
7.1 New Jersey Environmentally Sensitive Planning Units	45
7.2 Land Areas of Special Interest	47
7.3 Picatinny Land Uses	49
7.4 New Jersey State Wildlife Action Plan.....	51
 CHAPTER 8 – NATURAL RESOURCES MANAGEMENT	 53
8.1 Objectives	53
8.2 Forest Management.....	53
8.2.1 Silvicultural Systems	55
8.2.2 Reforestation.....	59
8.2.3 Silvicultural Guides	60
8.2.4 Silviculture and Wildlife.....	60
8.2.5 Silviculture and Indiana Bats	61
8.2.5.1 Silviculture and Northern Long Eared Bat.....	61
8.2.6 Urban Forestry	62
8.3 Agricultural/Grazing Out Leases.....	63
8.4 Wildlife and Fish Habitat Management	63
8.5 Game Harvest Management.....	65
8.5.1 Sportsman Program	65
8.5.2 Special Licenses and Permits.....	65
8.5.3 Records of Take and Fishing and Hunting Hours.....	65
8.5.4 Harvest Quotes	67
8.5.5 Seasons	67
8.5.6 Big Game Management	68
8.5.7 Small Game Animals.....	69
8.5.8 Waterfowl	69
8.5.9 Upland Game Birds	70
8.5.10 Furbearer Management	70
8.6 Fish Management	71
8.7 Transplants and Stocks	73
8.7.1 Fish Stocking	73

8.7.2 Pheasant Stocking	73
8.8 Threatened or Endangered Species Management, Species At Risk.....	74
8.8.1 Bog Turtle.....	74
8.8.2 Indiana Bat and Northern Long Eared Bat.....	75
8.8.2.1 At Risk Species of Concern	77
8.8.3 State-Listed Plants and Wildlife.....	77
8.8.4 Native Brook Trout	79
8.9 Other Nongame Management	79
8.9.1 Invertebrates	80
8.9.2 Amphibians and Reptiles.....	80
8.9.3 Birds.....	80
8.9.3.1 Migratory Bird treaty Act	81
8.9.3.2 Bald and Golden Eagle Protection Act	82
8.9.4 Chiroptera (bats)	83
8.9.5 Other Mammals	84
8.9.6 Urban Wildlife	84
8.10 Wetland Management.....	84
8.10.1 Stream Management.....	85
8.10.2 Lake Management.....	86
8.11 Water Quality Management.....	86
8.12 Soil Resources and Land Rehabilitation Maintenance.....	87
8.13 Controlling Nuisance Animals.....	87
8.13.1 Feral Dogs & Cats.....	88
8.13.2 Large Mammals	88
8.13.3 Resident Geese.....	88
8.13.4 Snakes	88
8.13.5 Exotic Wildlife.....	89
8.14 Cantonment Area Management.....	89
8.14.1 Mowing	90
8.14.2 Weed Control.....	90
8.14.3 Landscape Restoration and Plantings	90
8.14.4 Fertilizer Applications	91
8.14.5 Maintenance Procedures.....	91
8.14.6 Golf Course.....	93
8.15 Pest Management and Invasive Species.....	93
8.15.1 Insects and Disease.....	93
8.15.2 Invasive Species	93
8.15.3 Cantonment Disease and Insect Control	95
8.16 Fire Management	96
8.16.1 Prescribed Burning	96
8.16.2 Fire Prevention and Suppression.....	96
8.17 Special Interest Area Protection	97
8.18 Training Requirement Integration (TRI).....	98
 CHAPTER 9 – INVENTORY AND MONITORING.....	 99
9.1 Objectives	99
9.2 General	99
9.3 Flora Inventory and Monitoring.....	99
9.4 Monitoring Consumptive Use of Resource.....	99
9.5 Water Quality Monitoring	100
9.6 Soils Inventory and Monitoring	100
9.7 Data Storage, Retrieval and Analysis	100
9.8 Continual, Recurring, Periodic Inventories.....	100

CHAPTER 10 – RESEARCH AND SPECIAL PROJECTS 101

CHAPTER 11 - ENFORCEMENT 101

 11.1 Objectives 101

 11.2 History and Authority 101

 11.3 Education Activities 103

 11.4 Enforcement..... 103

CHAPTER 12 – ENVIRONMENTAL AWARENESS..... 104

CHAPTER 13 – OUTDOOR RECREATION 104

 13.1 Objectives 104

 13.2 Military Mission Considerations 104

 13.3 Public Access 104

 13.4 Hunting, Trapping and Fishing..... 104

 13.5 Other Natural Resources Oriented Outdoor Recreation 105

 13.5.1 Developed Recreation..... 105

 13.5.2 Dispersed Recreation 105

 13.6 Recreation and Ecosystem 105

 13.7 Safety and Security..... 106

CHAPTER 14 - CULTURAL RESOURCES PROTECTION..... 107

 14.1 Objectives 107

 14.2 Cultural and Historic Resources 107

 14.2.1 Walton Cemetery..... 107

 14.2.2 Historical Structures 108

 14.2.3 Archeological Sites..... 108

 14.3 Natural Resources Management Implications 108

CHAPTER 15 - NATIONAL ENVIRONMENTAL POLICY ACT..... 109

 15.1 Objectives 109

 15.2 NEPA Responsibilities and Implementation 109

 15.3 NEPA and Natural Resources Management..... 109

CHAPTER 16 - BIOPOLITICAL ISSUE RESOLUTION 110

CHAPTER 17 - IMPLEMENTATION 111

 17.1 Legal Authority 111

 17.2 Organization, Roles and Responsibilities..... 111

 17.3 Project and Program Priorities 111

 17.4 Command Support..... 113

ACRONYMS 114

TERMS AND DEFINITIONS 115

LITERATURE CITED (and Bibliography) 130

DOD and DA and PICA OFFICIAL DOCUMENTS..... 137

PERSONS CONSULTED	138
PREVIOUS PREPARERS & CURRENT REVIEWERS	40
APPENDICES	A Through J
Appendix A – Regional Context.....	A
I. New Jersey Highlands.....	A-1
A. Physical Environment	A-1
B. Biological Environment.....	A-4
C. Other Important Resources	A-5
II. Watershed Management Area 6	A-6
A. Physical Environment	A-6
B. Water Resources	A-8
C. Biological Environment.....	A-11
D. Other Important Resources	A-12
Appendix B – Picatinny Flora.....	B
B-1 Endangered Plants & Species At Risk.....	B-1
B-2 Non-Flowering Plants.....	B-3
Bryophytes	B-3
Ferns & Allies	B-4
B-3 Sedges & Sedge Allies	B-5
B-4 Aquatic Plants	B-6
Submerged Aquatic Plants	B-6
Submerged Surface Aquatic Plants.....	B-6
Emergent Aquatic Plants.....	B-6
Free Floating Aquatic Plants.....	B-7
B-5 Grasses and Vines	B-7
B-6 Forbs.....	B-9
B-7 Shrubs and Trees	B-14
Appendix C – Fauna.....	C
C-1. Dragonflies & Damesflies	C-1
C-2. Butterflies & Moths.....	C-3
C-3. Picatinny Fish	C-6
C-4. Picatinny Herptile List.....	C-7
C-5. Birds	C-9
C-6. Picatinny Mammal List	C-12
C-7. Threatened & Endangered Animals & Species At Risk	C-14
Appendix D – Grounds Maintenance Plant Lists.....	D
D-1. Grasses/Ground Covers/Trees/Shrubs/Vines used for Landscaping	D-1
Appendix E – Picatinny Water Resources	E
E-1. Lakes & Ponds	E-1
E-2. Brooks & Runs	E-2

Appendix F – Maps F
 General Installation Map of Picatinny Arsenal F-1
 Location Map for Connecticut-New York-New Jersey-Pennsylvania Highlands Area..... F-2
 Public Lands Adjacent to Picatinny Arsenal..... F-3
 Public Open Space in Watershed Management Area (WMA) 6 F-4
 Resource Planning and Management Map (RPMM) of the New Jersey State Development
 And Redevelopment Plan F-5
 Morris County, New Jersey, State Planning Areas F-6
 Picatinny Arsenal Sportsman Map..... F-7

Appendix G – Picatinny Arsenal Indiana Bat Endangered Species Management Component (112pp) .G

Appendix H – Picatinny Arsenal Bog Turtle Endangered Species Management Component (27pp) ...H

Appendix I – Picatinny Arsenal (Sportsman) Policy (PAP No.IMPI-MWR-006) (17pp) I

Appendix J – 16 USC 670a-f and Sikes Act Reauthorization Act-2013 (13pp).....J

LIST OF TABLES

Table 2.1 Picatinny Landscape Types 6
 Table 6.1 Soils Found At Picatinny..... 19
 Table 6.2 Picatinny Wetland Types 23
 Table 6.3 Picatinny Forest Types..... 25
 Table 6.4 Public Lands Around Picatinny Arsenal 29
 Table 8.1 Shade Tolerance of Various Forest Trees..... 57
 Table 8.2 Picatinny Harvestable Fish & Game Species..... 65

Introduction

This updated Integrated Natural Resources Management Plan (INRMP) essentially carries forward all of the previous goals, objectives, policies and procedures of the preceding version (May 2001-2015) with some relatively minor updates and changes. Citations and references are essentially the same, unless superseded by substantively new or different Best Management Practices (BMPs). Previous preparers and persons consulted are carried forward and included for reference and continuity.

Preparation and implementation of this INRMP are required by the *Sikes Act* (16 U.S.C. 670a et seq.), Army Regulation 200-1 (*Environmental Protection and Enhancement*), and by Department of Defense (DOD) Instruction 4715.03 (*Natural Resources Conservation Program*). Picatinny Arsenal (PICA) has developed this INRMP in accordance with Army Environmental Center Instruction, *Guidelines to Prepare Integrated Resource Management Plans for Army Installations and Activities*, dated April 1997.

The *Sikes Act* (Appendix J) requires the Army to manage the natural resources of its installations within the United States:

- To sustain the multipurpose uses of natural resources.
- To provide public access to the extent that such access is not inconsistent with the military mission.

The *Sikes Act Improvement Act* of 1997 further states that there shall be “no net loss in the capability of military installation lands to support the military mission of the installation.”

The INRMP is required to focus on natural resources management in support of the military mission at the installation level. Supporting the mission can take many forms. There is direct support such as interacting with soldiers, trainers, range coordinators, testers, and researchers; as well as minimizing encroachment and ensuring “no net loss” of testing lands or buffer spaces occur. There is indirect support ensuring a multitude of federal and state regulations are met through the National Environmental Policy Act (NEPA), Endangered Species Act (ESA) processes and various consultations and coordination with regulators. Finally, there are more subtle means of supporting the mission including improving relations with cooperating agencies and the surrounding community.

Department of Defense directives require all military installations that have suitable habitat for conserving and managing natural ecosystems to prepare INRMPs. It is DOD and Army policy to manage installations on an ecosystem basis. The Army’s stewardship requirements are to sustain natural resources on an ecosystem scale and to comply with the law. Plans will therefore be developed to maintain:

- Surface water quality.
- Soil productivity.
- Native biodiversity.
- Compliance with conservation laws.

The primary purpose for preparing an INRMP is to ensure that natural resources conservation measures and Army mission activities are integrated and are consistent with federal stewardship requirements. The management objectives are:

- a) Support the operational mission.
- b) Meet stewardship requirements.
- c) Enhance quality of life for Army personnel.

This plan will guide natural resources management at PICA from (Calendar Years) CYs 2015 through 2019 and through funding cycles of (Fiscal Years) FYs 2016 - 2020. It will be reviewed annually for sufficiency of operation and effect; and updated if there is a change in the Picatinny mission, if significant new information is developed, or if there is a substantial change in the Arsenal's natural resources. The INRMP will serve as a guide for the management and stewardship of all natural resources present on the Arsenal. It provides PICA with a detailed description of the installation (e.g. location, history, and mission), information about the surrounding physical and biotic environment, and goals and objectives for managing natural resources while conducting mission activities.

Furthermore, the INRMP provides various management guidelines designed to enhance and protect local ecosystems and to mitigate negative impacts of the installation's mission. These guidelines are in compliance with applicable federal, state, and local standards and are balanced against the Arsenal's requirements to accomplish its mission at the highest possible levels of efficiency. Therefore, the INRMP integrates all aspects of natural resources management while ensuring the successful accomplishment of the military mission.

Management Goals

The maintenance and enhancement of biological diversity are particularly important in the management of natural resources and will be accomplished through the implementation of specific management practices identified in this INRMP. Specifically, management practices shall:

- Ensure no net loss of land for mission activities.
- Minimize habitat fragmentation and promote the natural pattern and connectivity of habitats.
- Protect native species and discourage non-native, invasive species.
- Protect rare and ecologically important species.
- Protect unique or sensitive habitats.
- Maintain or mimic natural processes.
- Protect genetic diversity.
- Maintain, or restore as reasonably feasible, ecosystems, communities, and species.
- Monitor the impacts of management strategies described in this plan so that modifications can be made as conditions change.

Coordination and Approvals

The INRMP was developed using an interdisciplinary approach. Information was gathered from a variety of PICA organizations. Guidance was also solicited and received from federal, state,

and local agencies, including: the U.S. Fish and Wildlife Service (USFWS) New Jersey Field Office (NJFO); the U.S. Environmental Protection Agency; the New Jersey Department of Environmental Protection including the Divisions of Fish and Wildlife and Parks & Forestry, as well as offices of Endangered and Non-game Species Program and Natural Lands; USDA Forest Service; USDA Natural Resources Conservation Service; Palisades Interstate Park Commission; and the New Jersey State Planning Commission. This guidance contributed to the accuracy of the data concerning natural resources on or within the vicinity of the installation. It also helped to ensure that management guidelines are consistent with local and regional management strategies.

The *Sikes Act Improvement Act* of 1997 requires that INRMPs be developed “in cooperation with” the USFWS and each appropriate state fish and wildlife agency. The resulting plan for the installation should reflect the mutual agreement of the parties. Although mutual agreement is the goal for the entire plan, it is only required for those elements of the plan that are subject to the applicable legal authority of the respective agencies. Consequently, the USFWS and the New Jersey Department of Environmental Protection (NJDEP), Division of Fish & Wildlife (NJDFW), have not only been consulted in preparation of the plan, but also have been asked to comment on and concur with applicable sections of the plan.

The Region 5 (Hadley, MA) USFWS Sikes Act coordinator (Alex Hoar) has advised that this INRMP be reviewed by the local NJFO (Pleasantville, NJ) to fulfill Sikes Act requirements for external interagency review. Subject matter experts in that one office will review this document from the federal fish and wildlife perspective. Similarly the NJDEP will have the document reviewed initially by two biologists (one focused on fauna and one focused on flora). Other state subject matter experts may be tapped for comments as needed.

Reviews for Operation and Effect

The INRMP being a programmatic and dynamic document should be evaluated periodically by all stakeholders, especially the Sikes Act cooperators and mission personnel. Whenever significant changes in Army, USFWS, or State policies or regulations might impact the goals and objectives or standards and guidelines herein, a more formal re-evaluation is warranted. To the extent that projects, tasks, best management practices are being implemented and applied routinely and effectively in the balanced sustainment of the military and stewardship missions, then informal reviews, typically annually, are sufficient.

Chapter 1 – Policies and Goals

1.1 Policy

As part of its mission, the U.S. Army has chosen to be a national leader in natural resources stewardship now and in the future. This commitment is documented in the *U.S. Army Environmental Strategy into the 21st Century* (U.S. Department of the Army 1992). The sustainability of natural resources must be ensured in order to achieve the military mission. As a steward of natural and cultural resources, PICA acknowledges its commitment to conservation goals. The new Installation Management Command (IMCOM) logo features a tree image in a green diamond, symbolizing a commitment to environmental stewardship. The new logo was adopted in 2010 when the new headquarters was established in San Antonio, TX; and also features commitment to top quality installations and infrastructures, all Army missions and soldiers, and all families within the Army community.

Conservation is an integration or blending of natural resources management and preservation designed to maintain ecosystem integrity. This blending occurs in the Integrated Natural Resources Management Plan for the PICA, a dynamic document that will be maintained and adapted, as necessary, to reflect updated natural resources information. The development and implementation of the INRMP is another sign of the Army's commitment to natural resources as reflected in DOD Instruction 4715.03 (*Natural Resources Conservation Program*). All personnel will comply with the conservation policies and procedures specified in applicable DOD publications, Army Regulations (namely 200-1), and Army guidance memos; as well as all applicable laws. See Appendix J for statutory requirements of the Sikes Act which embrace all goals herein.

1.2 Goals

The New York-New Jersey Highlands Regional Study (1992) listed five goals for the 1.1 million acres of which the PICA is the largest tract of federal land in the New Jersey Highlands. Goals for the Highlands are:

- Manage future growth.
- Maintain an adequate supply of quality water.
- Conserve contiguous forests.
- Provide appropriate recreation opportunities.
- Promote economic prosperity that is compatible with the aforementioned goals.

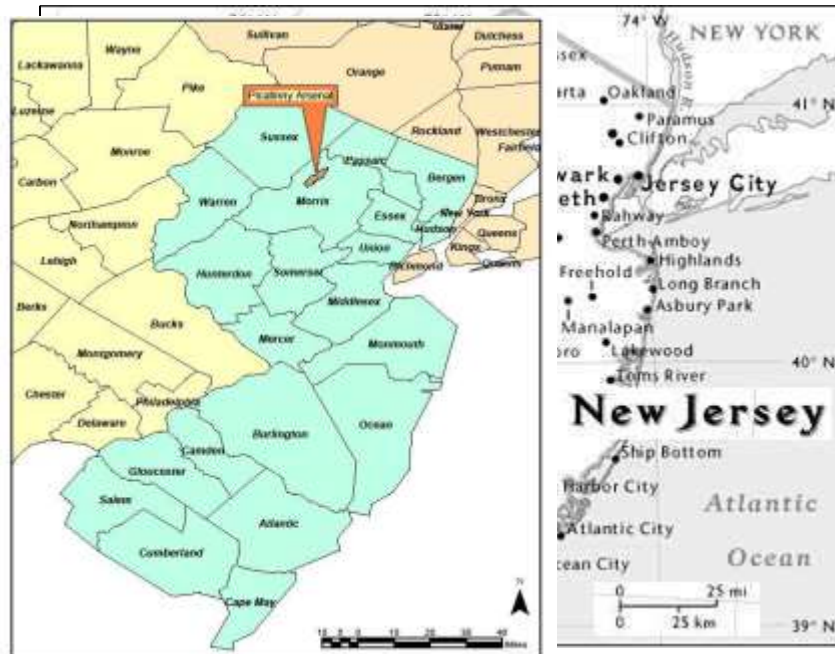
The PICA is an important component of the NY-NJ Highlands (see location map in Appendix F) and the integrated management of resources at the Arsenal will foster the vision for the Highlands area. Goals specific to the Arsenal are:

- Ensure “no net loss” of lands for mission activities and maintain the sustainability of lands for mission use.
- Provide for the protection of natural and cultural resources.
- Provide for recreation opportunities consistent with the military mission.

Chapter 2 – Location and Acreage

2.1 Location

The Arsenal is located in the New Jersey Highlands in Rockaway Township, Morris County, New Jersey. A small portion is located in Jefferson Township. The main entrance is located next to the junction of State Route 15 and Interstate highway I-80. Newark is located 32 road miles southeast and New York City is located 42 road miles east of the Arsenal. Newark International Airport, as well as highly developed rail, bus, and commuter modes of transportation serve this vicinity. This area is a greenbelt for a heavily populated area, which provides open space, recreation, and scenic beauty for millions of people. Appendix A contains a more complete description of the natural resources of the Highlands Region. The location map in Appendix F shows the Highlands area. The Delaware Water Gap National Recreation Area is located 45 miles to the west. This is the gateway to the naturally popular Pocono Mountains region of eastern Pennsylvania. Many Arsenal employees commute from this area as well.



Nearly five million people rely on the region for clean drinking water. The Arsenal is also located in the New Jersey Watershed Management Area Number 6 and serves as the headwaters of the Rockaway River Watershed-06CA (NJGeoWeb 2012). Its cold, clear waters provide important habitat to native Brook Trout, the State Fish. The Arsenal’s watersheds provide a source to recharge ground water aquifers.

2.2 Acreage

The Arsenal, covering 5,853 acres and containing two lakes, has 3.6 million square feet of indoor area, about half of which is devoted exclusively to scientific and engineering endeavors (667 buildings, including 64 laboratories). The steep slopes of the adjacent hills surround various facilities dotting the scenic valley floor. There are 4,082 acres of forested land on the Arsenal that provide a safety barrier to the surrounding community.

Additionally, the Army holds restrictive easements for 640 acres of private lands adjoining the Arsenal as safety buffers to ongoing operations and testing. No structures may be built upon these lands, nor may more than 25 persons gather at once on the private property so as to limit risk from potential catastrophic events. Often, the 640 acres is erroneously added to summary information listing total PICA acreage as roughly 6,500 acres.

Table 2.1. Picatinny Landscape Types and Acreage

Landscape Type	Acreage	Percent Total Landscape
FOREST:	4,082	70%
Upland	(3,531)	(60%)
Wet	(551)	(9%)
WETLAND:	1250	21%
Lakes & Shrub swamps	(554)	(9%)
Ponds/sloughs	(41)	(<1%)
Marsh	(44)	(<1%)
SEMI-IMPROVED:	109	2%
X-Storage	(28)	(<1%)
Open Testing	(8)	(<1%)
Roads/RoWs	(33)	(<1%)
IMPROVED:	994	17%
Offices/Buildings/Roads	(601)	(10%)
Urban Center	(134)	(2%)
Military Housing	(63)	(1%)
Golf Course	(157)	(3%)
Heliport	(28)	(<1%)
TOTAL	5,853*	110% *

* Forest / Wetland cover types overlap as well as overlapping Semi-improved, Improved areas

The vast undeveloped acreage provides the largest tract of forested public land in the New Jersey Highlands Region.

2.3 Installation History and Acquisition

U.S. Army Garrison, Picatinny Arsenal (USAG PICA) officially dates from 1879 when Congress authorized the purchase of 1,875 acres of land in Morris County, New Jersey, for the establishment of a powder depot. Unofficially, the history of the Picatinny region dates to the Revolutionary War when local iron forges under private ownership, smelted iron that was further refined at the Mount Hope furnace to produce solid shot for the troops of General Washington’s Continental Army.

Through the years, the Arsenal has come to be known as “the cradle of America’s ammunition industry.” During 1891, the Navy Department acquired 315 acres from the Army for the creation of the Lake Denmark Naval Ammunition Depot. In 1902, Picatinny started loading shells and in 1917 began making powder materials to accommodate munitions from 0.30 calibers to 16-inch rounds. In 1917, 56 acres of land were acquired and the Arsenal started the production of smokeless powder, TNT, and the loading of projectiles. Also at that time, the Picatinny Arsenal Research and Development Group was founded. One of the group’s first missions was the development of pyrotechnic signals and flares. It was during this time period that the Picatinny Powder Depot changed its name to Picatinny Arsenal.

In 1926, lightning caused the explosion of nine ammunition bunkers at the Lake Denmark Naval Ammunition Depot. The resulting explosion nearly leveled 1,000 acres of the Arsenal. It also sent unexploded ordnance across the landscape. This was the most significant event in the Arsenal's history and its effects remain today.

A major expansion period (1937 to 1944) occurred before and during World War II when 2,910 acres were added to the installation and 193 acres were transferred to the Navy. The installation at that time was converted into an "around the clock" production center for fuses, primers, propellant charges, and shell and bomb loading. The peak number of employees at the Arsenal was 18,000 in 1942.

Picatinny Arsenal was again called upon to accelerate its program during the Korean War. After that war, the Arsenal became the U.S. Army's research and engineering center for nuclear and non-nuclear ammunition (other than arms). Between 1955 and 1958, the installation acquired 572 acres by fee and subjected 639 acres of adjacent land to restrictive easements. These lands were acquired to provide the necessary buffer zones specified by safety regulations. In June 1960, the installation acquired 784 acres by transfer from the Navy. This adjacent property, originally known as the Naval Air Rocket Test Station and part of the original Lake Denmark Naval Ammunition Depot, is now called "Navy Hill."

In January 1977, Picatinny Arsenal became the U.S. Army Armament Research and Development Command (ARRADCOM) with Headquarters at Dover, NJ. It was a major Army subcommand of U.S. Army Materiel Development and Readiness Command (DARCOM). The mission of the facility was "to conduct or manage research, development, life-cycle engineering, initial acquisition, and acquisition through transition to DARCOM of assigned items/systems, including life cycle procurement and production of nuclear munitions; to execute assigned missions in support of other DARCOM or DOD elements having centralized management responsibility for specific weapons systems or items." In July 1983, ARRADCOM became the Armament Research and Development Center (ARDC), an organization of HQ, U.S. Army Armament, Munitions and Chemical Command (AMCCOM). The mission remained essentially unchanged.

In 1986, ARDC became Armament Research, Development and Engineering Center (ARDEC) and the mission remained unchanged. In 1994, ARDEC administration was transferred from AMCCOM to HQ, U.S. Army Tank-Automotive and Armaments Command (TACOM).

In 2003, ARDEC retained its mission and role at PICA, yet was reorganized under the new Research, Development and Engineering Command (RDECOM). RDECOM is a major subcommand under the long standing Army Materiel Command (AMC). In 2006, Army (administrative) transformation continued with the establishment of a new Direct Reporting Unit (DRU) known as Installation Management Command. IMCOM is headed by a 3-star General officer and functions through the Assistant Chief of Staff for Installation Management (ACSIM). The Army Environmental Command (AEC) is a major subcommand under IMCOM. IMCOM oversees 157 installations Army-wide; 32, including PICA, in the Eastern States (formerly Atlantic Region). Garrison Commanders (usually Colonels or Lieutenant Colonels), not unlike a town mayor, typically oversee the day to day management of the infrastructure, as well as the stewardship of the land and property at an installation. USAG-PICA houses at least ten other tenant organizations in addition to ARDEC.

Six are also subordinate organizations to AMC and/or Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (OASA (ALT)). Two tenants are subordinate organizations to DOD, one is a U.S. Marine Corps Reserve unit, and the newest one is a research and development unit of the Department of the Navy. Base Realignment and Closure (BRAC) decisions in 2005 mandated that PICA be a receiving installation for a few Navy facilities around the country that would be physically closed, yet their mission and some staff re-stationed or consolidated here. Approximately 200 civilian and some military Navy personnel have become part of the PICA community. Picatinny is shifting from just an Army-focused facility to being a critical hub for armaments development to benefit all branches of the U.S. military and DOD (PICA 2012). The present workforce is about 5000 employees; comprising 3900 federal civilian employees, 100 military personnel, and 1000 contractors. Approximately half of these employees are engineers and scientists.

2.4 Neighbors

Other public lands administered by the New Jersey Division of Fish and Wildlife (NJDFW), the New Jersey Division of Parks and Forestry (NJDPF), and the Morris County Park System adjoin the Arsenal. A Forest Legacy Tract purchased by the USDA Forest Service is located to the north of the Berkshire Valley Wildlife Management Area and is close to the Arsenal along State Route 15 (see the map of public lands adjacent to Picatinny in Appendix F). The Arsenal is also part of New Jersey Watershed Management Area #6 (WMA 6). Approximately 15 percent of WMA 6 is public open space. Although the Arsenal is the largest tract of public land within this watershed, public access is not permitted for safety and security reasons. Appendix A describes WMA 6 in greater detail and the map in Appendix F shows the public open space in WMA 6.

The Borough of Wharton, population 6,500, is located about 1 mile south of the installation, while the town of Dover, population 18,160, is located about 3 miles south of the installation. Rockaway Borough, population 6,440, is located 5 miles to the southeast of the installation. Many employees commute from eastern Pennsylvania. The Delaware Water Gap is 45 miles west on Interstate-80.

Chapter 3 – Military Mission

3.1 Overview

As mentioned previously, U.S. Army, Picatinny Arsenal is home to a number of tenant organizations besides the long established ARDEC mission. Other key AMC missions based at PICA include Program Executive Office for Ammunition (PEO-AMMO), PEO for Ground Combat Systems, Program Manager for Soldier Weapons, and Joint Munitions & Lethality- Life Cycle Management Command. The main objectives of these interrelated missions are to execute and manage life-cycle engineering processes required for research, development, production, field support, and demilitarization of ammunition, weapons, fire control, and associated items; also to provide procurement and management of initial production quantities and technical support to soldiers and equipment in the field, and to maintain a technology base to facilitate the design, development, procurement, production, and life-cycle support of assigned material or transitioned technologies. These objectives support the ARDEC vision: “Innovative Armaments Solutions for Today and Tomorrow.”

Picatinny Arsenal develops 90 percent of the Army's armaments, ammunition, and advanced weaponry (including non-lethal types). As the nation's Joint Center of Excellence for Armaments and Munitions, PICA is a critical hub for weapons development for all branches of the U.S. military across DOD. These high level activities are administered and integrated by a Senior Mission Commander, typically a Brigadier General.

Currently, the design and development functions are paramount. Production is essentially limited to creating prototypes for evaluation and procurement. As a part of the development and testing process, the installation stores various types of ammunition and explosives in specially designed storage magazines. The storage of ammunition and explosives creates safety and security issues that limit access and restrict the use of certain parts of the land base.

3.2 Natural Resources Needed to Support the Military Mission

The vast acreage of the Arsenal provides a buffer for armament testing and associated noise mitigation for the surrounding neighbors. It also provides a safety zone for the various research and testing facilities located on the Arsenal. Being located in a long valley with relatively steep sidewalls provides additional protection to surrounding areas. No training is conducted on the Arsenal except for infrequent, short duration Marine and Army reserve exercises having negligible impacts. For the most part, the mission, does not depend on, nor directly affect natural resources. Research and development occurs primarily in indoor laboratories or offices; whereas storage, testing, and some demilitarization of munitions, is performed in specific outdoor areas, mainly in unimproved grounds.

3.3 Military Mission and Natural Resources Impacts

The presence of unexploded ordnance from the 1926 explosion, superfund restoration investigations and remediations, restrict or preclude recreational opportunities in many areas of the installation. The Arsenal is closed to public use due to the sensitive nature of the mission.

Consequently, the Arsenal mission has had the effect of preserving resources throughout much of the undeveloped areas of PICA. On the other hand, the management of natural resources has not had an adverse effect on mission activities.

Given guidelines in this INRMP, and since no major expansion of facilities is anticipated outside the current developed areas, impacts to mission are likely to be minimal. Implementation of the Indiana Bat Endangered Species Management (Plan) Component (in 2007) has not hampered mission activities. Due to current and prior mission activities (e.g. potential presence of UXO) prescribed burning as a management tool is essentially disallowed.

Since PICA is a small installation, within a very densely populated and suburbanized landscape and isolated spatially from other DOD installations, there is no Missionscape plan. The missionscape at PICA is essentially our few small scale outdoor test ranges, and our indoor labs and research facilities. The unimproved grounds (natural landscape) essentially serve as a noise and safety buffer from our very close-in neighbors on all sides. The Army Compatible Use Buffer program has been discussed as a possible cooperative initiative to enhance or expand the scope of our rather limited missionscape, but is now abandoned.

3.4 Environmental Stewardship and Compliance Oversight

Picatinny Arsenal is committed to stewardship of the environment based on the following principles:

- Accomplishing the military mission while preventing future liability.
- Protecting and enhancing ecologically sensitive areas.
- Implementing an installation wide Environmental Management System.
- Aggressively promoting and instilling proper environmental management through awareness training.
- Ensuring the accountability of all affected (environmental & cultural) media through management plans.

In 2009 the Picatinny Environmental Management System (PEMS) was implemented in conformance with ISO 14001 and Army guidance. Besides commitment to continual improvement of the PEMS, the Garrison, through the Environmental Affairs Division, also promotes and administers a pollution prevention program and installation restoration program. All of these programs are intrinsically interrelated to Natural Resources Management at multiple levels. Many of the goals and objectives, standards and guidelines, and best management practices outlined in this INRMP are reinforced and implemented through the use of the PEMS which can track the environmental implications or requirements of every task or project conducted on post.

Chapter 4 - Facilities

4.1 Improved Areas

The improved and semi-improved grounds are the areas where most of the Arsenal’s human activities occur, such as work, residency, intensive recreation, and traffic. Picatinny has more than 800 buildings, including 64 laboratories. Approximately one fifth of the installation consists of developed land. The cantonment area is the primary developed portion of the installation, which includes administrative, operational offices; research and development buildings/labs; as well as military housing areas. The cantonment area is approximately 800 acres. Most of the facilities on the Arsenal are concentrated in the central and southern portion of the installation as indicated on the map in Appendix F. Facilities include:

Mission Facilities

Advanced Warhead Development F.
 Ballistic Rail Gun
 Ballistic Evaluation Center
 Armament Software Engineering Center
 Armament Technology F.
 Precision Munitions Development F.
 High Explosive Propellant Formulation
 Pyrotechnics
 Explosive Research, Development, Loading F.
 Propellant Surveillance F.
 Explosive Magazines (storage)
 Nano Technology Lab
 Precision Armaments Lab
 Fuze Engineering Complex
 Packaging, Handling, Storage & Transportation
 (Army and Navy)
 Guns & Weapons Technology (Navy)

Support Facilities

~~Power Generation Plant*~~
 Aquatic Center
 Post Chapel
 Commissary and Post Exchange
 Child Development Center (3)
 Fire Station
 Ball Fields
 Family Housing
 Cafeteria
~~Museum #~~
 Golf Course
 Emergency Services Center
 Conference Center

* This facility was abandoned and razed circa 2009.

This facility was decommissioned (2003), renovated and reutilized in 2012.

Many of the older (production era) buildings are being repaired and renovated to support the mission, especially since the research mission has overshadowed production of munitions. A few buildings are being decommissioned each year. Garrison Public Works Directorate is in the process of remediating and abating any hazardous or regulated materials in advance of the eventual demolition of nearly 250 bldgs on post through CY 2020.

There are also 35 earth-covered explosive storage magazines at scattered locations throughout the installation. These magazines are either 20 by 20 feet or 63 by 30 feet in size and are covered by 18 to 24 inches of soil. The earth cover on these magazines is in good condition and supports grassy vegetation. Per Major Command recommendations, Arsenal policy has been established to eliminate costly non-required mowing; the only exception being as a safety precaution at entranceways.

4.2 Partnership Program

Picatinny Arsenal has determined that in order to better perform its mission and provide the most effective and efficient services to its customers, the Arsenal must maximize the use of its real and intellectual property assets. Picatinny is therefore pursuing the possibility of joint military and commercial use of its real property assets to include, but not to be limited to, facilities and land for laboratories, light manufacturing, education/training, administration, and testing. In addition, the Arsenal is seeking to maximize its ability to transfer technology and intellectual property from military to commercial applications. In recognition of the need to maximize assets, IAW 10 USC 2667, the US Army Garrison Picatinny Arsenal entered into a Master Agreement with InSitech, a NJ-based 501(c) (3) non-profit corporation to develop and lease out 100K sq. ft. of non-excess existing facility space and potentially lease out up to 120 acres of land in the southern part of the installation to create the Picatinny Applied Research Campus (PARC). The lease of the land for the PARC is an option under the Master Agreement and has not been executed. Master Agreement and Leases for 100K sq. ft. of space were executed in FY06/FY07. InSitech owns the buildings while Government maintains ownership of the land. Insitech has invested ~\$7M into leased property/project to date including: demolition of 50K sq. ft. of unusable/dilapidated administrative space; built 27.5K sq. ft. of new administrative/flex space for mission related tenants (Bldg 356); and internal demolition of Bldg 353 (27K sq. ft.) to be developed in the future based upon tenant need.

4.3 Landscaped Areas

Planted areas at PICA occur generally on improved grounds or semi-improved grounds. The largest and most visible landscaped area on post is the centrally located golf course. Other areas planted for landscape purposes or that occur naturally adjacent to improved and semi-improved grounds consist of small areas, normally less than two acres in size that are maintained primarily for the purpose of beautification, screening, or slope stabilization.

Concieved and initiated on Armed Forces Day in 2005, memorial plantings of Red Oak (*Quercus rubra*), the state tree, have been made annually to commemorate those soldiers from NJ (resident) who have lost their lives in the Global War On Terrorism (GWOT). There are specific calendar year plots for each cadre of fallen service members. In the spring of 2006, plantings for Calendar Years 2001 through 2005 were planted near the main entrance and cantonment areas of downtown PICA. This past spring (2012) another plot was dedicated to those NJ heroes who fell in 2011. To date (Fall 2012), 159 Red Oak have been planted in memorium in 12 specific plots.

The last installation-wide Landscape Planting Plan was revised in 1964. Since 1987, rejuvenation plantings, replacement plantings, and new plantings have been made at various sites. An updated Landscape Planting Plan (per Annex I of Appendix C in TM 5-630) should be developed for the installation (see Chapter 8.14.3). An installation Design Guide is being prepared for PICA. Landscaping on post includes quarters, administrative buildings, community facilities, and areas requiring vegetative screening, areas in danger of eroding, and roadside beautification. A map of the installation depicting key landscape sites, both old and new, including the various year by year memorial tree plots, should also be prepared.

4.4 Urban Wildlife

The semi-improved grounds often provide habitat for, or are capable of being used by, a variety of wildlife species. Urban wildlife species are adapted or tolerant to the land conditions produced and dominated by the actions of man (Brocke 1979). Dominant features of the Arsenal's urban landscape include: lawns, composed of Kentucky blue grass (*Poa pratensis*), rye grass (*Lolium perenne*), bent grass (*Agrostis spp.*), and red fescue varieties (*Festuca rubra spp.*) mowed on a varying schedule from one to four weeks during the growing season; asphalt areas such as roads, parking lots, and walkways; and buildings and storage facilities. Common ornamental trees and shrubs planted in the improved grounds are: spruces (*Picea spp.*), pines (*Pinus spp.*), Norway maple (*Acer platanoides*), dogwoods (*Cornus spp.*), honey locust (*Gleditsia triacanthos*), junipers (*Juniperus spp.*), yews (*Taxus spp.*), rhododendrons (*Rhododendrons spp.*), euonymous' (*Euonymous spp.*), and forsythia (*Forsythia spp.*).

Aspects of the urban landscape important to wildlife species include: (a) numerous food sources; expanses of herbaceous plants, browse, as well as soft and hard mast, from ornamental shrubs and trees; and (b) diverse roosting, denning, and nesting sites afforded by buildings and foundations. Commonly observed birds on the urban landscape include species such as rock dove, house sparrow, European starling, and house finch (*Carpodacus mexicanus*). Indigenous birds include chipping sparrow (*Spizella passerina*), mourning dove (*Zenaida macroura*), barn swallow (*Hirundo rustica*), American robin (*Turdus migratorius*), northern cardinal (*Cardinalis cardinalis*), and common grackle (*Quiscalus quiscula*). Common mammals on developed lands include woodchucks (*Marmota monax*), Norway rats, house mouse, striped skunk, and feral cats and pets. The burrowing activity of woodchucks also provides suitable den sites for many other wildlife species (Lee and Funderburg 1982). Other species of wildlife that frequently use the urban landscape as part of their habitat include white tailed deer, gray squirrel, eastern cottontail, and American crow.

Wildlife inhabiting the developed areas provides excellent viewing opportunities for recreational users of urban land. From a recreational viewpoint, the urban landscape provides the majority of wildlife viewing opportunities for most Arsenal personnel. Many species can be easily observed in transitional areas between developed and undeveloped lands. Wildlife in urban environments may also frequently cause nuisance problems as discussed in Chapter 8.13 of this plan.

Chapter 5 – Responsible and Interested Parties

5.1 Installation Organization

The Natural Resources Manager (NRM) presently works within the Directorate of Public Works (IMPI-PWE) as part of the Environmental Affairs Division (EAD).

The following position is dedicated full time to the Natural Resources Program:

- Natural Resources Manager (1).

There have been no summer seasonal positions for the past 10 years:

The following personnel provide occasional support and backup to the Natural Resources Program:

- Environmental Scientist (1).

The following personnel formerly considered government-in-nature (GIN) were contracted out under the A-76 program in 2002 and now perform services through the Arsenal's Base Operations Support Contractor (A-76 successor) known as Chugach Industries:

- Installation Integrated Pest Management Coordinator (1). Hereafter referred to as IIPMC.

5.2 Other Defense Organizations

The Army Environmental Command under the co-located Installation Management Command (IMCOM) at Fort Sam Houston in San Antonio, TX provides natural resources assistance to Army posts worldwide. The Picatinny NRM occasionally receives guidance or assistance from the Army Environmental Command. The Army Corps of Engineers (Waterways Experiment Station) has electronic and hard copies of various map products.

5.3 Federal and State Agencies

The USFWS and the NJDFW are cooperating and signatory agencies in the implementation of this plan, as required by the *Sikes Act Improvement Act*.

The following Federal agencies are consulted on an as needed basis and provide assistance or products:

US Army Corps of Engineers.

USDA Natural Resources Conservation Service (soils maps and erosion control).

USDA Forest Service – State & Private Forestry Forest Health Protection.

US Geological Survey

USDI Fish & Wildlife Service (endangered species such as Indiana Bat & Bog Turtle).

The latter two agencies manage a web-based Information, Planning, and Conservation (IPaC) system designed for access to information (and maps) about the natural resources for which the USFWS has trust or regulatory responsibility. The IPaC tool aids with regulatory consultation, permitting and approval processes administered by USFWS.

New Jersey Division of Fish and Wildlife provides advice on hunting and fishing regulations. They also can provide assistance on wildlife habitat improvement projects, and Species At Risk.

The New Jersey State Planning Commission has provided assistance with this planning document and the importance of Picatinny within the New Jersey Highlands Region. The New Jersey Forest Fire Service provides assistance with wildfire suppression.

The State Historic Preservation Office (SHPO) is consulted regarding the effects of activities on the installation's cultural and historical resources. There are several historical or cultural sites on the Arsenal. A map of historic structures and districts is available.

5.4 Contractors and Other Interested Parties

Since the last version of this INRMP (2001) there has been an ever increasing role of contractors on post, yet PICA is still a Government Owned, Government Operated (GOGO) installation within DA and IMCOM. There are basically four types of contracts and contract personnel who support the day to day recurring activities – these are described in the Glossary under “Contractor”. These contractors along with federal employees and military members form what is known as TEAM Picatinny. The biggest and initial change occurred from 1999-2002 when the A-76 Competitive Sourcing process ensued. This is now referred to as Commercial Services Management by Office of Management and Budget. In 2002 Johnson Controls out competed the Most Efficient (government) Organization, resulting in scores of federal (PICA) workers being displaced; although many were retained by the private contractor.

In summer of 2005, Chugach Industries replaced Johnson Controls for Base Operations Support under a sole source contract award. Again, many former federal employees who had been hired by Johnson Controls were also retained by the new contractor Chugach. In this document these personnel are referred to as BasOpsSup.

Since 1996 Veolia Water has had renewed 5 year GOCO (Government Owned, Contractor Operated) contracts for operations, maintenance and repair of a former wastewater treatment plant (now demolished); as well as PICA drinking water supply services. This function is likely to be privatized in the next year or so.

In 2003, Sussex Rural Electric Cooperative was the first privatization contract awarded at PICA. This local company purchased the electrical distribution infrastructure and is responsible for its sustainment over a 50 year period (Maier, 2010).

In May 2006, The Residential Communities Initiative and Partnering program within PICA was implemented with the purchase of all existing military housing on post with a 50 year ground lease by GMH Military Housing Investments. GMH was later acquired by Balfour Beatty Communities in April of 2008. The aforementioned contracts and lease agreements represent privatization on portions of the installation and the on site contractor personnel representing these partners and entities are referred to hereafter as PrvPart.

In 2004, New Jersey Natural Gas and ChevronTexaco installed decentralized boilers at multiple locations on post to decentralize the steam system for interior building heating. Once this was completed the main PICA powerhouse (bldg 506) was deactivated and demolished in 2008. Chevron contract personnel work on site like many others with long term contracts for recurring support services. These type contractors are referred to herein as FacMtnSvc (Facilities Maintenance/Services personnel). Other examples of FacMtnSvc are the Turf Maintenance and Refuse Removal contract (First Occupational Center); and the Custodial Services contract (Employment Horizons).

Examples of Task specific contractors, just within the Garrison, include: Hazardous Waste Management; Hazardous Materials Management (aka HazMart); multi year contracts through the United States Army Corps of Engineers (USACE) for environmental consultants and field workers to advance the IRP (Installation Restoration Program); and most recently, UXO qualified contractors to support the Military Munitions Response Program (MMRP). Baltimore District and Huntsville District (USACE) respectively manage the IRP and MMRP. All of these contractor personnel and the work they perform have routine interface with the natural environment and resources at PICA. Managing and monitoring these disparate and overlapping activities IAW the stewardship responsibilities of Natural Resources Management is complex, since consistent communication with so many agents is difficult. Getting the various contracts to incorporate and reflect the essential requirements and policies inherent in this INRMP when necessary has been largely unsatisfactory or inconsistent.

The Picatinny Rod and Gun Association sponsored by the Family and Morale Welfare and Recreation office (FMWR) has about 160 members. The Audubon Society has conducted annual bird surveys on the Arsenal. Picatinny Peak is a designated hawk-watching site of the Hawk Migration Association of North America. Local universities, especially Rutgers University, offer assistance periodically when needed. Conversely, student projects concerning fish, wildlife, or environmental studies are usually permitted and encouraged on the installation.

5.5 Indian Nations and Tribes

A draft of this INRMP was sent to the Delaware Nation of Oklahoma, Delaware Tribe of Oklahoma, Shawnee Tribe, and Absentee-Shawnee Tribe of Oklahoma; all federally recognized sovereigns with ties to Northern New Jersey. Each sovereignty was invited to review and comment on this document at the same time that it was presented to the Sikes Act partners (USFWS and NJDFW) for external review.

Chapter 6 – Natural Resources and Climate

6.1 Setting

The PICA is located in the New York-New Jersey Highlands Region (see Appendix A). The Region comprises 1.1 million acres of Appalachian ridges and valleys stretching from the Hudson to the Delaware River. It is a landscape of national significance, rich in natural resources and recreation opportunities. The area, often described as “where the pavement ends and nature begins,” consists mainly of forests and farm fields adjacent to the New York/New Jersey Metropolitan Region. The setting forms an effective greenbelt and is contiguous with other public land in some areas (see maps in Appendix F).

The Arsenal is primarily located in Rockaway Township in Morris County, New Jersey. A small portion to the southwest is located in Jefferson Township, although no mission operations or activities occur on this acreage. The installation is located 32 miles northwest of Newark and 42 miles west of New York City. Local boroughs nearest the Arsenal are Wharton (1 mile), Dover (3 miles), and Rockaway (5 miles).

6.2 Topography and Relief

Northeast- to southwest-tending ridges separated by long, broad valleys characterize the New York – New Jersey Highlands. For general discussions of orientation or aspects, the ridges and valley(s) will be construed as running north-south. Situated geographically between North Latitudes 40 degrees, 55 minutes and 41 degrees, 00 minutes and West Longitudes 74 degrees, 28 minutes and 74 degrees, 36 minutes, the installation encompasses a wide central valley (Picatinny Valley) which is approximately seven miles long and a narrower parallel intermontane valley (Green Pond Gorge) about two miles long. Both are flanked by an easterly as well as a westerly ridge. The total breadth across the installation averages 1.5 miles.

The installation is depicted mostly on the Dover Quadrangle, as well as on minor portions of the Boonton and Newfoundland Quadrangles -- United States Geological Survey maps (7.5 minute series). These maps with 20 foot contour intervals were developed circa 1942. Although the Dover quadrangle has been updated, since 1943, the Arsenal boundaries are still not correctly depicted. In 1957, one of the last acquisitions to date added 204 acres to the Arsenal. This land in the northwest corner of the installation, known as the “Phineas Sprague tract” is not depicted on most contemporary USGS or commercial maps. The installation updated its topography through two surveys (1948 and late 1980s). Computer Assisted Design and Drafting (CADD) maps were prepared with 5-foot contour intervals. These are depicted on the Basic Information Map Series (BIMS), which also accurately depict all present boundaries. Unfortunately since the advent of GIS files and programs superceding the CADD BIMS, many printed outputs of PICA maps are posted or promulgated which do not accurately depict our actual fee simple boundaries. Often restrictive easement tracts are included when in fact these are not federal DA property. Map depictions of existing easements (or leased land) on PICA federal property is not readily available, when relevant to various projects. Recently maps generated from Highlands Council LIDAR data now depict 2 foot contours; and an ACSIM contract for LIDAR aerials will soon provide another set of 2 foot contours for PICA.

Elevations on the installation range from 685 to 1,287 feet National Geodetic Vertical Datum (NGVD). Elevations are generally lower to the south and east and higher to the north and west. The westerly ridge is Green Pond Mountain (GPMt) with summits ranging from 860 to 1,287 feet; and the local relief rises 200 to 400 feet above Picatinny Valley. The southern terminus of Copperas Mountain (COPMt) extends into the northern portion of installation property separating the Denmark Lake basin on the east from the Green Pond Brook (GPB) basin to the west. COPMt summits range from 1,100 to 1,200 feet; while western slopes rise only 50 to 150 feet above GPB wetlands in contrast with eastern slopes surmounting Denmark Lake by 275 to 375 feet. The easterly flank of the installation comprises a series of knobs with summits ranging from 860 to 1,066 feet; and local relief rises 150 to 250 feet above Picatinny Valley.

6.3 Geology

The eastern and southeastern areas of the installation consist of older Precambrian bedrock (granite gneiss). The western and northwestern areas consist mainly of younger Paleozoic bedrocks (quartz conglomerate and sandstone). This latter bedrock is known as the Green Pond Formation and dates back to the Silurian age. This formation dips northwesterly, giving rise to many prominent outcrops, resistant cliffs, and talus slopes along the truncated southeastern aspect. An inactive geologic fault is associated with Green Pond (a large lake north of the Arsenal). It follows Upper GPB through the Gorge and the base of Green Pond Mountain to the south. The fault tends to divide the older bedrocks to the east from the younger deposits to the west. The Cambrian age Leihsville Formation (dolomite) lies south of Picatinny Lake between GPB and Green Pond Mountain. Surficial geology throughout the Arsenal is mostly glacial till of Wisconsin age derived from the aforementioned bedrocks. Large glacial erratic are scattered throughout the Arsenal. The northern edge of the Wisconsin terminal moraine just touches the southwest corner of the installation. This geology results in the topography being marked by an abundance of stones, boulders, and bedrock outcroppings.

6.4 Climate and Climate Change

Global climate change issues are beyond the control of the NRM and the management actions discussed in this INRMP, yet shifts will be monitored. **Climate changes within the next several years are not expected to be significant**, having little overall effect on Picatinny Arsenal. Northern New Jersey is characterized by a temperate, continental climate with warm summers and cold winters. Some areas of the Arsenal have microclimatic conditions, which could be classified as “cool temperate” due to the particular topographic relief, aspect, and geology. Examples of such areas are north-facing exposures, “shadowed” slopes, and cold air sinks in certain ravines, the Gorge, and talus slopes. The data presented as follows is based on the observations and records of the Charlotteburg Reservoir reporting station (M. Gerbush, pers. comm., from National Climatic Data Center, 1981-2010 Normals).

6.4.1 Temperature

The Average Annual High temperature is 60.9 degrees Fahrenheit (F) and the Average Annual Low is 39.6 F. Overnight low temperature ranges from an Average Daily Low of 17.5 F in January to an Average Daily Low of 61.1 F in July. Daytime High temperature ranges from an Average Daily High of 36.2 F in January to an Average Daily High of 83.7 F in July. Based on these averages, the coldest month tends to be January and the hottest to be July. The lowest

recorded temperature occurred in 1912 when the thermometer registered 26 degrees below zero (-26 F). In 1936, the highest temperature, 105 F, was recorded.

6.4.2 Precipitation

Rainfall averages 52.20 inches and is evenly distributed throughout the year. The average monthly rainfall totals range from 3.27 inches in February to 4.94 inches in September, the rainiest month. The highest rainfall in any 24-hour period was in September 1894 with 7.76 inches. Thunderstorms account for most of the summer rain. Precipitation is generally not considered limiting to tree growth in the region.

The average yearly snowfall is 35.0 inches. Snow accumulation can begin as early as October and remain as late as April. On average, snow cover of 1 inch or more can be expected for 38 days during this period.

6.4.3 Frost Dates, Growing Season, and Ice Formation

The growing season or frost-free period in the Highland Region lasts approximately 172 days. The last killing frost occurs in early May and the first killing frost of autumn occurs at the beginning of October (USDA 1976). Ponds begin ice cover formation in December and are totally free of ice by the end of March. Generally, safe ice (greater than 4 inches) is found in January and February. Soil temperatures are such that even in winter, the ground does not stay frozen for very long and not to any appreciable depths. Leaf-emergence on trees occurs in early to mid-May and leaves begin to fall in late October.

6.5 Petroleum and Minerals

The Arsenal does not have any extractable minerals. There are no third party reservations for any minerals, natural gas, petroleum, sand, or gravel.

6.6 Soils

There are 26 recognized soil types (USDA Soil Conservation Service, 1976) on the installation. Soils in the area are primarily coarse textured, mostly sandy loams. These soils are derived from bedrock, glacial till, and colluvium.

Table 6.1. Soils found at Picatinny Arsenal

NAME	DRAINAGE	PROPERTIES	SLOPE
Adrian Muck (organic) Ad *	Very Poor	Muck surface/peat	Level
Carlisle Muck (organic) Cm *	Very Poor	Muck	Level
Hibernia Stony Loam HbC ‡	Poor Upland	Loam	3-15%
Hibernia Very Stony Loam H1D	Poor Upland	Loam	15-25%
Man Made Ma	Varies w/fill	Varies w/material	Level
Netcong Gravelly Sandy Loam NtB	Well Drained	Moderate Fertility	3-8%
Otisville Gravelly Loamy Sand OtC	Excessively Drained	Low Fertility Low Water Capacity	3-5%
Sand & Gravel Pits Ps	Excessively Drained	Active & Abandoned Pits	Vertical Sides
Pompton Sandy Loam ‡ PtB	Deep, Poorly Drained	Medium Fertility Moderate Water Capacity	3-8%

Preakness Sandy Loam * PvA	Deep, Poorly Drained	Medium Fertility Moderate Water Capacity	0-4%
Preakness Sandy Loam (Dark Variant) Pw *	Deep, Poorly Drained	Medium Fertility Moderate Water Capacity	0-4%

Ridgebury Very Stony Loam * RgA	Deep, Poorly Drained	Medium Fertility Moderate Water Capacity	0-3%
Ridgebury Extremely Stony Loam R1B *	Deep, Poorly Drained	Medium Fertility Moderate Water Capacity	3-10%
Riverhead Gravelly Sandy Loam RmB	Deep, Well Drained	Low Fertility Moderate Water Capacity	3-8%
Riverhead Gravelly Sandy Loam RmC	Deep, Well Drained	Low Fertility Moderate Water Capacity	8-15%
Rockaway Gravelly Sandy Loam ‡ RoB	Deep, Moderately/ Well Drained. Fragipan.	Medium Fertility Moderate /Low Water Capacity	3-8%
Rockaway Very Stony Sandy Loam RpC	Deep, Moderately/ Well Drained. Fragipan.	Medium Fertility Moderate /Low Water Capacity	3-15%
Rockaway Extremely Stony Sandy Loam RrD	Deep, Well Drained	Medium Fertility Moderate Water Capacity	15-25%
Rockaway Rock Outcrop Complex RsC	Deep, Well Drained	Medium Fertility Moderate Water Capacity	3-15%
Rockaway Rock Outcrop Complex RsD	Deep, Well Drained	Medium Fertility Low Water Capacity	15-25%
Rockaway Rock Outcrop Complex RsE	Deep, Well Drained	Medium Fertility Low Water Capacity	25-45%
Rock Outcrop-Rockaway Complex RvF	Deep, Well Drained	Medium Fertility Low Water Capacity	Steep
Rock Outcrop Rt	Excessively Drained	Bedrock at Surface	Ridge tops
Urban Land Ua		Original Soils Cannot Be Recognized	
Urban Land/ Rockaway Complex UrD		Highly Worked Soils, but Mostly Rockaway Properties	
Whitman Very Stony Loam * Wm	Deep, Poorly Drained	Moderate Fertility	Depressions, Drainages

* Hydric Soils

‡ Hydric inclusions

6.7 Water Resources

New Jersey's geology harbors, filters, and conveys much of the 1.5 billion gallons of water used on a daily basis to homes, businesses, industries, and farms in the Highlands Region. Of the 1.2 billion gallons of potable water used each day in homes and businesses, half flows through streams, rivers, and reservoirs that collect rainwater from the contributing watershed. The quality of this water is related to land use and development within the watershed.

Water is a major component of the Picatinny landscape, evidenced by 2 large lakes, 18 ponds, 4 perennial brooks, several intermittent runs, 3 freshet waterfalls, and a few springs and seeps.

Watersheds

The Arsenal is an important recharge area within New Jersey WMA 6 (see Appendix A for description and Appendix F for map) comprising the Upper Passaic, Whippany, and Rockaway Watersheds. Watershed Management Area #6 serves as the primary water supply for northern New Jersey.

The Farny Highlands Watershed, named for Farny State Park three miles northeast of PICA, comprises five sub-watersheds in northern Morris County. Comprising a substantive portion of The Green Pond drainage basin and a small part of the Hibernia Brook subwatershed, the installation represents 18 percent of the Farny Highlands Watershed, and more significantly, 33 percent of all public or conservation lands within the watershed.

Picatiny Arsenal comprises 61 percent of the 9,600-acre Green Pond third order watershed draining nearly 7,700 acres through the installation (USACE-WES 1995). The headwaters of this watershed originate from a 500-acre spring-fed lake known as Green Pond. Green Pond is north and adjacent to the installation. The Green Pond Watershed drains into the Rockaway River, which then drains to the Passaic River. The New Jersey Department of Environmental Protection (NJDEP) recognizes the Rockaway River as a high quality waterway.

Based on the hydrologic unit code (HUC) system developed by the United States Geological Service (USGS) for delineating and identifying drainage areas, there are 921 HUC 14 sub watersheds in New Jersey that range in size from 0.1 to 42 square miles (Stormwater Mgt Rule FAQ. 2008). There are 183 sub-watersheds within the Highlands region of NJ (Ecosystem Mgt Tech Rpt 2008).

Based on natural topographic divides across PICA, there are three separate sub-watersheds recognized and identified under the USGS HUC14 delineations: 06CA06= Green Pond Brook –above Burnt Meadow Brook (GPB-North of confluence); 06CA05= Green Pond Brook –below Burnt Meadow brook (GPB-South of confluence); and 06CA10= Hibernia Brook (HB). These sub-watersheds and abbreviations will be described and outlined below.

Drainage Bed Gradients

The Arsenal is comprised of five main drainages:

1. Green Pond Wetlands and Gorge. (GPB-N)
2. Denmark Lake and Wetlands. (GPB-N)
3. Middle Green Brook and Picatinny Lake. (GPB-S)
4. Lower Green Pond Brook. (GPB-S)
5. Hibernia Brook Sub-watershed.

From the uppermost reaches, water steps down through Picatinny Valley in three main drainage beds (2-4 above). The Gorge, as well as Bear Swamp Brook are parallel drainages originating at higher elevations which also flow into Picatinny Valley. The Upper GPB falls 300 feet through the Gorge from Green Pond and its associated wetlands at elevation 1,046 feet to the confluence with Lower Burnt Meadow Brook at 750 feet. Upper Burnt Meadow Brook is the source stream for Denmark Lake at elevation 821 feet. Water drops about 10 feet at Denmark Dam Spillway to the tailrace. Lower Burnt Meadow Brook falls 60 feet from this tailrace to the confluence with Upper GPB out of the Gorge. From this confluence Middle GPB grades 40 feet into Picatinny Lake at elevation 711 feet. The steep gradient from Green Pond Wetlands and Gorge to Picatinny Lake is about 339 feet. In contrast the step from Denmark Lake to Picatinny Lake is nearly 110 feet. Water drops 10 feet also at Picatinny Dam Spillway to its tailrace. The Lower GPB grades only 26 feet to its exit point at elevation 685 feet, near the main entrance to the Arsenal.

With such gradients and several smaller tributaries, runoff can be rapid during periods of extreme precipitation or snowmelt. Fortunately, the major portion of the watershed is in dense tree and grass cover retarding and reducing flood frequency.

Ames Brook (a tributary to Hibernia Brook) carries headwaters off of 250 acres of the installation downstream through Lake Ames and then into Hibernia Brook.

6.7.1 Lakes and Ponds

There are 621 acres of lakes, ponds, and their associated scrub-shrub wetlands on the Arsenal as indicated in Appendix E1. Picatinny Lake is designated by NJDEP and USFWS as an open water wetland. Denmark and Picatinny Lakes comprise 360 acres of open water. There are eighteen ponds/sloughs on the Arsenal; ten medium sized (>1 acre) and eight smaller (<0.5).

6.7.2 Streams

There are two main brooks that flow into the installation from the north. These are Green Pond Brook that originates from Green Pond and Burnt Meadow Brook, which arises from Egbert Lake. There are several small brooks and springs that originate from the installation that add to the flowage. All lotic corridors comprise 24 miles on post (see Appendix E-2). Two brooks discharge from the Arsenal. Green Pond Brook (7.3 miles) is the primary discharge and exits the southern boundary of the installation. Ames Brook exits the installation along the eastern boundary. There are nine high quality waterways in the Highlands Region. Green Pond Brook is cold and clean enough to support self-sustaining brook trout populations. The Rockaway River is currently considered by the NJ Department of Environmental Protection to be of good or excellent water quality. The PICA is one of the watersheds that flow into the Rockaway River, and ultimately to the Boonton Reservoir.

6.7.3 Storm Drainage

Water control structures at three dams and an extensive network of surface and subsurface conduits and culverts control storm drainage. Although the culverts have eased the severity of flood conditions in most areas, the possibility of flood problems still exists, especially during periods of extreme weather conditions and when the ground is saturated from snow melt or a previous rainfall. A series of Flood Plain maps reflecting various stages and frequencies have been prepared for the installation by the US Army Corps of Engineers, Waterways Experiment Station. The principal drainage channels flowing through improved grounds on the installation are the lower reaches of GPB and the middle and lower reaches of Bear Swamp Brook.

6.7.4 Wetlands

The Arsenal contains approximately 1,250 acres of wetlands (R. Lichvar, pers. comm. 1994). The wetlands are composed of forested wetlands and shrublands. Wetlands on the installation are very valuable to wildlife and serve as important ground water recharge sites. Wetlands are scattered throughout the installation and contribute significantly to the biodiversity of the Arsenal. A few pockets of shrub or forested wetlands (Palustrine) are located around the perimeter of Picatinny Lake.

There are 10 recognized cover types within five wetland types in two systems (USACE-WES 1995; after Cowardin et al. 1979). See Table 6.2, Picatinny Wetland Types. Red Maple swamp forests, Lakes and Ponds, and their associated woody scrub-shrub wetlands comprise 92% of all wetlands on post. Red Maple dominates terrestrial wetland cover types. The largest tract of Red Maple swamp near the southern end of the Arsenal is laced with drainage ditches, which have altered the surface hydrology and recharge potential of the wetland. Also, this swamp is significantly recharged from the southeastern slopes in shallow ground water movement through the unique glacial soils of the Ridgebury series. Foundation construction on these slopes could be problematic, not to mention diminished recharge of wetlands down gradient towards Lower GPB. Hydric soils comprise 26 percent of the ground at the Arsenal, mostly in Picatinny Valley and other riparian areas of the watershed. Hydric soil types are noted in Table 6.1 above, as well as soil types with hydric inclusions.

Table 6.2. Picatinny Wetland Types

Wetland Type	Number of Stands	Acreage	Percent Total Wetland
LACUSTRINE:		419	33%
Lakes		378	(30%)
Ponds/Sloughs		41	(3%)
PALUSTRINE SHRUBLANDS:		207	16%
Scrub Shrub 1 (Denmark Lk)		200	(16%)
Scrub Shrub 2 (Green Pond Gorge)		7	(-)
PALUSTRINE MARSH:		39	3%
Wet Meadow		39	(3%)
PALUSTRINE FOREST:		585	47%
Red Maple		534	(43%)
Yellow Birch/Red Maple		32	(3%)
Aspen/Gray Birch		18	(1%)
Hemlock (wet)		<1	(<1%)
TOTAL	209	1250	100%

6.8 Flora

The installation is approximately 70 percent forested. The forest is a result of ecological succession of land previously farmed or cleared as well as more recent selective logging. Most of the forested portion is in second-growth stages having been logged historically. The installation’s woodlands are representative of the forest types of the Highlands Region (Leak 1975).

New Jersey has documented 2,117 known native plant species within the “Garden State.” Of these, 15 percent are currently considered endangered by state authorities, yet only 7 species are federally listed. Nearly one third are categorized as species of conservation concern within the state. Nearly 25 percent of the state’s flora has been documented on the Arsenal (Anderson 1989). To date, 626 flowering plants and 90 non-flowering plants were identified on the Arsenal by Andrew Windisch (1993) and Bob Lichvar (1995) as part of a classification and mapping project to identify floristic associations. Appendix B-1 lists Endangered Plants and Species At Risk, as well as other plant species known to occur on the Arsenal.

There are seven state-listed endangered plants on the installation, four of which are aquatic species found in Denmark Lake: Featherfoil (*Hottonia inflata*), Robbin's pondweed (*Potamogeton robbinsii*), small bur-reed (*Sparganium minimum*) and lesser bladderwort (*Utricularia minor*). Large-leafed holly (*Ilex montana*), Slender wood reed grass (*Cinna latifolia*), meadow horsetail (*Equisetum pratense*), are associated with wetlands. The latter two plants which were seen (R. Radis, pers. comm. 1993), apparently have not been reported to the state for inclusion in the Natural Heritage database files (D. Snyder, pers. comm. 2012).

In addition, there are 14 more NJ "Plant Species of Concern". Most of these plants occur in the remote northern portion of the Arsenal. Six species are ranked S2 (Imperiled in NJ): Allegheny vine (*Adlumia fungosa*), mountain spleenwort (*Asplenium montanum*), purple cress (*Cardamine douglassii*), two fruited sedge (*Carex disperma*), purple virgin's bower (*Clematis occidentalis*), and green fruited bur reed (*Sparganium chlorocarpum*). Allegheny vine, mountain spleenwort, and purple virgin's bower are upland plants. The other three are wetland plants. Eight species are ranked S3 (Rare in NJ): Virginia snakeroot (*Aristolochia serpentaria*), purple fringed orchid (*Habenaria psychodes*), wood lily (*Lilium philadelphicum*), floating heart (*Nymphoides cordata*), tall cinquifol (*Potentilla arguta*), humped bladderwort (*Utricularia gibba*), flat leaved bladderwort (*Utricularia intermedia*), and purple bladderwort (*Utricularia purpurea*). All, except Virginia snakeroot, wood lily, and tall cinquifol, grow in wetlands. Ten other NJ Plant Species of Concern have been reported on post, but have not been confirmed. In 1999 a few small colonies of another state endangered plant, stiff clubmoss (*Lycopodium annotinum*) was identified (R. Radis, pers. comm. 1999). Appendix B-1 lists those plants known to exist on the Arsenal that are listed by New Jersey as either endangered or of conservation concern. Status is monitored through the Natural Heritage Program.

There are no federally Threatened or Endangered plants known to exist on the installation (Appendix B-1). However, two federally-listed species exist in the area, small whorled pogonia (*Isotria medeoloides*) and swamp pink (*Helonias bullata*), but they are not known to occur on the installation. No Candidate Species are expected to occur on or near the Arsenal (J. Markuson, pers. comm. 2012).

Poisonous plants include poison ivy (*Toxicodendron radicans*), poison sumac (*Rhus vernix*), and climbing nightshade (*Solanum. dulcamara*). The most annoying plant to people on the Arsenal is poison ivy. Poison ivy is found throughout the Arsenal, while poison sumac is restricted to wetlands. Nightshades can occasionally cause problems around developed recreation sites.

6.8.1 Grasslands and Shrublands

There are no major grassland areas associated with the installation outside the mowed portions of the cantonment area. The shrublands are associated with the wetlands near Denmark Lake. The principle species of these palustrine shrublands, based on abundance, are: Smooth Alder (*Alnus serrulata*), swamp azalea (*Rhododendron viscosum*), maleberry (*Lyonia alnifolia*), high bush blueberry (*Vaccinium corymbosum*), swamp loosestrife (*Decodon verticillatus*) buttonbush (*Cephalanthus occidentalis*), meadowsweet (*Spiraea latifolia*), and swamp rose (*Rosa palustris*).

6.8.2 Forest Types

There are 4,082 acres of forested land on the Arsenal. The upland forests of the installation are mixed oak and northern hardwood. The mixed oak type is the most widespread and prevalent forest type on the installation. At present, most of these stands are in the pole-sized stage. This type covers 2,656 acres and represents 65 percent of the total forested area. Oak species in these stands consist primarily of chestnut oak (*Quercus montana*), red oak (*Quercus rubra*), white oak (*Quercus alba*), black oak (*Quercus velutina*), and scarlet oak (*Quercus coccinea*). Species composition in these stands varies with elevation, available soil moisture, site quality, and past management and stand origin. As a general rule, stands at the lower elevations are dominated by species of the red oak group, while chestnut oak dominates the poor sites near the ridge tops.

Table 6.3. Picatinny Forest Types

Forest Type	Number of Stands	Acreage	Percent Total Forest Land
Mixed Oak	99	2,656	65%
Northern Hardwood	41	545	13%
Hemlock	7	322	8%
Red and White Pine	6	8	<1%
Red Maple* b/m	64	532	13%
Aspen/Gray Birch*	8	18	<1%
Hemlock (wet)*	(2)	1	<1%
TOTAL	225	4082	100%

* Palustrine Forest wetland cover type

b/m includes Yellow Birch/Red Maple cover type

The better oak sites on the installation have a northern hardwood component of sugar maple (*Acer saccharum*), basswood (*Tilia americana*), white ash (*Fraxinus americana*), yellow poplar (*Liriodendron tuliperfera*), hickory (*Carya spp*), and black cherry (*Prunus serotina*). Stands on the intermediate sites have components of white pine (*Pinus strobus*) and in some places hickory. On the poorer quality sites, oak stands have components of pitch pine (*Pinus rigida*) and big-toothed aspen (*Populous grandidentata*). Soil moisture has an influence on species composition. On the richer sites, components will range from yellow poplar, American elm (*Ulmus americana*), white ash (*Fraxinus americana*) and black gum (*Nyssa sylvatica*). As sites become dryer, pitch pine, pignut hickory (*Carya glabra*) and mockernut hickory (*Carya tomentosa*) become larger components. Swamp white oak (*Quercus bicolor*) is found on the saturated soils in the Picatinny Valley.

The northern hardwood forest type comprising 545 acres represents 13 percent of the total forested area. This forest type varies widely in species composition and can include upward of 20 species of trees; the single species common to all stands is sugar maple (Nyland et al. 1981). Other common associates include white ash, beech (*Fagus grandifolia*), yellow birch (*Betula alleghanensis*), red maple (*Acer rubra*), black birch (*Betula lenta*), basswood, black cherry, and hemlock (Nyland et al. 1981). Most northern hardwood stands are located in the Picatinny Valley and the eastern ridge of the installation.

The red maple forest type consists of almost pure red maple. Most of these stands are situated on the very moist or saturated soils. Some stands are located on organic soils—muck. Common associates of the red maple forest type include sugar maple, black gum, elm (*Ulmus spp.*), and black birch (Chambers 1983).

The red maple forest type located on moist soils at the installation is considered climax forest. Approximately 13 percent of installation's woodlands consist of this type.

The hemlock forest type is the only coniferous forest type located on the installation, except for some small pine plantations in the developed portion of the Arsenal. The hemlock type is found on 323 acres and represents 8 percent of the total forested area. Although the amount of hemlock forest type is low on the installation, it is of great concern that majorities of hemlock are dead or are dying (see Chapter 6.11.1). The hemlock woolly adelgid (*Adelges tsugae*) and the elongated hemlock scale (*Fiorinia externa*) have killed hemlock throughout the Highlands Region. Hemlock is located mostly in uniform stands on the western boundary of the installation and at one location in the valley. Several hardwood stands on the installation have a hemlock understory.

6.9 New Jersey Highlands Ecosystem Context

New Jersey Highlands

It has long been recognized by the United States Forest Service (USFS) and New York and New Jersey citizens that the national Highlands Region is a landscape of special significance. The New Jersey Highlands portion is a 1,343 square mile area comprising nearly 800,000 acres in the northwest part of the state, noted for its scenic beauty and environmental significance. Over 70 percent of its lands are environmentally sensitive. The region lies within portions of seven counties (Hunterdon, Somerset, Sussex, Warren, Morris, Passaic, and Bergen) and includes 88 municipalities. The Highlands yields approximately 379 million gallons of water daily from only 13 percent of the State's land area; and is a vital source of drinking water for more than half of New Jersey's families. For the past 15-20 years regional planning efforts have been undertaken to safeguard this essential landscape and ecosystem (NJ Highlands Council, 2011).

Highlands Act of 2004

The New Jersey Highlands Region is designated as a Special Resource Area in the State Development and Redevelopment Plan. In late summer of 2004 the NJ legislature passed, and the governor signed into law, the Highlands Water Protection and Planning Act; in order to preserve open space for recreation, sites of historic significance, and to protect the state's greatest diversity of natural resources including the precious water resources. The Highlands Act delineates the geographical boundary of the Highlands Region and establishes the Highlands Preservation Area and the Highlands Planning Area. It required the NJDEP to establish regulations in the Highlands Preservation Area; to create a Highlands Water Protection and Planning Council (aka Highlands Council); and to develop a regional master plan for the entire Highlands Region (NJ Highlands Council, 2011).

The Highlands Council approved the Highlands Regional Master Plan on 17 JUL 08 and became effective on 8 SEP 08 (NJ Highlands Council, 2011).

Although PICA property is covered by the Highlands Planning Area it is exempted from the Preservation Area rubrics (e.g. any regulatory or permitting requirements or constraints).

New Jersey Landscape Project

Since the last version of this INRMP, the NJDEP Landscape Project, which was released in 2001, has become more fully developed in the past ten years— now version 3.1. The Landscape Project is an ecosystem-level approach for the long-term protection of imperiled species and their important habitats in New Jersey. The project began in 1994 by the NJDFW Endangered and Nongame Species Program (ENSP). Through geographic information systems (GIS) technology, the Landscape Project uses documented species location data and land-use/land-cover as well as species life history information to produce maps that depict habitat for endangered, threatened and special concern wildlife species throughout the state. The goal of the project is to provide a tool that fosters protection of New Jersey’s biological diversity by facilitating the recovery and sustainability of endangered, threatened and special concern wildlife populations within healthy, functioning ecosystems (NJDFW 2012).

Landscape Project critical habitat maps were developed to provide users with peer-reviewed, scientifically-sound information that is easily accessible via the internet and hard copy (paper maps). Critical habitat maps were designed for use by anyone, but especially those individuals and agencies who have the responsibility for making land-use decisions. Included also with the wildlife habitat mapping are occurrences of endangered and species of special concern (rare) plants. Many of the species locations used to develop the mapping units or components around PICA came from decades of survey data collected by prior Natural Resources Managers and contract or other field biologists. N.B. The term of art “critical habitat” as used in this INRMP document can have two distinct connotations: 1) often used to suggest the relative importance of a specific habitat without necessarily defining or demarcating such habitat(s); or 2) when denoting federally recognized, listed, and geographically designated habitat(s) which are officially demarcated by the USFWS. There is no federally designated Critical Habitat on PICA; although two federally listed species occur on PICA.

The previous version of the Landscape Project was based on species occurrence data collected prior to 2008 and habitat data derived from 2002 Land Use/Land Cover (LULC). Since that time, more than 3,500 new species occurrence records have been added to New Jersey’s Biotics database which is maintained jointly by ENSP (animal data) and the Natural Heritage Program (plant and ecological community data). Also, habitat data has been updated to reflect the most recent (2007) LULC (NJDFW 2012).

Version 3.1 of the Landscape Project applies to the entire state a single standard method that was developed under peer-review and previously applied only in the Highlands Region. Thus for the first time, a more precise method for delineating habitat based on species-specific habitat associations is available throughout New Jersey. In addition to providing access to a list of species that occur in an area of interest defined by a user, the latest interactive program provides more detailed information that was not available in previous versions, such as type of occurrence, or feature label (e.g., colony, den, nest, foraging, etc.).

This state of the art mapping and database program is used by several NJDEP regulatory divisions; as well as by the NJ Field Office of USFWS, and the USDA-NRCS, especially when preparing National Environmental Policy Act (NEPA) documentation (NJDFW 2012). In May 2019, NJDEP launched a new program and platform known as Connecting Habitat Across New Jersey (CHANJ). This initiative is designed to evaluate habitat connectivity for

terrestrial wildlife by identifying key areas and actions to facilitate permeability and enhance safe crossings of roadways, infrastructure or utility corridors.

Natural Heritage Priority Sites

Natural Heritage Priority Sites (NHPS) have been designated by NJDEP through NJDPF Office of Natural Lands Management (ONLM) and mapped by the Landscape Project to identify critically important areas to conserve New Jersey's biological diversity. Natural Heritage Priority Sites are based on analysis of information in the New Jersey Natural Heritage Database which is a valuable tool to be used by individuals and agencies concerned with the protection and management of land. Statewide, the ONLM has identified 343 NHPS, representing some of the best remaining habitat for rare species and rare ecological communities in the state. Although the primary focus of these sites is rare plant species and ecological communities, the NJDEP Endangered and Nongame Species Program also provided key information and assisted with the delineation of a number of the sites that encompass significant habitats for rare animals. These NHPS are considered to be top priorities for the preservation of biological diversity in New Jersey.

Within PICA and within two of the NJ HUC 14 sub-watersheds there are three designated and mapped NHPS. These are listed and outlined below.

Green Pond Mountain Natural Heritage Priority Site (GPMNHPS)

As referenced previously in sub paragraphs 6.7 and 6.8 this NHPS is designated within HUC 14 GPB-N and features at least 2 state endangered plants and 5 of special concern alluded to before; as well as state listed animals (Ecosystem Mgt Tech Rpt 2008).

Lake Denmark Natural Heritage Priority Site (LDNHPS)

As referenced previously in sub paragraphs 6.7 and 6.8 this NHPS is designated within HUC 14 GPB-N and features at least 4 state endangered plants and 5 of special concern; as well as state listed animals (Ecosystem Mgt Tech Rpt 2008).

Picatinny Lake Natural Heritage Priority Site (PLNHPS)

This site contains two good occurrences of rare plant species as observed by the state botanist (D. Snyder, pers. comm. 2012).

Habitat

The forests of the Arsenal are unique within the Highlands Region. The Highland Region's forests are 75 percent privately owned and mostly in small lots. Over 85 percent of the Highlands tracts are less than 19 acres; 70 percent are tracts less than 9 acres. The Picatinny forested acreage (4,082 acres) is unique to the Highlands Region due to its size and connection to other public lands. The public lands adjoining or in proximity to the Arsenal provides significant forest area and green belt corridors in the New Jersey Highlands. The Berkshire Valley Fish and Wildlife Management Area (1,705 acres) is located southwest of the installation. The 248-acre Forest Legacy area is also located very close to the Arsenal. This

property was purchased in 1996 by the USDA Forest Service for its unique values to protect it from approaching development.

Over one third (5,948 acres) of the total acreage of all public lands surrounding PICA are in fact contiguous with installation boundaries, facilitating fish and wildlife movements and connectivity. Considering the integration of these lands, Picatinny’s natural lands (4,780), as well as safety buffer easements of adjacent private lands, 11,368 acres comprise a sizeable and seamless block of the Highlands ecosystem. Public parcels near installation property are listed in Table 6.4 below, Public Lands Around Picatinny Arsenal (Epstein, pers. comm. 2000). See the maps in Appendix F.

The Farney Highlands Trail System is connected to the Highlands Trail and Appalachian Trail and links most of these natural areas. This extensive network is administered and maintained by the NY/NJ Trail Conference. Picatinny Arsenal is centrally located within this network; however, issues of security, safety, and liability associated with unexploded ordnance are presently impediments to potential partnering agreements (and/or easements).

Table 6.4. Public Lands Around Picatinny Arsenal

Unit Identification	Managing Agency	Acres	Direction from Picatinny
Wildcat Ridge WMA (1 of 2)	NJDFW	(2of2) 2,583	N*
Copperas Tract	Rockaway TWP	200	N
Newark Watershed (to acquire)	Newark Watershed Authority	2,000	N
Wildcat Ridge WMA	NJDFW	-	NE*
Farney State Park (1,2 of 2)	NJDPF	750	NE
BSA Camps (1,2,3 of 3)	Boy Scouts of America	700	NE
Split Rock Reservoir (conservation easement)	Jersey City Power & Light	480	NE
Buck Mountain State Park	NJDPF	980	NE
Lake Ames Municipal Park	Rockaway TWP	230	E
Camp Hudsonia	Rockaway TWP	87	E
Mount Hope Pond Municipal Park	Rockaway TWP	15	E*
Morris County Historical Park	MCPC	750	E*
Richard Mine Park	MCPC	120	SE
Berkshire Valley WMA	NJDFW	1,705	SW
USDA Forest Legacy Tract	USFS & NJDFW	248	W
Rockaway River WMA	NJDFW	2,600	W*
Mahlon Dickerson Reservation	MCPC	2,300	W
Jefferson TWP Natural Area	MCPC	250	NW
		15,998	
Picatinny Restrictive Easements ‡ (5)	Department of the Army	640	NW *& E*
		16,638	

* Adjoining Boundary Line.

Abbreviations: WildlifeManagementArea, NJDivFish&Wildlife,

Rockaway Township, NJDivParks&Forestry, MorrisCountyParkCommission, USForestService.

‡ Undeveloped Private property

Wildlife

New Jersey is home to 90 mammal species, 79 reptile and amphibian species, more than 400 fish species, and approximately 325 species of birds. In addition, about 1.5 million shorebirds and 80,000 raptors make migratory stopover in New Jersey each year. About a third of the

known vertebrate animal species are classified as rare or endangered. One of the principle reasons for this is the destruction of habitat that has occurred.

Wildlife often depends on relatively large contiguous areas of habitat to survive or thrive. For example, some bird species cannot sustain breeding populations in forested areas smaller than 250 acres. Even low-density suburban development tends to fragment habitat.

New Jersey's effort to preserve its large mammals and birds, including black bear, bald eagle, peregrine falcons, and osprey, have had great success over the last 35 years. A highlight of this effort is the bald eagle, a species that has continued to increase. The ban of DDT, combined with restoration and management efforts by biologists within the NJDFW Endangered and Nongame Species Program, resulted in population increases to 23 pairs by 2000, 48 pairs by 2005, and to 82 pairs by 2010. ENSP recovery efforts – implemented since the early 1980's – have resulted in a steady recovery as New Jersey's eagle population has rebounded from the edge of extirpation (Smith and Clark 2011). In 2011 there were 113 pairs of eagles under observation, with 95 active nests. In summer of 2012, the first ever documented pair of eagles, constructed a nest in a pine tree on a tiny island in Lake Denmark on PICA. Two eaglets were observed in the nest and both juvenile eagles were successfully fledged in late July.

The Highlands Region, in which PICA is located, harbors substantial populations of fish and wildlife. This includes over 40 species of nesting birds; migrating raptors and waterfowl; large mammals like bobcat, black bear, and river otter; and wild trout fisheries. The presence of this wildlife is all the more remarkable because of its location at the periphery of the Nation's largest metropolitan area. People spend approximately \$721 million yearly on hunting, fishing, and non-consumptive uses in the Highlands.

Roughly 50 percent of the Highlands, about 500,000 acres, is considered important wildlife habitat. Besides the sheer size of this habitat, just as important is its location and contiguity. Large, unbroken tracts, such as the PICA, provide the interior forest habitat critical to the survival of nesting neotropical songbirds. Open lands located in key gap locations provide feeding and migration corridors, critical to the survival of large animals with extensive range requirements. Trout require cool, clean water provided by pristine up-stream watersheds and stream corridors. Future land development and parcelization (fragmentation) threatens and destroys these important wildlife and fish resources when it fragments large open spaces and interrupts migration routes, when it places dense human settlements in proximity to habitat, and when it adds pollutants to clean water.

New Jersey's State Forests, Fish and Wildlife Management Areas, state parks, natural areas and recreation areas, as well as private forests, serve several important functions. Many of them form large contiguous areas that provide habitat for the state's native plants and animals. Areas characterized by singular biological makeup are limited in the opportunities they offer to plant and animal species. But viewed as a whole, bogs, hardwood forests, grasslands, and wetlands provide a wealth of habitats for a wide variety of plants and animals. They also provide space and opportunity for wildlife to carve out special niches. These resources in turn help to preserve each of New Jersey's many different ecosystems thereby ensuring a richer and more diverse environment.

6.10 Fauna

The Arsenal's fish and wildlife community is representative of the fauna of the northeastern United States. Faunal diversity on the installation is better than average for North Central New Jersey. To date, 315 species of vertebrates are known to occur on the Arsenal.

Appendix C, Fauna, lists the fish and wildlife species documented on the Arsenal. "Occurrence" implies either resident, migratory, or visitor species. The vertebrates include: 26 fish species, 21 amphibian species, 19 reptile species, 208 species of birds of which approximately 169 are migrants, and 41 species of mammals. The large number of vertebrate species occurring on the Arsenal is in large part due to the diverse array of habitats present on the installation which includes dry forested ridge tops, talus slopes, bottomland hardwoods, mesophytic hardwoods, conifer stands, old fields, riparian sites, shrub stands, wetlands, brooks, ponds, and lakes.

6.10.1 Invertebrates

Appendix's C-1 and C-2 lists the most commonly observed invertebrates (Odonata and Lepidoptera) known to occur on the installation. These two Families include 63 dragonflies, 31 damselflies; 67 butterflies, and 136 moths. Using binoculars to observe these colorful insects is becoming an increasingly popular nature activity. From 1991 to 1995, an informal survey identified at least 150 different kinds of moths. There are undoubtedly others that occur.

Odonata species serve as an indicator species for water quality and/or subtle changes in habitat. Odonata diversity on the installation is exceptional, representing more than half the number of known species in any other state or province in North America (Carle 1995). For example, the rare New England bluet (*Enallagma laterale*) is a federal Species of Concern. The global range of this species in the northeastern US contains only 40 sites. The largest population (several hundred to a few thousand) occupies portions of Denmark Lake. One dragonfly species in NJ, *Leucorrhinia glacialis* is known from only one other site within the state. Odonata species deserve particular attention because they are relicts of the Paleozoic era, thus representing one of the oldest insect orders, and they serve as indicator species for water quality and/or subtle habitat changes. In general, as water quality degrades, the number (diversity) of Odonata species decreases. Also, most dragonflies/damselflies occupy very precise niches and many survive in spatially compact or restricted habitats (e.g. spring seeps).

6.10.2 Fish

Fish on the Arsenal include warm and cool water species such as largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), bullhead (*Ictalurus spp.*) and creek chubsucker (*Erimyzon oblongus*). The prime species fished for in lakes and ponds are largemouth bass, chain pickerel, northern pike (*Esox lucius*), crappie (*Pomoxis spp.*), yellow perch, catfish (*Ictalurus spp.*) and sunfish (*Lepomis spp.*). Sections of GPB and some ponds are quite suitable for stocking rainbow or brown trout (*Salmo gairdneri* or *trutta*). Appendix C-3 lists the fish species, including nongame and forage types, known to occur on the installation (25 species).

Native brook trout (*Salvalinus fontinalis*) and some stocked trout are found in the cold-water streams on the installation. Natural reproduction of trout is rare in New Jersey (NJDEP 1998a). A self-sustaining population can be found in the cold headwaters of Upper GPB and other brooks and streams. The upper (northerly) one third of GPB is the most suitable. The

population in GPB is considered to be a remnant of the original brook trout in the region. The natural habitat for brook trout can be either a stream or lake. They thrive in water with low temperatures and high oxygen content.

Brook trout mature at about two years of age and spawn in the fall. Nests are typically constructed by the female on the gravely bottoms of streams and lakes. Young trout feed primarily on insect larvae. Older fish eat an assortment of insects, worms, crustaceans, and small fish. The only cold-water species known to have a self-sustaining population on the Arsenal is brook trout. A recent stream shocking survey (30 AUG 12) was conducted by NJDFW Bureau of Freshwater Fisheries biologist Mark Boriek and two other staff. Fourteen brookies were captured and measured, and 5 others were observed; all representing only 1 age class – young of the year from 2011 hatchlings (M. Boriek, pers. comm. 2012). This sampling was conducted nearly in the same segment of stream and almost the same date as surveyed by the former NRM, Dr. Robert Parris, in 1987. In that previous survey four age classes were represented. Mr. Boriek noted excessive sedimentation and turbidity in the substrate during the sampling retrievals. Water quality parameters were consistent and adequate for Brook Trout Production Waters.

6.10.3 Amphibians and Reptiles

Amphibians and reptiles are often referred to collectively as “herptiles.” Amphibians and reptiles help to control insect and rodent populations and serve as a forage base for other wildlife. Common amphibians and reptiles on the installation include red spotted newt (*Notophthalmus viridescens*), green frog (*Rana clamitans*), bullfrog (*Rana catesbeiana*), American toad (*Bufo americanus*), and eastern painted turtle (*Chrysemys picta*), snapping turtle (*Chelydra serpentina*), garter snake (*Thamnophis sirtalis*), and black rat snake (*Elaphe obsoleta*). Two venomous snakes reside on the installation: northern copperhead (*Agkistrodon contortrix* ssp *mokasen*) is regularly occurring and often encountered near buildings in the 200 area (base of GPMt); whereas the timber rattlesnake (*Crotalus horridus*) is typically sighted once or twice per summer season, often in the 1200 area (base of COPMt). Appendix C-4 lists the amphibians and reptiles known to occur on the installation.

6.10.4 Birds

The species of birds on the installation are diverse. They include permanent residents, summer breeders, winter residents, and migrants that only pass through during the spring and fall. These species vary in their foraging preferences as herbivores, frugivores, granivores, insectivores, omnivores, predators and scavengers. Habitat preferences are similarly diverse and include urban lands, forested lands, wetlands, and grasslands (Chambers 1983, DeGraff et al. 1980). Due to the extensive wetlands and open water, the waterbird community is well represented with waterfowl, wading birds and a few inland shorebirds. Bird watching is a popular activity for some employees and residents. Appendix C-5 lists the 208 species of birds known to occur on the installation. This list is based in part on a statewide breeding bird survey sponsored by the NJ Audubon Society and is thought to be essentially complete.

The Arsenal has been fortunate to have the services of volunteer birders who have been observing and recording species since 1993. Of the 208 species, 39 are considered permanent residents, 64 summer residents, and 7 winter residents. The remaining 98 migrants “pass through” with occasional stopovers and incidental visits.

In addition, out of the 103 species inhabiting the Arsenal during the breeding season, 65 are confirmed breeders and 15 are probable breeders. The number of regularly occurring species recorded for New Jersey is 350 (R. Kane, pers. comm. 1995).

New Jersey Audubon Society has recognized Picatinny Arsenal North/Denmark Lake as one of 123 “Important Bird Areas” (IBA) within the state, through its Important Bird and Birding Areas technical committee, made up of professional ornithologists within the state. Picatinny Arsenal North/Lake Denmark is one of 37 IBAs within the Skylands physiographic region of NJ which includes the Highlands. IBAs are sites that provide essential habitat for one or more species of birds and that make a contribution to the long-term viability of native avian populations in New Jersey.

At the much larger landscape and ecosystem scale, PICA bird habitat lies within Bird Conservation Region 28 (aka Appalachian Mtns), one of sixty-seven Bird Conservation Regions (BCR) covering North America. BCR 28 lies within the Appalachian Mountains Joint Venture (AMJV), one of eighteen multi-agency partnerships in the U.S.; and is characterized as rugged terrain, including the northern ridge and valley physiography, generally dominated by oak-hickory and other deciduous forest types at lower elevations and by various combinations of pine, hemlock, spruce, and fir in higher areas. Priority forest birds for BCR 28 (which do occur on PICA) include Cerulean Warbler at low elevations and Blackthroated Blue Warbler at high elevations. Golden-winged Warblers are in early successional areas (BCR 2010). The North American Bird Conservation Initiative (NABCI) recognizes 37 BCRs north of Mexico.

6.10.5 Mammals

Bats

Bats represent approximately 20 percent of the potential mammalian fauna on the installation. This large percentage is similar to most mammalian communities of temperate zone terrestrial regions (Eisenberg 1981). Before Arsenal at large surveys in 1997-98, and post hibernation migration survey in 2006, most information on bat populations on Picatinny Arsenal had been derived from records of calls to extricate or remove bats from office spaces or residences. Dozens of Eastern Pipistrelles (*Perimyotis subflavus*) were observed in an abandoned mine shaft, just off post, in January 1994 by the NRM. These bats (now known as Tri Colored Bats) probably forage on post during the summer months. One warehouse on post, building 3236, was used as a summer colony by thousands of Little Brown Bats (*Myotis lucifugus*) and at least one or two Indiana Bats (in 1997). The local maternity colony thrived inside this structure until around 2009 when White Nose Syndrome was confirmed in NJ that preceding winter. Decline of the local Little Brown Bat population as monitored inside this warehouse was rather precipitous; most probably died at local mines or other regional hibernacula in the late winter months prior to their normal emergence and dispersal period.

White-Nose Syndrome (WNS), named for a cold-loving white fungus (now named *Pseudogymnoascus destructans*) typically found on the faces and wings of infected bats. White-Nose Syndrome causes bats to awaken more often during hibernation and use up the stored fat reserves that are needed to get them through the winter. Infected bats often emerge too soon from hibernation and are often seen flying around in midwinter. These bats usually freeze or starve to death (BCI, 2012) since there are few if any flying insects in winter

months. It is quite devastating to most species of bats which dwell in caves or mines over winter, particularly *Myotis lucifugus*.

Acoustic bat detectors are available and are useful for preliminary field reconnaissance. Mist netting is the primary sampling method and requires experienced and approved handlers, since collecting permits are always required. Digital call recording and audio analysis is being advanced as a supplemental tool for bat sampling; however species discrimination between two *Myotis* species (*M. sodalis* and *M. lucifugus*) is still problematic.

Nine species of bats, all in the super family Vespertilinidae, have ranges that include northwestern New Jersey (Humphrey 1982). Seven of these, all small-bodied insectivores, have been documented on the installation. Intensive sampling efforts (for Indiana Bats) in 1997 and 1998 revealed that the Little Brown Bat was the species most commonly encountered/captured (Rinehart and Kunz, 1998; Scherer, 2000).

Little brown bat and NLEB numbers have dropped off dramatically since the advent and progression of White Nose Syndrome (WNS) and are rare to catch where they once were common. Although the Little Brown Bat was the most often observed species in the cantonment and semi-improved grounds, the Northern long-eared bat (*Myotis septentrionalis*) was most prevalent in the forested portions of the Arsenal.

Tree foraging behaviors and roosting behaviors of NLEB are similar to, but not the same as Indiana bats. Both forage primarily in wooded areas, but foraging strategies differ in subtle ways (one example is that NLEBs will glean insects from water in addition to catching insects in flight. They tend to select foraging sites with water more than Indiana bats). Roosting strategies between the species again are similar but, compared to the Indiana bat, NLEBs are considered less habitat specific in their roosting habits. Tree foraging and roosting behaviors of Northern long-eared bat are similar to those of the Indiana Bat (*Myotis sodalis*); yet more varied by utilizing cavities/crevices, as well as smaller diameter trees (e.g. 3 inch DBH). They will roost in very small trees with small cavities, or other small areas of peeling bark, even in habitat low on a tree. Updated survey information from the Base will be required to characterize current dominant bat species.

Big brown bats and red bats may now be the most common bat species in forested areas on Base. Big brown bat numbers actually increased with the onset of WNS given the reduction in competition with WNS-impacted species. Several tree roosts of each of these forest adapted species were located on the eastern side of the Arsenal during a summer survey in 1997.

A historical discovery of a female Indiana Bat was made in July 1995. The trapping effort was the result of an environmental assessment process for a requested grant of easement by Mount Hope Hydropower Inc. This Indiana Bat was the first summer resident of this species documented in New Jersey or the northeastern US in decades. In the winter and spring of 1993, hibernating Indiana Bats were discovered in an abandoned mine about two miles from the Arsenal. The following year (1994), two more Indiana Bat hibernacula were found in abandoned mines within a half a mile of the installation. After the 1995 confirmation of a summer breeding Indiana Bat, an Endangered Species Management Plan (ESMP) was prepared for the Indiana Bat at PICA in accordance with prior Army Regulation 200-3 (now known as AR 200-1). Chapter 8.8.2 discusses Indiana Bat habitat requirements. The entire Indiana Bat

Endangered Species Management Component (ESMC) that explains and supports the installation objectives, standards and guidelines for this species is Appendix G.

Other Mammals

Other mammals on the Arsenal include small nongame types such as insectivores (moles and shrews), and rodents (mice and voles). The populations of these small species collectively provide a major forage base for most of the installation's predators. The most common of these animals are the white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), and short-tailed shrew (*Blarina brevicauda*).

The gray squirrel (*Sciurus carolinensis*) and the eastern cottontail rabbit (*Sylvagus floridanus*) are also found on the installation. The woodchuck (*Marmota montax*) den and forage in the open areas in close proximity to the developed areas. Fox, raccoon and opossum are observed periodically. Appendix C-6 lists the 41 species of mammals known to occur on the installation.

6.10.6 Game Species

Table 8.1 lists all legal game species which are allowed to be taken on the installation by sportsmen.

Game Fish

Trout fishing is very popular on post as it is throughout the state. Upper GPB produces Brook trout and the Arsenal formerly conducted a put-and-take program in the middle portion of the brook using non-native species, such as Rainbow and Brown Trout. Trout stocking in the Middle brook was discontinued after the 911 event, since this is a restricted AE storage area; however the Rainbow and Brown Trout are stocked in other more accessible water bodies on post. Since rescission of Sikes Act fee collections by the NRM, only the Picatinny Rod & Gun Association (PR&GA) purchases fish for the trout stocking program.

Game Birds

Native upland game birds on the Arsenal include wild turkey (*Meleagris gallopavo*), ruffed grouse (*Bonasa umbellus*), and American woodcock (*Philohela minor*). In New Jersey, the mourning dove (*Zenaida macroura*) does not have gamebird status and is protected as a songbird. Although ring-necked pheasant (*Phasianus colchius*) are non-indigenous, and do not maintain viable populations they are purchased and stocked for put-and-take hunting by the PR&GA. Captive Game Bird Permits are required by NJDFW, which the PR&GA procures to support this unique hunting activity. For the past 30 years up to 600 birds per year were stocked. Over the past 5 years, the number of birds handled has averaged about 450. Adult Pheasants are bought by the club prior to the start of the hunting season, held in temporary holding pens, and stocked on a weekly basis during the season. Grouse and woodcock hunting provide some recreation on the installation, but populations are low largely due to the lack of available habitat.

Waterfowl

Waterfowl species that can be hunted include wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*), green winged teal (*Anas carolinensis*), black duck (*Anas rubripes*), Canada goose (*Branta Canadensis*), and others. In addition, waterbirds such as coot (*Fulica americana*), common moorhen (*Gallinula chloropus*), Virginia rail (*Rallus bilimicola*), and sora (*Porzana carolina*) can also be harvested.

Large Game Animals

Game animals include the white-tailed deer (*Odocoileus virginianus*) and black bear (*Ursa americanus*). Only authorized sportsmen are permitted to hunt deer and bear (as well as small game animals) on the Arsenal under the day to day control of the Director of Outdoor Recreation (FMWR-ODR). The NRM provides oversight and coordination of this Sportsman Program with the objectives of the INRMP. The Picatinny deer population had been high; however, for the last ten years, the herd has been effectively stabilized with the cooperation of Picatinny hunters. White-tailed deer provide the majority of hunting recreation on the Arsenal and also provide some nonconsumptive recreation. Black Bears are routinely observed on the Arsenal, and are often a seasonal nuisance. The Arsenal provides an important travel corridor between winter dens and summer ranges. Black bears have not been hunted in New Jersey since 1971, mainly due to anti-hunting advocates, and the bruin population has steadily increased, including on PICA. Bear hunting was reinstated by state authorities in 2003. Although no bear were taken on PICA that season (DEC), this hunt was safe and successful across the bear hunting zones; yet opposition and politics halted bear hunting again until 2005. In that season 1 bear was harvested (300+ lbs). More lawsuits and politics stymied this population management tool until 2010. On 21 JUL 10 the New Jersey Black Bear Comprehensive Management Policy was officially adopted, published and implemented (Tarlowe 2010a). Later that year in the December week of hunting 9 bear were taken from PICA. One was 543 lbs and 2 were just over 300+ lbs. Last year (2011) only 1 bear was taken, the largest yet, weighing 546 lbs. It appears that bear hunting will now remain an annual season in NJ, as it is in many surrounding states (NJDEP. 2010).

6.11 Threatened and Endangered Species (TES), Species At Risk (SAR)

In the recently revised (18 MAR 11) Department of Defense Instruction (DODI) 4715.03 added emphasis is given to Species At Risk, formerly and informally referred to as “species of (special) concern.” The instruction states: “To the extent practicable, all DOD components shall establish policy and procedures for the management of SAR to prioritize proactive management of those species that, if listed, could adversely impact military readiness. Program objectives shall focus on efforts that have the greatest potential to prevent the listing of SAR (e.g., habitat conservation, planning level surveys, monitoring). Protecting these species is critical; therefore, the installation INRMP should consider funding for SAR protection a high priority (DODI 4715.03, 2011).”

Species At Risk (aka At Risk species by USFWS) are defined as follows: “Includes species on lists maintained by USFWS, NOAA Fisheries Service, and state agencies as threatened or endangered or candidates for such lists. Species At Risk also includes species whose designation as threatened or endangered may require conservation efforts significantly impacting a military

mission.” The guidance in this instruction reiterates the need to identify steps/efforts taken to preclude (federal) listing of species and Critical Habitat (CH); Reasonable and prudent measures taken to support and defend consultations with regarding any SAR; and the collaborative use of and reliance on up to date information in the state “heritage database network” for effective ecosystem management (DODI 4715.03, 2011).

The guidance on the intrinsic significance of natural resources considers a few variables when preparing an INRMP. The instruction points out that “natural resources may be significant on a local, regional, national, or international scale. All threatened or endangered species, and species at-risk, are significant natural resources that normally will require an INRMP”; and should “also consider the degree of active management, special natural features, aesthetics, outdoor recreational opportunities, and the ecological context of the installation.” In sum, resources identified as having special importance to an installation or its ecosystem need to be effectively managed to preclude the strictures of ESA listings or CH designations on DOD installations/property. It is clear that PICA is recognized by the local USFWS-NJFO, NJDEP, NJDFW-ENSP, NJDPF-ONLM, Highlands Council, NJ Audubon Society and many other conservation NGOs, as well as local academia biologists as having not only special, but critical importance to the Highlands area in Morris County for its water resources and overall ecological integrity and connectivity.

Two federally listed endangered mammals, the Indiana Bat and the Northern long-eared Bat; and one federally listed threatened reptile (Bog Turtle) are known to occur on the Arsenal (Appendix C-7). The Indiana Bat uses PICA habitat for Spring, Summer, and Fall foraging, being so close to the only three hibernacula known within the state. Summer roosting has been confirmed for male Indiana Bats (IBATs) and maternity colonies likely exist; although none have been documented on post to date. In 1997, Northern long-eared bats were documented roosting in a cluster of small dying trees just outside the Navy Hill gate.

The bog turtle was sighted and confirmed in 1987 in the wetlands associated with the east branch of GPB, but no sightings have occurred since then. An unproductive survey in 2004 at site of last historic sighting revealed highly degraded habitat.

Raptors seen from the hawk watch site on the Arsenal hunt over much of the facility and area. The bald eagle (*Haliaeetus leucocephalus*) and peregrine falcon (*Falco peregrinus*) are mostly transient species usually observed during migratory flyovers. However, suitable habitat exists in wetlands associated with Green Pond Lake, Denmark Lake, and upland ridges. Documented and successful Bald Eagle nesting has been observed on an island on Lake Denmark for the past several years.

- There are also several federal Species at Risk (Appendix C-7). Local species currently being evaluated are: Tri-colored bat (*Perimyotis subflavus*), Spotted Turtle, and Wood Turtle, Golden-winged warbler (*Vermivora chrysoptera*), and Little Brown Bat (*Myotis lucifugus*). None of the above-listed species currently receive any substantive or procedural protection under the ESA, and the Service has not yet determined if listing of any of these species is warranted. However, federal action agencies and other project proponents should be aware that these species are being evaluated for possible listing. Particularly for projects with long planning horizons and/or long operational lives,

proponents may wish to include these species in field surveys and/or impact assessments (Walsh 2011).

6.11.1 Bog Turtles

Bog turtles are normally found in small, discrete wetlands that are a mosaic of dry pockets, saturated areas, and areas that are periodically flooded. Bog turtles are semi-aquatic and are only active from April to mid-October (Copeyon 1997). They hibernate from October to April. Mating occurs in May and June. Females deposit eggs in sphagnum or sedge tussocks (Copeyon 1997) in June and July. The young turtles typically emerge in August or early September.

Bog turtles inhabit open, wet meadows and bogs with standing or slow-moving shallow water, usually over mucky substrate (USFWS letter 1999). Bog turtles also occur in herbaceous wetlands (like those on Picatinny), spring-fed fens, and within wetlands that contain emergent or scrub-shrub wetlands. Bog turtles prefer areas that have soft, muddy bottoms with slow-flowing water and open canopies. Bog turtles prefer areas with good sunlight, high evaporation rates, high humidity in the near-ground microclimate, and perennial saturation of portions of the ground (USFWS letter 1999). They have been discovered in New Jersey in calcareous fen habitats (shrub and herb communities in low-lying areas where groundwater percolates over limestone bedrock). The majority of bog turtle habitat in New Jersey is privately owned (Copeyon 1997).

Habitat may be characterized by the size of the area, degree of fragmentation, presence of invasive plants (non-native species), and extent of later-successional species. As open-canopy wetlands are transformed by woody vegetation, bog turtles may be forced to migrate from one wetland patch to another. Fire, beaver activity, grazing or flooding in periodic wet years could potentially disrupt successional growth and preserve bog turtle habitat. Extensive wetland fragmentation and roads adjacent to habitat pose serious threats to bog turtles.

Other threats to the bog turtle include habitat loss from wetland alteration, natural vegetation succession, and alteration of the hydrology of an area.

In 1987, the NJ Division of Fish, Game, and Wildlife, Endangered and Nongame Species Office, documented the last official sightings of bog turtles in the middle of the expanse of wetland that occurs in the lower end of the east branch of the Green Pond shrub-swamp. There have been no documented sightings since that time. However, this site is believed to be marginally suitable and a minimal population may still exist given the site characteristics.

6.11.2 Indiana Bats

The main breeding and hibernating areas for the Indiana Bats appear to be associated with the major cavernous areas in the Midwest and eastern United States (Indiana, Illinois, , and Missouri). Prior to WNS, during the winter, approximately 85 percent of the entire population hibernated in only seven caves (Evans et al. 1998); however as of 2019, 72% of the species overwinter in 4 hibernacula sites (Protus, pers. comm. 2019). Indiana Bats migrate between winter and summer habitats. In the winter, they hibernate in caves (or mines). They enter the caves during the early fall and continue to forage each night (Evans et al. 1998). In the winter, when hibernating, Indiana Bats form large, dense clusters of individuals. In March and early April, colonies disperse and migrate to areas where they forage throughout the summer. Until recently, lack of adequate protection of the hibernacula on private land immediately adjacent to

the installation was a serious threat to the Indiana Bats in the vicinity of the Arsenal. NJDEP Green Acres program acquired the two Mt Hope hibernacula in 2019 so they may be protected under state ownership. No hibernaculum has been discovered on the Arsenal.

Indiana Bats are insectivorous. They forage primarily in closed canopy riparian woodlands or upland forests (Humphrey et al. 1982). Indiana Bats prefer to forage around the crowns of large trees (Clawson 1987). Optimum summer habitat includes mature trees that serve as forage areas and dead, yet loose barked trees as roost sites. Preferred stream habitat appears to consist of streams lined on both banks with mature trees that overhang the water by at least 10 feet. Stream widths may vary from 10 to 70 feet. Typical forage areas consist of deciduous forest cover equal to or greater than 30 percent, with suitable roost trees located within a quarter mile of the foraging area and permanent water available within about a third of a mile from the roost. The dominant overstory is normally comprised of trees that measure 9.8 to 23.6 inches in diameter at breast height (DBH) (Evans et al. 1998). Forest fragmentation that occurs when forests are cleared for farmland or urban development degrades bat habitat (Copeyon 1997). The use of pesticides may pose a direct threat through poisoning or an indirect threat by eliminating food sources.

Adult female bats typically establish maternity roosts in dying trees with loose bark or hollow trees. Such trees may be located at varying distances from foraging habitat. Trees that possess tenacious bark that springs away from the trunk as the trees die are optimal. Shade is important to protect roost sites from intense heat, but ample solar insolation to maintain warmth beneath the bark is equally important. Areas with large trees and closed canopies are preferable. Although upland areas may be used extensively, maternity colonies appear to be formed mostly in riparian and floodplain forests near small to medium-sized streams (Clawson 1987). Bats have also been found along tree-lined ditches. Potential roosting habitat is destroyed or degraded by cutting large dead or dying trees (snags). In NJ and many other states maternity roosts have also been documented in artificial bat boxes, as well as in homes and structures.

6.11.2.1 Northern Long-eared Bats

A comparison between NLEB and Indiana Bats (IBAT) of their respective Life histories, summer & winter habitat uses and behaviors is presented in the following USFWS document: <https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/nlebinterimguidance6jan2014.pdf>

Based on the chart presented NLEB mating and reproductive patterns are the same as IBAT; and they are also tree dependent and insectivorous during summer. Differences and nuanced behaviors are noted as follows:

FALL Swarming (mating) at/near hibernacula: Very similar and overlapping temporally and spatially.

WINTER hibernation: Same in type and time.

Hibernacula: Same = Caves/mines or anthropogenic structures with equivalent interior microclimate conditions. May co-inhabit; yet spatially, NLEB tuck into cracks/crevices, seeking minor microclimate variances; ergo less observable. NLEB smaller clusters or pods vs. IBAT dense packed colonies.

Hibernacula philopatry: Unlike IBAT, NLEB may return to different winter roosts from year to year; and will actually move/relocate among different hibernacula during winter period.

SPRING emergence and migration: Very similar.

Migration dispersal: Maximum distances lesser for NLEB; yet minimal/local distances/movements between hibernacula and summer roosts are similar.

SUMMER range and habitat occupation: Very similar and overlapping temporally and spatially.

Roost sites: Primarily Trees, dead/dying under exfoliating bark; or live with curling, shingle type bark. NLEB will use several more species than those 33 species used by IBAT. NLEB will more readily exploit artificial or anthropogenic roost sites.

Roost Tree features: Similar with occasional overlapping selections; except NLEB greater than/equal to 3 inches DBH vs IBAT greater than/equal to 5 inches DBH. NLEB will roost at lower heights on tree than IBAT. NLEB will use live trees and exploit cracks, crevices, knotholes more frequently than IBAT.

Canopy cover around roost trees: Minimum canopy cover at least 25% more than for IBAT. NLEB more shade tolerant vs IBAT favors solar insolation.

Number of Roost trees used by individuals/colonies: NLEB will use several vs IBAT use a few alternate roost trees. NLEB more flexible vs IBAT more philopatric.

Maternity roost trees: NLEB rotate around “central node trees” vs IBAT focused around “Primary roost tree(s)”.

Roost tree switching frequency: Very similar = 2-4 days.

Forage distances (roost-food sites), aka “home ranges”: NLEB ca. 1.5 miles from roosts or 3 miles from captures vs 2.5 from roosts or 5 miles from captures.

SUMMER habitat philopatry: Very similar year to year; yet NLEB more flexible/variable with respect to actual roost trees or maternity roost sites.

Prey diet and foraging tactics: Both = flying insects via ‘hawking’. NLEB will also target/consume arachnids and orthopterans via ‘gleaning’.

Foraging strata/compartimentalization: NLEB favor lower layers, near ground for ‘gleaning’; yet mostly between under-story and sub-canopy for ‘hawking’. IBAT at or above canopy, yet not within canopy; occasionally dropping below sub-canopy; always ‘hawking’.

Forage habitat: NLEB favor upland forested hillsides/ridges, more than clearings, water or road corridors vs IBAT favor riparian/lotic corridors, floodplain forests, lentic sites; occasionally visiting upland forests, early forest seres, and ecotones in fragmented forest habitat.

Nocturnal Foraging weather conditions: Same; Optimal temperatures above 50 degrees, no heavy rain, no high winds, no heavy fog.

Crepuscular/Nocturnal roost tree/site emergence: Same; 20-30 minutes after civil sunset.

6.11.3 State-Listed Species

Although DOD facilities have always been required to protect federally listed Threatened and Endangered Species, and were encouraged to conserve state listed or state species of concern; there is a renewed impetus to manage for those SAR; especially those that could become candidate species or proposed for listing under ESA (DODI 4715.03 2011). There are a number of state-listed species that occur on the Arsenal (Appendices B-2 and C-7). These include “target” species that have been identified and ranked by the New Jersey Landscape Project and depend on a variety of habitat characteristics present on the Arsenal. The Landscape Project divided the state into five regions, the Skylands Region (NW NJ), containing the Highlands, being one. The purpose of the GIS and mapping project is to identify and protect habitat for all endangered, threatened, and SAR over the long run. Using satellite imagery, the area was divided into various categories: forests, grasslands, and wetlands. Each category was then associated with various target species. A ranking system was developed and land and species were then ranked by importance. Land located adjacent to existing public land was assigned a higher priority or ranking.

Plants

There are seven state-listed endangered plants (aka critically imperiled) on the installation, four of which are aquatic species found in Denmark Lake: Featherfoil (*Hottonia inflata*), Robbin's pondweed (*Potamogeton robbinsii*), small bur-reed (*Sparganium minimum*), and lesser bladderwort (*Utricularia minor*). Slender wood reedgrass (*Cinna latifolia*), meadow horsetail (*Equisetum pratense*), and large leaved holly (*Ilex montana*) are associated with wetlands. There are four other state-listed endangered species that are potentially present and 16 or more "Plant Species of Concern." New Jersey lists Plant Species of Concern and monitors status through the Natural Heritage Program. Most of these plants occur in the remote northern portion of the Arsenal (Green Pond Mountain NHPS and the parallel Lake Denmark NHPS). Seven other species are ranked by New Jersey as imperiled (S2 rank). Appendix B-1 lists those plants known to exist on the Arsenal that are listed by New Jersey as either endangered or of conservation concern. No federally Threatened or Endangered plants are known to exist on the installation. Suitable habitat may exist for Small Whorled Pogonia (*Isotria medeoloides*) so surveys will be planned by qualified biologist(s) (J. Markuson, pers. comm. 2014). Few, if any, federal candidate species or Species of Concern are expected to actually occur on the Arsenal (J. Markuson, pers. comm. 2012).

Brook Trout

Upper GPB has the ability to support self-sustaining populations of native brook trout. The state has designated a portion of GPB (reaches 1, 2, and 3) that is on PICA as a trout "production" stream (as distinguished from "maintenance"). The portion of the stream that is known to produce brook trout is actually "reach 2" of the Upper GPB. The designation has anti-degradation implications for the protection of the stream and the trout resource. Characteristics such as water quality, turbidity, sedimentation, water temperature, and woody debris are critical to trout production and maintenance.

Wildlife

Fifteen New Jersey state-listed Endangered species are known to occur on the Arsenal: one turtle, one snake, ten birds, and three mammals. Only seven of these animals actually reside or breed on the installation: Timber rattlesnake (*Crotalus horridus*), golden winged warbler (*Vermivora chrysoptera*) red-shouldered hawk (*Buteo lineatus*), bobcat (*Lynx rufus*) and IBAT; most recently (summer 2012) bald eagle (*Haliaeetus leucocephalus*); and northern goshawks (*Accipiter gentilis*) nest and forage sporadically. The remaining eight bird species may use the installation habitats in a transitory manner. One water bird, the pied-billed grebe (*Podilymbus podiceps*) is listed by the state as "critically imperiled" and may nest and breed in the Denmark shrub swamp.

Fourteen state-listed Threatened species are known to occur on the Arsenal: one turtle and thirteen birds. The most recent sighting of a wood turtle on the installation was documented in September 2012. Only two of the birds use the installation on a regular basis. The American kestrel (*Falco sparverius*), and barred owl (*Strix varia*) reside and breed on post. The remaining eleven bird species use a variety of installation habitats during the seasonal migrations; while some may breed on post.

6.12 Insects, Disease, and Invasive Species

Insects and disease are a natural part of the forest ecosystem. Human activities have changed forests by introducing (non-native) insects and diseases. Activities that changed plant species composition, tree density, canopy structure, and created a patchwork pattern of different stand ages, have all contributed to responses by insects and diseases that were outside their historic range. If kept within endemic level, i.e., levels that would be expected for a given stand age and forest type, the actual increase in the incidence of insects and disease is part of the inherent value of mature habitat. Pathogens present in the forest create trees with hollow boles, heart rot, dead tops, multiple leaders and witches brooms. Although these traits traditionally detract from the economic value of a stand, they also increase biodiversity by maintaining habitat for a wide variety of species – those that den, nest, rest, and forage. Part of the ecological role of the forest pathogens is providing for adequate snag and coarse woody debris recruitment. This structure, in turn supports categories of wildlife species that aid in dampening the cyclic nature of insect outbreaks. Likewise, the death of individual or small patches of trees creates openings and allows for additional diversity in forest structure.

6.12.1 Insects

The major pest problems on the natural lands are hemlock wooly adelgid (HWA) and cyclic outbreaks of the gypsy moth. Insects that are a problem for shrubs and ornamental trees include birch leaf miner (*Fenusa pussila*), adult Japanese beetle, various scales, sawflies (*Hymenoptera*), and eastern tent caterpillar (*Malacosum americanum*). The gypsy moth has been a cyclical pest in forested as well as planted areas on Post. Japanese beetles have been a problem on little leaf lindens (*Tilia cordata*). Several Austrian and white pines (*Pinus nigra* and *Pinus strobus*) have been hit hard with diplodia tip blight (*Diplodia pinea*) within the past several years.

Hemlocks in the Highlands Region are being decimated by combined infestations of hemlock wooly adelgid (*Adelges tsugae*) and elongated hemlock scale (*Fiorinia externa*).

It is estimated that 80 to 95 percent of the trees are dead or dying. (NJDEP 1998a). Hemlock wooly adelgid feeds at the base of needles, causing them to desiccate and the needles take on a gray cast. The trees eventually lose the needles and trees die within 4 to 10 years. The insect is native to Japan and Japanese hemlock is relatively resistant to attack unless the trees become stressed. The insect was discovered in Virginia in the 1950s and now populations have extended to as far north as Massachusetts and as far south as South Carolina.

The prognosis of hemlock under attack by the HWA is not good. There is no known effective and economical control outside the landscaped (suburban) setting. Several predators known to feed exclusively on adelgids have been imported and are being investigated for biological control (McClure 2001, Reardon and Onken 2004). Biological control research was first conducted on the introduction of the coccinellid beetle (*Sasajiscymnus tsugae*) by the Northeastern Forest Experimental Station in Hamden, CN. This beetle is a natural control agent in Japan. A few other biological control agents such as several species of lady beetles (*Scymnus spp.*) from China and a derodontid beetle (*Laricobius nigrinus*) from British Columbia are also being evaluated in recent years. For the past 4 years few signs of the pest are evident, and the large dead hemlocks hulks have been slowly decaying or heeling over to the ground. A resurgent outbreak is possible at any time under favorable conditions, which will eventually decimate any surviving younger trees.

Gypsy moth (*Lymantria dispar*) is a serious defoliator of deciduous forest in eastern North America. The gypsy moth was accidentally released in Boston, Massachusetts in 1869. The moth was detected in New Jersey in the 1950s and the killing front caused much mortality, especially in the oak dominated forests. Since the 1950s, New Jersey forests have been subjected to periodic outbreaks of the insects. Outbreaks occur between 7 to 10 years. In past outbreaks, the gypsy moth populations have declined substantially when trees are defoliated and the larvae become weak and are killed by several kinds of bacteria, fungi, and a nucleopolyhedrosis virus (aka NPV). NPV has been the principle killing agent to cause gypsy moth populations to decline to endemic levels.

In 1990, a fungus was detected in declining gypsy moth populations. The fungus was originally introduced from Japan into the Boston area in 1910. The fungus, *Entomophaga maimaiga*, was released in nearby infected forests, however no fungal infections subsequently resulted, and it was believed that the introduction was unsuccessful. Today, the fungus is widespread throughout the range of gypsy moth however its impact on larvae is diminished when there is insufficient precipitation. During moist, warm periods, the fungus has kept gypsy moth populations at low levels. Defoliation throughout the range has been slight. Again for the past 4 years or so this cyclical pest has been quiescent around PICA.

The following updates are from the Mid-Atlantic Region Forest Health Summary for 2011, by USDA-USFS based in Morgantown, WV.

The Asian Longhorn Beetle (*Anoplophora glabripennis*) (aka ALB) has been stopped in counties just east of PICA since 2008 after its discovery in NYC in 1996.

In 2009 NJ Forest Service surveyed for Sirex Woodwasp (*Sirex noctilio*) an exotic invasive species that arrives in wood packing from overseas into nearby shipping ports and tends to infect pines. None have been detected so far.

In 2010 NJ began a monitoring program by deploying pheromone traps for the Emerald Ash Borer (*Agrilus planipennis*) (aka EAB). Fortunately none were collected. The detection protocol has been expanded into north NJ by the state Forest Service – One trap has been placed on PICA.

Within the improved grounds, pest problems are mainly turf diseases at the golf course and insect/disease problems on trees and shrubs. Turf diseases at the golf course include: pink snow mold (*Fusarium nivale*), gray snow mold (*Typhula spp.*), leaf spot (*Drechslera spp.*), dollar spot (*Lanzia moellerodiscus*), brown patch (*Rhizoctonia solani*), summer patch (*Phialophora graminicola*), and pythium blight (*Pythium graminicola*). Diseases of ornamental trees and shrubs, which have caused minor damage, include: leaf spot, powdery mildew (*Erysiphe graminis*), and various rusts (*Puccinia* and *Uromyces spp.*) Turf damaging insects include: cutworms (*Nephelodes/Perroma/Agritis spp.*), sod webworms (*Crambus/Parapediasia spp.*), hyperodes weevil (*Hyperodes*), yellow ants (*Acanthomypos spp.*) and white grubs, mainly Japanese beetle (*Popillia japonia*).

6.12.2 Diseases

Occasionally, wildlife harbor diseases which are transmitted to humans and domestic animals. Wildlife exhibiting symptoms of disease or acting in a strange manner are typically isolated in a

safe area, then captured or humanely dispatched. If necessary, necropsies may be performed.

Rabies

Rabies was epizootic from 1991 until about 1993, apparently entering the state's raccoon populations from eastern PA and/or southern NY. After the initial spread, the incidence rate has stabilized and is now enzootic throughout the state. Periodic resurgences can be expected on a 4- or 5-year cycle; however, the number of future episodes (amplitude) is expected to be about one half or one third of the initial outbreak. Keeping raccoon density low via recreational trapping, as well as feral cats via pest management should minimize the potential on post. New military residents must be advised and reminded to abide by the Arsenal rules concerning pet vaccinations and leashes. Army regulations prescribe medical and veterinary protocols for bites/scratches to humans by pets or feral animals. Pets, if vaccinated, are quarantined at home; feral animals, if captured, will be decapitated (by local veterinarian) and the head prepared for immediate transport to the NJ State Department of Health laboratory in Trenton for prompt testing.

Lyme Disease

Ticks from deer, humans, and other mammals had been collected and sent to U.S. Army Center for Health Promotion and Preventive Medicine (CHHPM, formerly USAEHA) for testing since 1990. Deer blood was also analyzed in 1992 for presence of *Borellia burgdorferi* (Lyme Disease organism). Between 1993 and 1995, 164 Deer Ticks (*Ixodes dammini*) were tested by CHHPM and 34 (20%) were found to be carriers of the Lyme Disease spirochete. CHHPM concluded that PICA is a high-risk area for Lyme Disease. Since 2000, a few employees have manifested signs and/or symptoms of Lyme Disease apparently from tick bites/exposure on post (Dr. J. Billelo, pers. comm. 2012). Ticks removed at the clinic on post are now sent to U.S. Army Public Health Command (USAPHC) for testing; and results are provided to the patient. Sportsmen, residents, and employees are educated about the risk and preventive measures through periodic articles and announcements.

Encephalitis

The West Nile strain of the Encephalitis virus was detected in the New York City area in 1999 when large numbers of birds, especially crows, were found dead. It is believed the disease was introduced from flamingos that were brought to the Bronx Zoo. The disease is transmitted by mosquito and tick species to birds. The virus may reappear because of infected migrating birds. Experts believe the high mortality rates may be caused by a new virulent strain, and may have an effect on populations.

6.12.3 Invasive (Non-Native) Plants

On Feb 3, 1999, Executive Order 13112 was signed establishing the National Invasive Species Council (NISC). The Executive Order required that a Council of Departments dealing with invasive species be created. Currently there are 13 Departments (including DOD) and Agencies on the NISC (NISC n.d.).

A study at PICA was performed in 2003 by TetraTech EM Inc. revealing mild to moderate infestations of those aforementioned plant species. Among the 21 primary target species, 19

were present; among the 26 secondary target species, 14 were present (TetraTech 2003). The top five most ubiquitous across the installation from a distribution perspective are: Nepalese browntop (aka Japanese stilt grass), Japanese barberry, Multiflora rose, Garlic mustard, and Wineberry (TetraTech 2003). Spread rates are rather slow for most upland invasives, the most discernable active increase being the Autumn/Russian Olives. The most deleterious appear to be Oriental Bittersweet in certain pockets, and Common reed (phragmites) in the wetlands areas.

A key observation from this study is that the invasives are associated with the disturbed and open areas (semi-improved grounds); especially the edges around road shoulders, building clear zones, fencelines and RoWs. The larger blocks of unfragmented forest (unimproved grounds) are still resistant to many of the local invasive species. Maintaining the natural canopy cover is the best preventative practice to deter encroachment.

New Jersey had formed an Invasive Species Council (NJISC) in 2004 and from 2007 through 2009 an excellent strategic plan was developed (NJISC 2009). Although the plan was unveiled in January of 2010, the NJISC was disbanded in September of 2010. There is now no invasive species program in NJ, nor is there any official or sanctioned list of invasive species (plant or animal). Non-native plants may take the form of noxious weeds. They are considered exotic plants that colonize disturbed habitat or invade undisturbed native plant communities. They often have no predation from insects and/or diseases. Many non-native plants or “weeds” are very persistent, can spread very rapidly, and may displace native species indefinitely. The invasion of these highly competitive species has the potential to seriously affect species composition and other aspects of biodiversity in forest and nonforest communities. Noxious weed populations, once established, tend to expand at an exponential rate. Noxious weeds out-compete and replace native species thereby reducing biodiversity. Wildlife is also affected. Forage is often reduced for wildlife since nonpalatable noxious weeds replace palatable native plant species.

Several noxious weeds or invasive species on the installation are competing with native plants. The predominant noxious weed plant is Nepalese browntop (*Microstegium vimineum*). The Common reed (*Phragmites australis*) continues to creep through PICA wetlands that are open or disturbed. Purple loosestrife (*Lythrum salicaria*), Canada thistle (*Cirsium arvense*), Japanese knotweed (*Polygonum cuspidatum*), and multiflora rose (*Rosa multiflora*) are also problems. Japanese honeysuckle will probably require herbicide control while the other species can be treated mechanically. Autumn (*Elaeagnus umbellata*) and Russian olive (*Elaeagnus angustifolia*) are two species that threaten some natural habitats such as grassland and meadow areas. These two plants are becoming increasingly evident on the Arsenal and in adjacent areas.

Other noxious plants identified on the Arsenal include: garlic mustard (*Brassica rapa*) and water milfoil (*Myriophyllum spp.*). The aquatic water milfoil is common in the Arsenal lakes and ponds. Wet sites are often monopolized by common reed with purple loosestrife invading localized areas. Garlic mustard and Canada thistle are ubiquitous along roadsides and disturbed areas. The other species are scattered and localized on the installation. Appendix B lists plant species that are known to exist on the Arsenal. Invasive plants are indicated in these lists with the following symbol ☉.

Invasives can also be represented in the animal kingdom among all classes; as well as by microbial pathogens and viruses.

Chapter 7 – Land Use and Management Units

7.1 New Jersey Environmentally Sensitive Planning Units

As previously outlined, PICA is exempt from the Highlands Act and excluded from the Preservation Area; yet it remains within the Planning Area. The following information would inform and suggest how PICA ought to balance its stewardship mission with its R&D and testing mission.

Picatiny Arsenal is within the New Jersey Highland's Environmentally Sensitive Planning Area (designated in State Plan prepared by New Jersey Planning Commission) (see maps in Appendix F. of New Jersey and Morris County planning areas). Other environmentally sensitive areas are located near Delaware Bay, other estuary areas, and coastal barrier islands. These areas cover more than one million acres throughout New Jersey and contain contiguous land areas with valuable ecosystems, geological features, and wildlife habitats. The future environmental and economic integrity of the state rests in the protection of these irreplaceable resources. Environmentally Sensitive Planning Areas are characterized by watersheds of pristine waters, trout streams and drinking water supply reservoirs, recharge areas for potable water aquifers, habitats of endangered and threatened plant and animal species, coastal and freshwater wetlands, prime forested areas, scenic vistas, and other significant topographic or ecological features. These resources are critically important not only for the residents of these areas, but also for all New Jersey citizens.

The Environmentally Sensitive Planning Areas (see maps in Appendix F) are highly vulnerable to damage of many sorts from new development, including fragmentation of landscapes, degradation of aquifers and potable water, habitat destruction, extinction of plant and animal species and destruction of other irreplaceable resources vital for the preservation of the ecological integrity of New Jersey's natural resources.

The PICA is an important component of the New Jersey Highlands Environmentally Sensitive Area. The New Jersey State Development and Redevelopment Plan has established criteria for delineation of the Environmentally Sensitive Planning Areas. The PICA falls within the delineation criteria for the Highlands Planning Area:

- Population density of less than 1,000 people per square mile.
- Land area greater than one square mile (640 acres).
- Trout production and trout maintenance waters and their watersheds.
- Watersheds of existing or planned potable water supply sources.
- Prime aquifer recharge areas of potable water supply sources
- Habitats of populations of endangered or threatened plant or animal species.
- Contiguous freshwater wetlands systems.
- Significant natural features or landscapes such as critical slope areas, ridgelines, gorges and ravines, and important geological features or unique ecosystems.
- Prime forested areas, including mature stands of native species.

The New Jersey Planning Commission's policy for the protection of the Highlands Environmentally Sensitive planning area is: "Protect and preserve large, contiguous tracts and corridors of recreation, forest or other open space land that protects natural systems and sensitive natural resources, including endangered species, ground and surface water resources, wetland systems, natural landscapes of exceptional value, critical slopes areas, and other significant environmentally sensitive features. In the Highlands, communities and regions must protect the integrity of contiguous forested areas and scenic natural landscapes and features in equitable ways. Any new development that takes place in the Environmentally Sensitive Planning Area should capitalize on the inherent efficiencies of compact development patterns found in existing Centers. Outside of Centers, large contiguous tracts of land should be linked to each other to provide buffers and greenbelts and protection for critical habitats."

7.2 Land Areas of Special Interest

Areas on the installation that are noteworthy, deserve special protection, and/or provide important wildlife habitats are listed below (many are within state designated Natural Heritage Priority Sites-NHPS):

Unique Biota

- Picatinny Lake (PLNHPS)
Contains two good occurrences of state rare plant species.
- Gravel Dam Cove and Eastern Shoreline of Denmark Lake (LDNHPS)
This pond and lakeshore constitute the premier breeding habitat of a rare damselfly, the New England Bluet (*Enallagma laterale*). This species is very rare due to small-localized populations dependent upon very specialized habitats. The precise habitat requirements are not known and are under investigation. Although inhabiting a few other ponds or lakes in New Jersey and New England, the Denmark Lake population is the most abundant with perhaps several hundred individuals (F. Carle, pers. comm. 1992). The floating aquatic plant, watershield (*Brasenia schreberi*), appears to be used exclusively for egg deposition (on underwater stem).
- Denmark Lake Shrub Swamp (LDNHPS)
The upper half of Denmark Lake is a large undisturbed wetland mosaic of shrubs, ferns, tussocks, bog mats, and aquatic plants. This palustrine community is exemplary within the state due to its size, species diversity and abundance, and is relatively free of invasive or exotic species. The Legacy project report, *Natural Community Inventory of Picatinny Arsenal*, urges protection of this and other notable floral associations on the Arsenal (Windisch 1993). Six or more state-listed Plant Species of Concern wetland plants occur within this complex: delicate peat moss (*Sphagnum tenellum*), small bur reed (*Sparganium minimum*), at least four bladderworts (*Utricularia spp.*), and featherfoil (*Hottonia inflata*).
- Upper Green Pond Brook Wetlands (GPMNHPS)
This area is located at the north end of the Arsenal lying between Green Pond Mountain to the west and Copperas Mountain to the east. Two state-listed Plant Species of Concern occur in this drainage: featherfoil and large leaved holly (*Ilex montana*). Environmental consultants working for a hydropower company seeking a right-of-way across the Arsenal

documented two rare New Jersey wetland plants: purple cress (*Cardamine douglassii*) and two-fruited sedge (*Carex disperma*)(S. Balzano and R. Radis, pers. comm. 1992).

- Green Pond and Copperas Mountains Ridgetops and Outcrops (GPMNHPS & LDNHPS)
The ridges and side slopes exemplify the diversity within this area. Patches of pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) barrens occur upon exposures of bedrock amid another rare association, that of chestnut oak (*Quercus prinus*)-heath (*Ericaceae*) forest cover. One colony each of the wood lily (*Lilium philadelphicum*) and Allegheny vine (*Adlumia fungosa*), both state-listed rare plants, has been found within this habitat. The timber rattlesnake (*Crotalus horridus*) and another rare reptile, the northern copperhead (*Agkistrodon contortrix* ssp *mokasen*) inhabits this rocky terrain as well. Although timber rattlesnakes are well known to inhabit and den along Green Pond Mountain, recent surveys for a pending PICA (ARDEC) project in this terrain recently discovered another population or cohort of timber rattlesnakes that also den on Copperas Mountain.

Geological Areas, Rock Outcrops, Balds, and Cliff Faces; Western Ridges

The rocky terrain and steep slopes along the ridgelines of the western portion of the Arsenal are noteworthy, not just geologically, but for the stark and spartan microhabitats they represent and as scenic features to view or view from.

- Picatinny Peak
This distinctive landmark of talus and rock rubble, labeled on early maps as “Picatinny Peak”, is the namesake of the Arsenal (Rogers, 1931). Picatinny derives from Minsi Native American words “peek/pic” and “atin/atn” or “utenay/uteney,” that translates to “water body” and “hill” or “village.” A loose interpretation may be “water by the hill” (or village). A lookout platform (building 630A; elevation 1,025 feet) provides a great view of the southern third of the installation. This is an established and internationally recognized Hawk Watch site.

Scenic Vistas

There are several open areas along the western ridge with an easterly aspect that provide striking vistas. The vantage points provide excellent views of the New York City skyline.

- 650 Bald
This topographic feature is a small shelf of about one acre along the easterly face of Green Pond Mountain about 50 feet below Bear Swamp Road and the 650 test range. This large puddingstone flat offers a good view of Denmark Lake and the northeastern portion of the Arsenal (from elevation 1,090 feet).
- 670 Overlook (GPMNHPS)
This rock outcrop is located off Bear Swamp Road at the entrance to the 670-test range. This small precipice (elevation 1,135 feet) offers a good vista to the east unobstructed by trees. It overlooks the lower end of the Gorge.

- Gorge Overlook (GPMNHPS)
Located at the end of the road beyond the 670-test area is a large cliff face. A preponderance of quartzite gives the rocks a gleaming appearance. This sheer 50-foot cliff (elevation 1,100 feet) provides a commanding view across the Gorge; and the remoteness provides the sound of GPB below. This site is also an excellent example of the pitch pine-scrub oak xeric plant community on the installation.
- Copperas End Road Overlook (LDNHPS)
This road was built in 1990 as a service road for fire control near the Gorge open detonation area. A large water tank is installed on a crest of this road. A clearing at the end of the road (elevation 1,112 feet) offers a commanding view of Picatinny Lake and points south, as well as a good view of Denmark Lake during leaf-off periods.
- The Gorge (1222 Test Area) and Other Talus Slopes (GPMNHPS)
A fractured central valley fault between Green Pond Mountain and Copperas Mountain form the Gorge. The most dominant geologic feature within the Gorge is a talus slope of huge angular rocks; the height of the slope is about 200 feet. This nonvegetated rock wall is so extensive and massive that it is one of the most obvious and striking features on satellite imagery covering a multi-state area (R.Stechert, pers. comm. 1994). At the top of this slope just south of an existing powerline right-of-way is lodged one gigantic monolith. This cubic block has been coined “Grant’s Tomb.” The talus slope in the Gorge and extending farther north was formerly inhabited by the state-listed endangered wood rat (*Neotoma floridana*). The woodrat is now considered extirpated from the area of talus along GPMt (Mick Valent, pers. comm. 2012). This rugged habitat may still be a suitable site for its reintroduction. Timber rattlesnake hibernacula have been previously documented in this area before 1999.

7.3 Picatinny Land Uses

There are three major land uses pertinent to different types of management and operation. These uses are categorized as:

- 1) Improved grounds (994 acres).
- 2) Semi-improved grounds (109 acres).
- 3) Unimproved grounds (4,750 acres).

Improved grounds are typified by intensive development and infrastructure, landscape and ornamental plantings, and urban forestry. These areas are generally the areas associated with buildings, parking lots, main access road corridors, and other permanent improvements. They are highly visible and are characterized by the application of aesthetic standards. Intensive lawn, turf, or landscape maintenance is regularly required. These include 63 acres of family housing, 17 acres of parade grounds, 3 acres of orchard and garden (former community garden was converted to a dog park in 2009), 3 acres of major roads, and 714 acres primary buildings, parking lots and road networks comprising the 800-acre cantonment area. Additionally, there are 9 acres of athletic fields, a 28-acre former New Jersey Air National Guard heliport (now converted to a National Guard Vehicle Maintenance Facility), and a 157-acre golf course.

The golf course was begun in 1925 when four “par three” golf holes were constructed on the installation parade grounds. In the following 15 years the original layout was expanded and

reconfigured to 11 holes in the area bordered by Farley Avenue, Buffington Road, First Street and Fourth Avenue. Later an area south of First Avenue was cleared to establish seven more holes, and the existing 11 holes were rearranged to establish an 18-hole course. In 1965, building 94 was constructed on the 14th hole, which required another rearrangement, bringing the golf course to its current layout.

Semi-improved grounds are typified by dispersed and minimal development, some landscape plantings, and urban forestry. These areas require some, yet less intensive maintenance, for brush, grass, or other ground covers, as well as tree care. The semi-improved areas comprise 28 acres of explosive storage, 8 acres of outdoor test fire ranges, about 20 acres of utility rights of way, 3 acres of abandoned railroad right of way, 10 acres of secondary roads, 6 acres of picnic/camping grounds, a 2 acre former heliport crash field(now used as a massive soil storage site). This land is interspersed with 32 acres of fragmented early successional stage vegetation.

The unimproved grounds are the remaining undeveloped buffer areas of the Arsenal, characterized by natural vegetative cover and surface waters. They include lakes, streams, ponds, forested land, and a few remote buildings and structures. Although the Arsenal Master Plan generally designates safety, administrative, operation, and recreational areas as indicated above, this INRMP does not delineate management areas, but instead focuses primarily on natural resources management within the unimproved grounds or natural lands.

Low Impact Development

Although Low Impact Development (LID) was initiated in 2004 via the Unified Facilities Criteria (3-210-10) promulgated by DOD, the practical implementation has been slow; and at PICA only recently receiving impetus with the 19 JAN 2010 Memo (from Under Secretary of Defense AT&L) DOD Implementation of Storm Water Requirements under Section 438 of the Energy Independence and Security Act. The goal for PICA LID program is to guide development in a cost effective manner that helps mitigate potential environmental impacts (C. Appelquist pers.comm. 2012).

Key elements to be integrated into LID include:

- Restricting future development to footprints of former building and/or previously disturbed areas/sites.
- Stormwater controls that restore pre-construction hydrology, reduce stormwater runoff, and improve water quality by using bio-retention cells (e.g. rain gardens, vegetative buffers) and porous pavers; so that water is redirected and conditioned at its source for Ground Water recharge, contaminant removal, and evaporation, rather than directly entering the stormwater drainage system.
- Using LEED materials and concepts.
- Implementing water and energy conservation measures and BMPs.

7.4 State Wildlife Action Plan

In order to qualify for federal funding under the State Wildlife Grants program, each state was required to submit a Wildlife Action Plan to the USFWS by 1 OCT 2005. These are known as State Wildlife Action Plans (SWAP) and are prepared and outlined with 8 key elements. The New Jersey Wildlife Action Plan was submitted to USFWS on 1 OCT 2005, and received conditional approval due to a limited public comment period. After an extension of the public comment period, more internal reviews to incorporate comments from the public, and other stakeholders, a revised document was resubmitted to the USFWS on 4 AUG 2006, for final approval. The NJ SWAP continues to be refined as it is a living (or dynamic) document (Tarlowe, Paul. 2010b).

As mentioned previously (paragraph 6.11.3) the state's landscape is divided into 5 physiographic (or landscape) regions. PICA is within the "Skylands" which is described in the SWAP as follows:

"The Skylands Landscape is characterized by a broad array of habitat types that support a wide variety of wildlife species. Among the more prominent features of the region are the large, contiguous forests of the Kittatinny Ridge and Northern Highlands zones. These provide critical habitat for area-sensitive wildlife such as bobcats, forest-dwelling bats, woodland raptors, neotropical migrant songbirds, and timber rattlesnakes. The region's numerous limestone fens, vernal pools, and emergent, riparian and forested wetlands provide critical habitat for freshwater wetland birds, bog turtles, blue-spotted salamanders, and a host of other special concern reptiles and amphibians. The clear, unpolluted rivers and streams provide critical habitat for dwarf wedgemussels and other mollusks, wood turtles and long-tailed salamanders. The Skylands Landscape plays an accessory role in the conservation of the Fowler's toad, freshwater wetland birds, and rare dragonflies, damselflies, moths and butterflies" (Skylands Landscape. 2008).

The Skylands is further subdivided somewhat geographically into 7 conservation zones based on the ecological similarity of habitats (ecosystems). PICA is in the middle of the Northern Highlands conservation zone (Skylands Landscape. 2008).

Threats to the Skylands, including the Northern Highlands Conservation Zone, are outlined below and in turn frame much of the ecosystem management and stewardship goals and objectives in this INRMP.

Issues of concern include:

- Fragmentation which alters the habitat by breaking up large contiguous blocks into smaller patches that are unsuitable for area-sensitive species.
- New roads fragment habitats and create barriers to animal movements between habitats.
- Discontinuity of emergent and forested wetlands along with the loss of other suitable corridors leading eventually to the genetic bottlenecking of both bog turtles and spotted turtles.
- Contamination and alteration of waterways and wetlands, in combination with increased human encroachment into these riparian areas, affect all wetland dependent species and species groups.

- Non-point source pollution, reduction in stream flows, stream cleaning activities, culvert construction and the persistence of dams all have an impact on riparian and riverine species.
- Human encroachment on wetland habitats often results in an increase in invasive and exotic flora becoming more dominant. These species often decimate native wetland plant communities and can have a deleterious effect on wetland hydrology that results in a loss of habitat value to wetland-dependent wildlife.
- Over-browsing by deer can eliminate native shrub layers and damage breeding habitat for many species, particularly shrub-nesting birds. In addition, over-browsing by deer can create an environment conducive for invasive plants to germinate and crowd out native species and can eliminate rare plant communities.
- Invasive, non-indigenous species often cause substantial ecological and economic problems. See paragraph 8.15.2.

These issues are targeted and tackled through local conservation zone goals and actions laid out in the SWAP. A SWAP pamphlet (Skylands Pamphlet. n.d.; circa 2008) summarizes most of the major ecosystem management themes of this INRMP. The SWAP for Skylands (and Highlands) pursues the following Goals to deter negative impacts:

- **Conserve big, intact forests:** The mixed hardwoods that blanket the slopes of the Highlands typify the big forests that are home to bobcats, timber rattlesnakes, Indiana bats, songbirds, barred owls and red-shouldered hawks that cannot survive in isolated forest patches.
- **Connect forests and habitats:** A blue-spotted salamander crawls toward its breeding pond, but stops when it reaches a barrier - a new road cut in the forest. From salamanders to wide-ranging bobcats, wildlife are often blocked or isolated by roads and development. Preserving the remaining large, contiguous blocks of habitat, and maintaining connectivity between them, is critical to the long-term viability of spatial area-sensitive wildlife populations (Skylands Landscape. 2008).
- **Keep habitats healthy:** While nesting goshawks need old, large and closely spaced trees, golden-winged warblers require younger forests and brushy openings. Historically, natural forces like wind and fire created a kaleidoscope of habitats. Today's forests offer fewer habitat choices with the added threats of invasive plants, human disturbance from off-road vehicles.
- **Protect wetlands and water quality:** Skylands forests harbor limestone fens, vernal pools and other special wetlands. When development isolates one wetland from another, species such as bog turtles become trapped. If the buffers are too small, water quality suffers. At risk are rare damselflies and dragonflies, bog turtles, mussels, wood turtles and long-tailed salamanders.

Chapter 8 – Natural Resources Management

8.1 Objectives

Picatinny Arsenal's natural resources management objectives in support of the military mission are:

- a) Maintain land to support the military mission and sustainable forestry.
- b) Manage the ecosystem at the PICA to maintain biological diversity.
- c) Improve the quality of wildlife habitat for indigenous game and nongame species.
- d) Control and sustain harvestable game species through a recreational sportsman program.
- e) Provide special protection and management leading to endangered species recovery as prescribed.
- f) Cull/process limited forest products to enhance plant species diversity and forest health.
- g) Restore areas damaged by mission activities.
- h) Protect the real estate investment of the United States government from unnecessary depreciation and/or depletion.

8.2 Forest Management

The general goals of the forest management program are:

- Maintain a vegetative cover to screen the noise and to buffer possible discharged ordnance from the surrounding community.
- Provide forest cover for watershed and riparian area protection.
- Maintain wildlife habitat unique to the Highlands Region. Update forest inventory.

More specifically, management of Picatinny's forests shall attempt to:

- Maintain forest aesthetics in the improved grounds of the installation.
- Maintain forest as a buffer from the surrounding community.
- Provide forest habitat for wildlife.
- Moderate the urban atmosphere of the installation cantonment area.
- Preserve water quality by preventing soil erosion and maintaining forest floor qualities that hold moisture and enhance vertical infiltration of water.

The forest stands on PICA have grown with little active management for the past 30 years. Given mission activities and safety concerns, current forest plans do not contain management objectives or prescriptions. During the 1970s, there were four timber sales that were primarily thinning harvests. There is no record of a silvicultural prescription for the stand treatments and the harvests may or may not have improved stand quality. The Arsenal has conducted an on-post fuelwood program since the 1970s which continues today through the Garrison EAD and NRM. Most of the fuelwood has consisted of salvage of roadside trees that were damaged by storms or removed for other mission objectives such as safety. There is no current silvicultural treatment of stands through use of the fuelwood program.

In the early 1980s, a private consulting forester was contracted to conduct a timber cruise to update the 1974 woodland forest management plan. The forester provided a gross timber

volume figure for all wooded acreage on the Arsenal, but volume information did not separate the commercial forested land from the modified, restricted, or non-commercial forestland. Stands were not delineated from the total forest acreage and the silvicultural prescriptions necessary to make meaningful sustainable forest management decisions were not provided.

In 1987, the NRM of the installation conducted an inventory of the forest resources using three seasonal employees. The objective of the inventory was to define natural forest habitat communities. Although successful, the inventory lacks sufficient data and has not been useful in implementing sustained yield management of the forest. The procedures used for the inventory did not meet the professional standards typically associated with a management inventory.

Nevertheless, the 1987 inventory is the most current data available for making forest management decisions. The inventory showed that the total growing stock has a volume of 15.6 million board feet with an additional 67,000 cords of round wood. The total value was estimated to be two million dollars.

Due to limited acreage of commercial forestland, as well as multiple use management values and objectives, timber harvests will likely be infrequent and used to manage wildlife habitat. Discovery of the Indiana Bat and development of the Endangered Species Management Plan will likely limit the type, location, and frequency of any potential timber harvests in future years. This could change with updated forest inventory.

Although the seral stages could change in selected areas, no change in the types of species present is anticipated in the immediate future. Suppression of wildfire and minimal salvage will contribute to continued successional growth, but the forest will move slowly toward a mature or old growth condition. Shade-tolerant species (maples) in the understory will likely increase, but shade-intolerant species (oak) will decrease without any disturbances to the ground. Depending on silviculture treatments used, portions of the forest may become less monotone and more mixed across the landscape.

Forest management or harvest shall be guided by (but are not limited to) the following:

- 1) Harvests should be restricted to silvicultural treatments, such as thinning, for the purpose of improving habitat conditions or improving safety.
- 2) The best opportunity for timber harvest and sales in the immediate future may be for fuel wood, subject to limitations and standards and guidelines.
- 3) The installation's forests should be managed as nonindustrial forest for minimal timber or wood product production.
- 4) Fixed area plots or variable plots should be used for forest management inventories.
- 5) Prescribed fire (if allowable) and management of existing stands should be accomplished as appropriate to improve structural diversity and enhance connectivity.
- 6) Management actions should be coordinated with adjacent landowners and managers to increase dispersal habitat, create forest openings in selected areas, and improve connectivity.
- 7) All forest management outlined in this Chapter (8.2-8.2.4) is subject to the standards and guidelines of Section 8.2.5 and any others which may be specified and integrated into any future Endangered Species Management Plan(s) or Components.

8.2.1 Silvicultural Systems

There are two silvicultural systems that can be used by the installation to implement forest management objectives. The even-aged silvicultural system produces stands composed of trees of relatively small differences in age. Generally, this silvicultural system is used to regenerate tree species intolerant of shade. The uneven-aged silvicultural system produces stands composed of a variety of ages and sizes. This system is used to regenerate trees tolerant of shade.

The even-aged silvicultural system employs three regeneration harvest-cutting methods:

- Clearcutting. All the trees are removed at one time.
- Seed tree. Only a few scattered trees are left.
- Shelterwood. About ½ of the trees are removed and, after sufficient seedling revegetation is established, the remaining trees are removed.

Thinning harvests are used periodically before the regeneration harvest. A thinning harvest salvages high-risk trees, removes low quality trees, and provides optimum growing conditions for the remaining crop trees. Thinning harvests can also be used to shape the species distribution to the desired future condition.

The uneven-aged silvicultural system uses two harvest-cutting methods.

- Single tree selection. Similar to a thinning harvest except that large canopy gaps are created to promote the regeneration of shade-intolerant seedlings.
- Group selection. Removes small patches of trees across the stand. The larger the groups or patches, the more shade-intolerant species will be regenerated.
- Combination of single tree and group selection. Often used in stands that have variety of stand conditions.

Even-aged Silviculture

Even-aged Shelterwood Cuts to regenerate species that are somewhat tolerant of shade, such as oak, will be typically applied in two, closely timed cuts as follows:

- The first cut, or preparatory cut, will be a commercial cut that will leave 30 to 50 percent crown cover depending on the shade tolerance of the desired species, the visual quality objectives of the site, and the condition of the stand before cutting.
- Other than wildlife reserve trees, trees that remain should be of good quality, wind resistant, and of sufficient size to permit a commercial second or removal cut within ten years.
- Post sale treatments should be done within one year after the first cut to remove all other remaining stems over one inch in diameter at breast height that are not wildlife trees.
- After 3 to 5 years, if reproduction has reached a height of 3 to 5 feet, the remaining overstory will be removed if compatible with visual objectives.

Clearcutting should only be used when it is the optimum harvest method for achieving resource objectives. Clearcutting removes virtually all the existing trees from a site in order to salvage

trees; or create an opening where shade intolerant trees can naturally regenerate, different types of trees can be planted, or to maintain the open condition over time.

Clearcutting is the optimum method and will be used for:

- Salvaging damaged stands to stop the spread of an insect or disease outbreak.
- Regenerating of aspen and gray birch stands that are intolerant of shade and valuable for wildlife habitat and biological diversity.
- Removing planted softwoods from areas where hardwoods are better adapted to the site.
- Improving the condition of stands that have a high risk of dying within the next ten years or that are sparsely stocked and will be unable to fully utilize the site within ten years.
- Creating permanent upland openings for better vegetative diversity and improved wildlife habitat.
- Creating vistas or to create small temporary clearings to further the military mission.

Intermediate Cuts

Thinning harvests may be prescribed in overstocked even-aged stands to improve the growth and quality of desirable trees as determined by the silvicultural guide for each forest type. Thinning will normally be conducted every 20 years on the more productive sites. The first commercial thinning can be conducted when the stands are 40 years old.

Even-aged Management

At the PICA, the even-aged silvicultural system should be used to regenerate the mixed oak types. If the aspen and gray birch forest type is to be maintained on the installation, the clearcutting method should be used. Aspen and gray birches are associated with catastrophic events. To be effective, the clearcut should duplicate the light and temperature regimes of open fields, the condition under which early-successional species do well.

Although silvicultural prescriptions were not developed for the stands inventoried in 1987, future forest inventories should consider the following objectives when developing Even-aged prescriptions:

- a) Diversify stand types and age classes.
- b) Regenerate species intolerant or intermediately intolerant of shade such as aspen, gray birch, and oak.
- c) Regenerate high risk and sparse stands.
- d) Prevent the spread of insects and disease.
- e) Produce high quality sawtimber and other wood products.

Table 8.1 Shade Tolerance of Various Forest Trees

Shade Tolerant	
<u><i>Acer saccharum</i></u>	Sugar Maple
<u><i>Acer saccharinum</i></u>	Silver Maple
<u><i>Aesculus spp.</i></u>	Buckeyes
<u><i>Betula lenta</i></u>	Black Birch (aka Sweet Birch)
<u><i>Carpinus caroliniana</i></u>	American Hornbeam
<u><i>Chamaecyparis thyoides</i></u>	Atlantic White Cedar
<u><i>Cornus florida</i></u>	Flowering Dogwood
<u><i>Diospyros spp.</i></u>	Persimmon
<u><i>Fagus grandifolia</i></u>	American Beech
<u><i>Ilex opaca</i></u>	American Holly
<u><i>Morus rubra</i></u>	Red Mulberry
<u><i>Nyssa sylvatica</i></u>	Sour Gum (aka Tupelo)
<u><i>Ostrya virginiana</i></u>	Eastern Hophornbeam
<u><i>Picea glauca</i></u>	White Spruce
<u><i>Picea rubens</i></u>	Red Spruce
<u><i>Tilia americana</i></u>	Basswood
<u><i>Tsuga canadensis</i></u>	Eastern Hemlock

Intermediate Shade Tolerant	
<u><i>Acer rubrum</i></u>	Red Maple
<u><i>Betula alleghaniensis</i></u>	Yellow Birch
<u><i>Castanea dentata</i></u>	American Chestnut
<u><i>Celtis occidentalis</i></u>	Hackberry
<u><i>Fraxinus americana</i></u>	White Ash
<u><i>Fraxinus pennsylvanica</i></u>	Green Ash
<u><i>Fraxinus nigra</i></u>	Black Ash
<u><i>Pinus strobus</i></u>	Eastern White Pine
<u><i>Quercus alba</i></u>	White Oak
<u><i>Quercus macrocarpa</i></u>	Bur Oak
<u><i>Quercus velutina</i></u>	Black Oak
<u><i>Quercus rubra</i></u>	Northern Red Oak
<u><i>Ulmus americana</i></u>	American Elm
<u><i>Ulmus thomasii</i></u>	Rock Elm

Shade Intolerant	
<u><i>Betula papyrifera</i></u>	Paper Birch
<u><i>Betula populifolia</i></u>	Gray Birch
<u><i>Catalpa spp.</i></u>	Catalpas
<u><i>Carya spp.</i></u>	Hickories
<u><i>Juglans cinerea</i></u>	Butternut
<u><i>Juglans nigra</i></u>	Black Walnut
<u><i>Juniperus virginiana</i></u>	Eastern Red Cedar
<u><i>Liriodendron tulipifera</i></u>	Yellow poplar
<u><i>Pinus rigida</i></u>	Pitch Pine
<u><i>Platanus occidentalis</i></u>	Sycamore
<u><i>Populus deltoides</i></u>	Eastern Cottonwood
<u><i>Populus grandidentata</i></u>	Big-Tooth Aspen
<u><i>Populus tremuloides</i></u>	Quaking Aspen
<u><i>Prunus serotina</i></u>	Black Cherry
<u><i>Robinia pseudoacacia</i></u>	Black Locust
<u><i>Salix spp.</i></u>	Willows
<u><i>Sassafras spp.</i></u>	Sassafras

Uneven-aged Silviculture

Uneven-aged methods were developed by German foresters to duplicate the natural replacement of trees in old-growth forests. Although the single tree and group selection harvest cutting methods cause the least disturbance compared to even-aged harvest cutting methods, more skill is required to successfully implement the cuts. The cuttings require frequent stand entries (usually every 10 to 20 years) and require extreme care by fallers and skidders. Selection methods require more record keeping than even-aged methods and they are usually more costly due to lower harvest volumes and the higher degree of care that is necessary.

When uneven-aged silviculture is to be applied, the type of cutting will depend upon the conditions of the existing stand, the species desired, and the other resource objectives for the area. Uneven-aged silviculture techniques will normally be applied when selecting and cutting individual trees, small groups of trees, or a combination of individual trees and groups.

Individual tree selection will be used in:

- Northern hardwood stands where shade-tolerant species are desired.
- Hemlock stands
- Areas of visual concern

Group selection will generally result in cuts less than one acre and will be used in:

- Northern hardwood stands where species intermediately tolerant of shade are desired.
- Oak stands on poor sites where chestnut oak and scarlet oak regeneration will prevail.
- White pine stands.
- Stands where removal of high risk and low quality stems is needed.
- Areas needing small temporary openings to meet wildlife or visual quality objectives.
- Areas to facilitate the conversion of some even-aged stand to uneven-aged.

Both individual and group selection will be used when a combination of factors requiring both methods occur.

Uneven-aged Management

In areas that will require more attention to visual quality, the uneven-aged silvicultural system should be used. It must be recognized that if the uneven-aged system is used, the better sites will be converted to the more shade-tolerant northern hardwoods. On the poorer oak sites, group selection can be used successfully to regenerate oak, especially chestnut oak and scarlet oak. The uneven-aged silvicultural system can be used to regenerate the northern hardwood and the red maple types.

Although silvicultural prescriptions were not developed for the stands inventoried in 1987, future forest inventories should consider the following objectives when developing Unven-aged prescriptions:

- a) Diversify species and age classes within a stand.

- b) Maintain a continuous forest cover in areas with highly sensitive views (along roadsides, trails, and vistas).
- c) Maintain shade along streams.
- d) Meet resource objectives, such as wildlife habitat improvement, in “environmentally sensitive” locations, such as riparian areas.
- e) Regenerate tree species tolerant of shade.

8.2.2 Reforestation

Reforestation of cut-over areas will be accomplished by natural means within five years after the regeneration cut. In rare cases, artificial means will be used. Although reforestation will occur by natural regeneration, planting may be beneficial at times. In most cases, the site will be prepared for reforestation following regeneration cuts. The following guidelines shall apply:

Site Preparation

- 1) Prepare sites by hand (chainsaw felling), mechanical means*, or by prescribed burning.* *(only if site is cleared of MEC or UXO)
- 2) Conduct hand tree felling to eliminate unmerchantable vegetation where necessary to regenerate a timber stand.
- 3) Conduct mechanical site preparation where mineral soil is required for a seedbed and cannot be adequately achieved by summer logging.
- 4) Use prescribed burning for site preparation where needed to ensure oak regeneration on the more productive sites. Consider using prescribed burning as site preparation for planting.

Site Surveys

- 1) Survey all regenerated stands to ensure adequate stocking.
- 2) Conduct stocking surveys following the first and third growing seasons after even- and uneven-aged regeneration cuts. Sample stands using 1/700th acre plots (4.45^{ft} radius). Take a minimum of 10 plots in stands up to 20 acres, with an additional plot taken for every 2.5 acres over 20.
- 3) Vary minimum stocking levels for even- and uneven-aged stands:
 - (a) Even-aged stands. At least 60 percent of the plots should be stocked with one or more acceptable seedlings of a tree species that contributes to the attainment of the desired cover type.
 - (b) Uneven-aged stands. At least 35 percent of the plots should be stocked to attain the desired cover type.
- 4) Schedule any stand not meeting minimum desired stocking levels after the third growing season for a survey following the 5th growing season. Contact a forester to develop a prescription on how to achieve desired stocking levels.
- 5) Specify silvicultural prescriptions for artificial regeneration seedling spacing, acceptable stocking levels, and growing stock, depending on objectives for the area to be planted or seeded and the local conditions.

Reforestation of razed building areas within or in near proximity of natural woodlands and indigenous seed banks will be accomplished by allowing natural succession to proceed after removal of the former building’s foundation/footprint. This will be encouraged by backfill of

sufficient native or available soil with 2-3 inches of topsoil for initial establishment of a grass cover. In those rare cases where the former foundation is surrounded by several meters of pavement or other hardscape, gravel may be used as the topdressing for the regarded site. In those wooded or natural locations where it is anticipated that re-construction is likely to occur within the next 5-10 years, then gravel (in lieu of soil) may be placed upon the regraded subsoil in the footprint area; provided an effective weed block/barrier material underlies the gravel topping. This BMP will deter the establishment of invasive species within the fragmented and fallow areas in the otherwise natural forested tracts.

8.2.3 Silvicultural Guides

The following is a list of silvicultural guides to be used as appropriate in the implementation of the timber management objectives:

- Oak Forest Types – Even-aged Silviculture for Upland Central Hardwoods 1968. Agricultural Handbook 355. Manager’s handbook for Oaks in the North Central States.
- Northern Hardwoods – A Silvicultural Guide for Northern hardwoods in the Northeast. NE-143.
- Allegheny Hardwoods (Black Cherry, Yellow Poplar & Ash)-A Stocking Guide for Allegheny Hardwoods and Its Use in Controlling Intermediate Cuttings. USDA Forest Service Research Paper- NE-373. 1977
- White Pine Forest Type - A Silvicultural Guide for White Pine in the Northeast. NE-41.
- Aspen – Gray Birch Forest Type- Manager’s Handbook for Aspen in the North Central States. NC-36.
- Hemlock Forest Type - Managing Eastern Hemlock, A Preliminary Guide. NA-FR-30.

8.2.4 Silviculture and Wildlife

With proper planning and awareness, timber management practices can be highly beneficial to wildlife. Some items to consider are:

- Timing. To comply with the Migratory Bird Treaty Act, especially to migrant birds that raise their young on the installation, tree felling and forest disturbances from Mid-APR to Mid-AUG should be avoided.
- Hard Mast. Beech, Oak, and Hickory nuts are a high-energy food source for many species. Leaving even a few mature trees per acre, especially trees that look like good seed producers, is beneficial.
- Buffers. Leave buffer strips along streams, as recommended by the New Jersey Stormwater Best Management Practices (SWBMP) Manual (Blick et al. 2004), to help regulate stream temperatures and protect breeding fish populations.
- Cavities. Leave some trees with cavities for nesting and/or shelter.
- Landings. As recommended in the NJ SWBMP Manual, leave seeds in landings to provide food and cover for many woodland wildlife species.
- Diversity. Stands with good structural diversity and species diversity will support more varied populations of wildlife than uniform, single-species stands. Avoid clearcutting - promote selective thinning, if necessary.

- The Big Picture. Improving woodland habitats is often a matter of providing the missing picture in a larger landscape. It is important to look at the surrounding stands within the Arsenal and also on the surrounding ownerships to determine the role of that individual stand. The stand prescription may provide an element of habitat that may be missing over a much larger area. More than anything else, the Big Picture Concept is the secret to managing woodland habitats for wildlife.

8.2.5 Silviculture and Indiana Bats

On 1 OCT 07 the PICA IBAT ESMP was finally approved and adopted which included all the previous interim standards and guidelines. The PICA IBAT ESMC is now incorporated as Appendix G of this INRMP. The current Standards and Guidelines to protect and conserve IBATs are as follows:

- All of PICA is within 5 mile radii around nearby hibernacula, making foraging habitat conservation a priority for fall swarming and spring emerging bats.
- Consult on all tree impacts within Zones of Concern (ZoCs), regardless of time of year.
- Trees/limbs less than 5 inches in diameter are not subject to seasonal tree cutting/pruning restriction; yet informal consultation still required per ESMC if action is within a ZoC.
 - 1) Restrict / Prohibit tree trimming or cutting from 1 APR – 15 NOV (spring, summer, fall). This precludes any possible “taking” of roosting IBATs under ESA.
 - 2) Scope and schedule all anticipated projects well in advance of seasonal restrictions; since informal consultation with USFWS is prudent for most proposed projects, and required in ZoCs.
 - 3) All garrison or contract work involving tree removal or pruning must be coordinated with Natural Resources Manger, even during winter season (16 NOV--30 MAR).
 - 4) Minimize incremental or cumulative net loss of permanent forest cover over entire installation.
 - 5) No net losses of permanent forest cover in excess of 7%.
 - 6) Establish 0.75 mile buffer zone around documented capture / roost sites. There are currently 4 established ZoCs. Three other ZoCs from 2006 surveys (mostly overlapping previous ZoCs) have not been applied.
 - 7) Maintain or increase snag densities. Favor retention or creation of snags during any forest management. Strive for 24 suitable roost trees (>9 inches DBH) per acre.
 - 8) Retain all Shagbark Hickories and mature Sugar Maples and White Oaks.

8.2.5.1 Silviculture and Northern Long-eared Bats

On 11 DEC 19 during annual review of this INRMP for operation and effect Ms. Alicia Protus and supervisor Mr. Ron Popowski of USFWS-NJFO recommended clarification to our previously approved addendum concerning NLEB management under the ESA Section 4(d) rule. Addendum 1 (aka NLEB mgt) was approved by USFWS-NJFO on 28 AUG 17 and is still consistent with the following clarifying guidance. The current Standards and Guidelines to protect and conserve NLEBs are as follows:

- As for IBATs, all of PICA is within 5 mile radii around nearby hibernacula, making foraging habitat conservation a priority for fall swarming and spring emerging bats.

- Consult on all tree impacts of trees/limbs **greater than 3 inches DBH/diameter** within Picatinny Arsenal, during the summer roosting season (1 APR – 15 NOV); informally and via the USFWS “Key to the Northern Long-eared bat 4(d) Rule for Federal Actions that May Affect Northern Long-eared Bats” (aka ‘online wizard’) form, as necessary.
- Trees/limbs less than 3 inches in diameter are not subject to seasonal tree cutting/pruning restriction; yet informal consultation still required per ESMC if action is within an IBAT ZoC.
- Consult on all tree impacts within the designated NLEB hibernaculum Zone of Concern (NLEB H-ZoC), regardless of time of year.
- Consult on all tree impacts within the designated NLEB maternity roost Zone of Concern (NLEB MR-ZoC), regardless of time of year.
 - 1) Restrict / Prohibit tree trimming or cutting from 1 APR – 15 NOV (spring, summer, fall). This precludes any possible “taking” of roosting NLEBs under ESA.
 - 2) Scope and schedule all anticipated projects well in advance of seasonal restrictions; same as for IBATs.
 - 3) All garrison or contract work involving tree removal or pruning must be coordinated with Natural Resources Manager, even during winter season (16 NOV--30 MAR).
 - 4) Minimize incremental or cumulative net loss of permanent forest cover over entire installation.
 - 5) No net losses of permanent forest cover in excess of 7%.
 - 6) Establish 0.25 mile buffer zone around Mt. Hope West Shaft (aka NLEB Hibernaculum Zone of Concern).
 - 7) Establish 150 foot buffer zone around documented NLEB maternity roost tree/site. There are currently no documented or established NLEB MR-ZoCs on Picatinny.

8.2.6 Urban Forestry

Hazard Trees

With the overmaturing of many trees on post, either planted or naturally occurring in the improved and semi-improved grounds, as well as a recent cultural landscape survey/inventory; the need to develop an urban forestry or tree management program is apparent. Improper pruning conducted by summer aides over the years, continuous girdling impacts by increased use of weed whackers around boulevard trees, and careless construction injuries and compaction have stressed many trees around buildings and near roadways.

Since 2003 and to some degree before then, hazard trees (aka HazTree) on post have been routinely identified by various building and test range managers, Directorate of Public Works (DPW) personnel and BasOpsSup, which are verified and prioritized by the NRM. This process occurs annually so trees can be scheduled for take-down or pruning during the appropriate cutting window (16 NOV CY thru 31 MAR next CY) to avoid impacts to IBATs. If HazTree must be felled or pruned during the active IBAT & NLEB summer roosting period, then “emergency consultation procedures and protocols” per USFWS must be applied. These are established and have been coordinated with the local USFWS-NJFO (namely “roost tree exit/emergence observation” by “sitting” a single tree in question to determine bat occupation presence/absence). If multiple HazTrees are involved at one time, then the USFWS “Key to the

Northern Long-eared bat 4(d) Rule for Federal Actions that May Affect Northern Long-eared Bats” (aka ‘online wizard’) form will need to be completed and filed before felling/pruning. They have been used on a few rare occasions to the satisfaction of both USFWS and PICA; yet scheduling batches of HazTrees during the winter cutting window is more cost effective and ESA compliant.

In 2010 the HazTree program was improved by sharing lessons learned from Ft. Drum foresters, including a week long site visit. The Ft. Drum team was invited by DPW to inspect scores of trees along our major arterial roadways and some powerline RoWs. Between February 2010 until end of March 2010 and again last winter cutting window, over 200 trees were culled that had been rated as HazTrees. The same metrics and techniques for identifying and rating HazTrees is applied at PICA by the NRM.

Placing more emphasis on an Urban Forestry and street tree BMPs program should help to alleviate unnecessary stressors on the existing shade trees; while culling of those few remaining specimens in decline will continue and eventually level off to a mere handful each CY.

Fuelwood and Wood Products Salvage

When HazTrees are culled, trees removed/cleared for small scale construction projects, or deadfalls or blowdown trees are cleaned up the standard procedure on post is to buck the logs or limbs into manageable size bolts for transport and deposition in the central Fuelwood Storage Site. Only bolts that are greater than 8 inches diameter (small end) and less than 22 inches diameter (large/butt end) are accepted in the yarding site. Very large butt logs, stumps, and tops (slash) must be taken off post as solid waste debris. Occasionally and as directed by the NRM, if slash and small bolts and limbs are chipped, those chips may be cast into the woods (unimproved grounds) or collected and deposited in the Fuelwood Storage Site or alternate safe location. Quantities of woodchips that cannot be recycled in a reasonable amount of storage time will need to be removed as solid waste debris.

8.3 Agricultural/Grazing Out Leases

Although there are no agricultural or grazing opportunities currently available on the installation, such potential uses will be evaluated in the future; and/or considered as a management activity to enhance fish and wildlife habitat.

8.4 Wildlife and Fish Habitat Management

The general goals of wildlife and fish habitat management are:

- Maintain habitat connectivity and management consistency with contiguous areas outside the Arsenal.
- Maintain or enhance species biodiversity.
- Minimize habitat fragmentation within the Arsenal.

Currently, habitat quality and species diversity are high. The Arsenal is forested with large contiguous blocks of second-growth forest. Overall health is good despite degradation due to disease. Green Pond Brook and associated wetlands provide an aquatic corridor through the

Arsenal; however, other connectivity corridors have not been identified. In the future, probable areas of connectivity should be validated and management activities should support species diversity and maintain unfragmented areas.

The specific objectives of the wildlife and fish habitat management at the PICA are:

- a) Improve forest health and reduce disease infestations.
- b) Provide long range and annual plans for fish and wildlife habitat, development and maintenance, especially habitat for TES and SAR.
- c) Integrate fish and wildlife management practices with other natural resources management with emphasis on multiple use of the resource.
- d) Maintain all wetlands of value to waterfowl and other wildlife.
- e) Protect and preserve existing fish and wildlife species and those threatened with extinction.
- f) Optimize ecological development of land and water areas.
- g) Recommend fish and wildlife harvest designed to adjust fish and game populations to the capacity of the available habitat.
- h) Provide recreational benefits from fish and wildlife resources.

To accomplish the above objectives, the following standards and guidelines shall apply:

- 1) Manage landscape areas where little mature forest persists to retain late-successional patches.
- 2) Provide for retention of any old-growth fragments that remain in watersheds.
- 3) Suppress or manage wildfire, especially in riparian areas.
- 4) Allow salvage only for safety reasons along roads, near developed and recreation facilities, and to relieve the effects of catastrophic events such as fire, insects and diseases, should this occur.
- 5) Maintain open fields and permanent openings by periodic mowing, brush cutting, (possible hay lease); or prescribed burning outside of the songbird-nesting season*.
*(Per consultation with USFWS the songbird nesting season on PICA is established as 15 APR CY through 15 AUG CY).
- 6) Monitor any forest land defoliation and mortality, especially in riparian zones. Use biological controls if feasible.
- 7) Protect unfragmented and dispersal habitat as appropriate for selected species.
- 8) Coordinate and integrate management activity and plans with other contiguous stakeholders or land managers.
- 9) Prepare a site-specific implementation plan prior to any habitat manipulation activities.
- 10) Develop existing managed stands to allow for continued connectivity in response to landscape changes.
- 11) Implement projects using established techniques, such as thinning and prescribed burning, provided that the objective is to protect or enhance forest, riparian, or aquatic habitats.
- 12) Use appropriate silviculture techniques to match wildlife habitat needs.
- 13) Use prescribed burning* to maintain or increase biodiversity. Allow treatments along roads and in urban interface areas. *(use of prescribed burning only where and when authorized and safe from potential MEC or UXO hazards)

- 14) Build no new roads in remaining unroaded portions of the Arsenal unless required for mission.
- 15) Maintain natural forest cover along riparian areas and ridgelines, thereby providing for wildlife movement and coarse woody debris recruitment and retention*. *(no woody debris retained in/near (50 feet) of AE (Ammunition/Explosives bldgs or areas.)

8.5 Game Harvest Management

Table 8.2 lists the species of fish and wildlife on the Arsenal that may be legally taken.

Table 8.2. Harvestable Fish & Game Species

FISH:		SMALL GAME Cont.:	
Game fish:	Pan fish:	Waterfowl:	
Northern Pike	Yellow Perch	Canada Goose	Redhead
Largemouth Bass	Sunfish species	Snow Goose	Northern Pintail
Pickereel species	Crappie species	Mallard	American Green-winged Teal
Walleye	Catfish species	American Black Duck	Blue-winged Teal
Trout species	Other species	Ring-necked Duck	Common Snipe
		Wood Duck	Rail & Gallinule species
		Bufflehead	Other species
SMALL GAME:			
Game Animals:		Upland Gamebirds:	BIG GAME:
Beaver	Opossum	Ring-necked Pheasant*	Whitetail Deer
River Otter	Red Fox	Wild Turkey	Black Bear
Muskrat	Gray Fox	Ruffed Grouse	
Mink	Coyote	American Woodcock	
Weasels	Eastern Gray Squirrel		
Raccoon	Eastern Cottontail		
Striped Skunk		*stocked only put&take	

Game animals may be taken on post only IAW all applicable Federal and State laws and PAP No.IMPI-MWR-006.

8.5.1 Sportsman Program

The PICA is not open to the general public and is considered a “closed” post. Recreational hunting and fishing privileges are not extended to the general public for three main reasons: safety (liability), security, and natural resources capacity. Due to the disastrous explosion of 1926, as well as continuous testing, the PICA landscape is peppered with unexploded ordnance; thus posing an unacceptable risk factor to the general public.

Also, access to the installation by potentially unfriendly foreign nationals makes general access to the public an unacceptable security risk to the installation and the surrounding community. The installation is located near the largest metropolitan area in the United States. Millions of people are within a short commuting distance. In addition, if the area were open to the general public, the limited wildlife resources would be overwhelmed by the potential demand. A permit system would have to be adopted which would require increased administrative effort and expense.

Although the general public is usually excluded from this “closed-secure” installation, hunting, trapping, and fishing privileges are extended to select personnel as follows:

- Active Duty Military personnel affiliated with PICA (e.g. Unit Fund Eligible).
- Federal Civilian employees assigned to PICA
- National Guard or Reserve military personnel assigned to PICA.
- Retired Military personnel.
- Disabled (100%) American Veterans and Medal of Honor recipients.
- Federal Civilian personnel Retired from the installation with at least 15 years of total federal service.

These Primary eligible Sportsmen may sponsor up to 1 guest per outing. Guests must be approved by the Garrison Commander and possess US Government issued ID. Besides the aforementioned Primary Sportsmen; Associate Sportsmen eligibility is extended to National Guardsmen and Reservists, federal contractors assigned to PICA with photo ID or CAC (Computer Access Card), DEERS registered dependents (17 or older) of AD Military, and AD Military personnel not affiliated with PICA are allowed limited privileges, but may not sponsor guests. See Picatinny Arsenal Policy (PAP) 215-1 for complete requirements and restrictions. See also Chapters 11.4 and 13.4.

8.5.2 Special Licenses and Permits

Picatinny Arsenal Sportsman Permit. Sportsmen must purchase an Arsenal Permit with specific “authorizations” to hunt, trap, or fish on the installation. These authorizations are reflected on the permit which is valid for the CY in which it is issued. Authorizations are indicated and allowed only if the eligible person possesses the appropriate and corresponding NJ license(s). NJ License(s). The state issues a variety of licenses for sportsmen (junior, senior, resident and nonresident). Except for special short-term licenses, all are issued on an annual basis. New Jersey does waive residency requirements for military personnel. Thus resident licenses can be obtained by Active Duty military personnel. Free NJ Licenses are available to resident disabled veterans. Picatinny sportsmen must possess valid NJ annual license(s) in order to receive an Arsenal Permit.

State and Federal Stamps. All appropriate stamps must be purchased and validated by Arsenal sportsmen, except the NJ Pheasant Stamp. This stamp is required only if hunting or possessing pheasant or quail on designated state wildlife management areas.

Special State or Federal Permits. The number of special deer hunting permits for the installation Deer Management Zone (DMZ 54) are determined and allotted by the NJ deer biologist based on harvest statistics. See also Picatinny Arsenal Policy, PAP No.IMPI-MWR-006 (Appendix I herein) for additional details.

8.5.3 Records of Take and Fishing and Hunting Hours

Arsenal hunters are required to record all outings during the open season(s) in hunting registers, including all game harvested. There are two hunting logs - one for small game and one for deer. Fishermen are not required to record outings or catch. This information must be garnered from periodic creel surveys or questionnaires. Since transfer of day to day administration of the Sportsman Program to MWR, there is no longer a centralized sportsman database directly managed or accessible by the NRM. Harvest data and sportsman hours for all hunting, trapping,

and fishing on the installation for record keeping and statistical analyses will have to be garnered (secondhand) from the director of Outdoor Recreation (ODR) and the FMWR RecTrac database.

8.5.4 Harvest Quotas

The deer season harvest objectives for the Arsenal's deer herd are worked out in close coordination with the state deer biologist because the Arsenal comprises three deer management units (Nos. 93, 77, and 76) within DMZ 54 managed by the NJDFW. The NRM coordinates closely with the state wildlife control officer and Arsenal trappers to assure that sufficient beaver permits may be issued to reduce nuisance animals on post.

In addition, when it is justified due to a decline or a low level of abundance of a game species, the installation Commander can set stricter regulations, bag or creel limits, than the USFWS or NJDFW concerning the taking of game. The whitetail deer provides the majority of hunting recreation on the Arsenal and its presence also provides important wildlife viewing. The deer population has been relatively stable for the past several years. Deer-Car collisions in or near the improved and semi-improved grounds is minimal, with no serious damages or injuries to vehicles or persons. Since 1992, hunting has been a most effective tool in decreasing the overall number of deer inhabiting the Arsenal. At present the population is being stabilized at 30 deer per square mile.

8.5.5 Seasons

Hunting

Hunting is conducted primarily for deer, turkey, and waterfowl. With the re-opening of an annual bear season (despite intense ongoing political opposition) in 2011, several hunters also pursued this quarry. Bow hunters have approximately 123 days of archery opportunity. Gun hunters have approximately 145 days of shooting opportunity. No hunting is allowed on Sunday in NJ, except for archery hunting of deer on private property (with permission) or on state Wildlife Management Areas. Small game hunting seasons on the Arsenal extend from late September through late February. Small game quarry that may be pursued include: waterfowl, rails and gallinules, upland game birds, and upland game animals. Additionally, turkeys can be hunted during the spring gobbler season that runs from late April through late May, as well as fall season when open. Most of the small game hunting hours are spent in a couple hunting areas shooting the non-indigenous ring-necked pheasant, purchased and stocked exclusively by the PR&GA, and IAW NJDFW issued Captive Game Bird Permit. Big game hunting seasons for white tailed deer on the Arsenal extend from October through January. The six NJ deer seasons are: Open Fall Bow (24 days), Permit Bow (54 days on PICA*). Six (6) Day Firearm, Permit Shotgun (13 days on PICA*), Permit Muzzleloader (26 days on PICA*), and open Winter Bow (31 days). *PICA is a separate Deer Management Zone (DMZ 54) of the NJDFW Deer management program. Permit Deer Hunting Seasons are limited to specific geographical areas and cost hunters extra fees in addition to the annual license(s).

Trapping

Trappers have about 120 days each fall and winter to set traps or snares. Trapping opportunities exist on the installation for both terrestrial and aquatic furbearers. The main terrestrial furbearers include raccoon, opossum, and red fox; the main aquatic furbearer is the muskrat. The trapping season runs from mid-November through early March. Despite the trapping

opportunities, only one or two sportsmen pursue this activity. Since the profit margin is minimal in recent years, those who trap do so mainly as a tradition or hobby. The trappers' skill is needed and utilized to control muskrat and beaver when population increase creates nuisance situations.

Fishing

Fishermen have 365 days available for angling. Angling opportunities on the Arsenal are diverse. Recreational areas suitable for fishing include two large lakes and eight ponds. Open water fishing occurs 10 months out of the year and ice fishing for approximately 2 months. Anglers can select from fishing for warm/cool water fish or cold-water species. The most popular fishing is the result of a "put & take" trout-stocking program. Two or three stockings are made each year totaling approximately 1,000 trout. Fish are stocked in ponds to provide sport principally during April, May, and September. Since the abandonment of Sikes Act collection in 2010, with the minimization of PICA Sportsman Permit fees to \$2 per authorization merely to cover FMWR issuance expenses, the NRM no longer purchases any trout for this program. PR&GA membership dues, recycling revenues, and Civilian Welfare Council monetary grants are used by the PR&GA to purchase trout and some warmwater gamefish for stockings.

8.5.6 Big Game Management

The management objective for the Arsenal's deer herd is the maintenance of a viable population suitable for consumptive and nonconsumptive recreation. Herd size will be managed via sport hunting and habitat management. The objective is to stabilize deer herd size to about 30 deer per square mile or 300 deer on the installation. Fewer deer in the southern half of the Arsenal is desirable to minimize deer/car collisions as well as damage to ornamentals on improved grounds. Forest stands in the southern half of the installation will be allowed to succeed to more advanced and older growth stages that are not as conducive to deer productivity as younger seres. The deer herd can be monitored by harvest statistics, winter track counts, breeding statistics, and summer spotlight counts.

The main management objective for black bears on the Arsenal is to maintain adequate amounts of suitable habitat. The proposed forest management guidelines will provide for bear habitat needs - hard and soft mast producing areas, forest openings, and rocky outcroppings (den sites) (DeGraff et al. 1981, Pelton 1962). State biologists have been tagging and monitoring NJ bears for several years. Sightings and locations of ear-tagged bears are reported to NJDFW. Nuisance Bears are handled primarily by the Picatinny Arsenal Police Department (PICA PD). Currently 12 officers are trained by NJDFW for Black Bear Incident Response for Law Enforcement. PICA PD follows NJDFW guidelines as close as possible for responding to Black Bear calls. Black Bear Rating and Response Criteria defines three categories of black bear behavior and dictates how NJDEP and other governmental agency personnel should respond (NJ Fish and Game Council 2010). Category III black bears include dispersing animals that wander into densely populated areas, bears passing through rural and suburban neighborhoods and bears observed by hunters, hikers, campers and others using facilities in black bear habitat. Category III bears may occasionally utilize trash containers as supplemental food sources in the course of their activities. Until a Category III black bear returns to a particular site and repeats utilization of these food sources, it is not considered to be a nuisance or problem animal (Category II). PICA PD records and monitors Category 3 bears. Category II black bears are nuisance bears

that are not a threat to life and property; yet are habitual visitors to dumpsters or cause property damage less than \$500. Category II black bears are aversively conditioned using rubber buckshot or pyrotechnic charges (NJ Fish and Game Council 2010); however PICA PD has been unable to obtain recommended ammunition from/thru Department of the Army, so CAT II bears are hazed with Bean Bag (12 ga less-than- lethal) and siren (LT J. Opalecky, pers. comm. 2012). Category I black bears are those bears exhibiting behavior that is an immediate threat to human safety or which causes significant damage (\geq \$ 500) to property. Examples of Category I behavior are human attacks, home entries, attempted home entries, agricultural crop damage and killing or injuring livestock or pets.

Category I black bears are euthanized as soon as is possible in order to protect the public or eliminate further damage to property (NJ Fish and Game Council 2010). Although NJDFW recommends 12 gauge slug or a rifle of .30 caliber for dispatching CAT 1 bears, PICA PD only has 12 gauge buck shot and 5.56 mm FMJ, not recommended by NJDFW. PICA PD has been unable to obtain either from DA. The current PICA PD policy for CAT I bears is that they will be treated as CAT II unless presenting immediate threat to life or safety (LT J. Opalecky, pers. comm. 2012). The majority of calls are for simple sightings of wandering bears or for nuisance bears in dumpsters. There are two assigned Game Wardens (additional duty, not primary job). A log of bear complaint or sighting calls lists: 32 calls in the latter half of 2008, including two CAT I bears; 76 calls, with one CAT I bear in 2009; 65 calls, with two CAT I bears in 2011; and 43 calls to date in 2012 (LT J. Opalecky, pers. comm. 2012).

8.5.7 Small Game Animals

The management objectives for these small game species are to maintain viable populations suitable for consumptive and nonconsumptive recreation and to reduce nuisance problems associated with their presence, particularly the woodchuck. The gray squirrel is the most abundant terrestrial game species on the installation. Hunting pressure on squirrels is very light and road kills greatly outnumber hunter harvests. The eastern cottontail is the most common small game mammal harvested on post, although rabbit hunters are few.

Suitable populations of small game species will be maintained primarily by habitat management and hunting regulations. Trapping will chiefly solve nuisance problems.

8.5.8 Waterfowl

The management objectives for waterbirds on the Arsenal are:

- a) Maintain viable populations via habitat management and game regulations.
- b) Maintain where appropriate, wildfowl populations suitable for hunting and nonconsumptive use.
- c) Reduce nuisance problems caused by waterbirds.

Waterfowl populations have remained relatively stable except for Canada geese. Resident non-migratory geese have exploited choice habitats on post, thus becoming a nuisance at the golf course and popular fishing ponds. Special hunts during the non-migratory open seasons are exploited to reduce the numbers of resident geese.

8.5.9 Upland Game Birds

Native gamebirds will be managed to ensure populations are suitable to provide recreation. Harvest regulations and limited forest habitat management will be used to meet this objective. Also, the PR&GA stocks ring-necked pheasants (see Chapter 8.7.2). Although grouse and woodcock populations are inherently low, the opportunity exists to create more habitats through some forest management techniques. The same is true for wild turkeys. High quality turkey habitat consists of a diversity of forest types and age classes; the majority will be mature stands of mast-producing hardwoods with open understories that are well interspersed with small clearings and some conifer cover (Porter 1978, Vermont Fish and Game 1985, US Forest Service 1961).

Mast-producing hardwood stands (chiefly oak, hickory, and beech) provide food, suitable diurnal cover, and nocturnal cover (except in winter) for wild turkeys. Turkeys use forest openings, permanent herbaceous openings, and early forest growth stages, as brood and nesting habitat. Coniferous stands are chiefly used as thermal cover by the birds during winter. Forest seeps also serve as important winter and early spring feeding areas for wild turkeys (Porter 1978). PICA is within NJDFW Turkey Hunting Area 7 which has been closed for Fall Turkey seasons since 2009, due to sub-par reproduction. This Highlands region of northern NJ, dominated by hardwood forests, is not optimum for wild turkey reproduction (A. McBride, pers. comm. 2012), even though there are successful broods nearly every summer observed on the installation. Aside from the Put&Take pheasant hunting for PR&GA members, turkey hunting is the next most popular among PICA gunners; while other upland game bird hunting is very light.

8.5.10 Furbearer Management

Terrestrial furbearers inhabiting the Arsenal include coyote (*Canis latrans*), red fox (*Lynx rufus*), raccoon (*Procyon lotor*), and opossum (*Didelphis marsupialis*), striped skunk (*Mephitis mephitis*) and long tailed weasel (*Mustela frenata*). Aquatic furbearers are river otter (*Lutra canadensis*), muskrat (*Mustela vison*) and beaver (*Castor canadensis*). Except for the beaver and muskrat, which are herbivores, all the other furbears on the Arsenal are predators and scavengers (Eisenberg 1985). Furbearers provide both consumptive and nonconsumptive recreation to installation personnel. Due to their nocturnal behavior and wariness, most furbearers offer little opportunity for recreational viewing. Otter, raccoon, skunk and muskrat are exceptions and are routinely observed on the installation. Furbearers are harvested through trapping.

Trapping activity is very light. All the furbearers can be legally trapped except for the bobcat. In the late 1990's the beaver population had increased significantly, but with persistent trapping and more liberal state possession limits the population was reduced to a few surviving kits. A slight resurgence is occurring in a second cycle (in ten years) of dam and lodge building. Plugging of culverts and spillways by beavers is considered a nuisance. Special state trapping permits are required to take beaver or river otter. In the absence of trapping, mink and river otter populations depend on the amount and quality of available aquatic habitats. Muskrat populations are high throughout most aquatic habitats – lakes and drainage ditches.

The objective of the Arsenal's wildlife program for furbearers is to maintain populations near existing levels with some exceptions, depending on species viability. The following standards and guidelines shall apply:

- 1) Permit the legal harvest of furbearer species through trapping.

- 2) Control furbearers in nuisance situations.
- 3) Closely monitor furbearer populations to maintain viable populations
- 4) Enforce regulations requiring state and other permits.
- 5) Encourage reporting of furbearer sightings (Environmental Awareness).

Of particular concerns are the river otter and beaver. To monitor these populations, winter track counts, summer scent post surveys, and live trapping indices can be used. Reported sightings of furbearers by Arsenal employees and residents will further enhance monitoring.

8.6 Fish Management

Fishing is conducted on the two lakes and seven ponds primarily for warm-water species, both game and panfish. Trout are stocked in colder stream waters below Picatinny Lake Spillway, and up to three suitable ponds. Although certain frogs and turtles may be harvested in NJ, this activity is negligible at Picatinny. The management objectives for Arsenal fisheries are:

- a) Maintain self-sustaining populations of indigenous species in lakes, ponds, and streams where they presently occur.
- b) Provide angling opportunities for warm and cool water species, augmented by stocking.
- c) Provide angling opportunities for catchable trout through stocking.

To maintain and/or achieve desirable angling opportunities in lentic environments, fishery management will be geared towards the maintenance of a “balanced” fishery regarding both panfish and predatory species in the system. Panfish serve as a forage base for predatory fish. By achieving a balanced state, high quality angling will exist for both groups of fish.

Balance in regard to fisheries is a relative term that refers to fish communities that yield satisfactory crops of harvestable sized fish on a sustained yield basis (Bennett 1970, Swingle 1950). An unbalanced fishery is one in which harvestable-sized fish are not produced or not produced on a sustained yield basis. Specific criteria for the fisheries in the installation’s ponds and lakes are to maintain the fish community where at least 30 percent of the panfish biomass and 30 percent of the predator species biomass are at a harvestable size. Most of the fisheries at the Arsenal’s lentic habitats are in a balanced state or fairly close to it. In order to maintain a balanced fishery at all the lentic environments on the installation they will be monitored periodically to gauge their status. Information obtained will include proportional stock density, community composition, condition factors, and age and length distributions. These parameters are used to determine if the fishery is in a desirable state (Bennett 1970, Carlander 1969, Carlander 1977, Clark 1960, Stockdale 1976, Swingle 1950).

The primary technique that will be used to maintain each fishery in a balanced state is the setting of fishing regulations. Changes in such regulations as minimum length size, daily bag limit, and gear limitations are frequently successful in maintaining a balanced fishery or creating one (Bennett 1970). Catch-and-Release is strongly encouraged and for the most part adopted by Picatinny anglers. Other techniques commonly used to manage warm and cool water fisheries in lakes and ponds include: management of the surrounding land, aquatic weed control, fertilization, artificial aeration, stocking, dredging, use of artificial structures, and reclaiming the fish community.

The following information is based on personal communication by Ted Gabel of EAD and memos in his files.

In 2001 some Fish tissue (fillet) bioassays were performed as part of the eco risk assessment and human health risk assessment studies for the PICA Installation Restoration Program (IRP). The fieldwork to collect and analyze fish from various PICA ponds and Lakes was performed as a component of the Phase II Remedial Investigation (RI), under the Army's IRP or the Army's equivalent to the Superfund Program. The lab results of the fish fillet bioassays (of several contaminants of concern) were provided directly to the NJDEP before the finalization of the report itself.

In a letter dated 24 MAY 2002, the NJDEP provided a table that summarized (only) the mercury data by water body and species, along with recommended PICA fish consumption advisories. In June of 2002 PICA specific Fish Eating Advisories were added for the first time to the local Recreational Hunting, Trapping, Fishing, and Boating regulation for PICA sportsmen. This Table of advisories remained in all subsequent iterations of the local Sportsman regulation (now known as PAP No.IMPI-MWR-006).

In 2004 a Fish Consumption Health Risk Assessment Report was developed by Shaw Environmental Inc for the Army and approved by United States Environmental Protection Agency (USEPA) and NJDEP. The report provides the analysis of the fish samples from target species that were collected from August 10 through September 12 2001 at nine surface water bodies either known to be fished or highly likely to be fished at PICA.

In 2012 the local Sportsman regulation (formerly Picatinny Arsenal Regulation 200-1) was changed; but PAP No.IMPI-MWR-006 still provides a shortened summary of those previous advisories. The revised regulation also references the NJDEP website for further information. The NJDEP Fish Eating Advisories have been updated since 2002 to include analyses of PCBs in fish tissue in state waters. The 2002 PICA fish consumption advisory table is able to be viewed by PAP No.IMPI-MWR-006 fisherman as it remains on the FMWR-ODR web page.

The IRP is still in the Superfund process for the 3 water bodies or sites that include Lake Picatinny, Lake Denmark and the EOD Pond. The IRP team expects to public notice a Proposed Plan for these three sites in Fiscal Year 2013. Picatinny has agreed with the USEPA that fish consumption advisories or restrictions that have been obtained through the IRP-funded studies will be incorporated into the subsequent Record of Decision (ROD.) The format and exact requirements of these advisories or restrictions for the ROD have not yet been specified.

With regard to native brook trout, despite extensive and expensive efforts (ca. CY 05-06) to control erosion and sedimentation (c.f. 8.12) in this Open Detonation and Test Area known as the Gorge, silt has recently been finding its way into the brook (c.f.6.10.2). A more permanent silt barrier has been recommended in this stretch of the stream corridor next to the Test Range (M. Boriek, pers. comm. 2012). An award of available Congressional "add-monies" was received in May 2013 and stream protection barriers along the exposed stream corridor were emplaced in August 2013. Hopefully this will ensure no silt will enter this section of trout producing Green Pond Brook (c.f. 6.10.2).

8.7 Transplants and Stocks

Any proposed introduction or stocking of fish or wildlife species on post must be considered and approved by the NRM.

8.7.1 Fish Stocking

Stocking of fish is a common fishery management technique to enhance recreation opportunities. Fish stockings are commonly used to establish a fishery in a reclaimed or new pond, to supplement existing populations, to develop a new fishery, and for put-and-take fishery programs (Bennett 1970). The stocking program will continue as long as it is not detrimental to native brook trout maintenance or production. Species stocked include:

- Large mouth bass- to augment natural populations
- Northern pike- to introduce a sport fishery and to control pan fish populations. Fifty northern pike are stocked periodically in Picatinny Lake.
- Walleye- to introduce a sport fishery in Denmark Lake. Walleye were introduced in the 1980's using fry, but these stockings were unsuccessful. In 1992, yearling walleye were introduced and returns indicate good survival and growth rates.
- Catfish- to add variety and proper predator/prey relationships to ponds.

Trout stocking is done solely as a "Put & Take" program funded by the PR&GA (FMWR). Mostly rainbow and brown trout are stocked in 2-3 ponds, and anglers catch them within two months. The stockings occur at least once in the spring and once in the fall. The fall stocking coincides with the National Hunting and Fishing Day, which features a children fishing derby. At present, PR&GA purchases all stocked species. Previously (before 2010), some Sikes Act revenues were used for purchase of walleye and quantities of smaller trout, but now the PICA 21x5095 (Sikes Act) account is minimal and nearly exhausted.

8.7.2 Pheasant Stocking

Pen-reared ring-necked pheasants are seasonally stocked on the installation for recreational sport hunting. Pheasant hunting is by far the most popular form of small game hunting on post. The program, like the trout stocking program, is solely funded and administered by the PR&GA. Through 1988, there were about 600 birds stocked each year. Over the past several years, the number of birds stocked is nearly 350 and the stocking season has been extended. Pheasants are bought by the club prior to the start of the hunting season, held in temporary holding pens, and stocked on a weekly basis during the season. The birds are stocked in the southern portion of the installation where there is some remnant grass and shrublands undergoing rapid forest succession. The pheasant committee chairman coordinates with the NRM each season regarding which one or two Hunting Areas (HA) can be used by the PR&GA members for pheasant stocking, considering the need to allow deer hunter access also for control of deer in this portion of the Arsenal. Approximately 75 percent of the birds stocked are harvested on the installation.

8.8 Federal Threatened or Endangered Species Management, Species At Risk

As mentioned previously in paragraph 6.11 SAR covers both federally listed and state listed species, and when appropriate, species of concern at either level. All SAR on PICA are listed in Appendix C-7. A qualified survey for Small Whorled Pogonia has been recommended (J. Markuson, pers. comm. 2014). First of two planning level surveys was conducted May-July 2020; however no plants were observed in several parcels of potential habitat across the installation. A report was provided to USFWS-NJFO. No further PLS are proposed.

8.8.1 Bog Turtle

In October 1998, it was revealed that the federally “Threatened” bog turtle (*Clemmys muhlenbergii*) had been previously documented (circa 1980s) within the Arsenal boundary. There have been no sightings since 1987 or at least 1990; formerly suitable habitat has been degraded by woody succession. A marginal bog turtle population or remnant individuals may still occupy PICA property; yet suitable habitat still exists in contiguous wetlands. Because future recruitment could occur from a nearby population, PICA property is managed minimally. The management objectives for bog turtle habitat are:

- a) Protect bog turtle habitat in the area of the 1987 sightings.
- b) If an extant population is re-discovered nearby, maintain numbers and encourage recruitment in contiguous PICA habitat.

Standards and guidelines that shall be followed for managing bog turtle habitat on the Arsenal are:

- 1) Maintain the hydrology of wetland bogs and fens that have the characteristics to support bog turtles by taking no adverse actions that would degrade the habitat.
- 2) Avoid stream channelization that would drain or flood the wetland or change its characteristics.
- 3) Avoid activities that could enhance successional growth.
- 4) Maintain a 300-foot buffer around the identified wetland (bog and/or fen).
- 5) Conduct surveys to determine population.
- 6) Allow flooding of the habitat by beaver activity, if it serves to kill large woody trees and shrubs which have invaded the former emergent wetland habitat.
- 7) Maintain the wetland characteristics of existing bogs or fens by preventing or retarding successional vegetation growth (trees) within the bog or fen using herbicides or mechanical methods as appropriate.
- 8) Monitor herbicide and pesticide use in areas that could seep or drain into the habitat.

Developed in cooperation with the local USFWS and NJDFW-ENSP offices, as well as Picatinny master planning office(s), the PICA Bog Turtle ESMP was approved and adopted on 15 DEC 04 (see Appendix H).

Those objectives and standards are incorporated into the installation ESMC found in Appendix H. The management for Bog Turtles will not be implemented on PICA property unless the state ENSP can verify that an extant population of bog turtles is still present in the extensive Green Pond Wetland Complex to the north of our common property line with the Lake End community. Most of these wetlands fall within 105 acres of a DA restrictive easement tract known as 105E just south of the inhabited and developed headlands of Lake End Corporation.

8.8.2 Indiana Bat and Northern Long-eared Bat

In July 1995, the Indiana Bat, a federally listed Endangered species was netted and documented on the PICA. In 1997/98 surveys were conducted by Boston University graduate students of Dr. Thomas Kunz; and the local USFWS-NJFO staff. Portions of the Arsenal may provide important summer breeding and pre-and post-hibernation foraging habitat for the Indiana Bat. In 2006 two PICA sponsored surveys were conducted for IBATs. A Spring emergence and migration tracking effort was conducted that followed several female IBATs to portions of Morris Country south of PICA. One IBAT moved westerly and one to points unknown to the north. None of the tracked females roosted on PICA. In the summer of that year netting on post captured male IBATs and one was tracked to a roost site not far from the current Garrison and Installation headquarters' buildings. The other captures were in similar locations as the 1997 Boston University survey. There is an ongoing need to determine and document Fall and Spring bat foraging habitat requirements. There is also a new need to monitor relative and respective population declines or recoveries of all local bat species that have been plagued with the WNS. On April 2, 2015 the Northern Long-eared Bat was listed as Threatened under the 4(d) rule per USFWS.

Foraging

Overall, foraging habitat on the Arsenal is estimated to be good for both *Myotis* species. Interior forest habitat is excellent. The habitat management objectives for the bat are:

- a) Protect and conserve *Myotis* bat foraging habitat within the perimeter of the Arsenal.
- b) Support similar management actions by land managers outside the Arsenal within a 10 - mile radius to protect and support known hibernacula.

Studies in Kentucky indicate that Indiana Bats foraging prior to hibernation use forested areas within 2.5 miles of hibernacula heavily. Indiana Bats have been documented to roost in mine shafts on private land (recently acquired by state of NJ in 2019) immediately adjacent to the Arsenal. All three of New Jersey's known Indiana Bat hibernacula sites (which also harbor NLEB) are within 2.5 miles of the Arsenal. Bats associated with these hibernation sites have been documented to forage on the facility prior to hibernation.

Standards and Guidelines (S&Gs) that shall be followed for managing *Myotis* Bat foraging habitat on the Arsenal are:

- 1) Protect riparian and stream habitats, as well as upland forest habitats, from degradation and excessive fragmentation.
- 2) Avoid potential habitat and stream alteration unless neutral or beneficial to species.
- 3) Preserve water quality to support the insect fauna that serve as food for the Indiana Bat.
- 4) Protect vegetation along rivers and streams, as well as in upland understory strata.
- 5) Closely regulate/minimize development in riparian areas.
- 6) Limit selective tree cutting to November through March.
- 7) Preserve forest cover along rivers and streams using bands of vegetation (closed canopy) at least 100 feet wide.

- 8) Prohibit timber harvest and firewood cutting in riparian reserves along stream banks except where catastrophic events such as fire, flooding, wind, or insect damage have resulted in degraded riparian conditions.
- 9) Establish 150-foot buffer zones around “exceptional” habitat (if identified). This is different than 150 foot buffer known as NLEB MR-ZoC.
- 10) Inform and educate the public on the importance of bats (Environmental Awareness).

Roosting

Female bats have been known to occupy summer roosts under loose bark along riparian and floodplain forests. They have been confirmed to utilize upland forested habitats, especially those that contain dead trees (snags) that are near open areas, receive a significant amount of sunlight, and have loose bark that creates natural cavities (Evans et al. 1998). In NJ they have been confirmed in single family houses and artificial roost boxes (M. Valent, pers. comm. 2014). Although no maternity roost trees, for either the IBAT or the NLEB, have been found to date on the Arsenal, there are trees and areas that could potentially provide habitat. Threats to such trees include fire, wind events, and possibly new construction.

Potential maternity roost trees are present on the Arsenal, but have not been identified or protected. It is unknown whether actual maternity roost sites exist and the bat population is unknown. However, both Myotis Bats are assumed to roost within the Arsenal’s boundary given their presence in the area. The objectives for preserving Myotis Bat habitat are:

- a) Protect or improve potential and existing Myotis Bat roosting habitat and sites throughout the Arsenal.
- b) Maintain the existing bat population.

Standards and Guidelines that shall be followed for managing Myotis Bat roosting habitat on the Arsenal are:

- 1) Protect roost sites (and hibernacula) if found on the installation. Apply 0.75 mile buffer zone for IBAT summer roosts; 150 foot buffer zone for NLEB maternity roost tree/site.
- 2) Retain large, dead trees that are potential nursery sites.
- 3) Conduct surveys to locate roost trees.
- 4) Protect and retain snags for roosting habitat. Snags will be defined for these S&Gs as any dead, partially dead, or defective live (cull) tree at least six (6) feet tall and at least six (3) inches in diameter at breast height (DBH.).
- 5) Designate no-cut areas around potential roost trees to avoid accidental damage.
- 6) If ever permitted, restrict firewood cutting to trees (dead or live) five inches or less DBH: (1) in existing cull decks, (2) when thinning green trees (consistent with S&Gs), (3) to remove blowdown blocking roads, and (4) for fuel reduction where material poses a threat of catastrophic fire*. * Firewood program already restricts permittees to a central fuelwood storage site, or occasionally remote field locations. Permittees are not allowed to cut firewood in open woodlands on post.
- 7) Visibly mark roost trees, as appropriate, if discovered and prohibit timber harvest within 250 feet of sites containing bats.

- 8) Provide protection for caves, mines, and abandoned buildings that might be discovered as roost sites for bats.

These objectives and standards are incorporated in the installation Endangered Species Management Component (ESMC) developed in cooperation with the local USFWS and NJDEP offices, as well as Picatinny stakeholders. The ESMP (aka ESMC) was prepared, reviewed, and approved 1 OCT 07. See Appendix G.

Standards and Guidelines (constraints) to preclude any taking of IBATs or NLEBs are listed previously in paragraph 8.2.5 & 8.2.5.1, respectively

8.8.2.1 At Risk and Species of Concern

Six species to be closely monitored on PICA which may eventually become federally listed are: Monarch Butterfly, Golden Winged Warbler, Spotted Turtle, Wood Turtle, and Tri-colored Bat, since they are petitioned species as of 2019; and Little Brown Bat, an At Risk species as of 2019. The two bat species are under consideration due to WNS declines.

8.8.3 State-Listed Plants and Wildlife

Plants

Although state-listed plants or Plant Species of Concern discovered to date have been documented, the extent and locations of additional species are unknown. Consequently, there is a need to voucher and document photographically all Endangered Plants or Plant Species of Concern on a case-by-case basis as found or discovered. The objective for managing state-listed plants is to protect and conserve existing state-listed plants within the Arsenal boundary. The standards and guidelines for achieving this objective are:

- 1) Protect state-listed plants or Plant Species of Concern when identified.
- 2) Survey site-specific areas prior to ground-disturbing activities.
- 3) Use educational awareness programs to prevent destruction of species.

Submit record sheets to Office of Natural Lands Management (NJ Natural Heritage program) for discovery or observations of state-listed plants.

Wildlife

Although state-listed target species have been documented on the Arsenal, populations and trends are unknown. There is a need to conduct field reconnaissance to better document species occurrence and habitat utilization with priority given to wood turtles (state Threatened), timber rattlesnake, bobcat, and pied billed grebe. The objectives of managing state-listed species are:

- a) Protect and conserve state-listed wildlife within the Arsenal boundary using Best Management Practices.
- b) Promote an increase in species populations on post, if time and resources permit, consistent with mission goals, objectives, and operations, as well as off post if cooperative activities are feasible.

To protect or conserve species, the following standards and guidelines shall apply:

- 1) Passively maintain state-listed target species and associated habitats.
 - 2) If funding is available, conduct limited surveys for species to find high priority sites for species management. Rather, the surveys will be done according to a schedule that is most efficient and sites will be identified for protection at that time.
 - 3) Plot the type, extent, and location of species when found using GIS (or other database).
- 4) Submit record sheets to NJ Endangered and Non-game Species Program office for sightings of state-listed animals. More specific and detailed tasks to address select species follow. These are contingent upon available resources or supplemental funding and balanced with mission requirements. Many of these are recommendations by NJDFW, pursuant to the recently completed Legacy project (NJDFGW-ENSP 1995):
- Wood Turtle. Conduct more summer surveys during the egg laying period in area of historic sightings. If turtles are found, effective distance from brook should be defined and protected. In select reaches, streambank openings or forest thinnings can be carefully considered, and if appropriate, implemented.
 - Timber Rattlesnake. Designate a buffer zone of at least 1.5-mile radius around hibernacula in which large scale developments and critical season (APR-MAY and JUL-SEP) disturbance activities are excluded; and timber or forest operations are limited (Brown 1993). Recent surveys prompted by a major Powerline RoW project across Copperas and Green Pond mountains; as well as a major ARDEC sponsored excavation and construction project on Copperas Ridge have documented more rattlesnake and copperhead habitats since the last INRMP. See also paragraph 7.2. Maps prepared in 1994 by USACE biologists (USACE-WES 1994) predicting high potential for winter habitat along Copperas Ridge was confirmed by three recent surveys (Schantz 2011; Michell 2012; and E2PM 2012). The most recent (E2PM) survey conducted this year for the two NJ SAR venomous snakes also found them on Copperas Ridge, near a portion of the ARDEC SAFER project site.
 - Pied Billed Grebe. Conduct more intensive surveys for next few years to confirm if breeding/nesting is occurring in Denmark Lake shrub swamp. If summer residency is documented; then removal of woody cover to create more open water with herbaceous emergent plant margins within the swamp habitat may be beneficial.
 - Northern Goshawk / Red Shouldered Hawk / Barred Owl. Maintain forested wetlands, northerly forest stands with at least 70 percent canopy cover and protect from habitat fragmentation.
 - Allegheny Woodrat. Carefully consider and coordinate reintroduction proposals.
 - Bobcat. Protect the Gorge area and Copperas Mountain, especially diverse habitats. Juxtaposition and interspersions are key. Look for possible den sites in late winter/early spring among rock ledges and outcrops.

8.8.4 Native Brook Trout

New Jersey has designated Green Pond Brook above Picatinny Lake as trout-production waters. Upper GPB apparently supports and produces brook trout. The objectives for managing brook trout and/or associated habitat are:

- a) Maintain or enhance “production” of brook trout in Upper GPB and establish a stable population
- b) Restore production of brook trout in Middle GPB.

To achieve these objectives the following standards and guidelines shall apply:

- 1) Control herbicide and pesticide use to avoid adverse impacts to water quality.
- 2) Fell trees in riparian reserves only when they pose a safety risk. Keep felled trees on-site when needed to meet coarse woody debris objectives.
- 3) Cooperate with federal and state fish management agencies to identify and eliminate negative impacts associated with habitat manipulation, fish stocking, harvest, and poaching that threaten the continued existence and distribution of native fish stocks occurring on Army land.
- 4) Restore habitat that previously existed or habitat characteristics that are particularly suitable to sustaining viable brook trout populations.
- 5) Identify and attempt to secure in-stream flows needed to maintain riparian resources, channel conditions, aquatic habitat, and fish passage.
- 6) Manage streams to maintain high aquatic habitat complexity, stable stream flows, and channel stability.
- 7) Maintain cover and aquatic habitat complexity through in-channel woody debris, substrate, undercut banks, overhanging vegetation, and pools.
- 8) Do not exceed summer maximum water temperatures in streams being rehabilitated to provide brook trout habitat.
- 9) Meet the minimum standard for spawning substrate in brook trout streams and streams being rehabilitated to provide brook trout habitat.
- 10) Concentrate any efforts to save hemlock in riparian areas capable of support brook trout.

8.9 Other Nongame Management

There are 300 vertebrate species on the Arsenal; most are nongame species. The list includes: 24 fish species, 21 amphibian species, 19 reptile species, 208 species of birds, (approximately 169 are migrants), and 41 species of mammals. At least 23 additional species of vertebrates have the potential to occur on the installation (Appendices C-1 through C-6). The large number of vertebrates on the Arsenal is in large part due to the diverse array of habitat that includes dry forested ridge tops, talus slopes, bottomland hardwoods, mesophytic wetlands, conifer stands, old fields, riparian sites, shrublands, aquatic wetlands, brooks, ponds and lakes.

8.9.1 Invertebrates

These species should be passively maintained to the extent possible. The management objective is to maintain viable populations of indigenous species. Management actions will depend on available resources and future information that may be developed. State-listed or TES will be managed consistent with Best Management Practices and as patterned for other species in Chapter 8.8. Protection and maintenance of Odonata microhabitats within 27 different sites on Post is necessary, as well as periodic sampling to monitor population changes.

Management goals for conserving the New England Bluets (*Enallagma laterale*) will be to maintain the near shore environment of Denmark Lake and Gravel Dam Cove to include healthy stands of floating watershield (*Brasenia schreberi*), ample woody debris and detritus in the submerged littoral zone, and ample sunlit patches of knee high dried herbaceous plants.

Standards and Guidelines will include:

- 1) Passively maintain state-listed target species and associated habitats.
- 2) If funding is available, conduct limited surveys for species to find high priority sites for species management. Rather, the surveys will be done according to a schedule that is most efficient and sites will be identified for protection at that time.

8.9.2 Amphibians and Reptiles

Although the present inventory is fairly complete, information on the distribution patterns and habitat requirements remains sketchy. These species should be passively maintained to the extent possible. Management actions will depend on available resources and future information that may be developed. State-listed species will be managed as indicated in Chapter 8.8.3.

8.9.3 Birds

The non-game birds on the installation are diverse; they vary from permanent residents, summer breeders, winter resident, to neotropical migrants. Forest fragmentation may be a problem for certain Neotropical migratory birds. Mostly songbirds, Neotropical species are primarily forest-dwelling insect feeders that typically require large forested tracts to breed successfully. Neotropicals currently migrate through the Highlands Region in large numbers. Two potential barriers to this movement are fragmented habitats (forests, grasslands, wetlands) and ownership patterns that in some cases result in development. Fragmentation makes dispersal more difficult and may affect foraging, roosting, and denning. It also can increase forest “edge effects” that reduce shelter from the harsh winter wind and increases the incidence of predation for some species.

Consequently, the management objective for birds is to maintain habitat for both migrants and residents that supports current populations and allows effective neotropical migration.

Management actions shall:

- a) Maintain large forested tracts to the extent possible.
- b) Avoid further fragmentation of the forest when planning future facilities.

- c) Reduce or mitigate edge effects where possible in those areas that may be identified as important breeding or nesting habitats.
- d) Maintain sufficient snags for cavity nesters.

8.9.3.1 Migratory Bird Treaty Act

The following paragraphs are excerpted or paraphrased from the DOD Partners in Flight Website (DOD/PIF 2012)

The Migratory Bird Treaty Act (MBTA) of 1918, and as amended, is the primary legislation in the U.S. established to conserve migratory birds. The MBTA covers migratory bird species protected under four bilateral international treaties between the U.S. and Canada (1916), Japan (1972), Mexico (1936), and Russia (1976).

The USFWS, which has trust responsibility for migratory birds, is currently responsible for conservation and management of 1007 species of migratory birds. All but a few of the bird species (English Sparrow, Feral Pigeon, European Starling) naturally occurring in the U.S. are protected under the MBTA. Under the MBTA, besides “strict liability” prohibitions forbidding trading or selling, no one may take, pursue, hunt, capture, kill; or attempt to do same; possess, or transport any migratory bird, or their parts (including feathers), nests, or eggs except under rare conditions pursuant to Federal regulations.

Executive Order 13186

Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, was signed on 10 JAN 01. It was a crucial first step in creating a more comprehensive strategy for the conservation of migratory birds by the Federal government, thereby fulfilling the government’s duty to lead in the protection of this international resource.

Migratory Bird Legislation and DOD

On 31 JUL 06, DOD and USFWS entered into a Memorandum of Understanding (MOU) to Promote the Conservation of Migratory Birds, in accordance with Executive Order 13186. This MOU describes specific actions that should be taken by DOD to advance migratory bird conservation; avoid or minimize the take of migratory birds; and ensure DOD operations-are consistent with the MBTA. The MOU specifically pertains to the following categories of DOD activities:

1. Natural resource management activities, including, but not limited to, habitat management, erosion control, forestry activities, agricultural outleasing, conservation law enforcement, invasive weed management, and prescribed burning;
2. Installation support functions, including but not limited to, the maintenance, Construction or operation of administrative offices, military exchanges, road construction, commissaries, water treatment facilities, storage facilities, schools, housing, motor pools, non-tactical equipment, laundries, morale, welfare, and recreation activities, shops, landscaping, and mess halls;
3. Operation of industrial activities;

4. Construction or demolition of facilities relating to these routine operations; and Hazardous waste cleanup

The MOU does not authorize the take of migratory birds (DOD/PIF 2012).

In a Memorandum dated 3 APR 07, from Mr. Alex Beehler, Assistant Deputy Under Secretary of Defense (for Environment, Safety and Occupational Health) promulgated throughout DOD guidance was given to work cooperatively with the FWS to implement the actions described in the MOU and to take steps to further migratory bird conservation. Examples of DOD conservation measures promoted in the guidance memo and to be incorporated into INRMPs include the following:

- The most important factor in minimizing and mitigating takes of migratory birds is an understanding of when and where such takes are likely to occur. This means developing knowledge of migratory bird habits and life histories, including their migratory paths and stopovers as well as their feeding, breeding, and nesting habits.
- This basic inventory data provides the basis for the bird conservation section of the INRMP.
- Utilize the DOD Partners in Flight database of migratory bird species of concern (aka SAR) that are likely to occur on each installation (Eberly 2011). Besides ESA TES listed birds, this database includes USFWS Birds of Conservation Concern (USFWS 2008).
- Identify and understand the bird conservation goals and habitat protection objectives for the installation's Bird Conservation Region, promoted through the North American Bird Conservation Initiative, contained in the comprehensive bird conservation plans and SWAPs.

Based on the foregoing, Standards and Guidelines will include:

- 1) Scheduling all tree, shrub, or semi-woody plant or vine removal or clearing between 16 AUG CY and 14 APR next CY.
- 2) Avoiding or deferring vegetation removal or clearing actions during the active nesting season on PICA (15 APR CY through 15 AUG CY). This date range has been approved by the USFWS-NJFO as well as the state ENSP ornithologist, since PICA habitat is nearly completely forested and utilized by Forest Interior Dwelling Species (FIDS).
- 3) Field site inspections by the NRM during the active nesting season, if a project requires vegetation removal of any sort where nesting activity may be occurring.
- 4) Delaying removal of vegetation or disturbance of nesting area until nests are vacated or fledglings and feeding parents have dispersed from the nesting area.

8.9.3 2 Bald and Golden Eagle Protection Act

The following information is excerpted or paraphrased from the USFWS website: (USFWS 2012)

Although Bald Eagles were removed from the federal ESA list in 2007, they still remain protected under the Bald and Golden Eagle Protection Act and the MBTA.

The Bald and Golden Eagle Act prohibits anyone from "taking" bald eagles. Among other actions, "take" includes disturbance of bald eagles to the degree that it substantially interferes with breeding, feeding, or sheltering behavior or results in injury.

The USFWS developed National Bald Eagle Management Guidelines to help people minimize impacts to bald eagles, particularly where they may constitute “disturbance.” A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed or raise young; including construction of a road, development of renewable energy facilities and other lawful activities that may not only disturb, but may result in the injury or mortality of eagles.

In 2012 the first ever Bald Eagle nest on PICA was built by a breeding pair and 2 juvenile eagles were successfully fledged by late summer.

Standards and Guidelines will include:

- Documenting, reporting to State and USFWS Bald Eagle biologist(s), all nest and nesting activity of Bald Eagles on PICA.
- Monitoring all nests and nesting activity of Bald Eagles on PICA.
- If any installation activities may disturb roosting or foraging eagles, consultation with local USFWS eagle biologist for advice and recommendations will be undertaken.

8.9.4 Chiroptera (bats)

The primary management objective for bats will be to monitor the effects of White-Nose Syndrome across all local species and to help minimize effects of this devastating disease. A secondary objective will be to maintain or help restore populations to pre-WNS levels. Habitat management will be limited solely to maintaining foraging areas and protecting any natural diurnal roosts or hibernacula. Nine species of bats, all in the super family Vespertilinidae, have ranges that include northwestern New Jersey (Humphrey 1982). Seven of these, all small-bodied insectivores, have been documented on the installation. Prior to WNS, the Little Brown Bat (*Myotis lucifugus*) was probably the most common bat species on the Arsenal. Research needs for the bat community include: identifying major foraging areas; identifying species and relative abundance; and locating roosting sites/hibernacula. Understanding more about the pre and post hibernation foraging requirements and habitat of the Indiana Bat, as well as monitoring impacts of WNS will be the top priorities.

A historical discovery of a female Indiana Bat was made in July 1995. The trapping effort was the result of an environmental assessment process for a requested grant of easement by Mount Hope Hydropower Inc. This summer resident was the first Indiana Bat documented in New Jersey or the northeastern US in decades. In the winter and spring of 1993, hibernating Indiana Bats were discovered in an abandoned mine about two miles from the Arsenal. The following year (1994), two more Indiana Bat hibernacula were found in abandoned mines within a half a mile of the installation. As a result, an Endangered Species Management Plan was prepared for the Indiana Bat at PICA in accordance with Army Regulation 200-1 (formerly AR 200-3). Chapter 8.8.2 summarizes current management guidelines and policies on PICA for management of both IBAT and NLEB. Chapter 8.8.2.1 addresses Tri-colored Bat and Little Brown Bat declines since WNS. Appendix G fully describes and discusses IBAT conservation and management IAW ESA and Army ESMC elements specific to PICA.

In December of 2010 a Bat Condominium (artificial roost) was erected near warehouse 3236. The warehouse was razed in March 2012 after it was determined that no bats, especially *Myotis lucifugus*, were present after exclusion efforts (in 2011), as well as WNS impacts. Monitoring in summers of 2011 and 2012 reveal no apparent occupancy by bats of the freestanding condo.

8.9.5 Other Mammals

These species should be passively managed to maintain indigenous populations to the extent possible. Management actions will depend on available resources and future information that may be developed. State-listed species will be managed as indicated in Chapter 8.8.3. Management activities such as mowing and the use of prescribed fire (if allowed) should be done to avoid breeding seasons.

8.9.6 Urban Wildlife

Most urban wildlife management will consist of the planting of ornamental shrubs and trees. Species of ornamentals to be planted will include those with mast capabilities, but which also have unpalatable browse. This vegetation will provide a food source to urban wildlife and also precludes damage to the shrubs and trees due to their unpalatable leaves and buds. This activity will be coordinated with the NRM. In addition, vegetation management along right-of-ways and security fencing will be reviewed to see if techniques more conducive to wildlife can be implemented.

8.10 Wetland Management

Wetland habitats will be managed under a three-tiered priority scheme:

- The physical integrity and structure of wetlands will be managed to maintain or improve water quality.
 - Wetlands will be protected, conserved, and possibly manipulated for the benefit of TES, and/or SAR.
 - Wetlands may be managed additionally to enhance game species populations of fish or waterfowl.

Management of floodplains and wetlands is subject to the provisions of Executive Order 11990, *Protection of Wetlands* and Section 404 of the *Clean Water Act*. In addition to the guidelines below, Best Management Practices identified for surface waters are applicable.

- 1) Avoid the net loss of size, function, or value of wetlands.
- 2) Avoid modification of wetlands where there are practical alternatives.
- 3) Do not disturb perennial or intermittent streams without obtaining proper permits.
- 4) Maintain wetland buffers to reduce sediments and delivery of pollutants and provide habitat for Indiana Bats.
- 5) Protect habitats and sensitive wetland areas from disruption.
- 6) Restrict the use of chemicals in buffer areas.
- 7) Minimize the number of stream crossings and harden where possible.

8.10.1 Stream Management

The management objectives for the installation's streams are:

- a) Protect lotic areas primarily for indigenous insects, fish, reptiles and amphibians.
- b) Enhance habitat when appropriate.
- c) Provide limited fishing opportunities for native trout, if sustainable.
- d) Provide trout fishing recreation through trout stocking, where appropriate.

Management of streams usually entails three main techniques: management of in-stream characteristics, management of surrounding cover, and stocking. Modification of in-stream characteristics is a valuable management tool. Most of the moderate and high gradient streams in the Northeast are composed of a variety of habitats: riffles, pools, and runs. Riffles are shallow water areas with swift currents and nonsediment bottoms. Aquatic invertebrates, a main food supply for many fish species, are most abundant and diverse in riffle areas. Riffles are the major production areas in detritus based streams. Pools are deep areas in streams where invertebrate production is usually low; pools provide both thermal and concealment cover for fish as well as acting as temporary refuges during seasonal dry periods. Runs in streams are intermediate in characteristics between pools and riffles. It is in part due to this interspersed of different aquatic habitats that provide streams with their high species richness in invertebrates and vertebrates. Management of streams is in part the maintenance of these three diverse microhabitats.

Another important aspect of stream habitat is woody structure. Woody debris, trees, and shrubs in streams frequently provide increased invertebrate production as well as serving as cover for fish. Maintenance of the complete array of aquatic microhabitats in the Arsenal's streams will ensure the integrity of the biological community.

Surrounding vegetation is an important component of stream management. It influences a stream's temperature regime, sediment load, water flow, and energy source (Chambers 1983, Peterson 1983, Swift et al. 1979). All of these parameters impinge on the aquatic community. Most of the Arsenal's streams are in proximity to forested land and most have some protective canopy cover. The riparian areas must receive special protection from management activities.

- To preserve existing stream conditions, the clear cutting of forest stands and other even-aged management techniques should not be performed at forest stands within 300 feet of a stream, unless applicable permits are procured.

This will prevent streams from experiencing higher water temperatures, greater temperature fluctuations, and increased sediment load, as well as maintain sufficient woody debris recruitment.

The Burnt Meadow and Green Pond Brooks may require some stream rehabilitation work. This stream receives an excessive sediment load of sand that changes the stream's substrate from gravel/cobble to sand filling its pool habitat. This condition negatively impacts on the stream's biological capabilities. Periodic excavation if this stream's pools are required to restore stream habitats.

8.10.2 Lake Management

Aquatic management of the installation lakes and ponds will be performed to benefit both fish and wildlife. Denmark and Picatinny Lakes are the dominant water bodies on the installation, comprising 90 percent of the 400 acres of total open water habitat. Other lentic habitats on the installation include 10 medium size ponds (1.3 to 7.7 acres) and 8 smaller ponds/sloughs (0.1 to 0.4 acres). These open water features are classified as lacustrine or lake-cover types and mapped by the Corps of Engineers Waterways Experimental Station. These aquatic environments primarily support warm or cool water fish species. The two lakes and seven of the medium sized ponds (390 acres total) provide the majority of angling opportunities, including ice fishing.

Eleven of the Arsenal's 18 lentic sites are unavailable to anglers (10 acres) because of limited or difficult access; and one pond because of UXO or other contamination. Also, five are very small, shallow sloughs, and are in advanced stages of succession to a shrub type of vegetation. Only a few support game or panfish. Of the remaining five, three are small, relatively deep potholes. Two are much larger and comprise 8.2 acres of nonfishing ponds. Bear Swamp pond is reportedly devoid of fish and thus offers a unique habitat supporting some rare odonata species that are adapted to predator-free ponds. Since these ponds are not obvious fishing holes, they have been ignored in past management; however, they are still teeming with life and deserve future study.

8.11 Water Quality Management

Watershed protection is an important objective of Picatinny's natural resources management. The Highlands Region provides drinking water for over 5 million people in New York and New Jersey (NJ Highlands Council 2008). Water is the Highlands Region's most valuable resource. Loss of forest cover and urbanization within the Highlands Region may have significant effects on the Highlands high water quality.

All management practices will be consistent with the Clean Water Act and other applicable federal, state, and local laws and regulations. Management guidelines outlined below are intended to maintain or improve the quality of water that originates or passes through the Arsenal's boundaries and which may be affected by mission activities.

- 1) Implement erosion and sediment controls or streambank stabilization during construction activities or in areas that offer potential for sediment delivery.
- 2) Provide adequate sewage treatment and disposal for all facilities.
- 3) Use methods for grading, filling, soil removal, replacement, etc. that minimize sedimentation during construction.
- 4) Avoid building roads or recreation facilities in riparian areas.
- 5) Avoid chemical applications in areas where runoff could pollute streams or rivers.
- 6) Monitor and direct the location and use of toxic substances, such as pesticides, petroleum products, and other hazardous substances to minimize the risk of water contamination.
- 7) Keep land undeveloped where possible as a more cost-effective purification system than water filtration plants (Dennis Davidson, NJ Green Acres Program 1997).

8.12 Soil Resources and Land Rehabilitation Maintenance

Soil erosion is not a significant issue at the installation. The majority of the land is covered by forest or turf in improved grounds. There is almost no land exposed to either water or wind erosion. Occasionally, an area that has become temporarily exposed due to construction, unstable road banks caused by excessive rain, or other causes, will require immediate attention to control soil loss.

In 2005-2006 the NY District USACE supervised an erosion and sediment control project at the Gorge Open Detonation and Test Facility. Over 1280 cubic yards of rip rap and about 200 cubic yards of crushed stone were used to armor and stabilize about 2 acres of steep hillside, (which had been denuded of all vegetation by repeated open pit detonations); as well as 1 acre of steeply sloping roadside swales. This major project was designed to protect the nearby GP Brook inhabited by native Brook trout from excessive or uncontrolled runoff and sedimentation of large expanses of unconsolidated soil and sand used to buffer blasts.

A special case of urban land management is the restoration of such land to a more natural condition. Occasionally on the Arsenal, an antiquated building is razed, leaving the site in a degraded condition unsuitable for rapid revegetation. In most instances of urban clearance, the soil is left in a derelict state that precludes the normal sequence of ecosystem development (Bradshaw and Chadwick 1980). In many cases the soil at these sites has adequate pH and calcium levels for plant growth, but the heavy compaction of the soil and inadequate levels of nitrogen and phosphorus frequently inhibit revegetation (Bradshaw and Chadwick 1980). In order to establish vegetative cover at these sites, they will be cultivated to a depth of 3 inches. In addition, fertilizer will be applied to develop a suitable sward of vegetation. Mixes of ryegrass and clover have been used successfully in establishing vegetation at reclaimed urban sites. Crown vetch may also provide good coverage soil improvement. Pines may be well adapted to some sites. These areas may be kept as permanent herbaceous openings, park like stands of hardwoods, or as evergreen shelters. Revegetation of these sites will be done with forage species most compatible with site conditions and to benefit indigenous wildlife.

8.13 Controlling Nuisance Animals

Within the context of developed land management are both opportunities to enhance the wildlife resource as well as challenges to control nuisance wildlife situations. The goals for the management of wildlife on improved and semi-improved lands are:

- Integrate wildlife management with other presently managed land values.
- Reduce wildlife nuisance situations on urban lands.

Animal nuisance problems involving wildlife can be divided into five categories: use of buildings, damage to vegetation, harm to native fauna, motor vehicle accidents, and health concerns. The objectives for controlling nuisance animals include:

- a) Trapping and disposal of feral cats.
- b) Control of depredating animals by commonly accepted, humane, and legal methods.
- c) Control of exotic species, as warranted.

The species below are addressed and controlled via the most current installation Integrated Pest Management Plan (IPMP). The installation's BasOpsSup IPM Coordinator (IIPMC) performs most of the animal control work.

8.13.1 Feral Dogs & Cats

With the expanding coyote population in recent years, feral dogs are uncommon and rare on the Arsenal. Feral cats are more common and problematic. These animals have a negative impact on many indigenous wildlife species (Soddicker 1983). These felines also compete with native species on the Arsenal's undeveloped lands and as such can be considered to have a serious impact on the wildlife community (Soddicker 1983, Schaller 1967, USFWS 1974). Feral and free ranging cats and dogs are brought to a local animal clinic for either adoption or euthanasia. Raccoon Rabies is established throughout NJ. Due to their wide-ranging habits, feral cats can spread this disease to many other indigenous animals.

8.13.2 Large Mammals

Two big game animals occasionally cause problems on post. Bear sometimes habituate near residences to scavenge in trash cans and dumpsters. This behavior was particularly acute in the fall of 1995 following a spring and summer drought. Controlling odors, relocating receptacles, and hazing the bruins are methods of choice. Deer cause problems at times on the golf course and improved grounds when they browse on landscape ornamentals.

Careful plant selections and deer netting can deter feeding, while controlling the population via hunting remains the best long-term solution.

Beaver are becoming a nuisance species in the lower reaches of GPB. Hopefully, recreational trapping during the open season will curtail the numbers and problems. Woodchucks occasionally raid garden plots and ornamentals. The woodchuck population is monitored by roadside counts during the summer months. Skunks sometimes frequent residences. Pesky individuals are usually trapped and relocated. Raccoons are persistent predators around the pheasant pens. They have been deterred fairly well by electric fencing. Raccoons must be captured or dispatched when exhibiting signs of distemper or rabies. Recreational trapping during the open season helps control this population.

8.13.3 Resident Geese

A fairly aggressive resident goose control plan had been implemented that employed an integrated approach involving: habitat modification where possible; hazing tactics; egg puncturing; live trapping from the golf course and relocation on Post; and legal hunting. Despite success in ridding some areas of nuisance geese for a time, resident geese continually adapt and recruit back into unoccupied habitat. The special resident goose-hunting season, established in NJ, as in other Mid-Atlantic states, has been effective and continues as the primary tool to limit resident nuisance birds.

8.13.4 Snakes

Calls are often received about snakes and their real or imagined danger. Copperheads and rattlesnakes occasionally pose a risk to personnel when they habituate in or near buildings within their natural habitat. Personnel are advised not to kill or molest any snake, but to allow

for removal by the IIPMC. Venomous snakes are relocated as far from the structure as is practical without exceeding the normal seasonal range(s) of the animal. Non-venomous snakes are handled similarly, with an attempt to educate the complainant about snake identification and appreciation. Having received on site training by the state snake biologist, the NRM and a few other PICA EAD staff hold NJDFW-ENSP Letters of Authorization to collect and release venomous snakes on post.

8.13.5 Exotic Wildlife

Exotic species are non-native or species introduced to a region (Clugston 1986, Courtenay and Taylor 1986, Kohler 1986, Shafland and Lewis 1984, Welcomme 1986). There are no introduced species of reptiles and amphibians on the Arsenal. The most common avian exotics include: European starling, house sparrow, house finch (*Carpodacus mexicanus*), rock dove, Canada goose (breeding), mute swan (*Cygnus olor*), and ring-necked pheasant. The most common exotic mammals at the Arsenal include: the Norway rat (*Rattus norvegicus*), house mouse (*Mus domesticus*), and domestic cat. Although numerous, with the exception of geese, these species are not causing any significant nuisance situations. Most of the exotics with few exceptions are “tramp” species dependent on the activities of man to provide their ecological niches (Crosby 1986, Cody 1985, Johnsen 1982).

In the absence of the activities of humans these species would become extirpated or at least decline in numbers. The prime habitats of these exotic species on the Arsenal include the improved and semi-improved grounds as well as areas where natural vegetation has been disturbed. The majority of these exotic wildlife species are frequently involved in nuisance situations particularly in regards to their use of buildings and other man made structures or by their displacement of native fauna in more natural habitats (Crosby 1986, Dorrance 1983, Kohler 1986, Welcomme 1986, Wilmore 1979). One particularly troublesome mollusk, the zebra mussel (*Dreissena polymorpha*) has not yet posed a problem at Picatinny, but reconnaissance should be done, since both Picatinny Lake and Denmark Lake have underwater intakes/outfalls near their respective spillways. The installation’s objectives regarding non-native animal species are:

- a) Eliminate, if possible, or at least reduce their populations to a level not considered harmful to the native fauna.
- b) Aggressively control serious nuisance situations caused by exotics.

8.14 Cantonment Area Management

These lands are primarily managed to assist the military mission, for safety and security purposes, and for aesthetic values. This installation acknowledges its responsibilities as listed in the White House memorandum, *Environmentally and Economically Benefited Practices on Federal Landscaped Grounds* (Office of the President 26 April 1994). The memorandum’s requirements will serve as guidelines for management of the developed area(s).

The guidelines for management are:

- 1) Use regionally native plants for landscaping.
- 2) Use construction practices that minimize adverse effects on the natural habitat.

- 3) Reduce pollution by reducing the use of fertilizer and pesticides, using IPM, recycling green waste, and minimizing runoff.
- 4) Implement water-efficient practices.
- 5) Create demonstrations of these practices to promote their use elsewhere.

8.14.1 Mowing

Maintenance of the grounds is primarily mowing. Mowing of improved and semi-improved grounds throughout the installation is performed by a variety of contracts as outlined in paragraph 5.4. Hay leasing can also be considered. Besides the FacMtnSvc, and occasionally the BasOpsSup contractors, the golf course is managed by FMWR NAF groundskeepers, military housing areas by PrvPart; and the New Jersey National Guard Federal Maintenance Shop #7 that is mowed by the assigned troops.

8.14.2 Weed Control

Chemical weed control is primarily accomplished under the BasOpsSup contract as overseen by the BasOpsSup IIPMC. The IIPMC accomplishes small-scale treatments and areas requiring special attention. The IIPMC and other BasOpsSup NJ certified applicators can treat invasive broadleaf weeds around buildings, high explosive storage structures, fences, fire hydrants, established firebreaks, and steamlines as requested.

All herbicide applications are in strict compliance with recommended and label directions; as well as safety regulations. Pre-emergent herbicide is often used in shrub beds in the early spring; and most is applied to the mulch rings around the hundreds of memorial red oak trees. Treatment along sidewalks and curbs is performed as needed. BasOpsSup personnel, as needed, perform spot treatments on pavement areas.

8.14.3 Landscape Restoration and Plantings

As part of the annual maintenance practices, BasOpsSup personnel usually plant grass and other ground cover in the spring. In addition, employees revegetate areas damaged by snowplowing and deicing salt. When old buildings are razed and debris removed, the site is prepared and stabilized in quick cover vegetation, until perennial ground covers, shrubs or trees may be established. Soil preparation and seeding of disturbed areas should comply with the recommendations in the USACE report: *Development of Cost Effective Guidelines to Rehabilitate Disturbed Areas at Picatinny Arsenal*, Dover, NJ, dated October 1985.

New landscape plantings are completed on an as needed basis. Plants are obtained from a local nursery and then planted by the BasOpsSup grounds crew, including seasonal summer workers. Soil amendments, such as peatmoss and lime are ordered at the same time and are incorporated into the planting beds when needed.

Installation BasOpsSup personnel perform Arsenal At Large landscaping and small planting jobs. All plant material conforms to the American National Standards Institute, Inc. (ANSI), standard 260.1-1980, American Standard for Nursery Stock. All trees and shrubs should be planted according to the guidance found now in UFC 3-201-02 (Unified Facilities Criteria) from the Whole Building Design Guide website. Unified Facilities Criteria accepted by DOD may have replaced direction found in TM 5-830-4, *Planting and Establishment of Trees, Shrubs, Ground Covers and Vines*; which was superseded by TM 5-803-13, *Landscape Design and*

Planting Criteria. Major planting is typically performed as part of construction contracts. Unfortunately, due to minimal staffing, there is no updated or maintained Landscape Planting Plan; although the BasOpsSup Grounds Supervisor has retained a few hard copy plans for a few specific buildings during his tenure. In the summer of 1994, a planting program was started to reintroduce a resistant strain of American Elm shade trees on improved grounds. As of March 2015 none of these Liberty Elms have survived.

8.14.4 Fertilizer Applications

Feeding is divided into two major components - one that is installation-wide and one for the golf course. The golf course is intensively managed and therefore has a large-scale feeding program. See Chapter 8.14.6. In response to budget constraints, in 1992, fertilization and liming of improved grounds turf was abandoned in order to slow growth, thus reducing the number of mowing cycles. Residents at the installation have access to mulch for use in their yards – this is provided to them at a central location by the RCI partner (Balfour Beatty) through their landscaping sub-contractor.

8.14.5 Maintenance Procedures

Most major tasks in the cantonment (or installation-wide) not covered by FacMtnSvc or PrvPart, are performed by the BasOpsSup via Service Orders or Individual Job Orders. Only Hazard Tree removal is overseen by the EAD, since tree disposition and salvage program is the responsibility of the NRM.

Grass and Other Ground Cover

Turf renovation including repairing damage from snowplowing and deicing operations is scheduled during spring and other times as needed. Due to the age and changes in use with the installation's facilities, they are in a constant state of renovation. The garrison employed BasOpsSup grounds crew can landscape buildings on an as needed basis; although installation and ARDEC tenants may hire a landscape contractor for some jobs. Nearly all major land management and grounds maintenance activities are now contracted, including mowing, fertilizing, leaf pickup, brush removal, hazard tree removal, and the application of turf fertilizer, herbicides and liming. Areas with a high potential for soil erosion can be hydroseeded with crown vetch (*Coronilla varia*) or other appropriate forage species.

Maintenance for trees, shrubs and special ground cover plants is kept to a minimum IAW AR 200-1. This is accomplished by selecting appropriate low maintenance replacement plants, timely pruning and the use of mulches, fertilizer, and irrigation, only during initial planting. Hand weeding of ground cover and shrub plantings is completed as needed by BasOpsSup, and has been supplemented every summer by temporary student hires (aka summer aides).

Pruning of overgrown or diseased shade trees or shrubs is performed by the BasOpsSup grounds crew and summer hires. Trees too hazardous or inaccessible to remove or prune by installation employees are contracted out by EAD. When contractors are used to fell or prune a tree, they are required to remove the boles and large limbs to a designated on-post disposal site. This wood then becomes part of the Fuelwood Sales Program that provides economic return to the government. When tree removal occurs in areas that are considered maintained grounds, the contractor is

required to grind the stump to a minimum of eight inches below the soil level, fill the hole with topsoil, and plant grass seed.

Ammunition Storage Areas

There are 35 earth-covered magazines at scattered locations throughout the installation. The earth cover on these magazines is in good condition and supports grassy vegetation. Except at entranceways where hazards such as ticks, poison ivy, and snakes pose a threat to installation personnel, Arsenal policy is to eliminate or limit costly mowing. Selective herbicides are sometimes used to eliminate undesirable vegetation.

Irrigation

The only regularly scheduled irrigation during dry periods takes place on the golf course. There is no regularly scheduled irrigation plan for other lawn areas or quarters. Special areas of concern such as newly planted shrubs and ground covers are irrigated as needed, either by a landscape contractor or BasOpsSup personnel. Overall, various DPW personnel supervise the service water supply and delivery systems on post. Individual tenants are responsible for watering residence lawns and plants.

Policing

Improved and semi-improved grounds are policed periodically for the following items:

- Turf damage from winter snow plowing/salting operations or vehicles.
- Soil erosion areas.
- Fallen or broken trees, limbs and branches.
- Obstructions to mowing equipment.
- Excessive grass or plant clippings, and fallen leaves
- Obstructions to surface water drainage system.
- Safety hazards

The BasOpsSup grounds crew is responsible for repairing vehicular damaged turf, soil eroded areas, and the removal of large broken limbs or fallen trees. Most damaged turf repairs occur in the spring as a scheduled maintenance job. Other emergency repairs are completed on an as needed basis. Clearing and removal of downed trees, limbs, and branches occurs as needed. The Turf Maintenance contract calls for a general cleanup of debris in the spring, as well as leaf pickup on 50 percent of the improved grounds in the fall by the FacMtnSvc (Facilities Maintenance/Services contractors) crews. Leaves collected by the FacMtnSvc crews are recycled in the composting area. The compost area is managed by the BasOpsSup personnel.

In the RCI housing footprints, Balfour Beatty's landscaping sub-contractor collects and bags leaves around the military residences. BasOpsSup grounds crew, on a day-to-day basis polices small branches and mowing obstructions on improved grounds and landscaped areas.

8.14.6 Golf Course

Grassed area maintained by the golf course comprises approximately 2 acres of greens, 2 acres of tees, 27 acres of fairways, and 111 acres of rough totaling 142 acres. In addition to the 18 holes, there is a practice putting green, a sod green, and driving range. The seeding mixture for the tees consists of Kentucky bluegrass (*Poa pratensis*) and rye grass (*Lolium spp.*) varieties, while the greens are over seeded with bentgrass (*Agrostis spp.*) varieties. The fairways are seeded with Kentucky bluegrass and rye grass varieties. Kentucky bluegrass, red fescue (*Festuca rubra*) and red top (*Agrostis alba*) are used on the roughs. The golf course also maintains an area of bent grass specifically for use in replacing greens that have been damaged due to oil spills or some other damage.

Feeding practices for the golf course are more intense. Feeding is done three times a year for fairways and five times a year for tees and greens. Liming is on an as needed basis, depending on soil analyses. The golf course uses 24-0-11 fertilizers for fairways in the spring and fall. A slow release fertilizer (20-0-5) is applied at a rate of 22 lbs nitrogen per acre in the late fall and early winter. Fertilizer 12-4-5 is applied to tees and greens at a rate of 1 lb per 1000 sq ft.

The golf course has the only irrigation system on the installation. It is an underground system with a wide distribution of various irrigation piping for water application. A variety of applicators are used to irrigate the four acres of tees and greens while a double row automatic system is used to irrigate 27 acres of fairways. Operation and maintenance of the golf course irrigation system is the responsibility the golf course greens-keepers. Both tees and greens on the golf course are watered as needed. Tees have 2 pop-up heads that deliver a total of 26 gallons per minute each. Greens have four similar pop-up heads that deliver a total of 26 gallons per minute each. Fairways are watered as needed. Presently each fairway has a double row system wired in a block system, each head delivers 28 gallons per minute. In an average year, irrigation takes place for approximately 20 weeks from mid-May to mid-October. The golf course uses approximately 10 million gallons of water per year. Maximum daily usage is estimated at 300,000 gallons per day.

8.15 Pest Management and Invasive Species

8.15.1 Insects and Disease

Specific problems are addressed on a case-by-case basis and as resources allow. For example, the control of tip blight requires pruning of the diseased branches if possible. Some older trees have shown a terminal dieback and are being removed as soon as possible to prevent the spread of the disease to nearby pines.

During the year, periodic spot checks are made to determine if insect and disease damage is present in lawns or landscape plantings. When necessary, insecticides control turf-damaging insects. The BasOpsSup IIPMC and certified applicators perform spot treatments of tree and shrub diseases. The personnel at the golf course treat the turf with fungicides and/or insecticides on a scheduled basis for specific problems.

The USDA-Forest Service has the responsibility to provide technical support to all federal lands through the Forest Health Protection Unit- State & Private Forestry Branch. The staff can provide assistance as needed. Until recently due to a tragic airplane crash, the USDA-USFS

conducted aerial reconnaissance flights to detect and map the cyclical gypsy moth, as well as other forest pest outbreaks. Recent efforts by USFS and state foresters have been focused on the Emerald Ash Borer –EAB (*Agrilus planipennis*).

Besides the ALB, Sirex Woodwasp, and EAB (see paragraph 6.12.1) other pests in this part of NJ which are currently under surveillance and cooperative programs with NJ Forestry Service are: Beech Bark Disease (*Nectria coccinea*), and Scarlet Oak Sawfly (*Caliroa quercuscoccineae*).

The hemlock forests are of special concern. Hemlock occurs on the installation in pure stands and also to a lesser extent in northern hardwoods and mixed oak stands. The hemlock stands are the only coniferous forest type located on the Arsenal. By 2003, the HWA (*Adelges tsugae*) had infected all 26,000 acres of hemlock in New Jersey to some degree (USDA. 2003, and (http://www.state.nj.us/dep/parksandforests/forest/njfs_forest_health.html) . There is concern that all hemlock on the installation will eventually be killed. Watershed managers are concerned that hemlock losses may affect water quality, associated terrestrial and aquatic ecosystems, and aesthetics associated with New Jersey's hemlock forests. Riparian areas will receive priority for prevention, treatment or monitoring activities.

8.15.2 Invasive Species

Invasive, non-indigenous species frequently have competitive advantages because of the absence of predators, diseases and competitors that they evolved with in other ecosystems or because of more efficient mechanisms of reproduction, dispersal or use of resources. Invasive plants threaten species diversity, composition and structure of our fields, forests, wetlands, and aquatic habitats. Invasive invertebrates such as zebra mussels and Asiatic clams have the potential to adversely impact aquatic habitats and species. Emerald Ash Borer and ALB have the potential to severely damage our forests and wildlife habitat. Diseases such as West Nile virus have already impacted certain avian species (Skylands Landscape. 2008).

Executive Order 13112 (3 FEB 99) directs federal agencies to minimize economic, ecological, and human health impacts of invasive species by control of established alien species, as well as preventing their introduction. After its establishment, the NISC prepared its initial National Invasive Species Management Plan in 2001 which was 79 pages (NISC n.d.). Today the 2008-2012 National Invasive Species Management Plan is 35 pages (NISC 2008). Consistent with promulgated guidelines, agencies will be responsible for prevention, detection, control, restoration, monitoring, research and education with respect to invasive species.

On PICA invasive or non-native plant species are known to be present, and their extent and variety has been documented through field sampling surveys (TetraTech 2003). When discovered, or in areas where invasives are adversely affecting wildlife or other plants, they will be controlled or eradicated. In those cases where it is impractical to remove infestations, they will be documented and controlled to the extent possible. Mechanical means are currently used to remove or control autumn olive and other species on selected sites.

To achieve these objectives, the following standards and guidelines shall apply:

- 1) Do not introduce non-native species onto the Arsenal as a general rule. If an introduction of non-native species is proposed, assess the impacts.
- 2) Any introduction should avoid retarding or preventing achievement of other natural resources objectives (such as protecting bog turtle habitat).
- 3) Survey the Arsenal to document and map locations and extent of invasive plants.
- 4) Evaluate the current impacts of non-native species on indigenous plants.
- 5) Consult with NJ Department of Agriculture (Beneficial Insect Lab) for possible biological controls (entomophages, phytophages).
- 6) Develop management plans for eliminating or controlling non-native species. These will include an analysis of the impacts of implementing such programs on other species or habitats on the installation.
- 7) Tier management plans for the control of noxious weeds to the *Integrated Pest Management Plan* and the *Integrated Natural Resources Management Plan*.
- 8) Include an assessment in all project planning (including habitat and ecosystem restoration and new construction) that determines the potential for new infestations.
- 9) Use native species in developed or urban areas.
- 10) Treat known sites that threaten TES and where possible, use mechanical means to eliminate invasive infestations.
- 11) Continue to cull and treat Autumn/Russian Olive; as well as Oriental Bittersweet sites.

Personnel applying pesticides must be certified. The PICA IIPMC and one technician are NJ State Certified Applicators and two golf course personnel are certified DOD pesticide applicators. Specific requirements for applicators:

1. Recertification of DOD applicators is required every three years; and 5 years for NJ State Certified Applicators
2. All land management contractors using pesticides must be registered with NJDEP.
3. Contractors must also have a NJ applicator license and have registered applicators.
4. In accordance with Measures of Merit goals, pesticide use must be reduced by 52 percent from 1993 Levels.

Common reed in firebreaks should be mowed when soil conditions are suitable. Garlic mustard should be targeted for selective herbicide periodically to check its spread throughout the installation. On the improved grounds, species such as poison ivy (although native) may be controlled by spot treatments of glyphosate.

Personnel applying pesticides must be certified. The BasOpsSup-Chugach IIPMC and one technician are NJ State Certified Applicators; two BasOpsSup roads & grounds personnel are also NJ certified; and two golf course personnel (FMWR-NAF) are certified DOD Pesticide Applicators. Specific requirements for applicators:

1. Recertification of DOD applicators is required every 3 years.
2. Recertification of NJ State applicators is required every 5 years.

8.15.3 Cantonment Disease and Insect Control

Turf diseases mostly occur on the golf course and include: Pink Snow Mold (*Fusarium nivale*), Gray Snow Mold (*Typhula spp.*), Leaf Spot (*Drechslera spp.*), Dollar Spot (*Lanzia*

moellerodiscus), Brown Patch (*Rhizoctonia solani*), Summer Patch (*Phialophora graminicola*), and Pythium Blight (*Pythium graminicola*). Diseases of ornamental trees and shrubs that have caused minor damage include: Leaf Spot, Powdery Mildew (*Erysiphe graminis*), and various Rusts (*Puccinia* & *Uromyces* spp.).

Turf damaging insects include: Cutworms (*Nepheleodes/Peridroma/Agrotis* spp.), Sod Webworms (*Crambus/Parapediasia* spp.), Hyperodes Weevil (*Hyperodes*), Yellow Ants (*Acanthomyops* spp.) and White Grubs mainly Japanese Beetle (*Popillia japonica*).

Insects that are a problem for shrubs and trees on the installation include: Birch Leaf Miner (*Fenusa pussila*), adult Japanese Beetle, various Scales, Sawflies (Hymenoptera), and Eastern Tent Caterpillar (*Malacosma americanum*). The Gypsy Moth (*Porthetria dispar*) has been a cyclical pest in forested as well as planted areas on post. Japanese beetles have been a problem on Little Leaf Lindens (*Tilia cordata*). Several Austrian and White pines (*Pinus nigra* and *Pinus strobus*) have been hit hard with Tip Blight caused by *Diplodia pinea* within the past several years.

Tip Blight control requires pruning of the diseased branches if possible, but some older trees have shown a terminal dieback and are being removed as soon as possible so that this highly contagious disease will not spread to nearby pines. During the course of the year, periodic spot checks are made to determine if insect or disease damage is present in lawns or landscape plantings. Turf damaging insects are controlled by insecticides when necessary. Spot treatments of tree and shrub diseases can be performed by BasOpsSup pest controller(s). The golf course treats their turf with fungicides and/or insecticides on a scheduled basis for specific problems.

8.16 Fire Management

8.16.1 Prescribed Burning

At PICA prescribed burning has not been used because:

- a) There is a historic pattern of risk of unexploded ordnance due to the 1926 explosion event and decades of less stringent testing and post-test site clearance protocols.
- b) Proximity to SR 15 and surrounding residential communities where smoke could be an obscurant and/or annoyance.
- c) Air quality issues associated with smoke depending on scale of the burn.

The use of prescribed burns as a forest management tool is mentioned in Chapter 8.2.2 and 8.4.

8.16.2 Fire Prevention and Suppression

The Arsenal fire prevention and suppression is the responsibility of the Picatinny Fire Chief. The Arsenal has a cooperative agreement with the NJ Forest Fire Service, Division of Parks and Forestry, to provide mutual assistance for fighting wildfires on or near the installation. The agreement is updated annually to revise telephone numbers and contact persons. There are limited agreements with the Town of Dover, Borough of Rockaway, and Township of Rockaway for mutual assistance.

In the event of a wildfire at the installation or other areas threatening it, the Picatinny fire personnel will be dispatched to the incident. The Fire Chief may request additional support. This may be local fire departments and/or NJ Forest Fire Service.

The NJ Forest Fire Service has four-wheel drive vehicles capable of accessing fires at the installation; as well as air assets, including 300 gallon water dropping buckets. Water can also be drafted from Denmark Lake or Picatinny Lake for fire emergencies.

Although an 80-foot former fire tower (building 291) on Green Pond Mountain provides a commanding view of the installation and neighboring Jefferson Township, it is not used for fire spotting or incident coordination.

8.17 Special Interest Area Protection

A 1994 study of state and federal TES mapped the natural vegetative communities in an area that includes the Arsenal. In conjunction with that study, the state established priority protection areas. One such area was the Green Pond Macro site, later designated as the GPMNHPS; and LDNHPS. These two sites include most of the northern portion of Picatinny. Its boundaries include areas important for rare plants, insects, birds, and animals, especially those associated with Lake Denmark, Copperas (Mtn) Ridge and Green Pond (Mtn) Ridge; and Picatinny Lake. Due to the widespread presence of the federally endangered Indiana Bat, as well as state endangered Bobcat, the Natural Heritage Priority Sites are identified as critically important natural areas for conserving and preserving New Jersey's biodiversity. Information about the GPMNHPS is available from the NJ Office of Natural Lands Management through its Natural Heritage database.

Such information is routinely used and referenced by community planners, developers, ecological consultants, conservation agencies and organizations for environmental assessments, and natural resources management.

Although general habitat management guidelines for major land types as presented in this plan will meet the habitat needs for the vast majority of wildlife species; guidelines are also needed in special cases to ensure habitat requirements are instituted for all species. Unique habitats are frequently divided into the following classes: a) federally designated "critical habitats," b) areas supporting high concentrations of wildlife, c) areas critical to particular species, d) concentrated migration routes, e) land forms or areas of unusual vegetation associations that support unusual wildlife species, and f) areas that were significant as wildlife habitat in the past (Chambers 1983).

Federally designated critical habitats are ascertained and described by the USFWS. There are no such sites on the Arsenal. Areas that support high concentrations of wildlife include aquatic habitats where waterfowl raft or roost, waterbird colonies, communal roosting sites, or lakes. Concentrated migration routes include areas where migratory birds, fish, mammals, and insects concentrate during seasonal passage. Although unique habitats on the Arsenal were not documented in the past, many of these areas have recently been highlighted by the Legacy project (Windisch 1993, Carle 1995, NJDFGW-ENSP 1995, Radis 1995). Most of the obviously distinctive habitats, recognized also by the state as NHPS, have been identified in paragraph 6.9 and Chapter 7 of this plan. Appropriate management recommendations will be formulated to ensure habitat conservation and/or enhancement.

Outgrants

In the northern part of PICA and crossing the southern portion of the extensive scrub shrub swamp of Lake Denmark, is the 1.5 mile powerline Right of Way (perpetual easement granted by original landowners) for Public Service Gas and Electric (PSE&G). This 150 foot wide strip comprises about 27.5 acres of cleared and periodically maintained RoW across the very rugged slopes and valleys of Copperas and Green Pond ridges; as well as the impassable half mile over the shrub swamp wetlands of Lake Denmark. In 2012-13 the longstanding 80 foot towers are to be replaced with nearly 200 foot towers in order to upgrade the electric grid in northern NJ.

At the opposite end of PICA and within and along the southern boundary, nearly 25 acres is similarly granted to NJ Department of Transportation as an easement for the divided highway known as State Road 15. Although still Army property, the substantial forested portions of the median and the lowermost reach of GPBrook are not directly managed by the NRM or EAD. Recent private proposals to reconfigure parts of SR 15 are the subject of two additional outgrants for some fractional acreage. Questions arise regarding disposition of trees that were or will be felled by the private parties (or grantees) on this army property; as well as stewardship responsibilities under NHPA, MBTA, and ESA.

8.18 Training Requirement Integration

The installation's mission is primarily research and development of armament systems using small scale test sites. Laboratories and engineering facilities are fixed and permanent. Although surrounded by ample acreage of natural unimproved grounds, open test fire ranges are very limited in size and number and remain fixed. Very few mechanized military vehicles or craft are used on post, and if so, rarely in unimproved grounds. Such movement/testing is coordinated and nearly always conducted on existing roads or ranges. Consequently, it is not necessary or possible to rotate areas. ITAM (Integrated Training Area Management) and LRAM (Land Rehabilitation and Maintenance) are not applicable.

Occasionally unimproved grounds and terrain are utilized by military, law enforcement, or emergency services units for small scale and short duration field practice. Requests to schedule such exercises used to be coordinated with the NRM prior to authorization; but now such activities will be coordinated through PEMS.

Chapter 9 – Inventory and Monitoring

9.1 Objectives

The objectives for inventorying and monitoring ecosystems on the PICA are:

- a) Create and maintain systems to inventory the natural resources.
- b) Monitor those resources regularly that are important indicators of overall ecosystem integrity, the capability of land to support the military mission, the status of imperiled species or communities, and other special interests.

9.2 General

The US Army Corps of Engineers, Waterways Experimental Station and Information Management Systems prepared a list of maps (plates) of the PICA in September 1994. These are digitized in a Geographical Information System (ArcView/ArcInfo). The list of plates (layers) includes:

Ortho-Corrected Photography	Wetland Field Sampling Points
Topography, Buildings and Roads	CADD Based Vegetation
Bedrock Geology	Hand Drawn Vegetation
Surficial Geology	Field Verified Wetlands
Wells and Borings	Natural Communities
Hydrology	Annual Flood Plain
Soils	100 Year Flood Plain
Geomorphology	Historical Sites

Similar utilities for ecosystem management are found with the federal IPaC application and the state's Landscape Project.

9.3 Flora Inventory and Monitoring

The last forest inventory data was collected in 1984. The stand data was collected based on the stands determined from the hand drawn vegetation map. The data was entered into the Silviculture of Allegheny Hardwoods (SILVAH) program and the data was printed onto a hard copy. The information has limited application for obtaining information for forest management.

USFS has established long term Forest Inventory & Analysis Plots which is a longitudinal census of the nation's forests through tree growth measurements. There are two such plots established on PICA which are monitored about every five years.

9.4 Monitoring Consumptive Use of Resource

Wildlife population monitoring is in the form of game and fish harvest surveys and hunting log data. Deer population surveys can be conducted in cooperation with wildlife biologists from the NJDFW. Deer harvest quotas are determined by NJDFW from annual hunting records. Endangered species surveys have also been conducted for both plants and animals. The objectives for monitoring resource users includes: a) continuation and refinement of all those methods currently employed (outlined herein), b) development and distribution of a fisherman questionnaire, c) conduct periodic creel censuses.

An effective fish and wildlife program requires information on the users of the resource as well as information on the natural resources. Both the intensity of use as well as user preferences in outdoor recreation and in other matters pertaining to the management of natural resources needs to be assessed (Chambers 1983, Edington and Edington 1986, Eltringham 1984). Information on levels of use of the fish and wildlife resources assists in the formulation of regulations to ensure that the resource receives adequate protection from exploitation. This information is also germane to the process of creating more effective safety and security regulations for users.

Information on the interests of natural resources users allows management programs to be tailored within resource limitations to meet user demands. Information on the interests of natural resources users is obtained by a variety of methods. The number of hunters, anglers and trappers on the installation is monitored via the issuance of Arsenal Sportsman Permits. Hunting log data provides information on preferred game species, hours afield, and success rates. Data from fishing contests on the installation also provides information on angler success and preferences. In addition, input from the members of the PR&GA provides information on user preferences and interest in natural resources. No similar measures exist to estimate the number of individuals engaged in nonconsumptive use of the resources, except hours reported by volunteer birders.

9.5 Water Quality Monitoring

Water quality monitoring (ground and surface) is conducted by contractors responsible to the the installation EAD. The USGS maintains 2 “stream passing flow” gauging stations to record data for compliance with the installation’s NJDEP water allocation permit. The permit issued by the NJDEP, Division of Water Supply and Geoscience – Bureau of Water Allocation and Well Permitting, mandates a minimum passing flow downstream of the Picatinny Lake spillway and tailrace of 1.8 cfs in order to maintain GPB contribution to the water supply of nearby Boonton reservoir.

9.6 Soils Inventory and Monitoring

The 1976 Soil Survey of Morris County, New Jersey prepared by the USDA Natural Resources Conservation Service is used to obtain soil information. A soils layer from CGDCE also exists.

9.7 Data Storage, Retrieval and Analysis

Most of the data is stored as hardcopy files. Computer databases exist, but minimal staff limits timely updating. GIS system has limited access and training in use/utility.

9.8 Continual, Recurring, Periodic Inventories

- Inventory of the suitable timberlands.
- Inventory of Indiana Bat summer, and pre/post hibernation foraging habitat
- Encourage state ENSP personnel to conduct Bog Turtle Surveys north of PICA property line in south end of Green Pond wetlands complex.
- Continue to search for and document state-listed Species of special concern IAW State Wildlife Action Plan priorities. See paragraph 17.3.

Chapter 10 – Research and Special Projects

Research will be pursued in-house and cooperatively in partnership with other federal agencies, state agencies, universities, and interested parties. It will be conducted as funds are available and will meet natural resources and mission objectives.

Chapter 11 - Enforcement

11.1 Objectives

The law enforcement (LE) program consists of three parts:

- Education of the Picatinny community regarding conservation and protection of natural resources.
- Law enforcement of all applicable federal and state statutes.
- Administrative enforcement of installation regulations or policies.

Since the installation is a closed post, most of the LE for natural resources involves enforcement of hunting and fishing regulations; although under the PAP 215-1 state conservation LE officers may not access the installation unless invited by PICA PD or GC. Federal exclusive legislative jurisdiction applies to all PICA property, being owned in fee simple.

The objectives of enforcement are:

- a) Prevent inadvertent damage to wildlife or wildlife habitats.
- b) Ensure that personnel participating in such programs as hunting, fishing, fuelwood harvesting, and bird watching are complying with applicable laws and regulations.
- c) Protect TES.
- d) Ensure the safety of personnel engaged in natural resources related recreational activities.

11.2 History and Authority

Much of the following information is provided by Mr. Christopher Zimmerman, Conservation Law Enforcement Officer (CLEO), Fort Carson, CO.

DODI 4715.03 (2011) states: “DOD Components shall ensure that sufficient numbers of professionally trained natural resources management personnel and natural resources law enforcement personnel are available and assigned responsibility to manage their installations’ natural resources. Necessary supplemental training to ensure the proper and efficient management of those resources shall be provided in a timely manner (e.g., Naval Civil Engineer Corps Officers School’s Natural Resources Compliance Course, DOD Sikes Act Training Course).” Thus, CLEOs are duly commissioned LE officers specially trained and delegated the authority to enforce all applicable local, state, and federal environmental, natural, and cultural resource (DODI 4715.16 2008) laws, statutes and regulations on an installation. Conservation Law Enforcement Officers are typically assigned to the Directorate of Emergency Services. DODI 5525.17, Conservation Law Enforcement Program, recently promulgated (17 OCT 13) outlines responsibilities and training for CLEOs IAW INRMPS.

The goals and objectives for such LE personnel would be to have sufficient knowledge to recognize, report, coordinate, and cite violations of the following federal and state laws:

- a) Endangered Species Act (ESA)
 - b) Migratory Bird Treaty Act (MBTA)
 - c) Bald and Golden Eagle Protection Act (BGEPA)
 - d) Lacey Act (combats trafficking in illegal wildlife, fish, and plants)
 - e) NJDFW Game law compliance inspections
- Topics (a-e) above should be discussed and coordinated closely with the NRM.
- f) Archeological Resource Protection Act (ARPA)
 - g) Native American Graves Protection and Repatriation Act (NAGPRA)

Topics (f-g) above should be discussed and coordinated closely with the Cultural Resources Manager (CRM).

- h) Clean Water Act
- i) Clean Air Act
- j) Hazardous Waste Disposal Violations

Topics (h-i) above should be discussed and coordinated closely with the appropriate media manager within EAD.

Besides reporting problems to PICA PD criminal investigator(s) and the GC; all violations or suspected violations of any of the above laws and/or regulations should be reported and coordinated closely with the Chief, EAD, so that appropriate coordination with respective stakeholder agencies and organizations may also occur.

The NJDFW sets fish and game regulations for most harvestable species. The USFWS and the NJ Division of Fish and Wildlife provide migratory game bird regulations used on the Arsenal. All laws of the State of New Jersey related to hunting, fishing, or trapping, as well as all other federal laws, are fully enforced on the military reservation. All charges, arraignments, and prosecutions, must follow the procedures prescribed by the local federal magistrate. A forfeiture schedule mirroring those fines established in state courts for violations of the NJ Fish or Game Codes has been prepared and approved by the local magistrate. This derives from 16 USC 670e-1, a part of the Sikes Act which states, "All Federal laws relating to the management of natural resources on Federal land may be enforced by the Secretary of Defense with respect to violations of the laws that occur on military installations within the United States." 10 USC 2671, *Military reservations and facilities: hunting, fishing, and trapping*, mandates the Secretary of Defense to require that all hunting and fishing on an installation be in accordance with the fish and game laws of the state in which it is located. This statute also says that an act or omission committed on the installation that would have been punishable under state law be subject to a like punishment. Violation notices are issued by the Picatinny (DOD) police officers. Administrative sportsmen sanctions allow for the suspension of privileges by the GC until final disposition of a charge is accomplished in the magistrate's court. A procedure needs to be developed to inform the state in the event that state hunting and fishing privileges should also be suspended.

11.3 Education Activities

Education of the Picatinny community is accomplished in large part through the dissemination to the sportsmen of clearly stated rules in local (regulation) policy PAP No.IMPI-MWR-006. Additionally, hunters and trappers are required to view online or attend annual safety briefings. Those persons who do not engage in hunting or fishing activities become aware of the general program and natural resources by reading announcements or articles posted on the FMWR-ODR webpages. Messages are occasionally disseminated via Picatinny-wide e-mail distributions. The PR&GA complements the education aspect of the enforcement program by its monthly meetings.

11.4 Enforcement

Typically a Provost Marshal has the prime responsibility for the enforcement of fish and wildlife laws (federal and state) on an installation. At PICA this position is held by the Director of Emergency Services. Prior to 2009 the NRM made nearly all field observations of sportsmen and reports of any suspicious activities to PICA PD. Since the recent transfer of the Program to FMWR-ODR, the NRM has limited involvement in enforcement (see Appendix I for enforcement roles and responsibilities. In 2009 only three officers within the ranks of the PICA PD were designated as “game wardens” by the Director of Emergency Services to perform field enforcement duties and coordinate with the NRM and Director of ODR. At this time only one of those officers is partially available for this ‘other duty as assigned’. None of the DES LE personnel have received any Army sanctioned CLEO training. This lack of trained CLEOs and minimal enforcement is still an open issue to be resolved.

Activities of properly trained CLEOs would/should include:

- Proactively enforcing provisions of Federal laws to ensure compliance and help avoid violations by official and recreational users of military lands.
- Ensuring important habitat, waterways, nesting sites and culturally sensitive areas are identified by the NRM, CRM, EAD media manager, and routinely monitored via patrols, surveillance and the strategic placement of motion activated cameras.
- Actively patrolling HAs and FAs, particularly during hunting/fishing seasons, to prevent conflicts and ensure the safety of recreationists and mission R&D, Testing personnel, and contractors through compliance with local PAP No.IMPI-MWR-006.
- Conducting Federal and State license compliance inspections to ensure recreational users are properly authorized to hunt, trap, and fish on the installation and comply with all wildlife related laws and regulations.

Chapter 12 - Environmental Awareness

The public is made aware of the Picatinny Natural Resources Program by news releases for local newspapers, information on the Picatinny Web site, as well as occasional articles in the bi-weekly on-Post publication – *The Picatinny Voice*. A major responsibility of the NRM is to communicate the importance of the program with other managers and staff at Picatinny. Emphasis will be placed on informing the public on the importance of TES, such as bats, and the problem of invasive and non-native species.

Chapter 13 – Outdoor Recreation

13.1 Objectives

Picatinny Arsenal is unique in that it contains large tracts of undisturbed forest amidst a developing urban and suburban region due to its longstanding history and mission. Arsenal At Large outdoor recreation opportunities are limited, even to installation residents, due to the possible presence of unexploded ordnance and mission testing. The objective is to provide recreation opportunities consistent with safety and mission objectives. Therefore, most outdoor recreation pursuits are confined to limited areas. It is not anticipated that these areas or access to new areas will be significantly expanded in the next five years.

13.2 Military Mission Considerations

There are few developed recreation opportunities on the Arsenal. Dispersed recreation opportunities are heavily restricted by mission activities. Hiking and bird watching are limited to off hours and weekends when testing is not being performed. Even then, access into security enclosures is highly controlled.

13.3 Public Access

The installation is not open to general public use due to security of the military mission and the risk of unexploded ordnance. Limited access is allowed for the FMWR patrons of golf course, water-park, fitness center, Lake Denmark Picnic Area, and paintball course. Hunting/Trapping/Fishing (aka Sportsman Program) is allowed subject to approval of the GC.

13.4 Hunting, Trapping and Fishing

The sportsman program involves nearly 470 people annually throughout the year (170 hunters and a couple of trappers; and 300 fishermen). Hunters and trappers must view online or attend annual safety briefings. Although these pursuits are Category B activities under the Morale Welfare and Recreation Army Regulation AR 215-1, and the day to day administration of sportsman activities was recently assigned to the Director of Outdoor Recreation; the Sportsman Program natural resource relationship is overseen by the Natural Resources Manager IAW AR 200-1. See Chapters 8.5.1 – 8.5.4 for additional information.

13.5 Other Natural Resources Oriented Outdoor Recreation

13.5.1 Developed Recreation

A 3.5 acre and 15 acre area has been designated for Paintball Games near the Lake Denmark picnic area and ball field, using building 3800 for storage. This activity is scheduled through the PICA PD to prevent interference during the hunting and trapping seasons.

13.5.2 Dispersed Recreation

Aside from hunting and fishing, there are two other forms of dispersed recreation enjoyed on the installation – boating and bird watching. Canoes, kayaks, and rowboats are enjoyed at Lake Picatinny and Lake Denmark through the ODR programs. Swimming is not permitted in any of the natural lakes or ponds on the installations.

Bird watching is encouraged among the Natural Resources Volunteers who provide records of observations to the NRM. Their access and activities are coordinated through the NRM. Some bird watching hikes are conducted for both children and adults.

Hawk watching opportunities and facilities are ideal at Picatinny. Natural Resource volunteers man a Hawkwatch officially sanctioned by the Hawk Migration Association of North America (HMANA). The volunteers count migrating hawks every day from 1 SEP to 30 NOV and enter their data into the HMANA Database (hawkcount.org). Information (site description) and yearly statistics for Picatinny Peak Hawkwatch can be found on hawkcount.org. The Picatinny Peak Hawkwatch has been monitoring/counting Birds of Prey for 18 years. Picatinny Peak counts approximately 10,000 migrating hawks, falcons, harriers, Ospreys and Eagles each year. In a two week period every September (between the 10th and 24th), typically peaking about 15-20 SEP, the site averages approximately 6,000 Broad-winged Hawks in that week, some years up to 14,000 including "big days" of upwards of 10,000 Broad-winged Hawks in a day. The site also gets about 100 migrating Bald Eagles per fall season with a dozen Golden Eagles in late-OCT / early-NOV.

Other dispersed recreation opportunities available at Picatinny include some cycling and jogging along low traffic roadways and abandoned, yet improved, railroad beds. All roads and trails approved for jogging and bicycling are on the Picatinny Exercise Trail Map. Ice-skating is permitted at South Basin, when conditions allow.

13.6 Recreation and Ecosystem

People and social uses/needs are an integral part of ecosystem management. The outdoor recreation program is based on providing quality experiences while sustaining ecosystem integrity. Activities that have a direct effect on species populations, such as fishing and hunting, will be closely monitored to determine potential effects. As an example, the NRM may recommend that the GC impose more restrictive harvest limits for the installation than required by the State.

13.7 Safety and Security

Mission testing and unexploded ordnance preclude the full use of the installation for outdoor recreation activities. Test facilities usually have an associated Surface Danger Zone in which it is not considered safe to enter during active testing periods. Although the PICA is a public trust, it is not open for public use due to public safety and national security concerns. Recreation for authorized personnel will be confined to developed and established sites, or designated dispersed areas at times that do not pose a safety hazard. Some types of hunting are considered less of a risk than other potential activities because the participants typically are limited to one or two people who move through an area. Consequently, “risk” is less.

Chapter 14 – Cultural Resource Protection

14.1 Objectives

A cooperative objective of the Integrated Natural Resources Management Plan is to protect the cultural resources at the installation. Picatinny Arsenal has a rich history that predates the Revolutionary War. The NRM and the CRM work closely to ensure that the INRMP and Integrated Cultural Resources Management Plan (ICRMP) are harmonized and mutually supportive.

14.2 Cultural and Historic Resources

According to the CRM, PICA has 2 eligible archaeological sites and 102 eligible historic properties; however none of our properties are listed on the National Register of Historic Places (NRHP).

14.2.1 Walton Cemetery

The early settlers of the Mount Hope District of Morris County used this pre-Revolutionary War family cemetery. This cemetery is also referred to as the Hessian, Righter or Faesch Cemetery; or Walton Burial Ground. Grave markers consist of fieldstones (flat-sided if available) placed at both the head (about 12 to 20 inches above the ground) and foot (about 4 to 8 inches above ground and distinctly smaller overall than headstones). If there were ever inscriptions, none are now evident.

In 1994, there was only one original marker of some antiquity with legible inscription. It is believed to be the 10 year old daughter of Reuben and Susannah Walton, named Susan who died in 1813. This marker is a tooled slab, which lies flat on the ground, but unfortunately is shattered into 5 or 6 pieces. In 1974, only two commercial gravestones were noted in the cemetery, one of which is apparently the aforementioned Susan Walton. The other marker was described as “the stump of a red sandstone with only the epitaph remaining.” There are 2 to 3 red sandstone stumps at present, none of which reveal any inscription.

The cemetery is depicted on the General Site Map of the BIMS (Basic Installation Map Series). The site is slightly under two acres (1.5), surrounded by a recently installed (2012) split rail fence. There may be some fieldstone markers outside the present confines. The number of graves is uncertain, although a minimum of 100 is a reasonable estimate. In 1994, the NRM counted 47 headstones, which were broken flush to the ground, and 49 footstones. Various documents have estimated 50 to 75, 68, or 200 graves in this cemetery. Considering the space available, 200 interments are possible. Currently the CRM is working to photo document all of the evident gravestones.

14.2.2 Historical Structures

Several buildings on the Arsenal possess historical merit both for their period design as well as their cultural significance. The CRM in concert with the DPW Master Planner maintains a list of historical buildings. The Arsenal has evaluated over 1,100 structures and found 102 that are eligible for inclusion on the NRHP. Of these 102, 99 of them are located within five (5) historic districts, while an additional 24 are non-contributing properties and have exterior concerns as they are located within these Districts. (ref. “Definition of Historic Districts for PICA, Morris County, NJ” prepared by Pan American Consultants, Inc for the NY COE Final Report – SEP 99).

14.2.3 Archeological Sites

Field sites contain primarily early European settlement period features or artifacts. Examples include rock fences, early wagon roads and railroads, home sites, dumpsites, cisterns, springhouses, forge remnants, and iron mine tailings. In 1993 remnants of an old earthen dam forming a millpond for a former sawmill were discovered. Twenty-two (22) Native American sites consisting mostly of lithic scatters and small campsites have been found at the Arsenal. Several possible rock shelters have been inspected, and minimal evidence of pre-settlement use has been noted. The total number of archaeological sites, both historic and prehistoric, is 53.

14.3 Natural Resources Management Implications

To prevent activities from affecting significant cultural resources, natural resources projects that involve ground disturbing activities must be processed through the CRM. In areas where eligibility for the NRHP has not been determined, natural resources projects require coordination and consultation that is prescribed in Section 106 of the *National Historic Preservation Act*. For management purposes:

- 1) Treat sites deemed eligible for the National Register in exactly the same manner as sites that are actually listed in the NRHP. Concessions may need to be made to protect these sites.
- 2) Evaluate any excavation activities, as needed, using the NEPA process for impacts on natural resources.
- 3) Mitigate adverse effects through avoidance, minimization, or compensatory mitigation.
- 4) Keep any ground-disturbing activities a safe distance from known cultural resource sites, especially the referenced cemetery.
- 5) Immediately report any artifacts or archaeological sites that may be discovered during excavation or maintenance to the CRM and/or the Environmental Affairs Division. Cease all work until notified to proceed by proper authority.

Chapter 15 – National Environmental Policy Act

32 CFR Part 651, *Environmental Analysis of Army Actions*, 29 MAR 02, implements the *National Environmental Policy Act* (NEPA); and requires “early integration of environmental consideration” through “quality analysis of environmental effects” to support proper planning. It is a law of disclosure. The purpose of NEPA is to identify and disclose impacts to the environment to the decisionmaker and public. It is also a mechanism to promote efforts that will prevent or eliminate damage to the environment at early stages of project planning and development; or to mitigate and monitor unavoidable impacts.

15.1 Objectives

With regard to natural resources, the objectives of NEPA are:

- a) Identify projects and activities on the installation that might impact natural resources.
- b) Work with project planners to resolve issues early in the planning process.
- c) Ensure that this INRMP is documented according to guidance in 32 CFR Part 651.

15.2 NEPA Responsibilities and Implementation

All natural resources activities must conform to 32 CFR Part 651, which implements NEPA requirements, to include mitigation and monitoring as necessary. It is the responsibility of the NEPA coordinator to assure that all major activities affecting natural resources conform to the NEPA requirements. The NRM is responsible to provide expertise to other organizations at Picatinny to ensure that natural resources are protected.

15.3 NEPA and Natural Resources Management

The NEPA coordinator will ensure that the INRMP’s activities are properly planned, coordinated, and documented, and that they identify potential natural resources impacts. The INRMP’s associated Environmental Assessment (2001) provides an evaluation of various management activities of Picatinny’s natural resources. Since this INRMP is a programmatic document, future site-specific natural resources projects may require additional NEPA review and actions (according to 32 CFR Part 651). As a minimum, both this INRMP and its Environmental Assessment (EA) can be referenced with regard to describing the “affected environment” for future NEPA documentation. A Record of Environmental Consideration (REC) for this updated INRMP has been prepared which documents that the revisions contained herein do not require an amendment to the original EA. The REC document can be found on line at <http://www.pica.army.mil/ead/>. On this webpage select the “Planning” tab and then the National Environmental Policy Act tab on that dropdown menu; finally click on NEPA documentation link. Documents are in chronological date order, with most recent at the top.

Chapter 16 – Biopolitical Issue Resolution

As in many locations in the United States where there are military installations, three major issues confront the public: how to maintain a strong economic base that provides jobs and adequate tax base; how to control growth and protect natural resources, farmland, and open space; and how to ensure a strong national defense? In some cases, these issues appear to result in contradictory goals and objectives. For example, economic growth may result in the loss of undeveloped land that contributes to fragmentation of the landscape. Although large blocks of open space and forest may remain, if they are not “connected” wildlife and plant species diversity will decline. As development continues, it may begin to encroach upon or surround a military installation. In many cases, military installations have become islands of habitat within an increasing urbanized setting. This in turn may impact the ability of the military to maintain a ready and trained force.

As part of the larger Highlands Region, PICA is confronted by all three of the above issues. Besides its main purpose to develop and prove leading edge armaments the PICA mission has broadened recently to simply encompass “supporting the Army’s transformation goals.” In so doing, it provides jobs and contributes to the economy. At the same time, the Arsenal has a stewardship requirement to protect natural and cultural resources. Its military mission has enabled the Arsenal to make a substantial contribution to the surrounding area both in terms of employment and protection of natural resources. Continued existence of the Arsenal depends on successfully engaging all three issues.

Within this context, the Arsenal is partnering with the private sector by leasing installation facilities to private contractors to enhance the overall effectiveness of the facility. This proposed program is discussed in Chapter 4.2 of this INRMP. This could have an impact on the natural resources if the proposal does not consider the impacts on the Arsenal’s important natural resources. If development is restricted to the existing buildings or sites, there will likely be little impact to natural resources. The one exception to this could be the use of water and sewage demands placed on the downstream system. However, there is currently no intent to develop land outside the existing developed area. Such development, if proposed, will be subject to NEPA documentation and this INRMP will provide a baseline for evaluation of impacts. Currently only existing bldgs are being used for this program. If in the future unimproved grounds is used for Enhanced Use Leasing (EUL) then NEPA analysis will be required.

Chapter 17 - Implementation

17.1 Legal Authority

As at other military installations (USFWS 2006), legal authority for DOD conservation actions at PICA is provided under a ruling approved September 15, 1960, and commonly referred to as the “Sikes Act.” The stated purpose of the act is “to promote effectual planning, development, maintenance, and coordination of wildlife, fish, and game conservation and rehabilitation in military reservations.” All conservation actions and measures, S&Gs, BMPs, projects, and tasks, outlined in this INRMP are implemented pursuant to this overarching requirement.

17.2 Organization, Roles and Responsibilities

The current staffing is listed in Chapter 5.1. Staffing levels are expected to remain at the present levels for the next five years. Since the last version of this INRMP, scores of formerly government held positions were filled through the A-76 contractor (Johnson Controls) in DEC 2002. Two years later, a sole source Base Operations Support Contract was procured. In August of 2005, Chugach Industries contractor personnel became the BasOpsSup for PICA sustaining most of the facilities maintenance and information technology infrastructures on post.

17.3 Project and Program Priorities

Preparation of this INRMP is required by DOD Instruction 4715.03. The fact that this INRMP is the preferred alternative in a published NEPA document qualifies it for Class 1 funding. There are also programs within this INRMP that are required for compliance with other laws, especially laws involving endangered species and wetlands. Nevertheless, implementation of the INRMP projects or tasks is contingent upon funding.

However, it is unlikely that all programs within this INRMP will be funded immediately. Therefore, projects and programs are listed in relative importance. Estimated time schedules are provided. Low priority projects may be implemented ahead of higher ones. The following lists are based upon need and effect on this installation’s natural resources, not the likelihood of funding.

All requirements set forth in this INRMP requiring the expenditure of PICA funds are expressly subject to the availability of appropriations and the requirements of the Anti-Deficiency Act (31 U.S.C. Section 1341). No obligation undertaken by PICA under the terms of this INRMP will require or be interpreted to require a commitment to expend funds not obligated for a specific purpose.

FY 2016 to 2021 Projects & Tasks

Anticipated Programs and Projects

Priority	Project or Task
1	INRMP review by Picatinny stakeholders and external Sikes Act reviewers (FY 15).
2	Prepare tentative budgets to implement upcoming fiscal years' projects (FY16).
3	Continually assess habitat modification and/or management activities for sensitive species; namely Northern long-eared bat (NLEB), tri-colored bat, Timber rattlesnake, Wood turtle, Small whorled pogonia, and Bog turtle.
4	Develop and implement grounds maintenance and construction protocols to mitigate impacts to sensitive species and their habitats using PEMS.
5	Continue to refine environmental project tracking module (EPTM) within PEMS.
6	Develop effective Vegetation Control Plans for Fuelbreaks around AE facilities.
7	Revisit PICA IBAT ESMC for updating and possible addition of BMPs and management objectives/prescriptions for NLEB if listed (ca. APR 2014).
8	Develop and conduct next evolution of IBAT (and/or NLEB) survey(s) – acoustic and/or traditional mist netting; and/or tracking.
9	Conduct a planning level survey for Small Whorled Pogonia (<i>Isotria medeoloides</i>)
10	Monitor a sedimentation control plan for the Gorge test range and GPB.
11	Prepare and implement control program(s) of select invasive plants.
12	Identify and develop wetland enhancement projects to receive wetland credits from NJDEP.
13	Develop hydrologic management plans for proper controls of lake levels under various storm/drought scenarios.
14	Develop Urban Tree/Hazard Tree Program. Inventory trees and shrubs to identify needs for pruning, replacement or removal. Coordinate with Cultural Landscape Survey in historic districts.
15	Develop Landscape planting plan. Coordinate with Cultural Landscape Survey in historic districts.
16	Develop priority lists of SWAP target species (SAR) for focused searches/surveys. Prepare separate lists for birds, herptiles, and invertebrates.
17	Conduct den surveys for <i>Crotalus horridus</i> on Copperas Ridge.
18	Conduct a planning level survey for Mollusks in aquatic habitats.
19	Perform native tree/shrub plantings on reclaimed footprints of razed buildings.
20	Conduct verification surveys for select rare plants (SAR).
21	Replace culvert at 24 th Ave (Gorge gate) with Low Flowculvert to allow unrestricted upstream movements of native Brook trout.
22	Investigate the training needs and personnel requirements to better utilize current Geographic Information System (GIS). Populate flora/fauna location data where ever feasible in GIS and develop practical layers.
23	Monitor bald eagle breeding and nesting activities. Consider eaglet banding if feasible.
24	Develop a public relations program to promote partnerships (volunteer efforts) for the Arsenal's sensitive species conservation efforts.
25	Monitor recruitment and infestation of invasive plants in removed understory of MMRP sites, PSE&G RoW, and other fragmented /disturbed sites.
26	Monitor recruitment and habitation of <i>Myotis leibii</i> in rock spoil piles.
27	Develop education materials and a short seminar to educate all necessary personnel on the locations of Picatinny's wetlands, and on Federal and State wetlands regulations.
28	Conduct aquatic resource surveys for all lakes, ponds and streams.
29	Conduct the annual migrating birds and hawk census surveys.
30	Update fish fillet contaminant analyses and fish eating advisories consistent with IRP.
31	Monitor/survey for invasive forest (insect/disease) pests/pathogens. Coordinate with USDA.
32	Conduct a silvicultural examination and forest inventory of forest lands.
33	Make copies of the Erosion and Sedimentation Control Manual available for Base and contractor personnel performing on Base construction /earth-moving activities.
34	Update PICA Bog Turtle ESMC if/as necessary.

Priority	Project or Task

17.4 Command Support

Command support is essential to implementing this plan. Picatinny Arsenal's Garrison Commander, as well as the installation's Senior Mission Commander should ensure that this plan is properly implemented. Implementation of this plan further enhances ecosystem management and protects and enhances ecosystem components in concert with fulfilling the Arsenal's mission. Furthermore, management of natural resources on the installation will be done while considering the ecosystems that extend beyond the Arsenal's boundaries and in cooperation with the USFWS and the New Jersey Department of Environmental Protection. The Command is dedicated to maintaining and improving natural resources while meeting military mission goals and recognizes that this INRMP is a means to that end.

ACRONYMS

- ARDEC** – Armaments Research, Development, and Engineering Center
- CRM** – Cultural Resources Manager
- DBH** – Diameter Breast Height
- DOD** – Department of Defense
- DODI** – Department of Defense Instruction
- DPW** – Directorate of Public Works (USAG - PICA)
- EAD** – Environmental Affairs Division (PICA Directorate of Public Works)
- ENSP** – Endangered and Nongame Species Program (NJDFW)
- ESA** – Endangered Species Act
- FMWR** – Family and Morale, Welfare and Recreation
- GIS** – Geographic Information System
- GPB** – Green Pond Brook
- HUC** – Hydrologic Unit Code
- IMCOM** – Installation Management Command
- INRMP** – Integrated Natural Resources Management Plan
- IPM** – Integrated Pest Management
- IRP** – Installation Restoration Program
- MBTA** – Migratory Bird Treaty Act
- NEPA** – National Environmental Policy Act
- NJDEP** – New Jersey Department of Environmental Protection
- NJDFW** – New Jersey Division of Fish and Wildlife
- NJDPF** – New Jersey Division of Parks and Forestry
- NJFO** – New Jersey Field Office (USFWS)
- NRM** – Natural Resources Manager
- PICA** – Picatinny Arsenal
- SAR** – Species At Risk
- TES** – Threatened and Endangered Species
- USACE** – United States Army Corps of Engineers
- USAEC** – United States Army Environmental Command (formerly AECenter)
- USAG** – United States Army Garrison
- USFWS** – United States Fish and Wildlife Service
- WMA#6** – Watershed Management Area #6

TERMS AND DEFINITIONS

Acre – an area of land containing 43,560 square feet, approximately equal to the playing area of a football field.

Advanced Reproduction – well-established young trees that are capable of surviving after a regeneration treatment.

Agricultural Out-leasing – the use of Department of Defense lands under a lease to an agency, organization, or person for growing crops or grazing of animals.

Alien Species – with respect to particular ecosystem, any species capable of propagation that is not native to that ecosystem. See also exotic plants.

Aquifer – a subsurface geological formation that produces water to wells or other surface waters.

Aspect – the direction a slopes faces, such as to the southwest.

Basal Area – a measure of the density of trees on an area. It is determined by estimated the total cross-sectional area of all trees measured at breast height (4.5 feet) expressed in square feet per acre.

Bedrock – the solid rock underlying soils and the regolith in depths ranging from zero (where exposed by erosion) to several hundred feet.

Best Management Practices (BMP) – a series of soil erosion and pollution prevention measures to protect water quality from activities such as timber harvesting and other land disturbance operations as identified in state statutes.

Biological Diversity – the variety of life forms, the ecological roles they perform, and the genetic variability they contain within any defined time and space.

Brood Range – (cover)- low lying vegetation such as herbs and forbs, which afford food (insects) for young game birds, usually quail, turkeys, and grouse.

Browse – leaves, buds and woody stems used as food by woodland mammals such as deer.

Buffer Strip – a protective strip of land or vegetation, adjacent to an area requiring attention or protection.

Candidate Species – plants and animals for which the U.S. Fish and Wildlife Service (FWS) has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act (ESA), but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

Canopy – the more or less continuous cover of branches and foliage forming collectively by the crowns of adjacent trees and other woody growth.

Capability – the potential of an area to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity. Capability depends on current conditions and site conditions such as climate, slope, landform, soils, and geology as well as the application of management practices such as silvicultural protection from fire, insects and disease.

Clay – soils application: 1) a mineral soil separate consisting of particles less than 0.002 millimeter in equivalent diameter. 2). a soils textural class. Engineering Application: A fine-grained soil that has a plasticity index in relation to the liquid limits.

Clearcutting – a harvest that removes all trees from a designated area at one time, for the purpose of creating a new, even-aged stand.

Climax – an association of plants and animals that will prevail in the absence of disturbance. The culmination of a successional cycle.

Climax Forest – a stable, plant community representing the culminating stage of natural succession for a given locality and environment.

Coarse Fragment – rock and mineral particles greater than 2.0 millimeters in diameter.

Cruise – A survey of forest stands to determine the number, size and species of trees, as well as the terrain, soil condition, access and any other factors relevant to forest management planning.

Colluvium – poorly sorted soil material that accumulates through gravity, soil creep, and local wash on the lower slopes and depressions.

Commercial Forest Land – land under management capable of producing at least 20 cubic feet of merchantable timber per acre per year. It must be assessable and programmed for silvicultural prescriptions. The smallest area for classification is 5 acres. Roadside, streamside, and shelterbelt strips of timber must have or be capable of producing a crown width of at least 120 cubic feet to be classified as a commercial forest.

Conifer – any of a wide range of predominantly evergreen, cone bearing trees with needle-shaped or scale-like leaves, such as pine, spruce, or hemlock.

Conservation – The careful protection, planned management, and use of natural resources to prevent their depletion, destruction or waste.

Cooperative Agreement – a written agreement between a Department of Defense installation and one or more outside agencies (Federal, State, or local) that coordinates planning strategies. It is a vehicle for obtaining assistance in developing natural resources programs.

Constraint – a qualification of the minimum or maximum amount of an output or cost that could be produced or incurred in a given time period.

Contractor – At PICA the DA hires a variety of contractors to provide or deliver different government support and services. This is variously referred to as “contracting out”, “out-sourcing”, “A-76”, or “GOCO – government owned contractor operated”. On PICA there are basically four types of contracts/contractors:

Base Operations Support Contractors – Long-term contractor personnel whose roles and functions are essentially the same as former DA government personnel; primarily in the skilled trades, roads and grounds, and information management job duties. These personnel report to work daily, occupy government buildings on post, like DA government workers; and are considered integral to TEAM Picatinny. These contract personnel are referred to as BasOpsSup in this document.

Other Recurring Support Contractors – Long term contract personnel who maintain and/or manage entire systems of the installation infrastructure; such as power/energy supply, water supply, wastewater treatment, HVAC, turf, janitorial, and refuse. These contract personnel are referred to as Facilities Maintenance/Services Personnel (FacMtnSvc) in this document.

Privatization Contractors – Long term contractor personnel who own and manage portions or components of the installation infrastructure, excluding the underlying land, which is leased. These contract personnel are referred to as Privatization/Partners Personnel (PrvPart) in this document.

Periodic or Task specific Contractors – Short or long term contractor personnel who perform specific field tasks (construction, demolition, renovation) and/or provide specific deliverables or services.

Cord – a unit of gross volume measurement for stacked round wood; a standard cord contains 128 stacked cubic feet and generally implies a stack of 4-foot long sticks of wood, 4 feet high and 8 feet wide.

Cost Effective – achieving specified outputs or objectives under given conditions for the least cost.

Cost Efficiency – the usefulness of specified inputs (costs) to produce specified outputs (benefits). In measuring cost efficiency, some outputs include environmental, economic, or social impacts, are not assigned monetary values but are achieved at specified levels in the least cost manner. Cost efficiency is usually measured using present net value, although use of benefit-costs ratios and rates of internal return are sometimes used.

Cover – vegetation that provides concealment and protection to wild animals.

Creep (Soils) – slow mass movement of soil and soil material down relatively steep slopes, primarily under the influence of gravity but facilitated by saturation with water and by alternate freezing and thawing.

Critical Area – a severely eroded sediment-producing area that requires special management to establish and maintain vegetation in order to stabilize soil conditions.

Critical Habitat – any air, land, or water area (excluding existing synthetic structures or settlements that are not necessary to the survival and recovery of a listed species) and constituents thereof that the U.S. Fish and Wildlife Service has designated as essential to the survival and recovery of an endangered or threatened species or a distinct segment of its population.

Cultural Resource – the physical remains of past ways of life. They include historic and prehistoric sites; and the artifacts and features associated with these sites.

Culmination Mean Annual Increment (CMAI) – the point in growth of a tree where mean annual increment (total tree volume at any point in time divided by total age) is at a maximum. The “culmination point” for mean annual growth is regarded as the ideal harvesting or rotation age in terms of most effective volume production.

Cutting Methods – timber management practices employed to either regenerate a new stand (regeneration cutting) or to improve the composition and increase the growth rate of the existing forest (intermediate cutting).

DBH – diameter at breast (4.5 feet) height.

Demand – the amount of an output that users are willing to take at a specified price, time period and condition of sale.

Den Tree – a live tree at least 15” DBH containing a natural cavity used by wildlife for nesting, brood rearing, hibernating, daily or seasonal shelter and escape from predators.

Depth, Effective Soil – the depth of soil material that plant roots can penetrate readily to obtain water and plant nutrients; the depth to a layer that differs sufficiently from the overlying material in physical or chemical properties to prevent or seriously retard the growth of roots.

Early Successional – any association of plants and animals that are capable of surviving and reproducing under harsh environmental conditions. The first species to occupy an area after a major disturbance. Also known as “Pioneers”.

Ecological Process – the relationships between living organisms and their environment. Among these processes are natural disturbances such as periodic fire, flooding, or beaver activity, natural stresses such as disease or insects; catastrophic weather-related events such as severe storms or lightning strikes; or more subtle ongoing processes such as succession, hydrology and nutrient cycling.

Ecosystem – a complex array of organisms, their natural environment, the interactions between them, the home of all living things, including humans, and the ecological processes that sustain the system.

Ecosystem Management – an approach to natural resources management that focuses on the interrelationships of ecological process linking soils, plants, animals, minerals, climate, water, and topography. Managers view such processes as a living system that affects and responds to human activity beyond traditional commodity and amenity uses. They also acknowledge the importance of ecosystem services such as water conservation, oxygen recharge, and recycling.

Edge – the place where plant communities meet or where successional stages or vegetative conditions within plant communities come together.

Edge Effect – wildlife habitat where two or more vegetative types come together.

Effect, Environmental – net change (positive or negative) in the physical, biological, social or economic components of the environment resulting from human actions.

Effect, Economic – the change, positive or negative, in economic conditions, including the distribution and stability of employment and income in affected local, regional, and national economies, which directly or indirectly result from an activity, project, or program.

Effect, Physical, Biological – the change, positive, or negative, in the physical or biological conditions which directly or indirectly results from an activity, project, or program.

Effect, Social – the change, positive or negative, in social and cultural conditions which directly or indirectly results from an activity, project, or program.

Endangered Species – any plant or animal listed or proposed for listing as threatened or endangered by the Federal Government or State Government.

Environmental Assessment – a concise public document that serves to (1) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or finding of no significant impact, and (2) aid in agency's compliance with NEPA when no environmental impact statement is necessary.

Environmental Impact Statement (EIS) – a statement of environmental effects required for major Federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. It is a formal document, which must follow the requirements of NEPA, the Council of Environmental Quality (CEQ) guidelines, and directives of the agency responsible for the project proposal.

Ephemeral Stream – a stream that flows only in the direct response to precipitation, receives no water from springs and no long-continued supply from melting snow or other surface source. The channel may or may not be well defined, but at all times is above the water table.

Erosion – wearing away of the land's surface by water, wind, ice, and other geological agents.

Accelerated Erosion – erosion much more rapid than normal, natural, or geological erosion, primarily as a result of the influence of the activities of man or, in some cases, of other animals or natural catastrophes that expose base surfaces, for example fires.

Geological Erosion – the normal or natural erosion caused by geological processes acting over long periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plains, etc.

Gully Erosion – the erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.

Rill Erosion – an erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently cultivated soils.

Sheet Erosion – the removal of a fairly uniform layer of soil from the land surface by runoff water.

Exotic Species – any plant or animal not native to a region, State, or county. (This definition excludes certain game species that have become established, such as pheasants). See **Alien Species**

Even-aged Management – a timber management method that produces a forest or stand composed of trees having relatively small differences in age. The differences in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at rotation age.

Fertility, Soil – the quality of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specific plants when other growth factors, such as light, moisture, temperature, and the physical condition of the soil, are favorable.

Fertilizer – any organic or inorganic material of natural or synthetic origin that is added to a soil to supply elements essential to plant growth.

Filterstrip – a special management zone of largely undisturbed forest floor, maintained between a water body and any activity that disturbs the vegetative cover and exposes mineral soil. The main design function of a filterstrip is to absorb overland flow and trap sediment before it enters the water body.

Final Harvest – under even-aged harvest methods, the culmination of the current rotation when the overstory of the preceding stand is totally removed.

Fire Management – all activities required for the protection of resources and values from fire, and the use of fire to meet land management goals and objectives.

Flood – any level of a natural body of water exceeds its normal bank.

Floodplain – the lowland and relatively flat areas joining streams and rivers, including at a minimum that area subject to one percent (100 year recurrence) or greater chance of flooding in any given year.

Forest Land – land at least 10% occupied by forest trees of average size, or formerly having such tree cover, and not currently developed for non-forest use.

Forestry – the art and science of managing forests for the sustainable use of its resources.

Forest Type – a natural group or association of different species of trees, which commonly occur together over a large area. Forest types are defined and named after one or more dominant species of trees in the type.

Featured Species:

A fish or wildlife species whose habitat requires (including coordination, multiple-use planning, direct habitat improvements, and cooperative programs) on a unit of land or water.

A tree species that the forest management plans cites as having value for wood fiber production. The plan usually specifies one or more featured tree species to meet multiple-use management objectives.

Fish – fish or salt water finfish, other aquatic vertebrate organisms, and crustaceans and mollusks.

Floodplains – lowland or flat areas adjoining inland and coastal waters, including flood-prone areas on offshore islands that have a 1-percent or greater chance of flooding in any given year.

Forest Health – condition in which forest ecosystems sustain their complexity, diversity, resiliency and productivity over time.

Forest Land – land on which forest trees of various sizes constitute at least 10 percent of the area. This category includes open land that is capable of supporting trees and is planned for forest regeneration and management.

Formation – any assembly of rocks that have some characteristic in common, whether of origin, age, or composition.

Fragipan – a natural subsurface horizon with high bulk density relative to the solum above, seemingly cemented when dry but showing a moderate to weak brittleness when moist. The layer is low in organic matter, mottled, slowly or very slowly permeable to water, and usually shows occasional or frequent bleached cracks forming polygons. It may be found in profiles or either cultivated or virgin soils but not in calcareous material.

Fragmentation – division of a large forested area into smaller patches separated by areas converted to a different land use.

Frost Heave – a phenomenon caused by the expansion of water as it freezes. Such expansion may lift fieldstones, surveyor's stakes or roadway pavement.

Functioning Channel – a well-defined channel that clears itself at least once a year of small debris and litter, exhibits channel bank formation, and may often contain alluvial deposits of sand, gravel and/or rubble in the channel bed.

Game – any species of fish or wildlife for which State or Federal laws and regulations prescribe seasons and bag or creel limits.

Geographic Information System (GIS) – a computer-based means of mapping lands and resources and communicating values associated with them.

Ground Water:

Aquifer – any permeable underground formation, which yields, ground water.

Ground Water – water underneath the water table, in the zone of saturation, from which wells, springs, and base flow are supplied.

Water Table – the upper surface of the ground water, below which saturated conditions exist. A perched water table is formed by impermeable layers lying above the surface of the main water table and tends to fluctuate considerably.

Group Selection – an uneven-aged regeneration method to remove small groups of trees to favor the reproduction and establishment of late-successional species.

Growing Stock – all the trees growing in a stand generally expressed in the terms of number, density or volume.

Goal – a desired state of affairs towards which planned effort is directed.

Habitat – an area that provides the environmental elements of air, water, food, cover, and space necessary for a given species to survive and reproduce.

Habitat Capability – The estimated ability of an area, given existing or predicted habitat conditions, to support a wildlife, fish, or plant population. It is measured in terms of potential population numbers.

Hardwood – a broadleaved, flowering tree, as distinguished from a conifer or softwood. Trees belonging to the botanical group of angiosperm.

High Grading – an exploitive logging practice that removes only the best, most accessible and marketable trees in the stand.

Headwaters – a watershed of a first order stream (one that is not fed by a tributary stream).

Herbicide – a chemical compound used to kill or control growth of undesirable plant species.

Heritage Sites – sites identified by the NJDFW that have rare, threatened, or endangered species of plants or animals. Heritage sites are identified using a common standards-based methodology, which provides a scientific and universally applicable set of procedures for identifying, inventorying, and mapping these species.

Healthy Ecosystem – an ecosystem in which structure and function allow the maintenance of the desired conditions of biological diversity, biotic integrity, and ecological processes over time.

Highly Erodible Soils – soils that, because of their physical properties or slope, the U. S. Department of Agriculture, Natural Resources Conservation Service identifies as being highly susceptible to wind or water erosion.

Humus – the top layer of soil (organic plant and animal residues), which are undergoing decomposition.

Hydrologic Unit Code (HUC) – Hydrologic Unit Codes (HUCs) are part of a U.S. Geologic Survey (USGS) watershed classification system based on size. For management and analysis purposes, hydrologic units are defined as the area that drains to a stream segment between an upstream-downstream pair of points. Under this system, the United States is divided into major watersheds such as the Mississippi River, and then further divided into subwatersheds.

Improvement Cutting – an intermediate treatment to improve the growth rate of residual trees.

Improved Grounds – grounds on which personnel annually plan and perform intensive maintenance activities. These are developed areas of an installation that have lawns and landscape plantings that require intensive maintenance. They usually include the cantonment, parade ground, drill fields, athletic areas, golf courses (excluding roughs), cemeteries, and housing areas.

Indigenous Species – species historically native to an area.

Infiltration – the gradual downward flow of water from the surface through soil to ground water and water table reservoirs.

In-house – a collective reference to federal government (Department of the Army) workers; as differentiated from and excluding daily (A-76) or periodic short term contract workers.

Integrated Resource Management Plan – a natural and cultural resources management plan based on ecosystem management that shows the interrelationships of the individual component plans as well as mission and land use activities affecting the basic land management plans.

Intermittent Stream – a stream or reach of a stream that does not flow continuously, as when water losses from evaporation or seepage exceed the available stream flow. Flow occurs only at certain wet times of the year, as when the channel receives water from springs or from surface source. The channel is well defined.

Interior Dependent Species – those wildlife species that depend on large, unbroken tracts of forestland for breeding and long-term survival. The term is also often used in conjunction with Neotropical migratory bird species requiring large patches of fairly homogeneous habitat for population viability.

Intolerant Species – plant species those are incapable of establishing in the shade of other trees.

Invasive Species – alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Karst – a type of topography that is formed over limestone or by a dissolving or solution of the rocks, characterized by sinkholes, closed depressions, caves, solution channels, internal drainage and irregular bedrock surfaces.

Log Landing – A clearing where tree logs are skidded and decked for loading on trucks for transportation to a mill.

Land Management Unit – the smallest land management division that planners use in developing specific strategies of accomplishes natural resources management goals. Land management units may correspond to grazing units on agricultural outleased land, stands or compartments on commercial forest lands, various types of improved ground (for example, athletic fields, parks, yards in family housing, or landscaped areas around administrative buildings), or identifiable semi-improved ground (for example, airfield areas, utility right-of-way, or roadside areas).

Landscape – in addition to the traditional meaning of the term, in ecology landscape has a special meaning: an area composed of interacting and inter-connected ecosystems that are variously repeated because of geology, landform, soils, climate, biota, and human influences throughout the area.

Landslide – 1) A mass of material that has slipped downhill under the influence of gravity, frequently occurring when the material is saturated with water. 2) Rapid movement down slope of a mass of soil, rock, or debris.

Legume – a member of the pulse family, one of the most important and widely distributed plant families. The fruit is a pod that opens along two sutures when ripe. Leaves are alternate, have stipules, and are usually compound. Includes many valuable food and forage species, such as peas, beans, peanuts, clovers, alfalfas, sweet clovers, lespedezas, vetches, and kudzu. Practically all legumes are nitrogen-fixing plants.

Legume Inoculation – the addition of nitrogen-fixing bacteria to legume seed or to the soil in which the seed is to be planted.

Lentic – relating to or living in still waters such as lakes, ponds, and swamps.

Liming – application of crushed limestone to soils to raise the pH (make the soil less acid).

Litter – 1) The uppermost layer of organic debris on the ground under a vegetation cover, i.e., essentially the freshly fallen or only slightly decomposed vegetable material, mainly from foliage but also bark fragments, twigs, flowers, fruits, etc. 2) Refuse left by Picatinny employees.

Loamy – intermediate in texture and properties between fine-textured and coarse-textured soils; includes all textural classes with the words “loamy” or “loam” as a part of the class name, such as clay loam or loamy sand.

Lotic – relating to or living in actively moving water such as streams.

MBF – A unit of measure used in tree or log volumes. For example 1.0mbf = 1,000 board feet. One board foot (.01mbf) measures 12”L x 12”W x 1”thick.

Management Practice – a specific activity, measure, course of action, or treatment.

Market Value – goods, services and other uses, which are commonly bought and sold, and which are priced or valued directly from existing markets.

Mast – the fruits and nuts of such plants as oaks, beech, hickories, dogwood, blueberry and grape.

Merchantable – a standing tree that has a net value when processed and delivered to a mill or some other market, after all harvesting and transportation costs are considered.

Mineral – any inorganic material. The term is used to designate broadly all material that is not animal or vegetable. It includes sand, gravel, and stone.

Mixed Hardwoods – timber stands, characterized by a mixture of hardwood tree species, including oaks, basswood, white ash, hickories, red maple and others. A mixture of forest types.

Mortality – trees that die before the end of the rotation and are usually not harvested.

Mulch – a natural or artificial layer of plant residue or other materials, such as sand or paper, on the soil surface.

Multiple Use — the integrated, coordinated, and compatible use of various natural resources to derive the best benefit while perpetuating and protecting those resources.

Multiple Use and Sustained Yield Management – the care and use of natural resources so as to best serve the present and future needs of the United States and its people without impairing the productivity of the land and water.

Natural Resources Management Professional – a person with a degree in the natural sciences who manages natural resources on a regular basis and receives periodic training to maintain proficiency in that job.

National Register of Historical Places – a listing maintained by the National Park Service of areas which have been designated as being of local, regional or national historical significance.

Native – a plant or animal indigenous to a particular locality or ecosystem.

No Action Alternative – an alternative identified in an Environmental Analysis in which either (1) current management is continue or (2) a project does not occur.

Northern Hardwoods – primarily sugar maple, yellow birch and beech. May include red maple, white ash, black cherry, and hemlock.

Non-Game Species – animal species that are not usually hunted in this state. The State Legislature determines this classification.

Old-Growth Forest – a forest stands in which natural processes and succession have occurred over a long period of time relatively undisturbed by humans.

Operable – in reference to timber harvesting, a set of conditions including site access, prescription difficulty and potential product values that, in total, determine if a site is worth logging.

Over Mature – a stand of trees that is older than normal rotation age for the type.

Overstory – the upper crown canopy of a forest, but usually stated in reference to the largest trees.

Open Space – any parcel or area of open land or water essentially unimproved and set aside, dedicated, designated or reserved for the protection or natural resources or farmland; for public or private use or enjoyment; or for the use and enjoyment of owners and occupants or land adjoining or neighboring such open space, provided that such areas may be improved with only those buildings, structures, streets, and off-street parking and other improvements that are designed to be incidental to the natural openness of the land.

Outdoor Recreation – recreation that relates directly to and occurs in natural, outdoor environments.

Outdoor Recreation Resources – land and water areas and associated natural resources that provide, or have the potential to provide, opportunities for outdoor recreation for present and future generations.

Park – a tract of open space, designated and used by the public for active or passive recreation.

Parent Material (Soils) – the unconsolidated, more or less chemically weathered mineral or organic matter from which the solum of soils has developed by pedogenic processes. The C-horizon may or may not consist of materials similar to those which A- and B-horizons developed.

Peat – unconsolidated soil material consisting largely decomposed or only slightly decomposed organic matter accumulated under conditions of excessive moisture.

Perennial Stream – a stream that flows continuously throughout the year during most years. It receives water not only from precipitation, but also from underground sources such as springs and seeps, and its upper surfaces generally stand lower than the water table in the locality through which it flows. The channel is well defined.

Pest – a plant, animal or environmental stress, which the land manager determines to be detrimental to achieving resource management objectives.

Pesticide – any substance or mixture of substances used to control populations of injurious pests.

pH – a quantitative measure of hydrogen – ion concentration. A pH of 7 corresponds to exactly neutrality; a pH less than 7 indicates acidity; and a pH of greater than 7 indicates alkalinity.

Pioneer Tree Species – shade intolerant species, like aspen and grey birch, that are the first trees to invade freshly disturbed sites and abandoned fields.

Plant Species of Concern – a State of NJ term applied to plant species that warrant special conservation attention because of some evidence of decline, inherent vulnerability to environmental deterioration, habitat modification, or small populations. This is a transitional term that categorizes plants that may become state Endangered. This is equivalent to a threatened status even though this category does not exist for plants in NJ code or law.

Plantation – a forest crop of stand raised artificially, either by seeding or planting of young trees.

Point Source Pollution – pollution traceable to a discharge of pollutants from a discernible, confined and discrete conveyance, such as an effluent discharge from a sewage treatment plant.

Pole Timber – a DBH size-class representing trees that are usually more than 4.0 inches DBH and less than 10.0 inches.

Predator – an animal species that obtains its food by hunting other animal species.

Preparatory Cut – the first phase of a three-cut shelterwood system that removes species that will not be favored in the next stand.

Prescribed Fire – prescribed fire is the application of fire under specified conditions to achieve specific land management objectives.

Prescription – a course of action to effect change in a forest stand.

Prime Agricultural Land – land that is best suited for producing food, feed, forage, fiber, and oilseed crops, and also available for those uses; includes cropland, pastureland, rangeland, forest lands, but not urbanized land or water. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern agricultural methods.

Prime Timber Land – land that has soil capable of growing wood at the rate of 85 cubic feet or more per acre per year (at culmination of mean annual increment) in natural stands and is not in urban or built-up land uses or water.

Productivity – growth per unit time.

Project – an organized effort to achieve an objective identified by location, activities, outputs, effects, and time period and responsibilities for execution.

Pulpwood – wood suitable for manufacturing into wood pulp for paper products.

Reclamation – returning disturbed lands to a form and productivity that will be ecologically balanced and in conformance with the predetermined land management plan.

Record of Decision – the documentation of what the decision was, the date, and a statement of reasons for the decision.

Recreation Area – a relatively small, distinctly defined portion of the Post where concentrated public use for the more traditional recreation predominates, e.g. picnic area, boat launches.

Reforestation – the natural or artificial restocking of an area with trees.

Regeneration – the natural or artificial renewal of trees in a stand.

Regeneration Cuttings – trees are removed from the stand to create conditions that will allow the forest to reproduce a new stand of trees. This is accomplished under either an even-aged management system or a un-evenaged management system.

Regulated Forest Land – land managed for timber production under sustained yield principles.

Removal Cut – the final cut of the Shelterwood System which removes the remaining mature trees, releasing the young stand.

Reserve Trees – trees left for wildlife, visual screen, or study because of their superior growing characteristics in areas where timber is being cut.

Residual – trees that are left to grow in the stand following a silvicultural treatment.

Residual Soil – a soil formed in material weathered from bedrock without transportation from the original location.

Revegetation – the reestablishment of a plant cover occurring either naturally or artificially.

Rights of Way — a strip of land mapped for use by a street, crosswalk, railroad, road, electric transmission line, gas pipeline, water main, sanitary or storm sewer main, shade trees, or for another special use, whether or not that use is active.

Riparian Area – geographically delineated area with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems, floodplains and wetlands.

Riparian Ecosystem – a transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics and distinctive vegetation communities that require free or unbound water.

Rotation Age – the planned number of years between the regeneration of a forest stands its final cutting at a specific stage of maturity.

Salvage Cutting – the removal of dead, dying and damaged trees after a natural disaster to utilize the wood before it rots.

Sanitation Cutting – the removal of dead, dying and damaged trees after a natural disaster to prevent or interrupt the spread of insects and disease.

Sapling – trees that are more than 4.5 feet tall but less than 5.0 inches DBH.

Sawlog – a log considered suitable in size and quality for producing lumber; trees, larger than 9 inches at DBH.

Scarification – ripping the top six to ten inches of soil to relieve the effects of soil compaction caused from human activities such as timber harvest, agriculture, and recreation.

Sediment – solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice.

Seedbed – the soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

Seedlings – trees that are less than 4.5 feet tall.

Seed Tree – the removal of most of the trees in one cut, leaving a few scattered trees of desired species to serve as a source of seed for the new even-aged stand.

Semi-Improved Grounds – grounds where personnel perform periodic maintenance primarily for operational and aesthetic reasons. These usually include ground adjacent to ammunition storage areas, shooting ranges, picnic areas, and golf course roughs.

Shade Strip – a strip of standing trees, shrubs and other vegetation maintained along perennial streams to provide shade to the aquatic ecosystem and protect the fishery resource from adverse water temperature increases.

Shade Tolerance – the capacity of a tree to develop and grow in the shade of, and in competition with, other trees. An example of a highly shade tolerant species is sugar maple.

Shelterwood – a series of two or three treatments that gradually open the stand and stimulate natural reproduction of a new even-aged stand.

Silt – 1) a soil separate consisting of particles between 0.05 and 0.002 millimeter in equivalent diameter. 2) a soil textural class.

Silvicultural System – a management process whereby forests are tended, harvested, and replaced, resulting in a forest of distinctive form. Systems are classified according to the harvest method to remove the designated trees and provide for regeneration and according to the type of forest produced.

Silviculture – the art of science of growing forests for timber and other resource values.

Singletree Selection – the removal of individual trees under unevenaged regeneration methods.

Site Index – a measure of the relative productive capacity of an area based on tree height growth.

Site Preparation – an activity intended to make conditions favorable for planting or for the establishment of natural regeneration.

Skidder – a vehicle used to move logs from the stump to a landing. Most skidders have rubber tires and pull logs by the butt end (elevated), dragging the top.

Skid Trail – a temporary travel route used to move logs from the stump to a landing site where logs are loaded on a hauling vehicle.

Slope – the average angle of incline of the terrain usually expressed as a percentage of the amount of the incline rises over a horizontal distance.

Slash – branches, bark, tops, uprooted stumps, and broken or uprooted trees left on the ground after logging; also debris resulting from thinning, wind, or fire.

Snag – includes standing dead or partially dead trees, which are at least 6” in diameter at breast height (DBH) and 20 feet tall.

Softwood – a coniferous tree. Trees belonging to the botanical group gymnosperm. Softwoods at Picatinny include, hemlock, white pine and red pine.

Soil Association – a group of defined and named taxonomic soil units occurring together in an individual and characteristic pattern over a geographic region, comparable to plant associations in many ways.

Soil Fertility – the quality of soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and physical condition of soil, are favorable.

Soil Horizon – a layer of soil, approximately parallel to the soil surface, with distinct characteristics produced by the soil forming processes.

Soil Improvement – the processes for, or the results of, making the soil more productive for growing plants by drainage, irrigation, addition to fertilizers and soil amendments and other methods.

Soil Profile – a progression of distinct layers of soil, beginning at the surface that has been altered by normal soil forming processes.

Soil Survey – a general term for the systematic examination of soils in the field and in the laboratories; their description and classification; the mapping of kinds of soil; the interpretation of soils according to their adaptability for various crops, grasses, and trees; their behavior under use or treatment for plant production or for other purposes; and their productivity under different management systems.

Species At Risk (SAR) – Includes species on lists maintained by USFWS, NOAA Fisheries Service, and state agencies as threatened or endangered or candidates for such lists. SAR also includes species whose designation as threatened or endangered may require conservation efforts significantly impacting a military mission. SAR would include aka priority (non-game) species in NJ SWAP. The term also includes species of regional concern within regional conservation plans such as Partners in Flight Bird Conservation Plans, North American Waterbird Conservation Plan, United States Shorebird Conservation Plan, etc. (see also Species of Concern (federal) and Species of Special Concern (state)).

Species of Concern – an informal term used by the USFWS that refers to those species (plant or animal) which various regions believe might be in need of concentrated conservation actions. The conservation actions may range from mere monitoring to proposed listing under the ESA.

Species of Special Concern – a State of NJ term applied to wildlife species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a state Threatened species. This category would also be applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state.

Sprawl – a pattern of development characterized by inefficient access between land uses or to public facilities or services and a lack of functional open space. Sprawl is typically auto-dependent, single use, resource consuming, and discontinuous, low density development pattern.

Stand – a community of trees occupying a specific area and sufficiently uniform in composition, age, arrangement, and condition as to distinguishable from the forest on adjacent areas.

Stand Condition – a silvicultural classification used to describe the present condition of a stand, particularly in relation to its need for treatment.

Stem – the above ground portion of a tree between ground level and the first main branches in the canopy.

Standard – a principle requiring a specific level of attainment, a rule to measure against.

State Historical Preservation Officer – the State Historic Preservation Officer (SHPO) is the official within each State who has been designated by the Governor or Chief Executive of the State to administer the National Register and grants programs within the State.

Stewardship – the management of a resource base with the goal of maintaining or increasing the resource's value indefinitely into the future.

Stocking – an indication of the number of trees in a stand as compared to the optimum number of trees to achieve some management objective, usually improved growth rates or timber values.

Stony – containing sufficient stones to interfere with tillage but not to make intertilling crops impractical. Stones may occupy 0.01 to 0.1 percent of the surface. Stoniness is not a part of the soil textural class. The terms “stony” and “very stony” may modify the soil textural class name in the soil type, but this is simply a brief way of designating stony phases.

Stream Characteristics:

Braided Stream – one whose flow successively divides and rejoins, forming islands.

Drainage Density – measure of how well drained a watershed is by surface streams. It is the miles of perennial and intermittent streams divided by the square miles of watershed area.

Effluent Stream – a stream losing water to the ground water.

Riparian Vegetation – vegetation growing along the banks of a stream.

Stream Flow Duration:

Perennial Streams – streams whose flow persists almost throughout the year, during most years, in a well-defined channel.

Intermittent Streams – streams whose flow generally occurs only during wetter seasons, in a well-defined channel.

Ephemeral Streams – streams which flow only in response to storms; channels are not well defined.

Stream Orders:

First Order Stream – streams with an unbranched main stem. These streams are normally found in the headwaters portion of a watershed.

Second Order Stream – a second order stream is that portion of the main stem of a stream below the confluence of the two first order streams.

Third Order Stream – a third order stream is that portion of the main stem of a stream below the confluence of the two second order streams.

Structure – the vertical and horizontal arrangement of vegetation in a forest.

Stumpage – the value of timber as it stands in the woods just before harvest (on the stump).

Subsoil – the layer below the soil surface in which roots normally grow.

Succession – the orderly and predictable replacement of one plant community by another over time in the absence of disturbance.

Surface Soil – the uppermost part of the soil ordinarily moved on tillage or its equivalent in uncultivated soils, ranging in depth from about 5 to 8 inches. Frequently designated as the plow layer, the Ap layer of the Ap horizon.

Sustainability – the production and use of resources to meet the needs of present generation without compromising the ability of future generations to meet their needs.

Sustained Yield – an annual or periodic output of products from the forest without the impairment of the productivity of the land.

Timber Cruise – A statistical method used to determine the number, size, volume, and species in a selected stand of trees or forest.

Timber Sale – the cutting and removal of designated trees under the authority of a contract.

Thinning – generally, a reduction in the number of trees in an immature forest stand to reduce tree density and promote growth potential on fewer, higher quality trees.

Threatened Species – those federally –or state listed species of flora and fauna that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range and have been designated for special protection and management pursuant to the Endangered Species Act.

Tolerance – the ability of a tree to grow satisfactory in the shade of or in competition with other trees. Trees, which are classified as tolerant, can survive and grow under continuous shade.

Topsoil – the dark-colored surface layer of soil that ranges from a fraction of an inch to several feet deep.

Trace Element – elements naturally occurring in soil or vegetation not considered to be of major nutritional importance. Often referred to as micronutrients.

Trail – a designated path or travel way of varying width, which is maintained for hikers, horsemen, snow travelers, bicyclists, or motorized vehicles.

Transmission Pipeline – a pipeline which carries gas or liquid from a producing field or central collection facility to a storage or consumption facility, usually over long distances.

Treatment – any action in forest stands that is controlled by silvicultural prescription.

Trout Maintenance or Trout Production Waters – waters designated by the New Jersey Department of Environmental Protection for the support of trout throughout the year, or for spawning or nursery purposes during trout's first summer.

Unimproved Grounds – grounds not classified as improved or semi-improved and usually not mowed more than once a year. These include weapons ranges; forestlands; cropland and grazing lands; swales, ponds, and wetlands; and areas in weapon testing beyond the safety zone.

Uneven-aged Management – a timber management method that produces a stand composed of a wide range of tree ages and sizes.

Urban Forests – planted or remnant native tree species existing within urbanized areas such as parks, tree-lined residential streets, scattered tracts of undisturbed woodlands, and cantonment areas.

Urban Wildlife – wildlife that habitually live or periodically survives in an urban environment on improved or semi-improved grounds.

Utility Corridor – a linear tract of land of varying width forming a passageway through which various commodities such as oil, gas, and electricity are transported.

Viable Population – a population, which has adequate numbers and dispersion of reproductive individuals to ensure the continued existence of the species population on the planning area.

Volume Table – a chart that shows volume by DBH or log diameters and log heights (usually 16 feet) or actual manufactured log length.

Watchable Wildlife Areas – areas identified under the Watchable Wildlife Program as suitable for passive recreational uses such as bird watching, nature study, and other nonconsumptive uses of wildlife resources.

Water Measurement:

Acre Foot – a measure of water volume commonly used in describing lakes, or water yield equivalent to one level acre of water, one foot deep, or 43,560 cubic feet.

Cubic Feet Per Second (cfs) – a rate of water flow delivering one cubic foot of water each second, commonly used as a measure of stream discharge.

Watershed – the geographic area within which water drains into a particular river, stream, or body of water. A watershed includes both the land and body of water into which the water drains.

Water Table – the upper surface of the ground water.

Water Table, Perched – the surface of a local zone of saturation held above the main body of ground water by an impermeable layer or stratum, usually clay, and separated from the main body of ground water by an unsaturated zone.

Water Yield – the total net amount of water produced on the watershed including stream flow and ground water recharge.

Well Stocked – stands having sufficient growing stock for sawtimber production.

Wetlands – areas inundated or saturated by surface or ground water at a frequency and a duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wildlife Carrying Capacity – the maximum density of wildlife that a particular area or habitat can carry on a sustained basis without deterioration of the habitat.

Wildlife Corridor – a means of protecting land running between areas of habitat of significant wildlife communities, for the purpose of effectively extending the size of the area.

Wildlife Habitat – the sum total of environmental conditions of a specific place occupied by a wildlife species or a combination of such species.

Wildlife Openings – openings maintained to meet various foods or cover needs for wildlife. They may contain native vegetation or planted crops and can be maintained by burning, mowing, planting, fertilizing, grazing, or applying herbicides.

LITERATURE CITED (and Bibliography)

N.B. Online Sources as referenced in text (or consulted) are indicated by [**Internet**] in the following citations.

Anderson, K. 1989. Checklist of the Plants of New Jersey. NJ Audubon Society, Mount Holly, NJ.

BCI, Bat Conservation International. 2012. [**Internet**] White-Nose Syndrome. Available at:
<<http://www.batcon.org/index.php/what-we-do/white-nose-syndrome.html>>
[accessed 18 SEP 2012]

Bennett, G.W. 1970. Management of Lakes and Ponds. Van Nostrand Reinhold Co. New York.

Bird Conservation Region 28. 2010. [**Internet**] Bird Conservation Region 28. Available at:
<<http://www.nabci-us.org/bcr28.htm>> [accessed 25 SEP 2012]

Blick, S., F. Kelly, J.J. Skupien. 2004, rev 2009. [**Internet**] NJ Stormwater Best Management Practices Manual. NJDEP Division of Watershed Management. Available at:
<http://www.njstormwater.org/bmp_manual/NJ_SWBMP_covcon_CD.pdf>
[accessed 26 SEP 2012]

Bradshaw, A.D. and M.J. Chadwick. 1980. The Restoration of Land. University of California Press. Berkely.

British Columbia Ministry of Environment. 1979. Preliminary Reptile Management Plan for British Columbia. Misc. Report, B.C. Ministry of Natural Resources, Fish and Wildlife Branch.

Brocke, R.H. 1979. The Name of the Nongame. Wildlife Society Bull. 7:279-282.

Brown, W.S. 1993. Biology, status and management of the timber rattlesnake (*Crotalus horridus*): a guide for conservation. SSAR Herpetological Circular 22: 1-78.

Carlander, K.D. 1969. Handbook of Freshwater Fishery Biology, Volume I. Iowa State University Press. Ames.

Carlander, K.D. 1977. Handbook of Freshwater Fishery Biology, Volume II. Iowa State University Press, Ames.

Carle, F. 1995. A Survey of the Odonata of Picatinny Arsenal and Vicinity. Legacy Resource Management Project #417. Forest Environment and Natural Resources Division. (AMSTA-AR-PWR), Picatinny Arsenal, NJ.

Caughley, G. 1977. Analysis of Vertebrate Populations. J.Wiley & Sons. London.

Chambers, R.E. 1983. Integrating Timber and Wildlife Management Handbook. S.U.N.Y., College of Environmental Science and Forestry, N.Y. Department of Environmental Conservation.

- Chenger, J. 2006a. Mount Hope and Hibernia Mines Indiana Bat Spring Migration 2006. Bat Conservation and Management, Inc. (for PICA, DPW-EAD). Carlisle, PA.
- Chenger, J. 2006b. Summer Woodland Bat Survey Picatinny Arsenal 2006. Bat Conservation and Management, Inc. (for PICA, DPW-EAD). Carlisle, PA.
- Clark, C.F. 1960. Lake St. Mary's And Its Management. Publication W-324, Ohio Department of Natural Resources.
- Clawson, R. L. 1987. Indiana bats: Down for the count. *Endangered Species Tech. Bull.* 12(9): 9-11.
- Clugston, J.P. 1986. Strategies for Reducing Risks from Introductions of Aquatic Organisms: The Federal Perspective. *Fisheries* 11:26-27.
- Cody, T. L. 1985. *Habitat Selection in Birds*. Academic Press, New York.
- Copeyon, C. 1997. "Bog Turtles in North Carolina". *Pennsylvania Field Office*. U.S. Fish and Wildlife Service. State College, PA.
- Crosbey, A.W. 1986. *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*. Cambridge University Press, Cambridge.
- Dasmann, R.F. 1964. *Wildlife Biology*. J.Wiley & Sons, New York.
- Davis, D.E. and R.L. Winstead. 1980. Estimating Numbers and Wildlife Populations. In: *Wildlife Management Techniques Manual* (Ed.S.D. Schemnitz). The Wildlife Society, Washington, D.C.
- DeGraff, R.M., G.M. Whitman, and D.D. Rudis. 1981. *Forest Habitat for Mammals of the Northeast*. USDA-FS. U.S. Government Printing Office. Washington, D.C.
- Department of Defense/Partners in Flight. 2012. [**Internet**] Department of Defense/Partners in Flight. Available at: < <http://www.DODpif.org/plans/migratory/mbtaDOD.php>> [accessed 26 SEP 2012]
- Dorrance, M.J. 1983. A Philosophy of Problem Wildlife Management. *Wildlife Society Bulletin* 11:319-324.
- E2 Project Management. 2012. Timber Rattlesnake and Northern Copperhead Hibernacula/Emergence Survey, Early Basking Survey, Gestation/Birthing Survey 2012. (for Safe Armaments Facility for Energetic Research, Picatinny Arsenal). Rockaway, NJ.
- Eberly, C. 2011. [**Internet**] DOD Conservation Measures. Available at: <http://www.dodpif.org/downloads/DoD_Conservation_Measures.pdf> [accessed 26 SEP 2012]
- Ecosystem Management Technical Report. 2008. [**Internet**] Ecosystem Management Technical Report. (New Jersey Highlands Council) Available at: <http://www.highlands.state.nj.us/njhighlands/master/tr_ecosystem_management.pdf> [accessed 21 SEP 2012]

- Edington, J.M. and M.A. Edington. 1986. Ecology, Recreation and Tourism. Cambridge University Press, Cambridge.
- Eisenburg, J.F. 1981. The Mammalian Radiations: An Analysis of Trends In Evolution, Adaptation, and Behavior. University of Chicago Press. Chicago.
- Eltringham, S.K. 1984. Wildlife Resources and Economic Development. John Wiley & Sons, New York.
- Evans, D.E., W.A. Mitchell, R.A. Fischer. 1998. Species Profile: Indiana Bat (*Myotis sodalis*) on Military Installations in the Southeastern United States. Technical Report SERDP-98-3, U.S. Army Corps of Engineers Waterways Experiment Station. Vicksburg, MS.
- Hendee, J.C., G.H. Stankey, and R.C. Lucas. 1978. Wilderness Management. Misc. Publication No. 1365, USDA-FS
- Humphrey, S.R. 1982. Bats. In Wild Mammals of North America (Eds. J.A. Chapman and G.A. Feldhamer). John Hopkins University Press, Baltimore.
- Johnsen, A.M. 1982. Urban Habitat Use by House Sparrows, Rock Doves, and Starlings. Masters Thesis, S.U.N.Y., College of Environmental Science and Forestry, Syracuse.
- Kohler, C.C. 1986. Strategies for Reducing Risks from Introductions of Aquatic Organisms. Fisheries 11:2-3.
- Lee, D.S. and J.B. Funderburg. 1982. Marmot. In Wild Mammals of North America (Eds. J.A. Chapman and G.A. Feldhamer). John Hopkins University Press.
- (Maier, M. 2010 [**Internet**] Picatinny – SAME (Society of American Military Engineers) Presentation. Available at: < <http://www.samenj.com/pdfs/Maier-Picatinny-SAME-Presentation-Apr2010.pdf>> [accessed 23 SEP 2012]
- Mann, A. and V. Brack Jr. 2011. Summer Mist Net Survey for the Federally Endangered Indiana Bat (*Myotis sodalis*) at Site KM38 on Picatinny Arsenal Morris County, New Jersey for the Roseland-Bushkill Transmission Line Project Public Service Electric and Gas Company. Environmental Solutions and Innovations Inc. Cincinnati.
- Michell, K. 2012. Timber Rattlesnake Hibernacula/Emergence Surveys Public Service Electric and Gas (PSE&G) Susquehanna-Roseland Upgrade Project Picatinny Arsenal Township of Rockaway Morris County, New Jersey. (for PSE&G). Narrowsburg, NY
- McClure, M.S. 2001. Biological Control of Hemlock Woolly Adelgid in the Eastern United States. FHTET 2000-08. Morgantown, WV: U.S. Department of Agriculture, Forest Service, Forest Health Technology Enterprise Team; 10 p.
- National Invasive Species Council. 2008. [**Internet**] 2008-2012 National Invasive Species Management Plan. 35 pages. Available at: <http://www.invasivespecies.gov/main_nav/mn_NISC_ManagementPlan.html> [accessed 24 SEP 2012]

- National Invasive Species Council. n.d. [**Internet**] Welcome to InvasiveSpecies.gov. Available at: <<http://www.invasivespecies.gov/>> [accessed 24 SEP 2012]
- NatureServe. 2012. [Internet] NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available at: <<http://www.natureserve.org/explorer>> [Accessed: 27 SEP 2012]
- New Jersey Conservation Foundation. 1992. The New Jersey Highlands: Treasures at Risk. Mitchell. Morristown, NJ. 152p.
- New Jersey Department of Environmental Protection, 1998a. Highlights of the Initial Watershed Characterization and Assessment of Watershed Management Area 6 – Upper Passic, Whippany and Rockaway Watersheds. February. 25p.
- New Jersey Department of Environmental Protection. 1998b. Initial Watershed Characterization and Assessment for the Upper Passic, Whippany and Rockaway River Watersheds. (WMA #6). October. 49 p.
- New Jersey Division of Fish and Wildlife. 2012. [**Internet**] New Jersey Landscape Project, Version 3.1. Report. 33p. (New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program) Available at: <http://www.njfishandwildlife.com/ensp/landscape/lp_report_3_1.pdf> [Accessed 20 SEP 2012]
- New Jersey Division of Fish, Game and Wildlife- Endangered and Nongame Species Program. 1995. “Picatinny Arsenal Rare Species Survey.” 1995. Legacy Resource Management Project #417. Forest Environmental and Natural Resources Division (AMSTA-AR-PWR), Picatinny Arsenal, NJ.
- New Jersey Fish and Game Council. 2010. [**Internet**] Comprehensive Black Bear (*Ursa americanus*) Management Policy. Available at: <http://www.state.nj.us/dep/fgw/pdf/bear/policy_lit/cbbmp7-10.pdf> [accessed 21 SEP 2012]
- New Jersey Invasive Species Council. 2009. [**Internet**] New Jersey Strategic Management Plan for Invasive Species. Trenton, NJ. 110 pages. Available at: <<http://www.nj.gov/dep/njisc/docs/>> [accessed 19 SEP 2012]
- NJ GeoWeb Map Viewer. 2012. [**Internet**] Look for/in: Watershed Mgt Areas. Available at: <<http://njwebmap.state.nj.us/NJGeoWeb>> [Accessed 19 SEP 2012]
- NJ Highlands Council 2008 [**Internet**] Regional Master Plan. Available at: <http://www.highlands.state.nj.us/njhighlands/master/rmp/final/highlands_rmp_112008.pdf> [accessed 21 SEP 2012]
- NJ Highlands Council 2011 [**Internet**] New Jersey Highlands Council | Highlands Act & Maps. Available at: <<http://www.highlands.state.nj.us/njhighlands/actmaps/>> [accessed 21 SEP 2012]
- NJDEP. 2010 [**Internet**] News Release 10/P72 - Commissioner Martin Approves New Bear Management Policy that Calls for Bear Hunt. Available at <http://www.nj.gov/dep/newsrel/2010/10_0072.htm> [accessed 21 SEP 2012]

- Nyland, R.D. D.A. Maquis, and D.K. Whittemore. 1981. Northern Hardwoods. In: Choices in Silviculture for American Forests. Society of American Foresters. Washington, D.C.
- Peterson, R.M. 1983. Riparian Area Management on the National Forest System. *Fisheries* 8:22-25.
- Picatinny Arsenal. 2012. [Internet] Picatinny: Commander's Overview. Available at: <<http://www.pica.army.mil/PicatinnyPublic/welcome.asp>> [accessed 27 SEP 2012]
- Pinelands Alliance. 2007. [Internet] All of the Pinelands' Rare Plants should be Protected. Jan - Feb 08 ISSUE 44. Available at: <http://www.pinelandsalliance.org/downloads/pinelandsalliance_34.pdf> [accessed 14 OCT 12]
- Porter, W.F. 1978. The Ecology and Behavior of the Wild Turkey in Southeastern Minnesota. Doctoral Thesis, University of Minnesota.
- Radis, R. P. 1995. Botanical Survey for Threatened or Endangered Plant Species, and Species of Concern, at Picatinny Arsenal, NJ. Legacy Resource Management Project #417. Forest Environmental and Natural Resources Division (ANSTA-AR-PWR), Picatinny Arsenal, NJ.
- Reardon, R.; Onken, B., tech. coords. 2004. Biological Control of Hemlock Woolly Adelgid in the Eastern United States. FHTET-2004-04. Morgantown, WV: U.S. Department of Agriculture, Forest Service, Forest Health Technology Enterprise Team; 24 p.
- Rinehart, J.B. and T.H. Kunz. 1998. Biological Survey for the Federally Listed Endangered Indiana Bat (*Myotis sodalis*), Picatinny Arsenal, Morris County, New Jersey. Boston University
- Rogers, Captain J.A., Jr. 1931. The History of Picatinny Arsenal.
- Schaller, G.B. 1967. The Deer and the Tiger: A Study of Wildlife in India. University of Chicago Press, Chicago.
- Schantz, K.A. 2011. Preliminary Habitat Assessment and Gestation/Birthing Site Surveys for Timber Rattlesnakes and Northern Copperheads within and adjacent to Picatinny Arsenal's Proposed SAFER Site. NJDEP-Division of Fish and Wildlife-Endangered and Nongame Species Program.
- Scherer, A. 2000. A Survey for the Federally Listed Endangered Indiana Bat (*Myotis sodalis*), Picatinny Arsenal, Morris County, New Jersey. (USFWS)
- Smith, L. and K.E. Clark. 2011. New Jersey Bald Eagle Project, 2011, New Jersey Department of Environmental Protection, Division of Fish and Wildlife
- Soddicker, M.L. 1983. House Cats. Misc. Publication, Coop. Ext. Service. University of Nebraska.
- Shafland, P.L. and W.M. Lewis. 1984. Terminology Associated with Introduced Organism. *Fisheries* 5:17-18.
- Skylands Landscape. 2008. [Internet] Skylands Landscape Chap/Sec II-E. Available at: <<http://www.state.nj.us/dep/fgw/ensp/wap/pdf/skylands.pdf>> [accessed 4 OCT 2012]

- Skylands Pamphlet. n.d. [**Internet**] Skylands Pamphlet. Available at:
<http://www.nj.gov/dep/fgw/ensp/wap/pdf/pamphlet_skylands.pdf> [accessed 4 OCT 2012]
- Stockdale, T.M. 1976. Ohio Pond Management. Bulletin No. 374, Cooperative Extension Service, Ohio State University.
- Stormwater Management Rule FAQs. 2008. [**Internet**] Stormwater Management Rule FAQs. NJDEP. Available at: <<http://www.nj.gov/dep/watershedmgt/stormwaterfaqs2.htm>> [accessed 21 SEP 2012]
- Swift, M.J., O.W. Heal, and J.M. Anderson. 1979. Decomposition in Terrestrial Ecosystems. University of California Press, Berkeley.
- Swingle, H.S. 1950. Relationships and Dynamics of Balanced and Unbalanced Fish Populations. Bulletin No. 274, Auburn Agricultural Experimental Station.
- Tarlowe, P. 2010a. [**Internet**] Comprehensive Black Bear Management Policy - NJ Division of Fish and Wildlife. Available at: <<http://www.nj.gov/dep/fgw/bearpolicy10.htm>> [accessed 21 SEP 2012]
- Tarlowe, P. 2010b. [**Internet**] NJ Wildlife Action Plan (formerly referred to as the Comprehensive Wildlife Conservation Strategy for Wildlife of Greatest Conservation Need). Available at: <<http://www.nj.gov/dep/fgw/ensp/waphome.htm>> [accessed 4 OCT 2012]
- Tarlowe, P. 2012. [**Internet**] NJDEP Division of Fish & Wildlife - Wildlife Species of Special Concern in New Jersey. Available at: <<http://www.state.nj.us/dep/fgw/spclsp.htm>> [accessed 10 OCT 2012]
- TetraTech EM Inc. 2003. Draft Invasive Species Survey Summary Report – Picatinny Arsenal, Dover, NJ. DACA01-D-0016 DO#012. Rockaway, NJ.
- United States Fish and Wildlife Service. 1974. Controlling Cats. Circular AC-403, DOI
- United States Forest Service. 1992. New York – New Jersey Highlands Regional Study. Michaels, Neville, Edelman, Sullivan and Dicola. USDA-Forest Service. 130 p.
- United States Forest Service. 2004. Eastern Hemlock Forests: Guidelines to Minimize the Impacts of Hemlock Woolly Adelgid. Ward, Montgomery, Cheah, Onken and Cowles. USDA-Forest Service. 24 p.
- U.S. Army Corps of Engineers. 1994. Identification and Analysis of Wetlands, Floodplains Threatened and Endangered Species and Archeological Geomorphology at Picatinny Arsenal, NJ. Vol II-Plates.USACE – Waterways Experiment Station. Vicksburg, MS
- U.S. Army Corps of Engineers. 1995. Identification and Analysis of Wetlands, Floodplains Threatened and Endangered Species and Archeological Geomorphology at Picatinny Arsenal, NJ. Vol I-Text.USACE – Waterways Experiment Station. Vicksburg, MS
- U.S. Department of Agriculture. 1976. Soil Survey of Morris County, New Jersey. USDA-NRCS.

- U.S. Fish and Wildlife Service. 2008. **[Internet]** Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. Available at: http://library.fws.gov/Bird_Publications/BCC2008.pdf [accessed 26 SEP 2012]
- USFWS. 2006. **[Internet]** Management Guidelines for Species At Risk on Department of Defense Installations DOD Legacy Project #03-154. (Provided by Natureserve to the U.S. Fish And Wildlife Service. Available at: http://www.fws.gov/endangered/esa-library/pdf/DoD_SpeciesatRisk_Management_Guidelines_FINAL.pdf> [accessed 10 OCT 2012]
- USFWS. 2012 [Internet] Midwest Region Division of Migratory Birds Authorized Activities Involving Unintentional Eagle Disturbance. Available at: <http://www.fws.gov/midwest/MidwestBird/EaglePermits/pdf/R3EaglePermitsFactSheet.pdf>> [accessed 26 SEP 2012]
- Walsh, Wendy. 2011. **[Internet]** Evaluated_Species.pdf Available at: http://www.fws.gov/northeast/njfieldoffice/pdf/Evaluated_Species.pdf> [accessed 24 SEP 2012]
- Welconmie, R.L. 1986. International Measures for the Control of Introductions of Aquatic Organisms. Fisheries 11:4-9.
- Wilmore, S.B. 1979. Swans of the World. Taplinger Publishing Company, New York.
- Windisch, A. G. 1993. Natural Community Inventory of Picatinny Arsenal, New Jersey. Legacy Resource Management Project #417. Forest Environmental and Natural Resources Division. (AMSTA-AR-PWR), Picatinny Arsenal, NJ.

DOD and DA and PICA OFFICIAL DOCUMENTS

AR 200-1. 2007. *Environmental Protection and Enhancement*.

DODI 4715.03. 2011. *Natural Resources Conservation Program*.

DODI 4715.16. 2008. *Cultural Resources Management*.

Integrated Cultural Resources Management Plan. 2008. PICA.

Integrated Pest Management Plan. 2010. PICA c/o Chugach IIPMC.

TM 5-630. 1982. *Natural Resources - Land Management*.

TM 5-631. 1981. *Natural Resources - Forest Management*.

TM 5-633. 1982. *Natural Resources - Fish and Wildlife Management*.

TM 5-635. 1982. *Natural Resources - Outdoor Recreation and Cultural Values*.

TM 5-803-13. 1988. *Landscape Design and Planting Criteria*. USACE.

UFC 3-210-05FA. 2004. *Design: Landscape Design and Planting Criteria*.

UFC 3-201-02. 2009. *Landscape Architecture*.

USACE. 1985. "*Development of Cost Effective Guidelines to Rehabilitate Disturbed Areas at Picatinny Arsenal*." In Report, for Picatinny Arsenal, NJ.

USAG – PICA Bulletin (PAB 200-1) 29 NOV 2012. Environmental Protection and Enhancement. PICA; DPW-EAD.

USAG – PICA Policy (PAP No.IMPI-MWR-006) 19 DEC 2014. Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities. PICA; FMWR-ODR.

USAG – PICA Official Policy Statement 200-1. 29 NOV 2012. Installation Environmental Management

PERSONS CONSULTED *(including many circa 2000-2001 per previous INRMP)

Appelquist, Carl. Environmental Engineer, Environmental Affairs Office, Picatinny Arsenal.

Arroyo, Lisa.* Endangered Species Biologist, USFWS.

Balzano, Steve.* Environmental Consultant, Environmental Resources Specialists, Inc.

Billelo, Dr. James. Medical Doctor, Picatinny Arsenal Clinic.

Breden, Tom.* New Jersey Department of Environmental Protection, Office of Natural Lands Management. {deceased 2003}

Boriek, Mark. Principal Fisheries Biologist, Bureau of Freshwater Fisheries, NJDFW.

Brown, Richard. New Jersey Department of Environmental Protection, Office of State Plan Coordination.

Carle, Dr. Frank Louis.* Local Entomologist and Rutgers University Professor.

Davis, Kelly. Fisheries Biologist, Office of Environmental Review, NJDFW

Gerbush, Mathieu. New Jersey Assistant State Climatologist, Rutgers University.

Gray, Christina.* Former NEPA Coordinator, formerly PICA.

Guidetti, Ronald. Chief, PICA Fire Department.

Huggan, Jason. Cultural Resources Manager, PICA.

Kane, Rich. Ornithologist, New Jersey Audubon Society.

Kapoor, Vinod.* Former Chief, Master Plans and Programs Office, PICA.

Karp, Steven. Geographic Systems Manager, New Jersey Department of Community Affairs.

Lichvar, Robert.* Wetlands scientist, USACE-WES.

Markuson, Jeremy. Endangered Species Biologist, USFWS.

Mitchell, Greg. Installation Integrated Pest Management Coordinator, BasOpsSup-Chugach.

McBride, Anthony. Principal Biologist, Wildlife Services Section, NJDFW.

Myers, W. Gil. NEPA Coordinator, PICA.

O'Brien, Mike.* Avocational Lepidopterist.

Opalecky, James. Lieutenant, PICA Police Department

Perry, Kevin.* ARDEC (PICA) Employee. Avocational Cultural Historian. *retired

Phelps, Marcus. Highlands Coordinator, USDA Forest Service.

Radis, Rick. Local Naturalist and Environmental Consultant, Herpetological Associates, Inc.

Reed, John. ARDEC (PICA) Employee. Avocational Hawk Watcher.

Rittler Sanchez, Jessica. Environmental Projects Coordinator, New Jersey Office of State Planning.

Schantz, Kris. Principal Zoologist, Endangered and Nongame Species Program, NJDFW.

Scherer, Annette.* Senior Endangered Species Biologist, USFWS.

Sciascia, Jim.* Principal Zoologist, Endangered and Nongame Species Office, NJDFW.

Snyder, David. New Jersey State Botanist. New Jersey Department of Environmental Protection, Office of Natural Lands Management.

Stechert, Richard.* Herpetologist, Rattlesnake Expert.

Valent, Mick. Principal Zoologist, Endangered and Nongame Species Program, NJDFW.

Van De Venter, Jonathan. Natural Resources Manager, PICA.

Von Aulock, Sabina.* Hydrologist, Morris County Planning Commission.

Walsh, Barbara. Local Planning Assistance Unit, New Jersey Department of Community Affairs.

Previous Preparers: This INRMP was initially prepared circa 2000-2001 through an Interagency Agreement between the United States Army Environmental Center (USAEC) and the United States Department of Agriculture – Forest Service. The preparers included the following Forest Service personnel:

Bob Burt, previously-Green Mountain and Finger Lakes NF, VT retired, 2007

Helene Cleveland, previously-Aberdeen Proving Ground, MD; still USFS, Wash. D.C.

Tinathan Cogger, previously-State and Private Forestry, WV; still USFS, Wash. D.C. Now T Lewis

John Quidachay, Eldorado National Forest, CA; same

Eric Wolters, previously Aberdeen Proving Ground, MD; retired, ??

coordinated through:

Mark Cleveland {deceased}

US Army Environmental Center | ATTN: SFIM-AEC-EQN | 5179 Hoadley Road
Aberdeen Proving Ground, MD 21010-5401

Although dated, much of the information is still applicable and relevant and has been retained with the appropriate references.

Previous and Current Reviewers: This updated INRMP has been re-screened by current and local subject matter experts. This document has been reviewed and discussed with the following Picatinny personnel and/or staff:

Robert SMITH	IMPI-PWE	(EAD)	Env Eng - Air
Freddy SANCHEZ	IMPI-PWE	(EAD)	Env Eng - RECRA/EPCRA
Brad GARIE	IMPI-PWE	(EAD)	Env Eng - biologist
Jason HUGGAN	IMPI-PWE	(EAD)	CRM
Carl APPELQUIST	IMPI-PWE	(EAD)	Env Eng - wetlands/water
Gil MYERS	IMPI-PWE	(EAD)	Env Eng - NEPA
Ted GABEL	IMPI-PWE	(EAD)	Env Eng - IRP/CERCLA/soils
Christian URBIOLA	IMPI-PWE	(DPW)	Master Plans & Programs
Silvia BERGLUND	IMPI-MW	(DFMWR)	Director FMWR
Eli THOMAS	IMPI-PWH	(Housing)	Garrison RCI liaison
LT Jim OPALECKY	IMPI-ESP	(PICA PD)	Police officer
Greg MITCHELL	IMPI-PW	(Chugach)	IIPMC
AI LENNOX	RDAR-MEM-E	(Range Control)	Mech Eng
Sybil LUSARDI	RDAR-CRM	(Risk Mgt)	Env officer
Joanna BATEMAN	IMAT-PWD		Env Protection Specialist

APPENDIX A

Regional Context

REGIONAL CONTEXT

I. New Jersey Highlands

A. PHYSICAL ENVIRONMENT

1. Setting

The New Jersey Highlands is a region of 1.1 million acres stretching from the Hudson River to the Delaware River. It encompasses all or parts of nine counties and ninety-two municipalities (see map in Appendix F). It is a landscape of national significance that is rich in natural resources and recreation opportunities. The importance of the region is based on its location and characteristics:

148,000 acres of public open space,

Clean drinking water for over 5 million New York and New Jersey residents,

More than 500,000 acres of critical wildlife habitat that is mostly in forest land and is primarily privately owned (75%),

An integral part of the Maine-Georgia Appalachian chain providing habitat connectivity for numerous species of wildlife.

The highlands area is virtually in the back yard of the Nation's largest metropolitan area that is home to approximately 20 million people. About one in 12 Americans live within a one- to two-hour drive of the highlands. Portions of nine counties and ninety-two municipalities lie within the New Jersey Highlands. Consequently, the Highlands are potentially critically important for the protection of the drinking water supply and the conservation of the natural landscape for wildlife habitat. Retention of a working landscape is also important for providing farm and forest products, open space for outdoor recreation, and buffers between urbanized areas.

Within 40 miles of Manhattan, the Highlands ecosystem is home to black bear, otter, bobcat, and native trout. More than 500,000 acres of important habitat provides a critical flyway and nesting ground to nearly 100 species of neotropical songbirds. However, the highlands face the immediate prospect of unprecedented urbanization given trends in the area. The tri-state area of New York, New Jersey, and Connecticut has had a 60 percent increase in the amount of urban land in the last 25 years with only a six percent increase in population. Nationally, massive commercial and industrial development has jumped from the central city areas to the suburbs. The outlying areas of the American metropolitan regions are receiving most of the new regional job growth.

As a result of the development patterns, housing and subdivisions have edged further into the rural areas thereby replacing farms, wildlife habitat, and close-to-home recreational opportunities. Scattering people and jobs over the landscape creates a physical arrangement that causes traffic congestion, worsens air quality, reduces the attractiveness of the landscape, and threatens the quality and supply of drinking water. This in turn may threaten the long-term economic viability of the area if businesses choose to locate and invest in areas with greater ecological health.

Given the significance of the region's water supply and wildlife habitat, protection of the Highlands is critical to the long-term health of the region. Accommodating new residents could result in the Highlands becoming a part of the suburban landscape that extends north and westward from New York City. In the next 5 to 10 years many of the counties in the area, to include Morris County, will be considered urban. The effects of suburbanization and urbanization in the area are already apparent. It is estimated that several thousands of acres of farmland and forested land in the Highlands will be lost to residential or urban uses.

Continued development will increasingly place the natural resources of the Highlands at risk. One immediate consequence is that the forest is increasingly fragmented into smaller and smaller tracts. As additional development occurs, large forest patches will decline significantly. This fragmentation will eventually alter the physical and biological resources of the region. If the trend continues, it may result in lower quality drinking water, reduced aquatic habitats, the loss of large contiguous forested areas with the associated loss of wildlife and fish, degraded recreational experiences and scenic quality, the destruction of cultural resources, and the loss of a viable forest products industry.

2. Air Quality

National Ambient Air Quality Standards (NAAQS) have been established for six pollutants that are monitored in and around the Highlands on a routine basis. Pollutants that affect air quality (visibility, acid deposition, meteorology, etc.) are also routinely monitored. Annual average of rainfall shows that acid precipitation is a present environmental problem in the region.

Visibility is considered to be an important natural resource in the Highlands. Because much of this area is undeveloped, special regulations protecting visibility in national parks and wildlife refuges have been promulgated. Although no definitive trend in visibility has been discovered, it appears that a strong seasonal variation exists with the poorest visibility occurring during the summer.

3. Geophysical and Soil Characteristics

The mountains and valleys that comprise the Highlands are part of the Reading Prong. The province rises above the lower lying Triassic lowlands along their southeastern border. Millions of years ago these mountains uplifted along faults. The Ramapo Fault separates the Highlands province from the Triassic Lowlands. A series of discontinuous, steep-sided ridges and narrow valleys typify the landscapes of the region. Millions of years of erosion have exposed across much of the region a Precambrian bedrock complex of rock. Sedimentary rock is also found within the region. Green Pond and Schunemunk conglomerates are common in the northern areas. In the southern and western most areas, Kittatinny Limestone is present.

A combination of geologic forces, including a period of glacial advances, resulted in the existing rough terrain. The glacial movements stripped the higher elevations and redeposited the soil materials in the lower slopes and valley bottoms. The depth of the glacial material ranges from one to two feet on the lower slopes to many feet in the valley bottoms. Soils that formed on the slopes and upper portion of the ridges are shallow and very stony severely limiting them for most activities other than watershed protection. Soils on the lower slopes and valley bottoms are variable depending on their location. Some are stony and have an impervious layer that restricts percolation while others are deep and well-drained. An occasional high seasonal water table in these areas limits their use for development.

The mineral makeup of the bedrock has shaped much of the history of the Highlands. Iron in numerous

mineral forms is present throughout the region. Veins of iron deposits were extensively mined in the past and iron played an important role in the historical development of the area, especially during early wars for independence. Also of note are the subterranean solution cavities and caves resulting from the dissolution of limestone and dolomite by groundwater. Sinkholes indicate carbonate rocks and these areas are characterized by high yields of good quality groundwater.

Another significant mineral resource is uranium. Uranium has been mined in the Highlands in the past. Mining and the milling of uranium could release hazardous decomposition products such as radon gas. Radon gas has been found to accumulate in basements on homes in the Highlands.

4. Water Resources

Approximately 40 to 50 inches of rain falls annually in the Highlands. This rainfall provides important ground and surface water resources. Due to the predominant forest cover, the quality of water is very high (“good” to “excellent”) in the ten principal waterways in the Highlands. The forest cover in the region is also responsible for reducing peak flow that causes flooding and for maintaining minimum flows. It also maintains the quality and quantity of water recharge to groundwater aquifers and surface waters of the Highlands. Equally important is the dependence of the forest vegetation on the water balances and soil moisture content within the hydrologic system.

The critical water resources of the area are used for drinking water. There are ten major reservoirs and more than a dozen smaller impoundments located in the Highlands. These and other public water resources in the Highlands supply drinking water for nearly 5 million people in New York and New Jersey. Four of the six major surface supply systems for the northern part of New Jersey are located in the Highlands. In addition, seven major rivers are considered cold and clean enough to permit trout production and maintenance. Water may be the region’s most valuable resource.

5. Timber

The current harvest level is estimated to be about ten percent of the annual growth rate. A high percentage of the timberland can be classified as thick overcrowded stands with little vigor and poor health. The economic value of the sawlog and veneer harvest is over 3.2 million (1991). Another \$8 million of cordwood is harvested. Forty-eight percent of the Highlands region is forested, but most of the Highlands timberland is broken into small, privately owned tracts. Many of the private owners value the timberland for aesthetics and enjoyment rather than its economic value. Large contiguous tracts of timberland that could be efficiently and economically managed are rare.

6. Agriculture

There are approximately 160,000 acres of land classified as agricultural within the Highlands. Most farms in the region are in the 10 to 49 acre size class. They:

- Contain many of the region’s vast forest resources,

- Contribute significantly to the area’s economy (over 120 million dollars per year),

- Sustain the intrinsic natural character of the working landscape,

Provide jobs and a sustained quality of life for many landowners and residents of the Highlands.

Farm production in the region is quite varied. It includes livestock and poultry such as cattle, beef cows, milk cows, hogs, sheep, and chickens. It also includes crops such as corn, soybeans, hay, vegetables, orchards, fruits and nuts, berries, greenhouse crops, mushrooms, and sod. However, since about 1970, the percentage of agricultural land has decreased as a result of continued development and other economic factors.

B. BIOLOGICAL ENVIRONMENT

1. Biological Communities

Biological diversity means the variety of life and its processes. It refers to genetic variation, distinct species, biological systems, and the variety of systems and their linkages across regional landscapes. Two primary systems, terrestrial and freshwater wetlands are represented in the Highlands, predominantly in the large, contiguous blocks of forest. Within each system, there are a number of communities that constitute local variability. It is this variability that provides the Highlands with rich diversity of community types: glacial bogs, hardwood-conifer swamps, rock outcrop communities, and chestnut oak forests.

Maintaining biological diversity results in both physical and social benefits. Physical benefits accrue to the region from the natural vegetation systems. Physical benefits include: habitat for wildlife, protection against floods, replenishment of groundwater supplies, preventing land and soil erosion, climate control, and cleaner air. Social benefits include recreation opportunities for hunting, fishing, hiking, and wildlife observation; and the creation or maintenance of open space that offsets urbanization and increases land values and the quality of life.

2. Fish and Wildlife

The land and water of the Highlands support significant populations of fish and wildlife. Over 140 species of birds are known to nest in the Highlands. This includes over 40 species of nesting birds, migrating raptors, and waterfowl. Of particular concern are the 70 plus species of interior nesting neotropical migrants such as the red-eyed vireo, American redstart, Canada warbler and eastern wood-pewee, all of which require undisturbed forest patches.

A significant resource is the extensive areas of uninterrupted, unbroken forest. Large blocks of habitat, connected by corridors to other large blocks, are essential for preserving and enhancing biodiversity. Such habitat also provides migration corridors for large mammals such as bobcat, black bear, and river otter; and extends the feeding and breeding range of these populations. There are also extensive cold-water wild trout fisheries throughout the region. Other species present are yellow perch, small mouth bass, and anadromous fisheries in the Delaware and Hudson Rivers.

3. Endangered and Threatened Species

The Highlands region supports hundreds of species of flora and vertebrate fauna that are listed on state inventories for endangered or threatened species. Threatened or endangered species within the Highlands region include: the timber rattlesnake, bog turtle, spotted turtle, wood turtle, red-shouldered

hawk, barred owl, osprey, great blue heron, and Allegheny wood rat. Also, on state lists within the Highlands are hundreds of plant species listed as endangered or threatened. Of these, at least ten have some type of federal status.

Suitable habitats are critical for threatened and endangered species. The Highlands Region provides a vital link for many species of long distance migratory birds that travel to and from South or Central America (neotropical). Each year neotropical bird species pass through and breed in the area. Examples include warblers, thrushes, cuckoos, tanagers, orioles, grosbeaks, vireos, and flycatchers. Neotropicals represent a quarter of all US birds in the Highlands and half the breeding species. As in the East in general, many of these birds are thought to be in serious decline in the Highlands.

C. OTHER IMPORTANT RESOURCES

1. Land Use

The New Jersey Highlands are 45 percent forested (334,500 acres), 18 percent agricultural (136,700 acres), and 37 percent urbanized (271,500 acres) including residential development (THC). The northern part is more heavily forested while the southern portion is more agricultural. Morris County has the largest forested area with nearly 96,000 acres. However, Morris County also has 58 percent of its Highlands area in urban uses (150,000 acres) (THC). Surrounding counties are somewhat less urbanized.

About ten percent of highlands open space (48,000 acres) is watershed land managed by water supply authorities. The largest single ownership in the region is the City of Newark.

2. Recreation

The Highlands provide outdoor recreation opportunities for over 8 million people a year. There are over 147,000 acres of county, state, and federal parks in the Highlands and there are over 48,000 acres of land and water owned and managed by water purveyors. Although a percentage of these latter areas are not physically accessible, they provide scenic and wildlife values. Additionally, there are 548 miles of linear recreational features such as regional hiking trails, including the Appalachian Trail, abandoned canals, and county greenways, and there are approximately 750 miles of local hiking trails of which about 25 percent are on private land.

The heavy use does not meet current demand. It's estimated that an additional 75,000 acres of public parkland are needed to meet current demand. However, about 84 percent of the Highlands' open space is privately owned and is in danger of being developed. Recreational opportunities are economic as well as quality-of-life issues. The recreation and tourism industry in the nine-county Highlands area directly employs some 72,000 people with a payroll estimated at nearly \$900 million.

3. Cultural Resources

Human settlement in the Highlands has resulted in a rich array of archeological sites, agricultural uses, and industrial remnants, many of which have remained intact in their original setting. Based on surveys of prehistoric periods, prehistoric peoples used the shelters formed by rock outcroppings throughout the Highlands. Artifacts include projectile points, knives, ecofacts, tools, beads and pottery. Native American groups in the area included Minisinks, Hackensacks, and Tappans, all of whom were part of the widespread Algonquin linguistic and cultural heritage.

The Highlands has been an area where diverse cultures have come into contact. The first Dutch settlers

came south from the Hudson Valley. The distinctive Dutch stone houses exist today. Quickly overlaid on the Dutch culture was a mixture of English and Scots-Irish.

Highland water has been crucial for exploration and development of the area. The rivers provided transportation and supply routes in and out of the area prior to roads. The streams exposed the iron deposits that lay beneath them and then provided the power for mining operations and other industries. Highlands' iron, along with the abundant timber that provided charcoal for its processing, defined the region's development (Regional Study). Highlands' iron won the Revolutionary War. Bullets, cannon balls, and all kinds of armaments were made in Highlands' forges. In the process, a sound economy was created in the area that persisted until the Civil War. However, by then the railroad had made sources accessible farther west in Pennsylvania and the New Jersey iron industry slowly declined. Today, there is no accurate count of the historic industrial sites in the Highlands.

II. Watershed Management Area 6

A. PHYSICAL ENVIRONMENT

1. Setting

Watershed Management Area 6 (WMA#6) is one of 20 watershed management areas in New Jersey. Ninety-six watersheds in New Jersey have been grouped into 20 management units, of which WMA#6 is one. A watershed encompasses all the land that drains to a particular water body and has a natural boundary. Included in WMA #6 are the Rockaway, Whippany, Mid Passaic, and Upper Passaic Watersheds. WMA #6 is approximately 416 square miles and is about 30 miles long and 20 miles wide at the widest points. It is located in northeastern New Jersey, primarily in Morris County, although it includes small portions of Sussex, Somerset, Essex, and Union Counties. It lies within the mountainous Highlands Region where elevations range from 300 to 1400 feet. The PICA is located in the northern portion of WMA #6 in the Rockaway Watershed (see map in Appendix F).

The geology consists mainly of fractured bedrock. Unlike the northern area, the southeastern portion lies in the lower hills and swamps of the Piedmont Province where the geology consists primarily of sedimentary rock and glacial deposits. This geology influences the availability and movement of ground water and the course and hydrology of its rivers. The Whippany River drains the central portion of the Management Area and is about 15 miles long. It joins the Rockaway River that runs for approximately 40 miles and drains the northern portion of WMA #6. The Rockaway eventually joins the Upper Passaic River that is 50-miles long and drains the southeastern portion of the Management Area. This latter river runs through the Great Swamp National Park in the south before leaving WMA #6.

2. Land and Open Space

As of 1986, land uses in WMA #6 include developed land (189 square miles, 45%), forested (166 square miles, 39%), wetlands (35.5 square miles, 8.4%), water (11.4 square miles, 2.7%), agriculture (11 square miles, 2.6%), and barren land (3.2 square miles, 0.8%). As of 1990, approximately 600,000 people resided in 52 municipalities that lie entirely or partially with the management area.

The population is expected to grow to nearly 650,000 by 2020. That will in turn increase the density per square mile.

As indicated above, in 1986, almost half the land in WMA #6 was developed land. Historical industrial development has resulted in over 500 contaminated sites. Currently, 63,000 pounds per year of active pesticide ingredients are applied to lawns, golf courses and farmlands in the management area. In addition, about 70 million gallons of treated wastewater are discharged daily. Industrial and housing developments will continue to pressure water supplies by increasing demands for water. As land is developed, habitat for native and rare, threatened and endangered species is accordingly reduced. However, at least 15 percent of the area has been preserved for open space and recreation and wetland regulations have dramatically slowed the pace of loss of this habitat.

Public open space is land that is owned and managed by government agencies and nonprofit conservation groups for natural resources protection, recreation, and agricultural preservation. State and federal public open space (including US Army property) totals approximately 23,000 acres, or about 10 percent of the total management area. Park systems, conservation easements, and protected open space increases the percentage to somewhat over 15 percent. The 15 percent of the area preserved for open space equates to about 62 square miles. The actual amount may be higher since GIS mapping is incomplete. Municipalities, counties, state and federal agencies, and nonprofit conservation groups are continually attempting to add to both the amount of open space and its connectivity by acquiring undeveloped land.

3. Forest Resources

Data collected for the last USDA Forest Service Survey in Forest Statistics for New Jersey (1987) show that about 41 percent or 122,500 acres are classified as “timberland.” Timberland is defined as woodland that is capable of growing at least 20 cubic feet of wood per year and the land has not been restricted for timber utilization. The ownership of the timberland is as follows:

Private	88,200 acres	72.0%
County and municipal	27,800	23.0%
State	4,300	3.5%
Federal	2,200	1.8%

The majority of forest land (82,000 acres) is in the older larger tree size class of eleven inches in diameter or greater. There is no acreage in the seedling/sapling age class. Consequently, the forest is characterized by having very few early-successional forest stages across a landscape that is somewhat fragmented due to the loss of forest by conversion to other uses.

The forest in WMA #6 can be divided into four basic units or communities that characterize regional differences in land use and the landscape:

Glaciated Highlands: Occupies the northern quarter of the watershed. Large forested tracks exist in this portion of the watershed. Communities are dominated by a mixture of red, white, black, and chestnut oaks that comprise between 40 and 50 percent of the canopy. The subcanopy is dominated by a mixture of red maple, sugar maple, black birch, and American beech.

Unglaciated Highlands: Occupies the western 1/6th of the watershed. Large forested tracks are present in this portion of the watershed. A mixture of black, red, white, and chestnut oaks dominates communities, comprising 45 percent of the canopy. Sweet birch, red maple, pignut hickory and beech are common in the subcanopy. Tulip trees are sometimes co-dominant with the oak. Sugar

maple, birch, and hemlock are common in the ravines.

Glacial Lakes Plains: Occupies the central lowlands between the Highlands and the Watchung Range covering the SE portion of Morris County. Forested communities are fragmented by urban development and are mostly swampy. Some are seasonally flooded. All are dominated by red maple, sweetgum, swamp white oak, and pin oak.

Newark Piedmont: Occupies the southern and eastern portions of the watershed. Communities are small and fragmented by urban development. They are dominated by a mixture of oaks and tulip trees that make up about 60 to 80 percent of the canopy in mature forests. Black birch and beech are common in the subcanopy.

4. Forest Health

General forest resource concerns include fragmentation, changes in historic composition, invasive species, lack of riparian forest buffers, and diminished diversity. As tree composition changes, so does the forest's ability to assimilate pollutants, control runoff, and provide habitat and forage. This in turn can have a substantial impact on wildlife species. Invasive insect species include gypsy moth, hemlock woolly adelgid, and the long-horned beetle. Invasive plant species include Norway maple, multiflora rose, Dutch elm, wild mustard, and Japanese stilt grass.

The woolly adelgid is of particular concern to the hemlock within WMA #6. There are approximately 26,000 acres of hemlock (*Tsuga canadensis*) in northern New Jersey. Of this, approximately 2000 acres or 7.5 percent are in Morris County. Since hemlock grows along streams, rivers, ponds, and lakes, the loss of hemlock could significantly impact habitat and water quality. For example, 22 breeding bird species have been associated with hemlock. Three of these species breed primarily within hemlock ravines. Extensive hemlock mortality, creating forest gaps, could provide invasion opportunities for avian nest predators such as blue jays and cowbirds.

Additional impacts of hemlock mortality could include significant changes in energy and nutrient inputs to streams with hemlock riparian buffers. Defoliation will induce higher water temperatures and will likely cause increases in-stream nitrogen, phosphorous levels and possible algal blooms. High in-stream temperatures could also cause increased native brook trout mortality.

B. WATER RESOURCES

1. Surface Water Quality

Biological monitoring has been conducted at 71 stations in WMA #6. Monitored stations are classified by the degree of impairment exhibited. Monitoring for all stations in the management area have shown that 32 percent of monitored stream miles are not impaired, 55 percent are moderately impaired, and 13 percent are severely impaired. These results are consistent with statewide (New Jersey) data. Chemical and sanitary water quality at seven stations in the management area indicate that phosphorus, suspended solids, and fecal coliform often do not meet New Jersey Surface Water Quality Standards (SWQS). These results are consistent with statewide data collected at other stations.

Biological monitoring of the Rockaway Watershed indicates that the headwaters and portions of the mainstream are not impaired. However, impairment tends to occur downstream and at the outlets of

lakes. Chemical and sanitary water quality results indicate that numerical SWQS criteria for phosphorus, fecal coliform, and possible metals, are generally not met. Nitrate concentrations appear to have been rising significantly in the downstream portions of the river.

Biological monitoring of the Whippany Watershed indicates that the headwaters are not impaired. Nevertheless, moderate and severe impairment does occur in the Whippany and Watnong Brooks near Morristown. Chemical water quality monitoring results indicate that numerical SWQS criteria for suspended sediments, phosphorus, dissolved oxygen, and possibly metals, are generally not met. Nitrate concentrations appear to be significantly rising near Morristown.

Biological monitoring of the Upper Passaic Watershed indicates that the headwaters are not impaired or moderately impaired, but severe impairment has been documented in Loantaka and Black Brooks and the Passaic River below Chatham. Chemical and sanitary water quality monitoring results indicate that phosphorus, dissolved oxygen, suspended solids, fecal coliform, and possibly metals, exceed the numerical SWQS criteria. Nitrate concentrations appear to be rising significantly downstream.

Lake Ames, Mount Hope Pond, and Sunrise Lake are considered to be eutrophic based on monitoring results. Eutrophication is accelerated due to inputs of nutrients and sediments from upstream point sources and nonpoint sources such as runoff and large waterfowl populations. Streams and lakes that do not meet surface water quality standards, exhibit moderate or severe impairment based on benthic data, or have fish consumption advisories are listed in the Water Quality Limited Waters Report (303d list).

2. Ground Water Quality

The results of the Ambient Ground Water Quality Monitoring Program indicate that the natural quality of ground water from locations throughout WMA #6 is good when compared to ground water and drinking water quality standards. In some areas, however, gross alpha radiation, sodium, total dissolved solids, hardness, iron, manganese, aluminum, sulfate, and pH may exceed secondary drinking water criteria but do not adversely affect water potability. Volatile organic chemicals and other pollutants affect groundwater quality in some locations. These pollutants are thought to arise from contaminated sites such as underground storage tanks, commercial septic systems, drum storage, and coal gasification facilities. Elevated concentrations of chloride from road salting and nitrogen compounds from fertilization may also affect the quality of the groundwater. However, the complex geology of WMA #6 makes accurate monitoring and assessment difficult.

3. Drinking Water Quality

Drinking water is supplied from six reservoirs and over 600 public supply wells. Results of the required regular testing indicate that finished drinking water quality usually meets the microbiological and chemical drinking water standards. In WMA #6 surface water supplies are currently meeting standards, but are threatened by eutrophication due to excess phosphorus. Drinking water supplies may be threatened in the future by the standards for nitrates being exceeded. Ground water supplies at seven of 45 systems require treatment for volatile compounds and for naturally-occurring radon.

4. Water Quantity

On an annual basis, nearly 800 million gallons per day (mgd) of water enters WMA #6 from rainfall (primary source) and potable water imports. Water leaves the management area by evaporation, streamflow, potable water exports to other management areas, and transfers of sewage for treatment at facilities in other areas. In 1995, over 100 mgd were withdrawn from surface and ground water sources in WMA #6 for various uses such as potable, industrial, and agricultural uses (NJDEP 1998b). Potable water uses account for approximately 95 percent of the water used in the management area. A significant percentage of homeowners in some towns use wells. In general, public and private purveyors provide drinking water.

About 70 percent of the water actually used in the management area is ground water from fractured bedrock aquifers and buried valley aquifers. Buried valley aquifers are located throughout the eastern portion of the management area as well as along stream corridors in the western portion. In some cases they are hydraulically connected to overlying streams. There are over 600 active drinking water wells that include both community and noncommunity wells. Several locations in WMA#6 are experiencing water deficits that cause significant drop in the aquifer level.

Surface water that accumulates in WMA #6 reservoirs and rivers is withdrawn at the rate of approximately 50 mgd (Boonton Reservoir) and supplied to municipalities in other management areas, primarily WMA#5. The surface water reservoirs in WMA #6 are estimated have a total safe yield of approximately 72 mgd. However, severe droughts may significantly reduce this safe yield estimate.

5. Wetlands

Based on 1986 data, there are approximately 20,000 acres (41.4 square miles) of wetlands in WMA #6 (NJDEP 1998b). This acreage accounts for about 8 percent of the land area. The Great Swamp, Great Piece Meadows, and Troy Meadows are significant wetlands in WMA #6. These wetlands, along with smaller ones, provide for the purification and recharge of surface and ground water, flood and storm damage protection, soil erosion control, and critical habitat for fish and wildlife. Wet habitats that occur between upland and water are generally considered wetlands. Based on their location and characteristics, wetlands include marshes, wet meadows, swamps, and bogs.

6. Riparian and Stream Corridors

The riparian areas in the management area consist of stream channels and associated wetlands, uplands, flood plains, forested areas, and other important habitat. The stream and river corridors in the management area contribute to water supply protection, surface and ground water quality, flood control, critical habitat for fish and aquatic wildlife, and maintenance of genetic diversity of native species. The New Jersey Department of Environmental Protection has permitted stream encroachment activities by municipalities. Such permits regulate activities in the floodplain that potentially impact water quality, habitat and flooding. Areas of anticipated flooding have been identified along approximately 200 linear stream miles and include all major streams and most of their tributaries within WMA #6.

7. Flooding and Floodways

The Passaic River Basin is a unique drainage system. Prior to the last glacial epoch, the Rockaway, Whippany, and Upper Passaic Rivers in WMA #6 flowed in a southerly direction through a gap in the second Watchung Mountain. Advancing glaciers filled the gap. Upon eventual retreat of the glaciers, the largest glacial lake in New Jersey formed. Eventually, the Passaic River and its tributaries were forced to flow in a northerly direction. Since the new outlet to the sea was considerably higher than the original outlet, the river channel became extremely flat and the low-lying adjoining areas absorbed the energy of the flowing water. This in turn caused the former lakebed to fill with sediment to form swamp and meadowland that is known today as the Great Swamp, Troy Meadows, Great Piece Meadows, as well as others. As such, these wetlands that constitute the ancient lake bed, provide a natural retention basin.

The physiographic and historic conditions of the area, coupled with contemporary development, have resulted in a long history flooding in the Passaic Basin. Significant flood events have occurred in the area to the extent Declaration of National emergencies were issued for floods in 1968, 1971, 1975, 1984, and 1992.

C. BIOLOGICAL ENVIRONMENT

1. Vegetation

Watershed Management Area #6 supports or has supported various vertebrate and invertebrate species as well as over 100 vascular plant species that are “rare, threatened, or endangered” in New Jersey. Nearly all municipalities in WMA #6 have recorded occurrences of rare plant or animal species. Rare vascular plants with more than five sightings each include downy phlox, Virginia bunchflower, and scarlet Indian paintbrush. Rare communities in WMA #6 include Hardwood-Conifer Swamp, Glacial Bog, and bat hibernacula.

Based on a 1987 USDA forest inventory, the predominant tree species in Morris County, (the primary county in the management area), are chestnut oak, northern red oak, black oak, white oak, and hickory. Hemlock commonly grows in wet habitats along streams, ponds, and lakes. There is an estimated 2.7 square miles (1700 acres) of hemlock in WMA #6. Hemlock stands are currently infested by the woolly adelgid, an insect that can cause mortality with two to four years from infestation. Ninety-five percent of the hemlock trees on the PICA are dead (NJDEP 1998a). Hemlock losses may affect water quality and associated terrestrial and aquatic ecosystems.

2. Wildlife

Rare vertebrate species found in more than 20 municipalities include the barred owl, wood turtle, and red-shouldered hawk.

3. Aquatic Resources

Some reaches of rivers in WM#6 support either natural trout reproduction or trout stocking. Clear, cold rivers with high dissolved oxygen are needed for trout reproduction. Natural reproduction of brook, brown, and rainbow trout occurs in some portions of the three watersheds in WMA #6. Natural reproduction of trout is rare in New Jersey. Adult trout are stocked annually in the

Rockaway River Watershed. They are also stocked in portions of the Passaic and Whippany Rivers.

Warm water fisheries in the lakes and ponds include the two native species of chain pickerel and yellow perch, and several introduced species such as bass and sunfish. Channel catfish and northern pike are also stocked in the lakes. Except for the introduced species, fish populations in the major lakes are similar to those found in the 1950s. Warm water fisheries in rivers and larger streams in the management area include bass, sunfish, sucker, and a variety of smaller fish. Selected chemical testing of fish from streams in the state as resulted in fish consumption advisories for largemouth bass and chain pickerel.

Common freshwater mussel species, such as the eastern elliptio, are known to occur in WMA #6. There are also two recorded sightings of the less common triangle floater mussel. The triangle floater tends to be less tolerant than the eastern elliptio of poor water quality conditions. Although there are historic records of more rare mussels, no recent sightings have been reported. Typically, freshwater mussels require good to pristine water conditions in order to thrive.

D. OTHER IMPORTANT RESOURCES

1. Recreation

Crisscrossing the watershed are trails connecting local communities with public recreation and open space lands. Trails frequently form the backbone of greenways that protect river and stream corridors. Trails provide the public with the opportunity to appreciate the rivers, habitats, animals, and larger landscapes. The most notable of the trails in the region is Patriots' Path that connects all parts of Morris County. It provides both a wilderness path and urban walkway. In some sections, mountain bikers, cyclists, and horseback riders are also permitted on the trail. Over 30 miles of trail creates a maze of pathways throughout the county. Within the watershed management area, one branch follows the Whippany River north from Morristown. An offshoot from the Whippany River pathway crosses Troy meadows. Another links Morristown National Historical Park and Lewis Morris County Park.

2. Open Space

Approximately 17 percent of WMA #6 is designated by NJDEP as public open space (as of 1998b). That is, land owned or managed by federal and state agencies, county and municipal governments, and nonprofit conservation groups. Public open space is land that is used for natural resources protection, recreational purposes, or agricultural preservation. State and federal open space parcels (including PICA) total about 10 percent of the area. Morris County parkland is slightly under seven percent. The remaining portion is comprised of state conservation easements.

APPENDIX B

Picatiny Flora

For all of the Appendices **B-1** thru **B-7** the following codes or conventions apply (D. Snyder pers. comm. 2012):

Gray Highlight = indicates potential for species to occur, but presence has not been (adequately) documented/confirmed.

Strike thru = indicates a ~~dubious observation~~ or a ~~PICA survey record~~.

^ = Reported by qualified observer; but not officially confirmed via NJ Natural Heritage Program.

For Appendix **B-1** see also more specific federal, state and global codes explained at end of this list.

For Appendix **B-2** the following codes apply:

✦ = This list (Bryophytes) from USACE-WES, 1995, as observed (1993) and prepared by Robert Lichvar (botanist-USACE).

▲ = Observed (listed) by Windisch, 1993 This list may need confirmation of many species

For Appendices **B-3** thru **B-7** the following codes apply:

✦ = These vascular plants from USACE-WES, 1995, as observed (1993) by Robert Lichvar (botanist-USACE)

▲ = These vascular plants observed (listed) by Windisch, 1993

⊙ = Other contract field surveys (pre-1994)

⊗ = Invasive species per TetraTech, 2003

All lists are alphabetized by scientific names in second column (after common name).

Common names in immediate left column tend to follow those accepted/rendered by NatureServe database(s).

B1

ENDANGERED PLANTS AND SPECIES AT RISK

COMMON NAME	SCIENTIFIC NAME	FED STATUS	STATE STATUS	STATE RANK	GLOBAL RANK	HABITAT/ LOCATION
BRYOPHYTES (1 Species)						
DELICATE PEATMOSS	<i>Sphagnum tenellum</i>		psc	S2	G5	Wetlands
FERNS AND FERN ALLIES (4 Species)						
BRADLEY'S SPLEENWORT	<i>Asplenium bradleyi</i>		E	S1	G3	GPMT/Copp Mt
MOUNTAIN SPLEENWORT	<i>Asplenium montanum</i>		psc	S2	G5	
MEADOW HORSETAIL ^	<i>Equisetum pratense</i>		E	S1	G5	Wetlands
STIFF CLUBMOSS ^	<i>Lycopodium annotinum</i>		E	S1	G5	? Upper Gorge ?
SEDGES AND SEDGE ALLIES (4 Species)						
BEBB'S SEDGE	<i>Carex bebbii</i>		pse	S2	G5	Wetlands-
TWO FRUITED SEDGE	<i>Carex disperma</i>		psc	S2	G5	Wetlands/north part..
HOP LIKE SEDGE	<i>Carex lupuliformis</i>		pse	S2	G3/4	? Upper GPB ?
BEAKED SEDGE	<i>Carex rostrata</i>		pse	S2	G5	Wetlands/north part..
AQUATIC PLANTS (11 Species)						
FEATHERFOIL	<i>Hottonia inflata</i>		E	S1	G3/4	Denmark Lake
WATER LOBELIA	<i>Lobelia dortmanna</i>		E	SH	G4	?Denmark/Picatinny Lake
LITTLE FLOATING HEART	<i>Nymphoides cordata</i>		psc	S3	G5	Denmark Lake
ROBBIN'S PONDWEED	<i>Potamogetan. robinnsii</i>		E	S1	G5	Denmark Lake
NARROW LEAVED BUR REED	<i>Sparganium. angustifolium</i>		E	SH	G?	? Denmark Lake
GREEN FRUITED BUR REED	<i>Sparganium chlorocarpum</i>		psc	S2	G5	Wetlands/north part..
SMALL BUR REED	<i>Sparganium minimum</i>		E	S1	G5	Denmark Lake
HUMPED BLADDERWORT	<i>Utricularia gibba</i>		psc	S3	G5	Wetlands & Denmark Lk
FLAT LEAVED BLADDERWORT	<i>Utricularia intermedia</i>		psc	S3	G5	Wetlands & Denmark Lk
LESSER BLADDERWORT	<i>Utricularia minor</i>		E	S1	G5	Wetlands & Denmark Lk
PURPLE BADDRWORT	<i>Utricularia purpurea</i>		psc	S3	G5	Wetlands & Denmark Lk
GRASSES (1 Species)						
SLENDER WOOD REEDGRASS^	<i>Cinna latifolia</i>		E	S1	G5	Wetlands
VINES (2 Species)						
ALLEGHENY VINE	<i>Adlumia fungosa</i>		psc	S2	G4	north part of Arsenal
PURPLE VIRGIN'S BOWER	<i>Clematis occidentalis</i>		psc	S2	G5	north part of Arsenal
FORBS (15 Species)						
BRISTLY SARSAPARILLA	<i>Aralia hispida</i>		psc	S3	G5	Copperas Ridge
VIRGINIA SNAKEROOT	<i>Aristolochia serpentaria</i>		psc	S3	G5	Uplands
PURPLE CRESS	<i>Cardamine douglassii</i>		psc	S2	G5	Wetlands/north part..
BUTTERFLY PEA	<i>Choria. mariana</i>		E	SH	G5	? Uplands ?
TRAILING TICK TREFOIL	<i>Desmodium humifusum</i>	SC	E	SH	G1/2	? Spieer Rd ?
VELVETY TICK TREFOIL	<i>Desmodium viridifolia</i>		pse	S2	G5	? Uplands ?

See codes at end of B1

B1

COMMON NAME	SCIENTIFIC NAME	FED STATUS	STATE STATUS	STATE RANK	GLOBAL RANK	HABITAT/ LOCATION
NARROW LEAVED WILLOW HERB	<i>Epilobium leptophyllum</i>		psc	S3	G5	? Wetlands ?
MARSH BEDSTRAW	<i>Galium palustre</i>		pse	S2	G5	? Wetlands ?
PURPLE FRINGED ORCHID	<i>Habenaria psycodes</i>		psc	S3	G5	Wetlands
WOOD LILY	<i>Lilium philadelphicum</i>		psc	S3	G5	Uplands
WINGED MONKEY FLOWER	<i>Mimulus alatus</i>		pse	S4	G5	Wetlands
SWAMP LOUSEWORT	<i>Pedicularis lanceolata</i>		pse	S2	G5	Wetlands
TALL CINQUIFOIL	<i>Potenilla arguta</i>		psc	S3	G5	Uplands
COMMON BLUE EYED GRASS	<i>Syrinchium montanum</i>		E	S1	G5	??
FRASER'S MARSH ST. JOHN'S WORT	<i>Triadenum fraseri</i>		E	S1	G?	??
SHRUBS (2 Species)						
MEADOW WILLOW	<i>Salix petiolaris</i>		pse	S3	G4	? Wetlands ?
NARROW LEAVED MEADOWSWEET	<i>Spiraea alba var alba</i>		pse	S1	G5T5	??
TREES (2 Species)						
LARGE LEAVED HOLLY	<i>Ilex montana</i>		E	S1	G5	Wetlands/north part..
BUTTERNUT	<i>Juglans cinerea</i>	SC				Near boundary

CODES

Gray line indicates potential for species to occur, but presence has not been documented/confirmed.

Strike thru indicates dubious observation or PICA survey record (D. Snyder pers. comm. 2012)

^ Reported by qualified observer; but not officially confirmed via NJ Natural Heritage Program

State Status E – endangered psc- Plant Species of Concern N.B. “Plant Species of Concern” is synonymous with “threatened plant species.” (pinelands alliance 2007)	Federal Status SC – federal species of concern C# – federal candidate species (priority ranking 1-12) LT – federal listed threatened LE – federal listed endangered Above 4 codes per ESA
State Rank S 1 - critically imperiled S 2 - imperiled S 3 - rare S 4 - apparently secure S H - historical occurrence in NJ	Global Rank G 1 - critically imperiled G 2 - imperiled G 3 - rare G 4 - apparently secure G 5 - demonstrably secure T - infraspecific taxon rank
Habitat Location	
? - dubious or not ranked	

B2

NON-FLOWERING PLANTS

Bryophytes [†]
(63 species)

Common Name	Scientific Name
----- (moss)	<i>Andreaea rupestris</i>
ATRICHUM MOSS	<i>Atrichum angustatum</i>
WAVY CATHERINIA _(moss)	<i>Atrichum undulatum</i>
LITTLE GROOVE MOSS	<i>Aulacomnium androgynum</i>
AULOCOMNIUM MOSS	<i>Aulacomnium palustre</i>
BAZZANIA LICHEN _(liverwort)	<i>Bazzania denudata</i>
THREE LOBED BAZZANIA _(liverwort)	<i>Bazzania trilobata</i>
----- (moss)	<i>Brachytenium erectum</i>
RUSTY RAGGED MOSS	<i>Brachythecium plumosum</i>
CEDAR MOSS	<i>Brachythecium reflexum</i>
RECURVED BROTHERELLA MOSS	<i>Brotherella recurvans</i>
----- (liverwort)	<i>Calypogeja integristipula</i>
TWOTOOTHED CEPHALOZIA _(liverwort)	<i>Cephalozia bicuspidata</i> ssp <i>bicuspidata</i>
SNAKESKIN LIVERWORT	<i>Conocephalum conicum</i>
----- (moss)	<i>Dicranella cerviculata</i>
WHIP FORK MOSS	<i>Dicranum flagellare</i>
DICRANUM MOSS	<i>Dicranum fulvum</i>
MONTANE DICRANUM MOSS	<i>Dicranum montanum</i>
WAXYLEAF MOSS	<i>Dicranum polysetum</i>
BROOM MOSS	<i>Dicranum scoparium</i>
----- (moss)	<i>Ditrichum pusillum</i>
----- (moss)	<i>Drepanocladus aduncus</i>
FONTINALIS (aquatic) MOSS [^]	<i>Fontinalis spp?</i>
FISSIDENS MOSS	<i>Fissidens dubius</i>
----- (liverwort)	<i>Frullania asagrayana</i>
FRINGELEAF MOSS	<i>Hedwigia ciliata</i>
STAIRSTEP MOSS	<i>Hylocomium splendens</i>
----- (moss)	<i>Hypnum cupressiforme</i>
HYPNUM MOSS	<i>Hypnum imponens</i>
PINCUSHION MOSS [▲]	<i>Leucobryum albidum</i>
PINCUSHION MOSS	<i>Leucobryum glaucum</i>
VARIABLELEAF CRESTWORT _(liverwort)	<i>Lophocolea heterophylla</i>
----- (liverwort)	<i>Lophozia ventricosa</i>
COMMON LIVERWORT	<i>Marchantia polymorpha</i>
HORN CALCAREOUS MOSS	<i>Mnium hornum</i>
----- (moss)	<i>Mnium thomsomii</i>
----- (liverwort)	<i>Nowellia curvifolia</i>
----- (liverwort)	<i>Odontoschisma denudatum</i>
PALLAVICINIA _(liverwort)	<i>Pallavicinia lyellii</i>
----- (moss)	<i>Paraleucobryum longifolium</i>
COMMON PELLIA _(liverwort)	<i>Pellia epiphylla</i>
PLATYGERIUM MOSS	<i>Platygyrium repens</i>
FEATHER MOSS	<i>Pleurozium schreberi</i>
POHLIA MOSS	<i>Pohlia nutans</i>
COMMON HAIRCAP MOSS	<i>Polytrichum commune</i>
JUNIPERM OSS	<i>Polytrichum juniperinum</i>
NORTHERN NAUGEHYDE LIVERWORT	<i>Ptilidium ciliare</i>
----- (moss)	<i>Racomitrium heterostichum</i>
----- (liverwort)	<i>Radula complanata</i>
SHAGGY MOSS	<i>Rhytidiadelphus triquetrus</i>
HEATH EARWORT _(liverwort)	<i>Scapania irrigua</i>
----- (liverwort)	<i>Scapania nemorea</i>
NORTHERN PEATMOSS	<i>Sphagnum capillifolium</i>
GIRGENSOHN'S PEATMOSS	<i>Sphagnum girgensohnii</i>
PRAIRIE PEATMOSS	<i>Sphagnum palustre</i>
RED PEATMOSS	<i>Sphagnum rubellum</i>
RUSSOW'S PEATMOSS ^{⊗?}	<i>Sphagnum russowii</i>
DELICATE PEATMOSS	<i>Sphagnum tenellum</i>
----- (moss)	<i>Tetraphis geniculata</i>
DELICATE FERNMOSS	<i>Thuidium delicatulum</i>
TINY CEDAR MOSS	<i>Cyrt-hypnum minutulum</i>
----- (moss)	<i>Thuidium recognitum</i>
----- (moss)	<i>Ulota crisa</i>

B2

Ferns and Fern Allies

(30 species)

Common Name	Scientific Name
EBONY SPLEENWORT	<i>Asplenium platyneuron</i>
MAIDENHAIR SPLEENWORT	<i>Asplenium trichomanes</i>
MOUNTAIN SPLEENWORT	<i>Asplenium montanum</i>
LADY FERN	<i>Athyrium filix femina</i>
MATRICARY GRAPE FERN	<i>Botrychium matricariifolium</i>
RATTLESNAKE FERN	<i>Botrychium virginianum</i>
HAY SCENTED FERN	<i>Denstaedia punctilobula</i>
CRESTED SHIELD FERN †	<i>Dryopteris cristata</i>
MARGINAL WOOD FERN	<i>Dryopteris marginalis</i>
SPINULOSE WOOD FERN	<i>Dryopteris spinulosa</i>
FIELD HORSETAIL	<i>Equisetum arvense</i>
ROUGH HORSETAIL †	<i>Equisetum hyemale</i>
SMOOTH SCOURING RUSH †	<i>Equisetum laevigatum</i>
MEADOW HORSETAIL † ^	<i>Equisetum pratense</i>
STIFF CLUBMOSS ^	<i>Lycopodium annotinum</i>
RUNNING CLUBMOSS	<i>Lycopodium clavatum</i>
SHINING CLUBMOSS	<i>Lycopodium lucidulum</i>
TREE CLUBMOSS	<i>Lycopodium obscurum</i>
SENSITIVE FERN	<i>Onoclea sensibilis</i>
CINNAMON FERN	<i>Osmunda cinnamomea</i>
INTERRUPTED FERN	<i>Osmunda claytoniana</i>
ROYAL FERN	<i>Osmunda regalis</i>
COMMON POLYPODY	<i>Polypodium virginianum</i>
CHRISTMAS FERN	<i>Polystichum achrostichoides</i>
BRACKEN	<i>Pteridium aquilinum</i>
NEW YORK FERN	<i>Thelypteris noveboracensis</i>
MARSH FERN †	<i>Thelypteris palustris</i>
MASSACHUSETTS FERN †	<i>Thelypteris simulata</i>
RUSTY WOODSIA	<i>Woodsia ilvensis</i>
BLUNT LOBED WOODSIA ▲	<i>Woodsia obtusa</i>

B3

SEDGES AND SEDGE ALLIES

Sedges and Sedge Allies

(52 species)

Common Name	Scientific Name	
BAILEY'S SEDGE	<i>Carex baileyi</i>	
BEBB'S SEDGE + ^	<i>Carex bebbii</i>	
BUTTON SEDGE +	<i>Carex bullata</i>	
HOARY SEDGE ^	<i>Carex canescens</i>	
BRISTLY SEDGE	<i>Carex comosa</i>	emerg
FRINGED SEDGE	<i>Carex crinita</i>	emerg
TWO FRUITED SEDGE	<i>Carex disperma</i>	
LONG SEDGE +	<i>Carex folliculata</i>	
MEADOW SEDGE +	<i>Carex granularis</i>	
ASA GRAY'S SEDGE	<i>Carex grayi</i>	
PORCUPINE SEDGE	<i>Carex hystericina</i>	emerg
BLADDER SEDGE +	<i>Carex intumescens</i>	
SPREADING SEDGE	<i>Carex laxiculmis</i>	
BRISTLY STALK SEDGE ^	<i>Carex leptalea</i>	
FALSE HOP SEDGE + ^	<i>Carex lupuliformis</i>	
HOP SEDGE	<i>Carex lupulina</i>	emerg
SALLOW SEDGE	<i>Carex lurida</i>	emerg
PENNSYLVANIA SEDGE	<i>Carex pennsylvanica</i>	
BROAD LEAVED SEDGE	<i>Carex platyphylla</i>	
ROSE SEDGE	<i>Carex rosea</i>	
BEAKED SEDGE ^	<i>Carex rostrata</i>	emerg
ROUGH SEDGE	<i>Carex scabrata</i>	
POINTED BROOM SEDGE	<i>Carex scoparia</i>	
WEAK STELLATE SEDGE +	<i>Carex seorsa</i>	
AWL FRUITED SEDGE +	<i>Carex stipata</i>	
TUSSOCK SEDGE	<i>Carex stricta</i>	emerg
SWAN'S SEDGE	<i>Carex swanii</i>	
THREE SEED SEDGE ^	<i>Carex trisperma</i>	
INFLATED SEDGE	<i>Carex vesicaria</i>	emerg
RIBBED SEDGE	<i>Carex virescens</i>	
FOX SEDGE	<i>Carex vulpinoidea</i>	emerg
TOOTHED FLATSEEDGE	<i>Cyperus dentatus</i>	
YELLOW NUT SEDGE +	<i>Cyperus esculentus</i>	
STRAW COLORED FLATSEEDGE +	<i>Cyperus strigosus</i>	emerg
DULICHIMUM	<i>Dulichium arundinaceum</i>	emerg
LEAST SPIKERUSH ^	<i>Eleocharis acicularis</i>	emerg
CREEPING SPIKERUSH +	<i>Eleocharis palustris</i>	emerg
BLUNT SPIKERUSH	<i>Eleocharis ovata</i>	emerg
SMOOTH FUIRENA	<i>Fuirena pumila</i>	
CANADA RUSH +	<i>Juncus canadensis</i>	
WEAK RUSH	<i>Juncus debilis</i>	
SOFT RUSH	<i>Juncus effusus</i>	emerg
STOUT RUSH +	<i>Juncus nodatus</i>	
KNOTTED RUSH G?	<i>Juncus nodosus</i>	
SCIRPUS LIKE RUSH	<i>Juncus scirpoides</i>	
PATH RUSH	<i>Juncus tenuis</i>	
FORKED RUSH	<i>Juncustenuis var dichotomous</i>	
WHITE BEAKRUSH +	<i>Rhynchospora alba</i>	
SMALL HEADED BEAKRUSH	<i>Rhynchospora capitellata</i>	
OLNEY THREE SQUARE	<i>Scirpus americanus</i>	
WOOL GRASS +	<i>Scirpus cyperinus</i>	emerg
SOFT STEMMED BULRUSH	<i>Scirpus validus</i>	

emerg= chiefly an emergent aquatic type plant

(16 species)

B4

AQUATIC PLANTS

Aquatic Plants: Submerged

(10 species)

Common Name	Scientific Name
FANWORT	<i>Cabomba caroliniana</i>
HORNWORT	<i>Ceratophyllum demersum</i>
CANADA WATER WEED	<i>Elodea canadensis</i>
WATER MILFOIL ☉	<i>Myriophyllum spp.</i>
SAGO PONDWEED †	<i>Potamogeton pectinatus</i>
FLATLEAF (Robbin's) PONDWEED	<i>Potamogeton robbinsii</i>
SUBTERMINATE BULRUSH ▲	<i>Scirpus subterminalis</i>
FLAT LEAF BLADDERWORT ▲	<i>Utricularia intermedia</i>
LESSER BLADDERWORT	<i>Utricularia minor</i>
TAPEGRASS	<i>Vallisneria americana</i>

Aquatic Plants: Submerged-Surface

(12 species)

Common Name	Scientific Name
WATER SHIELD	<i>Brasenia schreberi</i>
FEATHERFOIL ▲	<i>Hottonia inflata</i>
SOUTHERN POND LILY	<i>Nuphar advena</i>
BULLHEAD LILY	<i>Nuphar variegata</i>
WHITE WATER LILY	<i>Nymphaea odorata</i>
LITTLE FLOATING HEART	<i>Nymphoides cordata</i>
HUMPED BLADDERWORT ▲	<i>Utricularia gibba</i>
PURPLE BLADDERWORT ▲	<i>Utricularia purpurea</i>
SMALLER FLOATING BLADDERWORT	<i>Utricularia radiata</i>
LARGE LEAF PONDWEED	<i>Potamogeton amplifolius</i>
NUTTAL'S (ribbonleaf) PONDWEED ▲	<i>Potamogeton epihydrus</i>
FLOATING PONDWEED	<i>Potamogeton natans</i>

Aquatic Plants: Emergent

(18 species)

Common Name	Scientific Name
SOUTHERN WATER PLANTAIN	<i>Alisma subcordatum</i>
SPOON LEAF SUNDEW †	<i>Drosera intermedia</i>
ROUNDLEAF SUNDEW ▲	<i>Drosera rotundifolia</i>
WATERCRESS	<i>Nasturtium officinale</i>
ARROW ARUM	<i>Peltandra virginica</i>
COMMON REED ☉	<i>Phragmites australis</i>
PICKERELWEED	<i>Pontederia cordata</i>
MERMAID WEED	<i>Proserpinaca palustris</i>
ACID WATER ARROWHEAD	<i>Sagittaria engelmanniana</i>
GRASS LEAVED ARROWHEAD	<i>Sagittaria graminea</i>
BROAD LEAVED ARROWHEAD	<i>Sagittaria latifolia</i>
SLENDER BUR REED	<i>Sparganium americanum</i>
BRANCHING BUR REED	<i>Sparganium androcladum</i>
NARROW LEAVED BUR REED	<i>Sparganium angustifolium</i>
GREEN FRUITED BUR REED ▲	<i>Sparganium chlorocarpum</i>
SMALL BUR REED	<i>Sparganium minimum</i>
NARROW LEAVED CATTAIL	<i>Typha angustifolia</i>
BROAD LEAVED CATTAIL	<i>Typha latifolia</i>

See also those sedge and sedge allies which are chiefly emergent type species
(16 species)

B4

Aquatic Plants: Free-Floating

(4 species)

Common Name	Scientific Name
LESSER DUCKWEED	<i>Lemna minor</i>
GREATER DUCKWEED	<i>Spirodela polyrhiza</i>
GREATER BLADDERWORT	<i>Utricularia vulgaris</i>
WATERMEAL	<i>Wolffia spp.</i>

B5

GRASSES AND VINES

Grasses

(49 species)

Common Name	Scientific Name
WHEATGRASS +	<i>Agropyron trachycaulum</i>
REDTOP +	<i>Agrostis alba</i>
TICKLEGRASS	<i>Agrostis hyemalis</i>
ROUGH BENTGRASS +	<i>Agrostis scabra</i>
SPREADING BENTGRASS +	<i>Agrostis stolonifera</i>
FOXTAIL	<i>Alopecurus spp.</i>
BROOM SEDGE +	<i>Andropogon virginicus</i>
POVERTY GRASS	<i>Aristida dichotoma</i>
BEARDED SHORT HUSK	<i>Brachyelytrum erectum</i>
BROOK GRASS +	<i>Catabrosa aquatica</i>
STOUT WOOD REEDGRASS +	<i>Cinna arundinacea</i>
SLENDER WOOD REEDGRASS +	<i>Cinna latifolia</i>
ORCHARD GRASS + ☉	<i>Dactylis glomerata</i>
COMMON WILD OAT GRASS	<i>Danthonia spicata</i>
COMMON HAIRGRASS	<i>Deschampsia flexuosa</i>
SMOOTH CRABGRASS	<i>Digitaria ischaemum</i>
HAIRY CRABGRASS +	<i>Digitaria sanguinalis</i>
BARNYARD GRASS +	<i>Echinochloa crusgalli</i>
SALT MARSH COCKSPUR GRASS	<i>Echinochloa walteri</i>
VIRGINIA WILD RYE +	<i>Elymus virginicus</i>
PURPLE LOVEGRASS	<i>Eriogrostis spectabilis</i>
NODDING FESCUE	<i>Festuca subverticillata</i>
CANADA MANNA GRASS +	<i>Glyceria canadensis</i>
NORTHEASTERN MANNA GRASS	<i>Glyceria melicaria</i>
ATLANTIC MANNA GRASS +	<i>Glyceria obtusa</i>
FOWL MANNA GRASS +	<i>Glyceria striata</i>
RICE CUTGRASS +	<i>Leersia oryzoides</i>
WHITEGRASS +	<i>Leersia virginica</i>
RYEGRASS	<i>Lolium perenne</i>
NEPALESE BROWNTOP (stiltgrass) ☉	<i>Microstegium vimineum</i>
LEAFY DROPSEED	<i>Muhlenbergia frondosa</i>
WIRESTEM MUHLY	<i>Muhlenbergia mexicana</i>
DEER TONGUE GRASS	<i>Panicum clandestinum</i>
SPREADING PANIC GRASS +	<i>Panicum dichotomiflorum</i>
SWITCHGRASS	<i>Panicum virgatum</i>
FIELD PASPALUM	<i>Paspalum laeve</i>
REED CANARY GRASS ☉	<i>Phalaris arundinacea</i>
TIMOTHY ☉	<i>Phleum pratense</i>
CANADA BLUEGRASS	<i>Poa compressa</i>
KENTUCKY BLUEGRASS	<i>Poa pratensis</i>
TALL (meadow) FESCUE +	<i>Schedonorus arundinaceus</i>
MEADOW FESCUE +	<i>Schedonorus pratensis</i>
LITTLE BLUESTEM	<i>Schizachyrium scoparium</i>
JAPANESE BRISTLE GRASS +	<i>Setaria faberi</i>
YELLOW FOXTAIL	<i>Setaria glauca</i>
GREEN FOXTAIL	<i>Setaria viridis</i>
JOHNSON GRASS ☉	<i>Sorghum halepense</i>
INDIAN GRASS +	<i>Sorghastrum nutans</i>
CORN	<i>Zea mays</i>

B5

Vines

(23 species)

Common Name	Scientific Name
ALLEGHENY VINE	<i>Adlumia fungosa</i>
SANDVINE	<i>Ampelamus albidus</i>
HOG PEANUT	<i>Amphicarpa bracteata</i>
TRUMPET CREEPER	<i>Campsis radicans</i>
ASIATIC BITTERSWEET ☉	<i>Celastrus orbiculatus</i>
PURPLE VIRGIN'S BOWER	<i>Clematis occidentalis</i>
VIRGIN'S BOWER	<i>Clematis virginiana</i>
COMMON DODDER	<i>Cuscuta gronovii</i>
YELLOW (common wild) YAM †	<i>Dioscorea villosa</i>
EVERLASTING PEA	<i>Lathyrus latifolius</i>
JAPANESE HONEYSUCKLE ☉	<i>Lonicera japonica</i>
CLIMBING HEMPWEED	<i>Mikania scandens</i>
VIRGINIA CREEPER	<i>Parthenocissus quinquefolia</i>
CLIMBING FALSE BUCKWHEAT †	<i>Polygonum scandens</i>
WHITELEAF (cat) GREENBRIER ▲	<i>Smilax glauca</i>
CARRION FLOWER	<i>Smilax herbacea</i>
COMMON GREENBRIER	<i>Smilax rotundifolia</i>
ANNUAL WILD BEAN	<i>Strophostyles helvula</i>
POISON IVY ▲	<i>Toxicodendron radicans</i>
SUMMER GRAPE †	<i>Vitis aestivalis</i>
FOX GRAPE	<i>Vitis labrusca</i>
RIVERBANK GRAPE	<i>Vitis riparia</i>
CHINESE WISTERIA ☉	<i>Wisteria sinensis</i>

B6

FORBS
(327 species)

Common Name	Scientific Name
VIRGINIA COPPERLEAF	<i>Acalypha virginica</i>
YARROW	<i>Achillea millefolium</i>
WHITE BANEBERRY	<i>Actaea pachypoda</i>
GARLIC MUSTARD ☉	<i>Alliaria petiolata</i>
WILD LEEK	<i>Allium tricoccum</i>
FIELD GARLIC ☉	<i>Allium vineale</i>
COMMON RAGWEED	<i>Ambrosia artemisiifolia</i>
GREAT RAGWEED	<i>Ambrosia trifida</i>
SCARLET PIMPERNEL	<i>Anagallis arvensis</i>
PEARLY EVERLASTING	<i>Anaphalis margaritacea</i>
WOOD ANEMONE	<i>Anemone quinquefolia</i>
TALL ANEMONE †	<i>Anemone virginiana</i>
RUE ANEMONE	<i>Anemonella thalictroides</i>
FIELD PUSSYTOES	<i>Antennaria neglecta</i>
GROUNDNUT	<i>Apios americana</i>
SPREADING DOGBANE	<i>Apocynum androsaemifolium</i>
HEMP DOGBANE	<i>Apocynum cannabinum</i>
WILD COLUMBINE	<i>Aquilegia canadensis</i>
SICKLEPOD	<i>Arabis canadensis</i>
SMOOTH ROCK CRESS	<i>Arabis laevigata</i>
BRISTLY SARSAPARILLA	<i>Aralia hispida</i>
WILD SARSAPARILLA	<i>Aralia nudicaulis</i>
THYME LEAVED SANDWORT	<i>Arenaria serpyllifolia</i>
JACK IN THE PULPIT	<i>Arisaema triphyllum</i>
VIRGINIA SNAKEROOT	<i>Aristolochia serpentaria</i>
MUGWORT †	<i>Artemisia vulgaris</i>
WILD GINGER	<i>Asarum canadense</i>
POKE MILKWEED	<i>Asclepias exaltata</i>
SWAMP MILKWEED	<i>Asclepias incarnata</i>
FOUR LEAVED MILKWEED	<i>Asclepias quadrifolia</i>
COMMON MILKWEED	<i>Asclepias syriaca</i>
BUTTERFLY WEED	<i>Asclepias tuberosa</i>
WILD ASPARAGUS	<i>Asparagus officinalis</i>
WHORLED ASTER †	<i>Aster acuminatus</i>
HEART LEAVED ASTER	<i>Aster cordifolius</i>
BUSH ASTER †	<i>Aster dumosus</i>
COMMON WHITE HEART LEAVED ASTER	<i>Aster divaricatus</i>
SQUARROSE WHITE ASTER	<i>Aster ericoides</i>
CALICO ASTER †	<i>Aster lateriflorus</i>
LOWRIE'S ASTER	<i>Aster lowrieanus</i>
NEW ENGLAND ASTER †	<i>Aster novae angliae</i>
AWL ASTER †	<i>Aster pilosus</i>
FLAT TOP WHITE ASTER †	<i>Aster umbellatus</i>
EARLY WINTER CRESS	<i>Barbarea verna</i>
WINTER CRESS	<i>Barbarea vulgaris</i>
BLACKBERRY LILY	<i>Belamcanda chinensis</i>
NODDING BEGGAR TICKS †	<i>Bidens cernua</i>
PURPLE STEM BEGGAR TICKS †	<i>Bidens connata</i>
DEVILS BEGGAR TICKS †	<i>Bidens frondosa</i>
FEW BRACTED BEGGAR TICKS	<i>Bidens discoides</i>
SMALL SPIKE FALSE NETTLE †	<i>Boehmeria cylindrica</i>
FIELD MUSTARD	<i>Brassica rapa</i>
WILD CALLA	<i>Calla palustris</i>
CALOPOGON	<i>Calopogon tuberosus</i>
MARSH MARIGOLD	<i>Caltha palustris</i>
TALL BELLFLOWER	<i>Campanula americana</i>
CREeping BELLFLOWER	<i>Campanula rapunculoides</i>
SHEPHERD'S PURSE	<i>Capsella bursa pastoris</i>
PURPLE BITTER CRESS †	<i>Cardamine douglassii</i>
PENNSYLVANIA BITTER CRESS	<i>Cardamine pennsylvanica</i>
MUSK THISTLE †	<i>Carduus nutans</i>
PARTRIDGE PEA	<i>Cassia fasciculata</i>
WILD SENSITIVE PLANT †	<i>Cassia nitidans</i>
SPOTTED Knapweed ☉	<i>Centaurea maculosa</i>
FIELD CHICKWEED	<i>Cerastium arvense</i>
MOUSE EAR CHICKWEED	<i>Cerastium fontanum</i>
COMMON MOUSE EAR CHICKWEED †	<i>Cerastium vulgatum</i>
DEVIL'S BIT	<i>Chamaelirium luteum</i>
CELANDINE	<i>Chelidonium majus</i>
TURTLEHEAD	<i>Chelone glabra</i>
LAMBS QUARTERS	<i>Chenopodium album</i>
JERUSALEM OAK	<i>Chenopodium botrys</i>
OAK LEAVED GOOSEFOOT	<i>Chenopodium glaucum</i>

B6

Common Name	Scientific Name
RIVER BEAUTY ⇄	<i>Chamerion latifolium</i>
SPOTTED WINTERGREEN	<i>Chimaphila maculata</i>
WATER CARPET	<i>Chrysosplenium americanum</i>
CHICORY	<i>Cichorium intybus</i>
BULL THISTLE +	<i>Cinna vulgare</i>
SMALLER ENCHANTER'S NIGHTSHADE	<i>Circaea alpina</i>
ENCHANTER'S NIGHTSHADE	<i>Circaea lutetiana</i>
CANADA THISTLE	<i>Cirsium arvense</i>
BULL THISTLE ⊙	<i>Cirsium vulgare</i>
SPRING BEAUTY	<i>Claytonia virginica</i>
WILD BASIL	<i>Clinopodium vulgare</i>
BUTTERFLY PEA +	<i>Clit. mariana</i>
HORSE BALM	<i>Collinsonia canadensis</i>
COMMON DAYFLOWER ⊙	<i>Commelina communis</i>
SQUAWROOT	<i>Conopholis americana</i>
CANADA HORSEWEED +	<i>Conyza canadensis</i>
GOLDTHREAD	<i>Coptis trifolia</i>
LANCE LEAVED COREOPSIS	<i>Coreopsis lanceolata</i>
YELLOW CORYDALIS	<i>Corydalis flavula</i>
PALE CORYDALIS	<i>Corydalis sempervirens</i>
COMMON DODDER	<i>Cuscuta gronovii</i>
QUEEN ANNE'S LACE	<i>Daucus carota</i>
SHOWY TICK TREFOIL	<i>Desmodium canadense</i>
TRAILING TICK TREFOIL	<i>Desmodium humifusum</i>
SMOOTH LEAVED TICK TREFOIL	<i>Desmodium marylandicum</i>
PROSTRATE TICK TREFOIL	<i>Desmodium rotundifolium</i>
VELVETY TICK TREFOIL	<i>Desmodium viridifolia</i>
DEPTFORD PINK	<i>Dianthus armeria</i>
BUTTONWOOD	<i>Diodia teres</i>
TEASEL ⊙	<i>Dipsacus fullonum?</i>
PURPLE CONEFLOWER +	<i>Echinacea purpurea</i>
VIPER'S BUGLOSS	<i>Echium vulgare</i>
BEECH DROPS	<i>Epifagus virginiana</i>
FIREWEED	<i>Epilobium angustifolium</i>
PURPLE LEAF WILLOW HERB +	<i>Epilobium coloratum</i>
NARROW LEAVED WILLOW HERB +	<i>Epilobium leptophyllum</i>
HELLEBORINE	<i>Epipactis helleborine</i>
PILEWORT	<i>Erechtites hieracifolia</i>
DAISY FLEABANE	<i>Erigeron annuus</i>
COMMON FLEABANE	<i>Erigeron philadelphicus</i>
TROUT LILY	<i>Erythronium americanum</i>
EASTERN JOE PYE WEED	<i>Eupatorium dubium</i>
HYSSOP LEAVED BONESET	<i>Eupatorium hyssopifolium</i>
SPOTTED JOE PYE WEED	<i>Eupatorium maculatum</i>
BONESET	<i>Eupatorium perfoliatum</i>
PURPLE NODE JOE PYE WEED	<i>Eupatorium purpureum</i>
WHITE SNAKEROOT	<i>Eupatorium rugosum</i>
FLOWERING SPURGE	<i>Euphorbia corollata</i>
CYPRESS SPURGE	<i>Euphorbia cyparissias</i>
MILK PURSLANE	<i>Euphorbia maculata</i>
BUCKWHEAT	<i>Fagopyrum esculentum</i>
WOODLAND STRAWBERRY +	<i>Fragaria vesca</i>
WILD STRAWBERRY	<i>Fragaria virginiana</i>
SHOWY ORCHID	<i>Galearis spectabilis</i>
CLEAVERS	<i>Galium aparine</i>
ROUGH BEDSTRAW	<i>Galium asprellum</i>
NORTHERN BEDSTRAW	<i>Galium boreale</i>
WILD LICORICE	<i>Galium circaezans</i>
MARSH BEDSTRAW +	<i>Galium palustre</i>
SOUTHERN THREE LOBED BEDSTRAW	<i>Galium tinctorium</i>
GAURA +	<i>Gaura coccinea</i>
FRINGED GENTIAN	<i>Gentianopsis crinita</i>
WILD GERANIUM	<i>Geranium maculatum</i>
HERB ROBERT	<i>Geranium robertianum</i>
WHITE AVENS	<i>Geum canadense</i>
VIRGINIA AVENS	<i>Geum virginianum</i>
GILL OVER THE GROUND ⊙	<i>Glechoma hederacea</i>
FRAGRANT CUDWEED	<i>Gnaphalium obtusifolium</i>
DOWNY RATTLESNAKE PLANTAIN	<i>Goodyera pubescens</i>
AMERICAN PENNYROYAL	<i>Hedeoma pulegioides</i>
LESSEY PURPLE FRINGED ORCHID	<i>Habenaria psycodes</i>
SOUTHERN SNEEZEWEED	<i>Helenium flexuosum</i>
LONG BRANCHED FROSTWEED	<i>Helianthemum canadense</i>
WOODLAND SUNFLOWER	<i>Helianthus divaricatus</i>
PALE LEAVED SUNFLOWER	<i>Helianthus strumosus</i>
OX EYE	<i>Heliopsis helianthoides</i>
TAWNY DAY LILY	<i>Hemerocallis fulva</i>

B6

Common Name	Scientific Name
HEPATICA	<i>Hepatica nobilis</i>
KING DEVIL	<i>Hieracium caespitosum</i>
HAIRY HAWKWEED	<i>Hieracium gronovii</i>
YELLOW KING DEVIL	<i>Hieracium caespitosum</i>
ROUGH HAWKWEED	<i>Hieracium scabrum</i>
RATTLESNAKE WEED	<i>Hieracium venosum</i>
NORTHERN ST. JOHN'S WORT †	<i>Hypericum boreale</i>
SLENDER ST. JOHN'S WORT †	<i>Hypericum mutilum</i>
COMMON ST. JOHN'S WORT	<i>Hypericum perforatum</i>
DOTTED ST. JOHN'S WORT	<i>Hypericum punctatum</i>
YELLOW STARGRASS	<i>Hypoxis hirsuta</i>
STIFF ASTER †	<i>Ionactis linariifolius</i>
YELLOW TOUCH ME NOT	<i>Impatiens pallida</i>
SLENDER BLUE FLAG	<i>Iris prismatica</i>
LARGER BLUE FLAG	<i>Iris versicolor</i>
WHORLED POGONIA	<i>Isotria verticillata</i>
TWO FLOWERED CYNTHIA	<i>Krigia biflora</i>
TALL BLUE LETTUCE	<i>Lactuca biennis</i>
WILD LETTUCE	<i>Lactuca canadensis</i>
WOODLAND LETTUCE	<i>Lactuca floridana</i>
TWO ROW STICKSEED	<i>Lappula squarrosa</i>
MOTHERWORT	<i>Leonurus cardiaca</i>
PEPPER GRASS	<i>Lepidium virginicum</i>
ROUND HEADED BUSH CLOVER	<i>Lespedeza capitata</i>
WAND LIKE BUSH CLOVER	<i>Lespedeza intermedia</i>
THUNBERG'S BUSH CLOVER †	<i>Lespedeza thunbergii</i>
SLENDER BUSH CLOVER	<i>Lespedeza virginica</i>
MEADOW LILY	<i>Lilium canadense</i>
WOOD LILY	<i>Lilium philadelphicum</i>
TURK'S CAP LILY	<i>Lilium superbum</i>
BUTTER AND EGGS	<i>Linaria vulgaris</i>
LARGE TWAYBLADE	<i>Liparis liliifolia</i>
CARDINAL FLOWER	<i>Lobelia cardinalis</i>
INDIAN TOBACCO	<i>Lobelia inflata</i>
KALM'S LOBELIA	<i>Lobelia kalmii</i>
BUSHY SEEDBOX †	<i>Ludwigia alternifolia</i>
COMMON WATER PURSLANE	<i>Ludwigia palustris</i>
EVENING LYCHNIS	<i>Lychnis alba</i>
CUT LEAVED WATER HOREHOUND	<i>Lycopus americanus</i>
NORTHERN BUGLEWEED †	<i>Lycopus uniflorus</i>
FRINGED LOOSESTRIFE	<i>Lysimachia ciliata</i>
WHORLED LOOSESTRIFE	<i>Lysimachia quadrifolia</i>
SWAMP LOOSESTRIFE	<i>Lysimachia terrestris</i>
PURPLE LOOSESTRIFE ☉	<i>Lythrum salicaria</i>
CANADA MAYFLOWER	<i>Maianthemum canadense</i>
INDIAN CUCUMBER ROOT	<i>Medeola virginiana</i>
SPOTTED MEDICK	<i>Medicago polymorpha</i>
ALFALFA	<i>Medicago sativa</i>
COW WHEAT	<i>Melampyrum lineare</i>
WHITE SWEET CLOVER ☉	<i>Melilotus alba</i>
YELLOW SWEET CLOVER ☉	<i>Melilotus officianalis</i>
FIELD MINT	<i>Mentha arvensis</i>
EUROPEAN HORSEMINT	<i>Mentha longifolia</i>
WINGED MONKEY FLOWER	<i>Mimulus alatus</i>
SQUARE STEMMED MONKEY FLOWER	<i>Mimulus ringens</i>
PARTRIDGE BERRY	<i>Mitchella repens</i>
WILD BERGAMOT	<i>Monarda fistulosa</i>
INDIAN PIPE	<i>Monotropa uniflora</i>
FORGET ME NOT	<i>Myosotis scorpioides</i>
CATNIP	<i>Nepeta cataria</i>
EVENING PRIMROSE	<i>Oenothera biennis</i>
NORTHERN WOOD SORREL	<i>Oxalis acetosella</i>
DWARF GINSENG	<i>Panax trifolius</i>
SILVER WHITLOW WORT	<i>Paronychia argyrocoma</i>
WOOD BETONY	<i>Pedicularis canadensis</i>
SWAMP LOUSEWORT	<i>Pedicularis lanceolata</i>
FOXGLOVE BEARDTONGUE	<i>Penstemon digitalis</i>
DITCH STONECROP	<i>Penthorum sedoides</i>
SUMMER PHLOX	<i>Phlox paniculata</i>
POKEWEED †	<i>Phytolacca americana</i>
CLEARWEED †	<i>Pilea pumila</i>
ENGLISH PLANTAIN	<i>Plantago lanceolata</i>
COMMON PLANTAIN ☉	<i>Plantago major</i>
RED STEMMED PLANTAIN	<i>Plantago rugelii</i>
MAY APPLE	<i>Podophyllum peltatum</i>
FRINGED POLYGALA	<i>Polygala paucifolia</i>
WHORLED MILKWORT	<i>Polygala verticillata</i>
SOLOMON'S SEAL	<i>Polygonatum biflorum</i>
HAIRY SOLOMON'S SEAL	<i>Polygonatum pubescens</i>

B6

Common Name	Scientific Name
HALBERD LEAF TEARTHUMB ▲	<i>Polygonum arifolium</i>
COMMON KNOTWEED	<i>Polygonum aviculare</i>
CESPTOSE SMARTWEED	<i>Polygonum cespitosum</i>
JAPANESE KNOTWEED ⊙	<i>Polygonum cuspidatum</i>
MARSHPEPPER SMARTWEED +	<i>Polygonum hydropiper</i>
FALSE WATER PEPPER	<i>Polygonum hydropiperoides</i>
NODDING SMARTWEED	<i>Polygonum lapathifolium</i>
PRINCE'S FEATHER	<i>Polygonum orientale</i>
PENNSYLVANIA SMARTWEED	<i>Polygonum pennsylvanicum</i>
LADIES' THUMB	<i>Polygonum persicaria</i>
DOTTED SMARTWEED	<i>Polygonum punctatum</i>
COURSE SMARTWEED	<i>Polygonum robustius</i>
ARROW LEAF TEAR THUMB +	<i>Polygonum sagittatum</i>
DOCK LEAVED SMARTWEED	<i>Polygonum lapathifolium</i>
JUMPSEED	<i>Polygonum virginianum</i>
COMMON PURSLANE	<i>Portulaca oleracea</i>
SILVERY CINQUEFOIL	<i>Potentilla argentea</i>
TALL CINQUIFOIL	<i>Potentilla arguta</i>
ROUGH CINQUEFOIL	<i>Potentilla norvegica</i>
SULPHUR CINQUIFOIL	<i>Potentilla recta</i>
SELF HEAL	<i>Prunella vulgaris</i>
VIRGINIA MOUNTAIN MINT +	<i>Pycnanthemum virginianum</i>
SHINLEAF	<i>Pyrola elliptica</i>
ROUNDLEAF PYROLA	<i>Pyrola orbiculata</i>
TALL BUTTERCUP	<i>Ranunculus acris</i>
CREEPING BUTTERCUP ⊙	<i>Ranunculus repens</i>
BLACK EYED SUSAN	<i>Rudbeckia hirta</i>
SHEEP SORREL	<i>Rumex acetosella</i>
CURLED DOCK ⊙	<i>Rumex crispus</i>
SWAMP DOCK +	<i>Rumex verticillatus</i>
BLOODROOT	<i>Sanguinaria canadensis</i>
SNAKEROOT	<i>Sanicula spp.</i>
SOAPWORT	<i>Saponaria officinalis</i>
PITCHER PLANT	<i>Sarracenia purpurea</i>
LIZARD'S TAIL	<i>Saururus cernuus</i>
SWAMP SAXIFRAGE	<i>Saxifraga pennsylvanica</i>
EARLY SAXIFRAGE	<i>Saxifraga virginensis</i>
MAD DOG SKULLCAP +	<i>Scutellaria lateriflora</i>
GOLDEN RAGWORT	<i>Senecio aureus</i>
COMMON GROUNSEL ⊙	<i>Senecio vulgaris</i>
BLADDER CAMPION	<i>Silene vulgaris</i>
NARROW LEAVED BLUE EYED GRASS	<i>Sisyrinchium angustifolium</i>
COMMON BLUE EYED GRASS	<i>Sisyrinchium montanum</i>
FALSE SOLOMON'S SEAL	<i>Smilacina racemosa</i>
HORSE NETTLE	<i>Solanum carolinense</i>
CLIMBING NIGHTSHADE +	<i>Solanum dulcamara</i>
BLACK NIGHTSHADE	<i>Solanum nigrum</i>
SILVERROD +	<i>Solidago bicolor</i>
WREATH GOLDENROD +	<i>Solidago caesia</i>
CANADA GOLDENROD +	<i>Solidago canadensis</i>
SLENDER GOLDENROD	<i>Solidago erecta</i>
ZIG ZAG GOLDENROD +	<i>Solidago flexicaulis</i>
GIANT GOLDENROD +	<i>Solidago gigantea</i>
GRASS LEAVED GOLDENROD +	<i>Solidago graminifolia</i>
EARLY GOLDENROD	<i>Solidago juncea</i>
SWEET GOLDENROD ▲	<i>Solidago odora</i>
ROUGH LEAF GOLDENROD +	<i>Solidago patula</i>
WRINKLED LEAVED GOLDENROD +	<i>Solidago rugosa</i>
SWAMP GOLDENROD	<i>Solidago uliginosa</i>
ELM LEAVED GOLDENROD +	<i>Solidago ulmifolia</i>
COMMON SOW THISTLE	<i>Sonchus oleraceus</i>
NODDING LADIES' TRESSES	<i>Spiranthes cernua</i>
NORTHERN SLENDER LADIES TRESSES	<i>Spiranthes lacera</i>
SPRING LADIES' TRESSES	<i>Spiranthes vernalis</i>
COMMON CHICKWEED	<i>Stellaria media</i>
SKUNK CABBAGE	<i>Symplocarpus foetidus</i>
DANDELION	<i>Taraxacum officinale</i>
GOAT'S RUE	<i>Tephrosia virginiana</i>
EARLY MEADOW RUE	<i>Thalictrum dioicum</i>
TALL MEADOW RUE	<i>Thalictrum pubescens</i>
OYSTER PLANT	<i>Tragopogon porrifolius</i>
GOAT'S BEARD	<i>Tragopogon pratensis</i>
FRASER'S MARSH ST. JOHN'S WORT	<i>Triadenum fraseri</i>
MARSH ST. JOHN'S WORT ▲	<i>Triadenum virginicum</i>
BLUE CURLS	<i>Trichostema dichotomum</i>
NARROW LEAVED BLUE CURLS	<i>Trichostema setaceum</i>
STARFLOWER	<i>Trientalis borealis</i>

B6

Common Name	Scientific Name
YELLOW HOP CLOVER	<i>Trifolium aureum</i>
RED CLOVER	<i>Trifolium pratense</i>
WHITE CLOVER	<i>Trifolium repens</i>
VENUS' LOOKING GLASS	<i>Triodanis perfoliata</i>
COLTSFOOT	<i>Tussilago farfara</i>
STINGING NETTLE	<i>Urtica dioica</i>
PERFOLIATE BELLWORT	<i>Uvularia perfoliata</i>
WHITE HELLEBORE	<i>Veratrum viride</i>
MOTH MULLEIN	<i>Verbascum blattaria</i>
COMMON MULLEIN	<i>Verbascum thapsus</i>
BLUE VERVAIN	<i>Verbena hastata</i>
WHITE VERVAIN	<i>Verbena urticifolia</i>
NEW YORK IRONWEED	<i>Veronia noveboracensis</i>
AMERICAN BROOKLIME	<i>Veronica americana</i>
COMMON SPEEDWELL	<i>Veronica officinalis</i>
TUFTED VETCH †	<i>Vicia cracca</i>
HALBERD LEAVED VIOLET	<i>Viola hastata</i>
LANCE LEAVED VIOLET	<i>Viola lanceolata</i>
NORTHERN MARSH VIOLET	<i>Viola palustris</i>
WHITE VIOLET	<i>Viola macloskeyi</i>
COMMON BLUE VIOLET	<i>Viola priceana</i>
DOWNY YELLOW VIOLET	<i>Viola pubescens</i>
ROUND LEAVED VIOLET	<i>Viola rotundifolia</i>
CAROLINA YELLOWEYED GRASS	<i>Xyris caroliniana</i>
TWISTED YELLOWEYED GRASS †	<i>Xyris torta</i>
HEARTLEAF ALEXANDERS †	<i>Zizi aptera</i>

B7 SHRUBS AND TREES

Shrubs (72 species)

Common Name	Scientific Name
OBLONGLEAF JUNE BERRY	<i>Amelanchier canadensis</i>
SWAMP SERVICE BERRY	<i>Amelanchier X intermedia</i>
WILD SARSAPARILLA	<i>Aralia racemosa</i>
BLACK CHOKEBERRY	<i>Aronia melanocarpa</i>
JAPANESE BARBERRY ☉	<i>Berberis thunbergii</i>
BUTTON BUSH	<i>Cephalanthus occidentalis</i>
COAST PEPPER BUSH +	<i>Clethra alnifolia</i>
SWEET FERN	<i>Comptonia peregrina</i>
ALTERNATE LEAVE DOGWOOD +	<i>Cornus alternifolia</i>
SILKY DOGWOOD ▲	<i>Cornus amomum</i>
RED OSIER DOGWOOD	<i>Cornus sericea</i>
AMERICAN HAZEL	<i>Corylus americana</i>
BEAKED HAZEL	<i>Corylus cornuta</i>
HAWTHORN	<i>Craetegus spp.</i>
WATER WILLOW	<i>Decodon verticillatus</i>
RUSSIAN OLIVE + ☉	<i>Elaeagnus angustifolia</i>
AUTUMN OLIVE ☉	<i>Elaeagnus umbellata</i>
TRAILING ARBUTUS	<i>Epigaea repens</i>
WINGED (burningbush) SPINDLE TREE ☉	<i>Euonymus alata</i>
WINTERGREEN	<i>Gaultheria procumbens</i>
BLACK HUCKLEBERRY	<i>Gaylussacia baccata</i>
DWARF HUCKLEBERRY	<i>Gaylussacia dumosa</i>
DANGLEBERRY	<i>Gaylussacia frondosa</i>
WITCH HAZEL	<i>Hamamelis virginiana</i>
WILD HYDRANGEA	<i>Hydrangea arborescens</i>
SMOOTH WINTERBERRY	<i>Ilex laevigata</i>
WINTERBERRY +	<i>Ilex verticillata</i>
VIRGINIA WILLOW	<i>Itea virginica</i>
SHEEP LAUREL	<i>Kalmia angustifolia</i>
MOUNTAIN LAUREL +	<i>Kalmia latifolia</i>
FETTER BUSH +	<i>Leucothoe racemosa</i>
SPICE BUSH	<i>Lindera benzoin</i>
TARTARIAN HONEYSUCKLE	<i>Lonicera tatarica</i>
MALE BERRY	<i>Lyonia ligustrina</i>
BLACK CHOKEBERRY +	<i>Photinia melanocarpa</i>
GREAT LAUREL	<i>Rhododendron maximum</i>
PINK AZALEA (pinxter flower) ▲	<i>Rhododendron periclymenoides</i>
SWAMP AZALEA	<i>Rhododendron viscosum</i>
SMOOTH SUMAC	<i>Rhus glabra</i>
STAGHORN SUMAC	<i>Rhus typhina</i>
POISON SUMAC +	<i>Rhus vernix</i>
BRISTLY BLACK CURRANT +	<i>Ribes lacustre</i>
PASTURE ROSE	<i>Rosa carolina</i>
MULTIFLORA ROSE ☉	<i>Rosa multiflora</i>
SWAMP ROSE	<i>Rosa palustris</i>
PRAIRIE ROSE +	<i>Rosa setigera</i>
ALLEGHENY BLACKBERRY +	<i>Rubus allegheniensis</i>
NORTHERN DEWBERRY	<i>Rubus flagellaris</i>
SWAMP DEWBERRY	<i>Rubus hispidus</i>
COMMON RED RASPBERRY +	<i>Rubus idaeus</i>
BLACK RASPBERRY	<i>Rubus occidentalis</i>
PURPLE FLOWERING RASPBERRY	<i>Rubus odoratus</i>
WINEBERRY ☉	<i>Rubus phoenicolasium</i>
DWARF BLACKBERRY ▲	<i>Rubus pubescens</i>
BEBB WILLOW +	<i>Salix bebbiana</i>
PUSSY WILLOW	<i>Salix discolor</i>
SANDBAR WILLOW +	<i>Salix exigua</i>
MEADOW WILLOW	<i>Salix petiolaris</i>
SILKY WILLOW	<i>Salix sericea</i>
COMMON ELDER	<i>Sambucus canadensis</i>
NARROW LEAVED MEADOWSWEET	<i>Spiraea alba var alba</i>
BIRCH LEAVED SPIRAEA	<i>Spiraea betulifolia var corymbosa</i>
BROADLEAF MEADOWSWEET +	<i>Spiraea latifolia</i>
BRIDAL WREATH SPIRAEA	<i>Spiraea prunifolia</i>
CORAL BERRY	<i>Symphoricarpos orbiculatus</i>
LATE LOW BLUEBERRY	<i>Vaccinium angustifolium</i>
HIGH BUSH BLUEBERRY	<i>Vaccinium corymbosum</i>
VELVET LEAF BLUEBERRY	<i>Vaccinium myrtilloides</i>
EARLY LOW BLUEBERRY	<i>Vaccinium pallidum</i>
DEER BERRY	<i>Vaccinium stamineum</i>
MAPLE LEAVED VIBURNUM	<i>Viburnum acerifolium</i>
SOUTHERN ARROW WOOD	<i>Viburnum dentatum</i>
NANNY BERRY	<i>Viburnum lentago</i>

B7
Trees
(64 species)

Common Name	Scientific Name
TREE OF HEAVEN ☉	<i>Ailanthus altissima</i>
STRIPED MAPLE	<i>Acer pensylvanicum</i>
NORWAY MAPLE	<i>Acer platanoides</i>
RED MAPLE	<i>Acer rubrum</i>
SUGAR MAPLE	<i>Acer saccharum</i>
SILVER MAPLE	<i>Acer sacharinum</i>
MOUNTAIN MAPLE	<i>Acer spicatum</i>
SPECKLED ALDER ▲	<i>Alnus incana</i>
SMOOTH ALDER	<i>Alnus serrulata</i>
DOWNY SERVICEBERRY ▲	<i>Amelanchier arborea</i>
YELLOW BIRCH	<i>Betula alleghanensis</i>
BLACK BIRCH	<i>Betula lenta</i>
GRAY BIRCH	<i>Betula populifolia</i>
IRONWOOD	<i>Carpinus caroliniana</i>
PIGNOT HICKORY	<i>Carya glabra</i>
SHAGBARK HICKORY	<i>Carya ovata</i>
MOCKERNUT HICKORY ▲	<i>Carya tomentosa</i>
AMERICAN CHESTNUT ▲	<i>Castanea dentata</i>
NORTHERN CATALPA	<i>Catalpa speciosa</i>
HACKBERRY	<i>Celtis occidentalis</i>
FLOWERING DOGWOOD	<i>Cornus florida</i>
PERSIMMON	<i>Diospyros virginiana</i>
BEECH	<i>Fagus grandifolia</i>
WHITE ASH †	<i>Fraxinus americana</i>
BLACK ASH	<i>Fraxinus nigra</i>
RED ASH	<i>Fraxinus pennsylvanica</i>
LARGE LEAVED HOLLY	<i>Ilex montana</i>
BUTTERNUT	<i>Juglans cinerea</i>
BLACK WALNUT	<i>Juglans nigra</i>
RED CEDAR	<i>Juniperus virginiana</i>
EUROPEAN LARCH †	<i>Larix decidua</i>
TULIP TREE	<i>Liriodendron tulipifera</i>
WHITE MULBERRY ☉	<i>Morus alba</i>
SOUR GUM	<i>Nyssa sylvatica</i>
HOP HORNBEAM †	<i>Ostrya virginiana</i>
NORWAY SPRUCE	<i>Picea abies</i>
PITCH PINE	<i>Pinus rigida</i>
WHITE PINE	<i>Pinus strobus</i>
SCOTCH PINE	<i>Pinus sylvestris</i>
SYCAMORE	<i>Platanus occidentalis</i>
COTTONWOOD †	<i>Populus deltoides</i>
BIG TOOTHED ASPEN	<i>Populus grandidentata</i>
QUAKING ASPEN ☉	<i>Populus tremuloides</i>
SWEET CHERRY	<i>Prunus avium</i>
BLACK CHERRY	<i>Prunus serotina</i>
WHITE OAK	<i>Quercus alba</i>
SWAMP WHITE OAK	<i>Quercus bicolor</i>
SCARLET OAK	<i>Quercus coccinea</i>
SCRUB OAK	<i>Quercus ilicifolia</i>
SWAMP CHESTNUT OAK ▲	<i>Quercus michauxii</i>
CHESTNUT OAK	<i>Quercus prinus</i>
PIN OAK	<i>Quercus palustris</i>
DWARF CHESTNUT OAK	<i>Quercus prinoides</i>
RED OAK	<i>Quercus rubra</i>
BLACK OAK	<i>Quercus velutina</i>
BLACK LOCUST ☉	<i>Robinia pseudoacacia</i>
WEeping WILLOW †	<i>Salix babylonica</i>
BLACK WILLOW	<i>Salix nigra</i>
SASSAFRAS	<i>Sassafras albidum</i>
AMERICAN MOUNTAIN ASH	<i>Sorbus americana</i>
BASSWOOD	<i>Tilia americana</i>
HEMLOCK	<i>Tsuga canadensis</i>
AMERICAN ELM	<i>Ulmus americana</i>
BLACK HAW	<i>Viburnum prunifolium</i>
NORTHERN ARROW WOOD †	<i>Viburnum recognitum</i>

APPENDIX C

Fauna

For all of the Appendices C-1 thru C-7 the following codes or conventions apply:

Gray Highlight = indicates potential for species to occur, but presence has not been (recently) documented/confirmed.

For Appendix C-1 see also PICA Odonata Checklist (pamphlet).

For Appendix C-2 the following information and codes apply:

PICA moth list originated *c/o* Janet Sedicino from observations and use of field identification keys during her tenure in the early 1990s. All species were essentially captured and identified from the small white (lighted) entrance alcove to Bldg 3028.

PICA records list of butterflies and moths was reviewed circa MAY 1998 by Dr. Dale F. Schweitzer. Dr. Schweitzer is also a member of NJ Endangered and Nongame Species Advisory Committee.

In his review of the PICA Lepidoptera Checklist (pamphlet) Dr. Schweitzer suggests:

24 additional species (not in Appendix C-2) are likely to be present on PICA; these are included in the pamphlet.

⊙ = indicates probable occurrence

☒ = with gray highlight indicates dubious record or likely misidentified similar species.

For Appendix C-5: ssc = indicates a species of special concern in NJ.

For Appendix C-7 see more specific federal, state and global codes explained at end of this list.

All lists are alphabetized by scientific names in second column (after common name).
Common names in immediate left column tend to follow those accepted/rendered by NatureServe database(s).

C1

Dragonflies

(64 species)

COMMON NAME	SCIENTIFIC NAME
CANADA DARNER	<i>Aeshna canadensis</i>
MOTTLED DARNER	<i>Aeshna clepsydra</i>
BLACK TIPPED DARNER	<i>Aeshna tuberculifera</i>
SHADOW DARNER	<i>Aeshna umbrosa</i>
GREEN STRIPED DARNER	<i>Aeshna verticalis</i>
COMMON GREEN DARNER	<i>Anax junius</i>
COMET DARNER	<i>Anax longipes</i>
LILYPAD CLUBTAIL	<i>Arigomphus furcifer</i>
UNICORN CLUBTAIL	<i>Arigomphus villosipes</i>
SPRINGTIME DARNER	<i>Basiaeschna janata</i>
FAWN DARNER	<i>Boyeria vinosa</i>
CALLICO PENNANT	<i>Celithemis elisa</i>
HALLOWEEN PENNANT	<i>Celithemis eponina</i>
DELTA SPOTTED SPIKETAIL	<i>Cordulegaster diastatops</i>
TWIN SPOTTED SPIKETAIL	<i>Cordulegaster maculata</i>
ARROWHEAD SPIKETAIL	<i>Cordulegaster obliqua</i>
BANDED PENNANT	<i>Celithemis fasciata</i>
AMERICAN EMERALD	<i>Cordulia shurtleffi</i>
STREAM CRUISER	<i>Didymos transversa</i>
PETITE EMERALD	<i>Dorocardulia lepida</i>
RAQUET TAILED EMERALD	<i>Dorocordulia libera</i>
BLACK SHOULDERED SPINYLEG	<i>Dromogomphus spinosus</i>
SWAMP DARNER	<i>Epiaeschna heros</i>
COMMON BASKETTAIL	<i>Epitheca cynosura</i>
PRINCE BASKETTAIL	<i>Epitheca princeps</i>
EASTERN PONDHAWK	<i>Erythemis simplicicollis</i>
HARLEQUIN DARNER	<i>Gomphaeschna furcillata</i>
LANCET CLUBTAIL	<i>Gomphus exilis</i>
ASHY CLUBTAIL	<i>Gomphus lividus</i>
SABLE CLUBTAIL	<i>Gomphus rogersi</i>
DUSKY CLUBTAIL	<i>Gomphus spicatus</i>
DRAGON HUNTER	<i>Hagenius brevistylus</i>
WHITE CORPORAL	<i>Ladona exusta</i>
CHALK FRONTED CORPORAL	<i>Ladona julia</i>
SOUTHERN PYGMY CLUBTAIL	<i>Lanthus vernalis</i>
FROSTED WHITEFACE	<i>Leucorrhinia frigida</i>
CRIMSON RINGED WHITEFACE	<i>Leucorrhinia glacialis</i>
DOT TAILED WHITEFACE	<i>Leucorrhinia intacta</i>
SPANGLED SKIMMER	<i>Libellula cyanea</i>
SLATY SKIMMER	<i>Libellula incesta</i>
WIDOW SKIMMER	<i>Libellula luctuosa</i>
TWELVE SPOTTED SKIMMER	<i>Libellula pulchella</i>
FOUR SPOTTED SKIMMER	<i>Libellula quadrimaculata</i>
PAINTED SKIMMER	<i>Libellula semifasciata</i>
GREAT BLUE SKIMMER	<i>Libellula vibrans</i>
SWIFT RIVER CRUISER	<i>Macromia illinoiensis</i>
ELFIN SKIMMER	<i>Nannothemis bella</i>
CYRANO DARNER	<i>Nasiaeschna pentacantha</i>
BLUE DASHER	<i>Pachydiplax longipennis</i>
WANDERING GLIDER	<i>Pantala flavescens</i>
SPOT WINGED GLIDER	<i>Pantala hymenaea</i>
EASTERN AMBERWING	<i>Perithemis tenera</i>
COMMON WHITETAIL	<i>Plathemis lydia</i>
SPATTERDOCK DARNER	<i>Rhionaeschna mutata</i>
MOCHA EMERALD	<i>Somatochlora linearis</i>
CLAMP TIPPED EMERALD	<i>Somatochlora tenebrosa</i>
WILLIAMSONS EMERALD	<i>Somatochlora williamsoni</i>
EASTERN LEAST CLUBTAIL	<i>Stylogomphus albistylus</i>
JANE'S MEADOWHAWK	<i>Sympetrum janeae</i>
WHITEFACED MEADOWHAWK	<i>Sympetrum obtusum</i>
BAND WINGED MEADOWHAWK	<i>Sympetrum semicinctum</i>
AUTUMN MEADOWHAWK	<i>Sympetrum vicinum</i>
CAROLINA SADDLEBAGS	<i>Tramea carolina</i>
BLACK SADDLEBAGS	<i>Tramea lacerata</i>

C1

Damselflies
(30 species)

COMMON NAME	SCIENTIFIC NAME
EASTERN RED DAMSEL	<i>Amphiagrion saucium</i>
VARIABLE DANCER	<i>Argia fumipennis</i>
RIVER JEWELWING	<i>Calopteryx aequabilis</i>
EBONY JEWELWING	<i>Calopteryx maculata</i>
AURORA DAMSEL	<i>Chromagrion conditum</i>
AZURE BLUET	<i>Enallagma aspersum</i>
BOREAL BLUET	<i>Enallagma boreale</i>
TULE BLUET	<i>Enallagma carunculatum</i>
FAMILIAR BLUET	<i>Enallagma civile</i>
TURQUOISE BLUET	<i>Enallagma divagans</i>
MARSH BLUET	<i>Enallagma ebrium</i>
STREAM BLUET	<i>Enallagma exsulans</i>
SKIMMING BLUET	<i>Enallagma geminatum</i>
HAGEN'S BLUET	<i>Enallagma hageni</i>
NEW ENGLAND BLUET	<i>Enallagma laterale</i>
ORANGE BLUET	<i>Enallagma signatum</i>
SLENDER BLUET	<i>Enallagma traviatum</i>
VESPER BLUET	<i>Enallagma vesperum</i>
LILYPAD FORKTAIL	<i>Ishnura kellicoti</i>
FRAGILE FORKTAIL	<i>Ishnura posita</i>
EASTERN FORKTAIL	<i>Ishnura verticalis</i>
SPOTTED SPREADWING	<i>Lestes congener</i>
NORTHERN SPREADWING	<i>Lestes disjunctus</i>
AMBER WINGED SPREADWING	<i>Lestes eurinus</i>
SWEETFLAG SPREADWING	<i>Lestes forcipatus</i>
ELEGANT SPREADWING	<i>Lestes inaequalis</i>
SLENDER SPREADWING	<i>Lestes rectangularia</i>
SWAMP SPREADWING	<i>Lestes vigilax</i>
SPHAGNUM SPRITE	<i>Nehalennia gracilis</i>
SEDGE SPRITE	<i>Nehalennia irene</i>

C2

Butterflies

(43 species)

COMMON NAME	SCIENTIFIC NAME
HOARY EDGE	<i>Achalarus lyciades</i>
PEPPER AND SALT SKIPPER ☉	<i>Amblyscirtes hegon</i>
LEAST SKIPPER	<i>Ancyloxypha numitor</i>
DELAWARE SKIPPER	<i>Anatrytone logan</i>
SPRING AZURE	<i>Celastrina argiolus</i>
COMMON WOOD NYMPH	<i>Cercyonis pegala</i>
HARRIS' CHECKERSPOT ☉	<i>Chlosyne harrisii</i>
ALFALFA BUTTERFLY	<i>Colias eurytheme</i>
CLOUDED SULPHUR	<i>Colias philatice</i>
MONARCH	<i>Danaus plexippus</i>
NORTHERN PEARLY EYE ☉	<i>Enodia anthon</i>
SILVER SPOTTED SKIPPER	<i>Epargyreus clarus</i>
WILD INDIGO DUSKWING	<i>Erynnis baptisiae</i>
JUVENAL'S DUSKWING	<i>Erynnis juvenallis</i>
EASTERN TAILED BLUE	<i>Everes comyntas</i>
INDIAN SKIPPER	<i>Hesperia sassacus</i>
VICEROY	<i>Limenitis archippus</i>
RED SPOTTED PURPLE	<i>Limenitis arthemis</i>
AMERICAN COPPER ☒	<i>Lycaena dione</i>
LITTLE COPPER	<i>Lycaena phlaeas</i>
LITTLE WOOD SATYR	<i>Megisto cymela</i>
COMPTON TORTOISE SHELL	<i>Nymphali vau album</i>
MOURNING CLOAK	<i>Nymphalis antiopa</i>
TIGER SWALLOWTAIL	<i>Papilio glaucus</i>
BLACK SWALLOWTAIL	<i>Papilio polyxenes</i>
SPICEBUSH SWALLOWTAIL	<i>Papilio troilu</i>
ORANGE BARRED SULPHUR ☒	<i>Phoebis philea</i>
PEARL CRESCENT	<i>Phyciodes tharas</i>
CABBAGE BUTTERFLY	<i>Pieris rapae</i>
HOBOMAK SKIPPER	<i>Poanes hobomak</i>
LONG DASH ☉	<i>Polites mystic</i>
CROSSLINE SKIPPER ☉	<i>Polites origenes</i>
QUESTION MARK	<i>Polygonia interrogationis</i>
GRAY COMMA ☒	<i>Polygonia progne</i>
BANDED HAIRSTREAK	<i>Satyrium calanus</i>
EDWARD'S HAIRSTREAK ☉	<i>Satyrium edwardsii</i>
APPALACHIA EYED BROWN	<i>Satyroides appalachia</i>
GREAT SPANGLED FRITILLARY	<i>Speyeria cybele</i>
GRAY HAIRSTREAK	<i>Strymon melinus</i>
NORTHERN CLOUDYWING	<i>Thorybes pylades</i>
RED ADMIRAL	<i>Vanessa atlanta</i>
AMERICAN PAINTED LADY	<i>Vanessa virgineinsis</i>
BROKEN DASH ☒	<i>Wallengrenia otho</i>

C2

Moths
(150 Species)

COMMON NAME	SCIENTIFIC NAME
GARDEN WEBWORM MOTH	<i>Achyra rantalis</i>
LOBELIA DAGGER MOTH	<i>Acronicta lobeliae</i>
LUNA MOTH	<i>Actias luna</i>
FOUR BARRED GRAY	<i>Aethalura intertexta</i>
THE GREEN MARVEL	<i>Agriopodes fallax</i>
VENERABLE DART	<i>Agrotis venerabilis</i>
COPPER UNDERWING	<i>Amphipyra pyramidoides</i>
AMERICAN BARRED UMBER	<i>Anagoga occiduarua</i>
CELERY LOOPER MOTH	<i>Anagrapha falcifera</i>
VARIABLE ANTEPIONE	<i>Antepione thisoaria</i>
POLYPHEMUS MOTH	<i>Antheraea polyphemus</i>
NAIS TIGER MOTH	<i>Apantesis nais</i>
BRANDED TIGER MOTH	<i>Apantesis vittata</i>
SPOTTED APATELODES	<i>Apatelodes torrefacta</i>
APODA BIGUTTAT	<i>Apoda biguttata</i>
RAY BANDED LEAFROLLER MOTH	<i>Argyrotaenia alisellana</i>
DOT LINED WHITE	<i>Artace cribraria</i>
TWO SPOTTED LOOPER MOTH	<i>Autographa bimaculata</i>
COMMON LOOPER MOTH	<i>Autographa precatlonis</i>
OAK BESMA	<i>Besma quercivoraria</i>
BALTIMORE BOMOLOCHA	<i>Bomolocha baltimoralis</i>
CLOVER LOOPER MOTH	<i>Caenurgina crassiuscula</i>
FORAGE LOOPER MOTH	<i>Caenurgina erechtea</i>
PALE BEAUTY	<i>Campaea perlata</i>
WONDERFUL UNDERWING	<i>Catocala nira</i>
WHITE UNDERWING	<i>Catocala relicta</i>
WAVED SPHINX	<i>Ceratonia undulosa</i>
TUFTED BIRD DROPPING MOTH	<i>Cerma cerintha</i>
THE LAUGHER	<i>Charadra deridens</i>
BENT LINE DART	<i>Choephora fungorum</i>
FORMOSA LOOPER MOTH	<i>Chrysanympa formosa</i>
CLOAKED MARVEL	<i>Chytonix palliatricula</i>
CLOSEBANDED YELLOWHORN	<i>Colocasia propinquilinea</i>
CRAM. LAQUATELLUS	<i>Crambus laqueatellus</i>
SWEETFERN GEOMETER	<i>Cyclophora pendulinaria</i>
OREGON CYCNIA	<i>Cycnia oregonensis</i>
LETTERED SPHINX	<i>Deidamia inscripta</i>
GRAPE LEAFROLLER MOTH	<i>Desmia funeralis</i>
SHOWY EMERALD	<i>Dichorda iridaria</i>
ARCHED HOOKTIP	<i>Drepana arcuata</i>
TWO LINED HOOKTIP	<i>Drepana bilineata</i>
ROSY MAPLE MOTH	<i>Dryocampa rubicunda</i>
GIANT LEOPARD MOTH	<i>Ecpantheria scribonia</i>
THE SMALL ENGRAILED	<i>Ectropis crepuscularia</i>
MAPLE SPANWORM MOTH	<i>Ennomos magnaria</i>
ELM SPANWORM MOTH	<i>Ennomos subsignaria</i>
TULIP TREE BEAUTY	<i>Epimecis hortaria</i>
THE BEGGAR	<i>Eubaphe mendica</i>
MOTTLED EUCHLAENA	<i>Euchlaena tigrinaria</i>
LEAST MARKED EUCHLAENA	<i>Euchlaeno irraria</i>
SCALLOPED SALLOW	<i>Eucirroedia pampina</i>
PEARLY WOOD NYMPH	<i>Eudryas unio</i>
TWO SPOT DART	<i>Eueretrotis perattenta</i>
LESSER GRAPEVINE LOOPER MOTH	<i>Eulithis diversilineata</i>
CONFUSED EUSARCA	<i>Eusarca confusaria</i>
BEAUTIFUL EUTELIA	<i>Eutelia pulcherrima</i>
CHOSEN SALLOW	<i>Eutolype electilis</i>
CURVE TOOTHED GEOMETER	<i>Eutrappela clemataria</i>
WHITE FURCULA	<i>Furcula borealis</i>
ANNA TIGER MOTH	<i>Grammia anna</i>
FIGURED TIGER MOTH	<i>Grammia figurata</i>
PLACENTIA TIGER MOTH	<i>Grammia placentia</i>
VIRGIN TIGER MOTH	<i>Grammia virguncula</i>
BANDED TUSOCK MOTH	<i>Halysidota tessularis</i>
CLYMENE MOTH	<i>Haploa clymene</i>
COMMON SPRING MOTH	<i>Heliomata cycladata</i>
HERC. COLINALIS	<i>Herculia colinalis</i>
THREE SPOTTED FILIP	<i>Heterophleps triguttaria</i>
PISTACHIO EMERALD	<i>Hethemia pistasciaria</i>
GOAT SALLOW	<i>Homoglaea hircina</i>
CLOVER HAYWORM MOTH	<i>Hypsopygia costalis</i>

C2

Moths

COMMON NAME	SCIENTIFIC NAME
RIPPLED WAVE ☒	<i>Idaea obfusaria</i>
LESSER MAPLE SPANWORM MOTH	<i>Itame pustularia</i>
GRAND ARCHES	<i>Lacanobia grandis</i>
BRISTLY CUTWORM MOTH	<i>Lacinipolia renigera</i>
SCALLOPED SACK BEARER	<i>Lacosoma chiridota</i>
YELLOW HEADED LOOPER MOTH	<i>Lambdina pellucidaria</i>
WALNUT SPHINX	<i>Laothoe juglandis</i>
MANY LINED WAINSCOT	<i>Leucania multilinea</i>
PHRAGMITES WAINSCOT	<i>Leucania phragmitidicola</i>
GREEN LEUCONYCTA	<i>Leuconycta diptheroides</i>
PINK BARRED LITHACODIA	<i>Lithacodia carneola</i>
BLACK DOTTED LITHACODIA	<i>Lithacodia synochitis</i>
ASHEN PINION (green fruitworm)	<i>Lithophane antennata</i>
DOWDY PINION	<i>Lithophane unimoda</i>
DRAB BROWN WAVE	<i>Lobcleta ossularia</i>
GRAY SPRING MOTH	<i>Lomographa glomeraria</i>
GYPSY MOTH	<i>Lymantria dispar</i>
COMMON LYTROSIS	<i>Lytrosis unitaria</i>
MOTTLED PROMINENT	<i>Macrurocampa marthesia</i>
EASTERN TENT CATERPILLAR MOTH	<i>Malacosoma americanum</i>
CANADIAN MELANOLOPHIA	<i>Melanolophia canadaria</i>
SIGNATE MELANOLOPHIA	<i>Melanolophia signataria</i>
WHITE RIBBONED CARPET	<i>Mesoleuca ruficollata</i>
COMMON METARRANTHUS	<i>Metarranthus hypochraria</i>
OAK BEAUTY	<i>Nacophora quernaria</i>
WHITE DOTTED PROMINENT	<i>Nadata gibbosa</i>
RED BORDERED EMERALD ☒	<i>Nemoria lixaria</i>
DOUBLE-TOOTHED PROMINENT	<i>Nerice bidentata</i>
THREE SPOTTED NOLA	<i>Nola triquetrana</i>
ROSE HOOKTIP	<i>Oreta rosea</i>
BENT LINE CARPET	<i>Orthonama centrostrigaria</i>
SPECKLED GREEN FRUITWORM MOTH	<i>Orthosia hibisci</i>
BROWN PANOPODA	<i>Panopoda carneicosta</i>
BLINDED SPHINX	<i>Paonias excaecatus</i>
SMALL EYED SPHINX	<i>Paonias myops</i>
NORTHERN BURDOCK BORER MOTH	<i>Papaipema arcivorens</i>
SENSITIVE FERN BORER MOTH	<i>Papaipema inquaesita</i>
CARMINE SNOUT MOTH	<i>Peoria approximella</i>
OVAL BASED PROMINENT	<i>Peridea basitrens</i>
CHOCOLATE PROMINENT	<i>Peridea ferruginea</i>
HUBNER'S PERO	<i>Pero hubneraria</i>
SMALL PHIGALIA	<i>Phigalia strigataria</i>
THE HALF WING	<i>Phigalia titea</i>
COMMON OAK MOTH	<i>Phoberia atomaris</i>
HOLLOW SPOTTED PLAGODIS	<i>Plagodis alcoolaria</i>
FERVID PLAGODIS	<i>Plagodis fervidaria</i>
PURPLE PLAGODIS	<i>Plagodis kuetzingi</i>
LEMON PLAGODIS	<i>Plagodis serinaria</i>
DOGWOOD PROBOLE	<i>Probole nyssaria</i>
LARGE MAPLE SPANWORM MOTH	<i>Prochoerodes transversata</i>
SKIFF MOTH	<i>Prolimacodes badia</i>
PORCELAIN GRAY	<i>Protoarmia porcelaria</i>
FIGURE EIGHT SALLOW	<i>Psaphida resumens</i>
GRAPEVINE EPIMENIS	<i>Psychomorpha epimenis</i>
PYRAUSTA ACRIONALIS	<i>Pyrausta acronalis</i>
ORANGE PATCHED SMOKY MOTH	<i>Pyromorpha dimidiata</i>
BORDERED SALLOW	<i>Pyrrha umbra</i>
DISCOLORED RENIA	<i>Renia discoloralis</i>
LARGE LACE BORDER	<i>Scopula limboundata</i>
SHARP LINED YELLOW	<i>Sicya marularia</i>
DOUBLE BANDED CARPET	<i>Sparганia magnoliata</i>
ABBOT'S SPHINX	<i>Sphecodina abbottii</i>
WILD CHERRY MOTH	<i>Sphinx drupiferarum</i>
AGREEABLE TIGER MOTH	<i>Spilosoma congrua</i>
VIRGINIAN TIGER MOTH	<i>Spilosoma virginica</i>
HAWAIIAN BEET WEBWORM MOTH	<i>Spoladea recurvalis</i>
WHITE HEADED PROMINENT	<i>Symmerista albifrons</i>
WAVY LINED EMERALD	<i>Synchlora aerata</i>
WHITE SLANT LINE	<i>Tetracis cachexiata</i>
YELLOW SLANT LINE	<i>Tetracis crocallata</i>
LARGE TOLYPE	<i>Tolype velleda</i>

C2

Moths

COMMON NAME	SCIENTIFIC NAME
CROCUS GEOMETER	<i>Xanthotype sospeta</i>
FALSE CROCUS GEOMETER	<i>Xanthotype urticaria</i>
PALE BANDED DART	<i>Xestia badinodis</i>
GREATER BLACK LETTER DART	<i>Xestia dolosa</i>
DOT AND DASH SWORDGRASS MOTH	<i>Xylenia curvimacula</i>
BETHUNE'S ZALE	<i>Zale bethunei</i>
EARLY ZANCLOGNATHA	<i>Zanclognatha cruralis</i>
LEOPARD MOTH	<i>Zeuzera pyrina</i>

C2-M

Mollusks and Crustaceans

(## Species)

COMMON NAME	SCIENTIFIC NAME

C3

PICATINNY FISH

(24 Species)

COMMON NAME	SCIENTIFIC NAME
ALEWIFE	<i>Alosa pseudoharengus</i>
BLUE SPOTTED SUNFISH	<i>Enneacanthus gloriosus</i>
BANDED SUNFISH	<i>Enneacanthus obesus</i>
CREEK CHUBSUCKER	<i>Erimyzon oblongus</i>
REDFIN PICKEREL	<i>Esox americanus</i>
NORTHERN PIKE	<i>Esox lucius</i>
CHAIN PICKEREL	<i>Esox niger</i>
YELLOW BULLHEAD	<i>Ictalurus natalis</i>
BROWN BULLHEAD	<i>Ictalurus nebulosus</i>
CHANNEL CATFISH	<i>Ictalurus punctatus</i>
RED BREASTED SUNFISH	<i>Lepomis auritus</i>
PUMPKINSEED	<i>Lepomis gibbosus</i>
BLUEGILL	<i>Lepomis macrochirus</i>
LARGEMOUTH BASS	<i>Micropterus salmoides</i>
GOLDEN SHINER	<i>Notemigonus acrysoleucas</i>
STONE CAT	<i>Noturus flavus</i>
BLACK CRAPPIE	<i>Pomoxis nigromaculatus</i>
WHITE CRAPPIE	<i>Pomoxis annularis</i>
YELLOW PERCH	<i>Perca flavescens</i>
RAINBOW TROUT +	<i>Salmo gairdneri</i>
BROWN TROUT +	<i>Salmo trutta</i>
BROOK TROUT	<i>Salvelinus fontinalis</i>
WALLEYE +	<i>Stizostedion vitreum</i>
EASTERN MUD MINNOW	<i>Umbra pygmaea</i>

+ = stocked; no reproducing population

C4

Picatinny Herptile List
Amphibians: Salamanders
 (9 Species)

COMMON NAME	SCIENTIFIC NAME
JEFFERSON SALAMANDER	<i>Ambystoma jeffersonianum</i>
SPOTTED SALAMANDER	<i>Ambystoma maculatum</i>
NORTHERN DUSKY SALAMANDER	<i>Desmognathus fuscus</i>
NORTHERN TWO LINED SALAMANDER	<i>Eurycea bislineata</i>
FOUR TOED SALAMANDER	<i>Hemidactylium scutatum</i>
RED SPOTTED NEWT	<i>Notophthalmus viridescens</i>
RED BACKED SALAMANDER	<i>Plethodon cinereus</i>
SLIMY SALAMANDER	<i>Plethodon glutinosus</i>
NORTHERN RED SALAMANDER	<i>Pseudotriton ruber</i>

Amphibians: Frogs
 (10 Species)

COMMON NAME	SCIENTIFIC NAME
NORTHERN CRICKET FROG	<i>Acris crepitans</i>
NORTHERN SPRING PEEPER	<i>Hyla crucifer</i>
GRAY TREEFROG	<i>Hyla versicolor</i>
UPLAND CHORUS FROG	<i>Pseudacris triseriata ssp feriarum</i>
NEW JERSEY CHORUS FROG	<i>Pseudacris triseriata ssp kalmi</i>
BULLFROG	<i>Rana catesbeiana</i>
GREEN FROG	<i>Rana clamitans ssp melanota</i>
PICKEREL FROG	<i>Rana palustris</i>
NORTHERN LEOPARD FROG	<i>Rana pipiens</i>
WOOD FROG	<i>Rana sylvatica</i>

Amphibians: Toads
 (2 Species)

COMMON NAME	SCIENTIFIC NAME
AMERICAN TOAD	<i>Bufo americanus</i>
FOWLER'S TOAD	<i>Anaxyrus fowleri</i>

Reptiles: Turtles
 (7 Species)

COMMON NAME	SCIENTIFIC NAME
SNAPPING TURTLE	<i>Chelydra serpentina</i>
EASTERN PAINTED TURTLE	<i>Chrysemys picta</i>
SPOTTED TURTLE	<i>Clemmys guttata</i>
WOOD TURTLE	<i>Glyptemys insculpta</i>
EASTERN MUD TURTLE	<i>Kinosternon subrubrum</i>
STINKPOT	<i>Sternotherus odoratus</i>
EASTERN BOX TURTLE	<i>Terrapene carolina</i>

C4

Reptiles: Snakes

(11 Species)

COMMON NAME	SCIENTIFIC NAME
NORTHERN COPPERHEAD	<i>Agkistrodon contortrix ssp mokasen</i>
NORTHERN BLACK RACER	<i>Coluber constrictor</i>
TIMBER RATTLESNAKE	<i>Crotalus horridus</i>
NORTHERN RINGNECK SNAKE	<i>Diadophis punctatus</i>
BLACK RAT SNAKE	<i>Elaphe obsoleta</i>
EASTERN HOGNOSE SNAKE	<i>Heterodon platyrhinos</i>
EASTERN MILK SNAKE	<i>Lampropeltis dolia</i>
NORTHERN WATER SNAKE	<i>Natrix sipedon</i>
NORTHERN BROWN SNAKE	<i>Storeria dekayi</i>
EASTERN RIBBON SNAKE	<i>Thamnophis sauritus</i>
EASTERN GARTER SNAKE	<i>Thamnophis sirtalis</i>

Reptiles: Lizards

(1 Species)

COMMON NAME	SCIENTIFIC NAME
FIVE LINED SKINK	<i>Eumeces fasciatus</i>

C5

Birds
(208 Species)

NAME COMMON	SCIENTIFIC NAME
COOPER'S HAWK ssc	<i>Accipiter cooperii</i>
NORTHERN GOSHAWK	<i>Accipiter gentilis</i>
SHARP SHINNED HAWK ssc	<i>Accipiter striatus</i>
SPOTTED SANDPIPER ssc	<i>Actitis macularius</i>
NORTHERN SAW WHET OWL	<i>Aegolius acadicus</i>
RED WINGED BLACKBIRD	<i>Agelaius phoeniceus</i>
WOOD DUCK	<i>Aix sponsa</i>
CHUKAR	<i>Alectoris chukar</i>
GRASSHOPPER SPARROW	<i>Ammodramus savannarum</i>
NORTHERN PINTAIL	<i>Anas acuta</i>
AMERICAN WIGEON	<i>Anas americana</i>
AMERICAN GREEN WINGED TEAL	<i>Anas carolinensis</i>
BLUE WINGED TEAL	<i>Anas discors</i>
MALLARD	<i>Anas platyrhynchos</i>
AMERICAN BLACK DUCK	<i>Anas rubripes</i>
MUSCOVEY DUCK	<i>Anas spp.</i>
GADWALL	<i>Anas strepera</i>
WATER PIPIT	<i>Anthus spinoletta</i>
GOLDEN EAGLE	<i>Aquila chrysaetos</i>
RUBY THROATED HUMMINGBIRD	<i>Archilochus colubris</i>
GREAT BLUE HERON ssc	<i>Ardea herodias</i>
LONG EARED OWL	<i>Asio otus</i>
REDHEAD	<i>Aythya americana</i>
RING NECKED DUCK	<i>Aythya collaris</i>
GREATER SCAUP	<i>Aythya marila</i>
CANVASBACK	<i>Aythya valisineria</i>
UPLAND SANDPIPER	<i>Bartramia longicauda</i>
CEDAR WAXWING	<i>Bombycilla cedrorum</i>
RUFFED GROUSE	<i>Bonasa umbellus</i>
AMERICAN BITTERN	<i>Botaurus lentiginosus</i>
CANADA GOOSE	<i>Branta canadensis</i>
GREAT HORNED OWL	<i>Bubo virginianus</i>
CATTLE EGRET	<i>Bubulcis ibis</i>
BUFFLEHEAD	<i>Bucephala albeola</i>
RED TAILED HAWK	<i>Buteo jamaicensis</i>
RED SHOULDERED HAWK	<i>Buteo lineatus</i>
BROAD WINGED HAWK ssc	<i>Buteo platypterus</i>
ROUGH LEGGED HAWK	<i>Buteo regalis</i>
GREEN HERON	<i>Butorides virescens</i>
PECTORAL SANDPIPER	<i>Calidris melanotos</i>
LEAST SANDPIPER	<i>Calidris minutilla</i>
COMMON SNIFE	<i>Capella gallinago</i>
EASTERN WHIP POOR WILL ssc	<i>Caprimulgus Antrostomus vociferus</i>
CANADA WARBLER ssc	<i>Cardellina canadensis</i>
WILSON'S WARBLER	<i>Cardellina pusilla</i>
NORTHERN CARDINAL	<i>Cardinalis cardinalis</i>
COMMON REDPOLL	<i>Carduelis flammea</i>
PINE SISKIN	<i>Carduelis pinus</i>
AMERICAN GOLDFINCH	<i>Carduelis tristis</i>
HOUSE FINCH	<i>Carpodacus mexicanus</i>
PURPLE FINCH	<i>Carpodacus purpureus</i>
GREAT EGRET	<i>Casmerodius albus</i>
TURKEY VULTURE	<i>Cathartes aura</i>
VEERY ssc	<i>Catharus fuscescens</i>
HERMIT THRUSH	<i>Catharus guttatus</i>
SWAINSON'S THRUSH	<i>Catharus ustulatus</i>
BROWN CREEPER	<i>Certhia familiaris</i>
BELTED KINGFISHER	<i>Ceryle alcyon</i>
CHIMNEY SWIFT	<i>Chaetura pelagica</i>
KILLDEER	<i>Charadrius vociferous</i>
GREATER SNOW GOOSE	<i>Chen caerulescens</i>
COMMON NIGHTHAWK ssc	<i>Chordeiles minor</i>
NORTHERN HARRIER	<i>Circus cyaneus</i>
MARSH WREN	<i>Cistothorus palustris</i>
OLDSQUAW	<i>Clangula hyemalis</i>
EVENING GROSBEEK	<i>Coccythraustes vespertinus</i>
YELLOW BILLED CUCKOO	<i>Coccyzus americanus</i>
BLACK BILLED CUCKOO ssc	<i>Coccyzus erythrophthalmus</i>
NORTHERN FLICKER	<i>Colaptes auratus</i>
NORTHERN BOBWHITE	<i>Colinus virginianus</i>
ROCK DOVE	<i>Columba livia</i>

C5

Birds

COMMON NAME	SCIENTIFIC NAME
EASTERN WOOD PEWEE	<i>Contopus virens</i>
BLACK VULTURE	<i>Coragyps atratus</i>
AMERICAN CROW	<i>Corvus brachyrhynchos</i>
FISH CROW	<i>Corvus ossifragus</i>
BLUE JAY	<i>Cyanocitta cristata</i>
WHISTLING SWAN	<i>Cygnus columbianus</i>
MUTE SWAN	<i>Cygnus olor</i>
BLACK THROATED BLUE WARBLER ssc	<i>Dendroica (Setophaga) caerulescens</i>
BAY BREASTED WARBLER	<i>Dendroica (Setophaga) castanea</i>
YELLOW RUMPED WARBLER	<i>Dendroica (Setophaga) coronata</i>
PRAIRIE WARBLER	<i>Dendroica (Setophaga) discolor</i>
BLACKBURNIAN WARBLER ssc	<i>Dendroica (Setophaga) fusca</i>
YELLOW PALM WARBLER	<i>Dendroica (Setophaga) palmarum</i>
CHESNUT SIDED WARBLER	<i>Dendroica (Setophaga) pensylvanica</i>
YELLOW WARBLER	<i>Dendroica (Setophaga) petechia</i>
PINE WARBLER	<i>Dendroica (Setophaga) pinus</i>
BLACKPOLL WARBLER	<i>Dendroica (Setophaga) striata</i>
BLACK THROATED GREEN WARBLER ssc	<i>Dendroica (Setophaga) virens</i>
BOBOLINK	<i>Dolichonyx oryzivorus</i>
PILEATED WOODPECKER	<i>Dryocopus pileatus</i>
GRAY CATBIRD	<i>Dumetella carolinensis</i>
LITTLE BLUE HERON	<i>Egretta caerulea</i>
ALDER FLYCATCHER	<i>Empidonax alnorum</i>
LEAST FLYCATCHER ssc	<i>Empidonax minimus</i>
WILLOW FLYCATCHER	<i>Empidonax traillii</i>
ACADIAN FLYCATCHER	<i>Empidonax virescens</i>
HORNED LARK	<i>Eremophila alpestris</i>
RUSTY BLACKBIRD	<i>Euphagus carolinus</i>
MERLIN	<i>Falco columbarius</i>
AMERICAN KESTREL	<i>Falco sparverius</i>
AMERICAN COOT	<i>Fulica americana</i>
COMMON MOORHEN	<i>Gallinula chloropus</i>
COMMON LOON	<i>Gavia immer</i>
COMMON YELLOWTHROAT	<i>Geothlypis trichas</i>
BLUE GROSBEAK	<i>Guiraca caerulea</i>
BALD EAGLE	<i>Haliaeetus leucocephalus</i>
WORM EATING WARBLER ssc	<i>Helmitheros vermivorum</i>
BARN SWALLOW	<i>Hirundo rustica</i>
WOOD THRUSH ssc	<i>Hylocichla mustelina</i>
YELLOW BREASTED CHAT ssc	<i>Icteria virens</i>
BALTIMORE ORIOLE	<i>Icterus galbula</i>
ORCHARD ORIOLE	<i>Icterus spurius</i>
TREE SWALLOW	<i>Iridoprocne bicolor</i>
LEAST BITTERN ssc	<i>Ixobrychus exilis</i>
DARK EYED JUNCO	<i>Junco hyemalis</i>
NORTHERN SHRIKE	<i>Lanius excubitor</i>
HERRING GULL	<i>Larus argentatus</i>
RING BILLED GULL	<i>Larus delawarensis</i>
GREAT BLACK BACKED GULL	<i>Larus marinus</i>
HOODED MERGANSER	<i>Lophodytes cucullatus</i>
RED BELLIED WOODPECKER	<i>Melanerpes carolinus</i>
RED HEADED WOODPECKER	<i>Melanerpes erythrocephalus</i>
WILD TURKEY	<i>Meleagris gallopavo</i>
SWAMP SPARROW	<i>Melospiza georgiana</i>
SONG SPARROW	<i>Melospiza melodia</i>
COMMON MERGANSER	<i>Mergus merganser</i>
RED BREASTED MERGANSER	<i>Mergus serrator</i>
NORTHERN MOCKINGBIRD	<i>Mimus polyglottos</i>
BLACK AND WHITE WARBLER	<i>Mniotilta varia</i>
BROWN HEADED COWBIRD	<i>Molothrus ater</i>
GREAT CRESTED FLYCATCHER	<i>Myiarchus crinitus</i>
BLACK CROWNED NIGHT HERON	<i>Nycticorax nycticorax</i>
CONNECTICUT WARBLER	<i>Oporornis agilis</i>
KENTUCKY WARBLER ssc	<i>Oporornis (Geothlypis) formosus</i>
MOURNING WARBLER	<i>Oporornis philadelphia</i>
EASTERN SCREECH OWL	<i>Otus asio</i>
RUDDY DUCK	<i>Oxyura jamaicensis</i>
OSPREY	<i>Pandion haliaetus</i>
RED CRESTED CARDINAL	<i>Paroaria cristata</i>

C5

Birds

COMMON NAME	SCIENTIFIC NAME
BLACK CAPPED CHICKADEE	<i>Parus atricapillus</i>
EASTERN TUFTED TITMOUSE	<i>Parus bicolor</i>
HOUSE SPARROW	<i>Passer domesticus</i>
SAVANNAH SPARROW	<i>Passerculus sandwichensis</i>
FOX SPARROW	<i>Passerella iliaca</i>
INDIGO BUNTING	<i>Passerina cyanea</i>
CLIFF SWALLOW	<i>Petrochelidon pyrrhonata</i>
DOUBLE CRESTED CORMORANT	<i>Phalacrocorax auritus</i>
RING NECKED PHEASANT	<i>Phasianus colchicus</i>
ROSE BREASTED GROSBEAK	<i>Pheucticus ludovicianus</i>
AMERICAN WOODCOCK	<i>Philohela Scolopax minor</i>
DOWNY WOODPECKER	<i>Picoides pubescens</i>
HAIRY WOODPECKER	<i>Picoides villosus</i>
PINE GROSBEAK	<i>Pinicola enucleator</i>
EASTERN TOWHEE	<i>Pipilo erythrophthalmus</i>
SCARLET TANAGER	<i>Piranga olivacea</i>
SNOW BUNTING	<i>Plectrophenax nivalis</i>
BLACK BELLIED PLOVER	<i>Pluvialis squatarola</i>
RED NECKED GREBE	<i>Podiceps agrisegeta</i>
PIED BILLED GREBE	<i>Podilymbus podiceps</i>
BLUE GRAY GNATCATCHER	<i>Poliotilta caerulea</i>
VESPER SPARROW	<i>Poocetes gramineus</i>
PURPLE MARTIN	<i>Progne subis</i>
PROTHONOTARY WARBLER	<i>Protonotaria citrea</i>
COMMON GRACKLE	<i>Quiscalus quiscula</i>
VIRGINIA RAIL	<i>Rallus bilimicola</i>
CLAPPER RAIL	<i>Rallus longirostris</i>
RUBY CROWNED KINGLET	<i>Regulus calendula</i>
GOLDEN CROWNED KINGLET	<i>Regulus satrapa</i>
BANK SWALLOW	<i>Riparia riparia</i>
EASTERN PHOEBE	<i>Sayornis phoebe</i>
OVENBIRD	<i>Seiurus aurocapillus</i>
LOUISIANA WATERTHRUSH	<i>Seiurus motacilla</i>
NORTHERN WATERTHRUSH	<i>Seiurus noveboracensis</i>
NORTHERN PARULA ssc	<i>Setophaga americana</i>
HOODED WARBLER ssc	<i>Setophaga citrina</i>
CERULEAN WARBLER ssc	<i>Setophaga cerulea</i>
AMERICAN REDSTART	<i>Setophaga ruticilla</i>
EASTERN BLUEBIRD	<i>Sialia sialis</i>
RED BREASTED NUTHATCH	<i>Sitta canadensis</i>
WHITE BREASTED NUTHATCH	<i>Sitta carolinensis</i>
YELLOW BELLIED SAPSUCKER	<i>Sphyrapicus varius</i>
AMERICAN TREE SPARROW	<i>Spizella arborea</i>
CHIPPING SPARROW	<i>Spizella passerina</i>
FIELD SPARROW	<i>Spizella pusilla</i>
ROUGH WINGED SWALLOW	<i>Stelgidopteryx serripennis</i>
BARRED OWL	<i>Strix varia</i>
EASTERN MEADOWLARK ssc	<i>Sturnella magna</i>
EUROPEAN STARLING	<i>Sturnus vulgaris</i>
CAROLINA WREN	<i>Thryothorus ludovicianus</i>
BROWN THRASHER ssc	<i>Toxostoma rufum</i>
GREATER YELLOWLEGS	<i>Tringa melanoleuca</i>
SOLITARY SANDPIPER	<i>Tringa solitaria</i>
HOUSE WREN	<i>Troglodytes aedon</i>
WINTER WREN ssc	<i>Troglodytes hiemalis</i>
AMERICAN ROBIN	<i>Turdus migratorius</i>
EASTERN KINGBIRD	<i>Tyrannus tyrannus</i>
BARN OWL ssc	<i>Tyto alba</i>
GOLDEN WINGED WARBLER	<i>Vermivora chrysoptera</i>
BLUE WINGED WARBLER	<i>Vermivora cyanoptera</i>
NASHVILLE WARBLER	<i>Vermivora ruficapilla</i>
YELLOW THROATED VIREO	<i>Vireo flavifrons</i>
WARBLING VIREO	<i>Vireo gilvus</i>
WHITE EYED VIREO	<i>Vireo griseus</i>
RED EYED VIREO	<i>Vireo olivaceus</i>
BLUEHEADED VIREO ssc	<i>Vireo solitarius</i>
MOURNING DOVE	<i>Zenaida macroura</i>
WHITE THROATED SPARROW	<i>Zonotrichia albicollis</i>
WHITE CROWNED SPARROW	<i>Zonotrichia leucophrys</i>

C6

Picatunny Mammal List

Mammals: Marsupials

(1 Species)

COMMON NAME	SCIENTIFIC NAME
OPOSSUM	<i>Didelphis marsupialis</i>

Mammals: Insectivores

(4 Species)

COMMON NAME	SCIENTIFIC NAME
SHORTTAIL SHREW	<i>Blarina brevicauda</i>
STARNOSE MOLE	<i>Condylura cristata</i>
EASTERN MOLE	<i>Scalopus aquaticus</i>
MASKED SHREW	<i>Sorex cinereus</i>

Mammals: Bats

(7 Species)

COMMON NAME	SCIENTIFIC NAME
BIG BROWN BAT	<i>Eptesicus fuscus</i>
RED BAT	<i>Lasiurus borealis</i>
EASTERN SMALL FOOTED BAT	<i>Myotis leibii</i>
LITTLE BROWN BAT	<i>Myotis lucifugus</i>
NORTHERN LONG EARED BAT	<i>Myotis septentrionalis</i>
INDIANA BAT	<i>Myotis sodalis</i>
TRI COLORED BATS	<i>Perimyotis subflavus</i>

Mammals: Carnivores

(10 Species)

COMMON NAME	SCIENTIFIC NAME
COYOTE	<i>Canis latrans</i>
RIVER OTTER	<i>Lutra canadensis</i>
BOBCAT	<i>Lynx rufus</i>
STRIPED SKUNK	<i>Mephitis mephitis</i>
LONGTAIL WEASEL	<i>Mustela frenata</i>
MINK	<i>Neovison vison</i>
RACCOON	<i>Procyon lotor</i>
GRAY FOX	<i>Urocyon cinereoargenteus</i>
BLACK BEAR	<i>Ursa americanus</i>
RED FOX	<i>Vulpes fulva</i>

C6

Mammals: Rodents

(17 Species)

COMMON NAME	SCIENTIFIC NAME
BEAVER	<i>Castor canadensis</i>
BOREAL REDBACK VOLE	<i>Clethrionomys gapperi</i>
PORCUPINE	<i>Erethizon dorsatum</i>
SOUTHERN FLYING SQUIRREL	<i>Glaucomys volans</i>
WOODCHUCK	<i>Marmota monax</i>
MEADOW VOLE	<i>Microtus pennsylvanicus</i>
HOUSE MOUSE	<i>Mus musculus</i>
WOODLAND JUMPING MOUSE	<i>Napaeozapus insignis</i>
ALLEGHENY WOODRAT	<i>Neotoma magister</i>
MUSKRAT	<i>Ondatra zibethica</i>
WHITE FOOTED MOUSE	<i>Peromyscus leucopus</i>
PINE VOLE	<i>Pitymys pinetorum</i>
NORWAY RAT	<i>Rattus norvegicus</i>
EASTERN GRAY SQUIRREL	<i>Sciurus carolinensis</i>
EASTERN CHIPMUNK	<i>Tamias striatus</i>
RED SQUIRREL	<i>Tamiasciurus hudsonicus</i>
MEADOW JUMPING MOUSE	<i>Zapus hudsonius</i>

Mammals: Lagomorphs

(1 Species)

COMMON NAME	SCIENTIFIC NAME
EASTERN COTTONTAIL	<i>Sylvilagus floridanus</i>

Mammals: Artiodactyls

(1 Species)

COMMON NAME	SCIENTIFIC NAME
WHITE TAILED DEER	<i>Odocoileus virginianus</i>

C7

THREATENED AND ENDANGERED ANIMALS AND SPECIES AT RISK

COMMON NAME	SCIENTIFIC NAME	FED STAT.	STATE STATUS	STATE RANK	STATE MGT-OBJ	GLOBAL RANK
FISH (4 Species)						
Slimy Sculpin	<i>Cottus cognatus</i>			S3	X	G5
Banded Sunfish ^{HP}	<i>Enneacanthus obesus</i>				RP	
American Brook Lamprey	<i>Lampetra appendix</i>			S2	(RP)	G4
Brook Trout	<i>Salvelinus fontinalis</i>			S3	X	G5
DRAGONFLIES & DAMSELFLIES (6 Species)						
ARROWHEAD SPIKETAIL	<i>Cordulegaster obliqua</i>		ssc	S3		G4
NEW ENGLAND BLUET	<i>Enallagma laterale</i>	SC	ssc	S1	X	G2
SABLE CLUBTAIL	<i>Gomphus rogersi</i>		ssc	S3		G4
CRIMSON RINGED WHITEFACE	<i>Leucorrhinia glacialis</i>		ssc	S3		G5
SPATTERDOCK DARNER	<i>Rhionaeschna mutata</i>		ssc	S3		G3
WILLIAMSONS EMERALD	<i>Somatochlora williamsoni</i>		ssc	S3		G5
BUTTERFLIES (1 Species)						
HARRIS' CHECKERSPOT	<i>Chlosyne harrisii</i>		ssc	S3	M	G4
MONARCH	<i>Danaus plexippus</i>	SC				
MOTHS (0 Species)						
AMPHIBIANS: SALAMANDERS (1 Species)						
JEFFERSON SALAMANDER	<i>Ambystoma jeffersonianum</i>		ssc	S3	M	G4
AMPHIBIANS: FROGS (1 Species)						
FOWLERS TOAD	<i>Anaxyrus fowleri</i>		ssc	S3	M	G5

C7

COMMON NAME	SCIENTIFIC NAME	FED STAT.	STATE STATUS	STATE RANK	STATE MGT-OBJ	GLOBAL RANK
REPTILES: TURTLES (4 Species)						
SPOTTED TURTLE	<i>Clemmys guttata</i>		ssc	S3	M	G5
WOOD TURTLE	<i>Glyptemys insculpta</i>		T	S2	I	G3
BOG TURTLE ^{H-p}	<i>Glyptemys muhlenbergii</i>	LT	E	S1	I	G3
EASTERN BOX TURTLE	<i>Terrapene carolina carolina</i>		ssc	S3	M	G5
REPTILES: SNAKES (4 Species)						
NORTHERN COPPERHEAD	<i>Agkistrodon contortrix mokasen</i>		ssc	S3	M	G5T5
TIMBER RATTLESNAKE	<i>Crotalus horridus</i>		E	S1	I	G4
EASTERN HOGNOSE SNAKE	<i>Heterodon platirhinos</i>			S4	M	G5
EASTERN RIBBON SNAKE	<i>Thamnophis sauritus</i>			S4	M	G5
REPTILES: LIZARDS (0 Species)						
BIRDS (75 Species)						
COOPER'S HAWK	<i>Accipiter cooperii</i>		ssc/s	S2b/S4n	M	G5
NORTHERN GOSHAWK	<i>Accipiter gentilis</i>	SC ³	E/ssc	S1b/S3n	I	G5
SHARP SHINNED HAWK ^{ssc}	<i>Accipiter striatus</i>		ssc/ssc	S3b/S3n	M	G5
SPOTTED SANDPIPER ^{ssc}	<i>Actitis macularius</i>		ssc/u	S3b/S4,5n	M	G5
GRASSHOPPER SPARROW	<i>Ammodramus savannarum</i>		T/T	S2b/S2n	I	G5
GREAT BLUE HERON	<i>Ardea herodias</i>		ssc/s	S3b/S4nn	M	G5
LONG EARED OWL	<i>Asio otus</i>		T/T	S2b/S2n	I	G5
UPLAND SANDPIPER	<i>Bartramia longicauda</i>		E/E	S1b/S1n	RP	G5
AMERICAN BITTERN	<i>Botaurus lentiginosus</i>		E/ssc	S1b/S3n	I	G4
CATTLE EGRET	<i>Bubulcus ibis</i>		T/ssc	S2b/S3n		G5
RED SHOULDERED HAWK	<i>Buteo lineatus</i>		E/ssc	S1b/S3n	I	G5
BROAD WINGED HAWK ^{ssc}	<i>Buteo platypterus</i>		ssc/s	S3b/S4,5n	M	G5
GREEN HERON	<i>Butorides virescens</i>			S4	M	G5
EASTERN WHIP POOR WILL ^{ssc}	<i>Caprimulgus vociferus</i>		ssc/u	S3b/S4,5n	R	G5
CANADA WARBLER ^{ssc}	<i>Cardellina canadensis</i>		ssc/s	S3b/S4n	I	G5
PURPLE FINCH	<i>Carpodacus purpureus</i>			S4	I	G5
VEERY ^{ssc}	<i>Catharus fuscescens</i>		ssc/ssc	S3b/S3n	I	G5
CHIMNEY SWIFT	<i>Chaetura pelagica</i>			S4	I	G5
COMMON NIGHTHAWK ^{ssc}	<i>Chordeiles minor</i>		ssc/ssc	S3b/S3n	R	G5
NORTHERN HARRIER	<i>Circus cyaneus</i>		E/ssc	S1b/S3n	I	G5
YELLOW BILLED CUCKOO	<i>Coccyzus americanus</i>			S4	I	G5
BLACK BILLED CUCKOO ^{ssc}	<i>Coccyzus erythrophthalmus</i>		ssc/s	S3b/S4,5n	I	G5
NORTHERN FLICKER	<i>Colaptes auratus</i>			S4	M	G5
EASTERN WOOD PEWEE	<i>Contopus virens</i>			S4	I	G5
BLACK THROATED BLUE WARBLER ^{ssc}	<i>Dendroica caerulescens</i>		ssc/s	S3b/S4n	M	G5
PRAIRIE WARBLER	<i>Dendroica discolor</i>			S4	I	G5
PINE WARBLER	<i>Dendroica pinus</i>			S4	M	G5
BLACK THROATED GREEN WARBLER ^{ssc}	<i>Dendroica virens</i>		ssc/s	S3b/S4n	I	G5
BLACKBURNIAN WARBLER ^{ssc}	<i>Dendroica fusca</i>		ssc/s	S3b/S4n	M	G5
BOBOLINK	<i>Dolichonyx oryzivorus</i>		T/ssc	S2b/S3n	I	G5
GRAY CATBIRD	<i>Dumetella carolinensis</i>			S4	M	G5
LITTLE BLUE HERON	<i>Egretta caerulea</i>		T/s	S2b/S4n		G5
LEAST FLYCATCHER ^{ssc}	<i>Empidonax minimus</i>		ssc/u	S3b/S4,5n	I	G5
ACADIAN FLYCATCHER	<i>Empidonax virescens</i>			S4	I	G5
WILLOW FLYCATCHER	<i>Empidonax traillii</i>			S4	I	G5
HORNED LARK	<i>Eremophila alpestris</i>		T/ssc	S2b/S3n	(M)	G5
PEREGRINE FALCON	<i>Falco peregrinus ssp anatum</i>	delisted	E/ssc	S1b/S3n	(R)	G4T4
AMERICAN KESTREL	<i>Falco sparverius</i>		T/T	S2b/S2n	I	G5
BALD EAGLE	<i>Haliaeetus leucocephalus</i>	delisted	E/T	S1b/S2n	I	G5

Integrated Natural Resources Management Plan

COMMON NAME	SCIENTIFIC NAME	FED STAT.	STATE STATUS	STATE RANK	STATE MGT-OBJ	GLOBAL RANK
WORM EATING WARBLER ssc	<i>Helmitheros vermivorum</i>		ssc/s	S3b/S4n	I	G5
WOOD THRUSH ssc	<i>Hylocichla mustelina</i>		ssc/s	S3b/S4n	I	G5
YELLOW BREASTED CHAT ssc	<i>Icteria virens</i>		ssc/s	S3b/S4n	I	G5
BALTIMORE ORIOLE	<i>Icterus galbula</i>			S4	I	G5
LEAST BITTERN	<i>Ixobrychus exilis</i>		ssc/s	S3b/S4n	I	G5
LOGGERHEAD SHRIKE	<i>Lanius ludovicianus ssp migrans</i>	SC ³	n/a/E	Snab/S1n		G4T3Q
RED HEADED WOODPECKER	<i>Melanerpes erythrocephalus</i>		T/T	S2b/S2n	I	G5
BLACK AND WHITE WARBLER	<i>Mniotilta varia</i>			S4	I	G5
GREAT CRESTED FLYCATCHER	<i>Myiarchus crinitus</i>			S4	M	G5
BLACK CROWNED NIGHT HERON	<i>Nycticorax nycticorax</i>		T/ssc	S2b/S3n	I	G5
KENTUCKY WARBLER ssc	<i>Oporornis formosus</i>		ssc/ssc	S3b/S3n	(I)	G5
EASTERN SCREECH OWL	<i>Otus asio</i>			S4	M	G5
OSPREY	<i>Pandion haliaetus</i>		T/s	S2b/S3n	I	G5
SAVANNAH SPARROW	<i>Passerculus sandwichensis</i>		T/T	S2b/S2n	I	G5
INDIGO BUNTING	<i>Passerina cyanea</i>			S4	I	G5
CLIFF SWALLOW	<i>Petrochelidon pyrrhonata</i>		T/s	S2b/S4n	M	G5
ROSE BREASTED GROSBEAK	<i>Pheucticus ludovicianus</i>			S4	I	G5
EASTERN TOWHEE	<i>Pipilo erythrophthalmus</i>			S4	I	G5
SCARLET TANAGER	<i>Piranga olivacea</i>			S4	M	G5
PIED BILLED GREBE	<i>Podilymbus podiceps</i>		E/ssc	S1b/S3n	I	G5
VESPER SPARROW	<i>Pooecetes gramineus</i>	(SC ^{3,5})	E/ssc	S1b/S3n	I	G5
LOUISIANA WATERTHRUSH	<i>Seiurus motacilla</i>			S4	I	G5
NORTHERN PARULA	<i>Setophaga americana</i>	SC ³	ssc/s	S3b/S4n	M	G5
HOODED WARBLER ssc	<i>Setophaga citrina</i>		ssc/s	S3b/S4n	M	G5
YELLOW BELLIED SAPSUCKER	<i>Sphyrapicus varius</i>			S4	M	G5
FIELD SPARROW	<i>Spizella pusilla</i>			S4	I	G5
BARRED OWL	<i>Strix varia</i>		T/T	S2b/S2n	I	G5
EASTERN MEADOWLARK	<i>Sturnella magna</i>		ssc/s	S3b/S4n	I	G5
BROWN THRASHER ssc	<i>Toxostoma rufum</i>		ssc/s	S3b/S4n	I	G5
WINTER WREN ssc	<i>Troglodytes hiemalis</i>		ssc/s	S3b/S4n	M	G5
EASTERN KINGBIRD	<i>Tyrannus tyrannus</i>			S4	I	G5
BARN OWL	<i>Tyto alba</i>		ssc/ssc	S3b/S3n	(R)	G5
GOLDEN WINGED WARBLER	<i>Vermivora chrysoptera</i>	(SC ^{3,5})	E/ssc	S1b/S3n	I	G4
BLUE WINGED WARBLER	<i>Vermivora cyanoptera</i>			S4	M	G5
YELLOW THROATED VIREO	<i>Vireo flavifrons</i>			S4	M	G5
BLUEHEADED VIREO	<i>Vireo solitarius</i>		ssc/s	S3b/S4n	I	G5

C7

COMMON NAME	SCIENTIFIC NAME	FED STAT.	STATE STATUS	STATE RANK	STATE MGT-OBJ	GLOBAL RANK
MAMMALS: BATS (5 Species)						
EASTERN SMALL FOOTED BAT	<i>Myotis leibii</i>	SC ⁵	u	Su	I	G1-G3
LITTE BROWN BAT	<i>Myotis lucifugus</i>	SC ⁵	u	Su		G3
INDIANA BAT	<i>Myotis sodalis</i>	LE	E	S1	I	G2
NORTHERN LONG EARED BAT	<i>Myotis septentrionalis</i>	SC ⁵	u	Su		G1-G3
TRICOLORED BAT	<i>Perimyotis subflavus</i>		u	Su		G3
MAMMALS: OTHER (2 Species)						
BOBCAT	<i>Lynx rufus</i>		E	S1	I	G5
ALLEGHENY WOODRAT ^{Ex-p}	<i>Neotoma magister</i>	SC	E	S1	R	G3-G4

Ex-p - considered extirpated from PICA
H-p - Historical records; not reconfirmed on PICA

CODES

Gray line indicates potential for species to occur, but presence has not been (recently) documented or confirmed.

State Status	Federal Status
ssc –(faunal)species of special concern */* - breeding population / transient pop. s - stable */* - underline indicates which population occurs on Post u – undetermined n/a T - threatened E - endangered	SC - federal species of concern (per ESA and/or MBTA for birds) C# = federal candidate species (priority ranking 1-12) LT - federal listed threatened LE - federal listed endangered Above 3 per ESA
State Rank	Global Rank
S 1 - critically imperiled S 2 - imperiled S 3 - rare S 4 - apparently secure ? - dubious or not ranked	G 1 - critically imperiled G 2 - imperiled G 3 - rare G 4 - apparently secure G 5 - demonstrably secure ? - dubious or not ranked T - infraspecific taxon rank applies to a subspecies or variety Q - taxonomic questions associated with ranking
SWAP Conservation Management Objectives in Northern Highlands Zone of Skylands Landscape	
M - Maintain population I – Increase and Stabilize population R – Research and Restore population; suitable habitat, presence unknown RP - Species is of Regional Priority X - Species present; management strategy TBD? (M,I,R) - parens indicate mgt obj in nearby habitat zone within Skylands landscape	

Bird and other animal info from <<http://www.conservewildlifenj.org>> List date 2/21/2012; updated 4/6/2012

APPENDIX D

Grounds Maintenance Plant Lists

D1

Grasses/Groundcovers/Trees/Shrubs/Vines Used For Landscaping

Grasses
(11 species)

COMMON NAME	SCIENTIFIC NAME
REDTOP	<i>Agrostis alba</i>
KENTUCKY 31 TALL FESCUE	<i>Festuca arundinacea</i>
CREEPING RED FESCUE	<i>Festuca rubra</i>
JAPANESE BLOOD GRASS	<i>Imperata cylindrica</i> var 'RED BARON'
PERENNIAL RYEGRASS	<i>Lolium perenne</i>
GIANT CHINESE GRASS	<i>Miscanthus floridulus</i>
MAIDEN GRASS	<i>Miscanthus sinensis</i> var <i>gracillimus</i>
SWITCHGRASS	<i>Panicum virgatum</i>
HEAVY METAL GRASS	<i>Panicum virgatum</i> var 'HEAVY METAL'
DWARF FOUNTAIN GRASS	<i>Pennisetum alopecuroides</i> var 'HAMLEN'
KENTUCKY BLUEGRASS	<i>Poa pratensis</i>

Groundcovers
(6 species)

COMMON NAME	SCIENTIFIC NAME
MOONBEAM GRASS	<i>Coreopsis</i> sp? var 'MOONBEAM'
CROWN VETCH	<i>Coronilla varia</i>
IVY VARIETIES	<i>Hedera</i> spp.
JAPANESE CREEPER	<i>Parthenocissus tricuspidata</i>
PACHYSANDRA	<i>Pachysandra terminalis</i>
PERIWINKLE ☉	<i>Vinca minor</i>

Trees
(33 species)

COMMON NAME	SCIENTIFIC NAME
MAPLE	<i>Acer</i> spp.
BIRCH	<i>Betula</i> spp.
HICKORY	<i>Carya</i> spp.
ATLAS CEDAR	<i>Cedrus atlantica</i>
'KOUSA' DOGWOOD	<i>Cornus chinensis</i> var 'KOUSA'
'SCARLET' HAWTHORN	<i>Crataegus laevigata</i> var ?
ASH	<i>Fraxinus</i> spp.
GINKGO	<i>Ginkgo biloba</i>
'SUNBURST' LOCUST	<i>Gleditsia tricacanthos</i> var <i>inermis</i>
AMERICAN HOLLY	<i>Ilex opaca</i>
GOLDENCHAIN TREE	<i>Laburnum x watereri</i>
AMERICAN LARCH	<i>Larix laricina</i>
MAGNOLIA	<i>Magnolia</i> spp.
FLOWERING CRABAPPLE VARIETIES	<i>Malus</i> sp? var ?
DAWN REDWOOD	<i>Metasequoia glyptostroboides</i>
COLORADO SPRUCE	<i>Picea pungens</i>
NORWAY SPRUCE	<i>Picea abies</i>
'KOSTER' BLUE SPRUCE	<i>Picea glauca</i>
DWARF ALBERTA SPRUCE	<i>Picea glauca</i> var 'CONICA'
SERBIAN SPRUCE	<i>Picea omorika</i>
AUSTRIAN PINE	<i>Pinus nigra</i>
WHITE PINE	<i>Pinus strobus</i>
SCOTCH PINE	<i>Pinus sylvestris</i>
JAPANESE CHERRY VARIETIES	<i>Prunus serrulata</i> var ?
DOUGLAS FIR	<i>Psuedotsuga taxifolia</i>
PEAR	<i>Pyrus</i> spp.
OAK	<i>Quercus</i> spp.
WILLOW	<i>Salix</i> spp.
MOUNTAIN ASH	<i>Sorbus</i> spp.
ARBORVITAE VARIETIES	<i>Thuja occidentalis</i> var ?
LITTLELEAF LINDEN	<i>Tilia cordata</i>
HEMLOCK	<i>Tsuga canadensis</i>
AMERICAN 'LIBERTY' ELM	<i>Ulmus americanus</i> var <i>libertas</i>

D1

Shrubs
(30 species)

COMMON NAME	SCIENTIFIC NAME
SERVICEBERRY (a.k.a. SHADBLOW)	<i>Amelanchier spp.</i>
AZALEA VARIETIES	<i>Azalea spp.</i>
BARBERRY	<i>Berberis spp.</i>
COMMON BOXWOOD	<i>Buxus sempervirens</i>
FLOWERING QUINCE	<i>Chaenomeles japonica</i>
SUMMERSWEET	<i>Clethra spp.</i>
ROCK COTONEASTER	<i>Cotoneaster horizontalis</i>
CRYPTOMERIA	<i>Cryptomeria spp.</i>
SLENDER DEUTZIA	<i>Deutzia gracilis</i>
BURNING BUSH	<i>Euonymus alatus</i>
FORSYTHIA	<i>Forsythia x intermedia</i>
ROSE-OF-SHARON	<i>Hibiscus syriacus</i>
HYDRANGEA VARIETIES	<i>Hydrangea spp.</i>
JAPANESE HOLLY	<i>Ilex crenata</i>
JUNIPER VARIETIES	<i>Juniperus spp.</i>
MOUNTAIN LAUREL	<i>Kalmia latifolia</i>
PRIVET	<i>Ligustrum spp.</i>
SWEET MOCKORANGE	<i>Philadelphus coronarius</i>
ANDROMEDA	<i>Pieris japonica</i>
MOUNTAIN ANDROMEDA	<i>Pieris floribunda</i>
FLOWERING ALMOND	<i>Prunus glandulosa</i>
WHITE FOUNTAIN WEEPING CHERRY	<i>Prunus subhirtella</i>
WEEPING HIGAN CHERRY	<i>Prunus subhirtella var pendula</i>
SCARLET FIRETHORN	<i>Pyracantha coccinea</i>
RHODODENDRON VARIETIES	<i>Rhododendron spp.</i>
SPIRAEA VARIETIES	<i>Spiraea spp.</i>
COMMON LILAC	<i>Syringa vulgaris</i>
YEW VARIETIES	<i>Taxus spp.</i>
VIBURNUM VARIETIES	<i>Viburnum spp.</i>
VILLAGE GREEN ZELKOVA	<i>Zelkova serrata</i>

Vines

(1 species)
(excluding ground cover vines)

COMMON NAME	SCIENTIFIC NAME
WISTERIA	<i>Wisteria floribunda</i>

APPENDIX E

PICATINNY WATER RESOURCES

E1
PICATINNY LAKES AND PONDS - LENTIC AREAS

LENTIC IDENTIFICATION	WATER SURFACE ELEVATION	RANGE OF FLUCTUATION	MAX DEPTH (ft)	ACRES	SHORELINE (ft)	# of INFLOWS	# of OUTFLOWS	WATER CONTROL DEVICES	STAND DESIGNINATION (surrounding forest)
Lakes (2)									
Denmark Lake (open water)	13.5	13.5 to -17.6	14.0	262.8	20560	1	2	3Submerged Valves and passive Spillway	2-Valley-002
Denmark Lake (shrub swamp)				192.5		(1)	See above	N/A	3-Valley-002/ 3-Valley-001
Picatinny Lake (open water)	13.1	13.1 to -18.9	12.0	97.4	16500	(?) 4	1	Spillway w/4 Lift Gates (and siphon valve)	2-Valley-001
Picatinny Lake (delta/mouth)				1.7		2	See above	N/A	2-Valley-001
Ponds (18)									
Pyro Pond			6.0	1.3	2668	(2)	1	Culvert	1-Valley-020
Fishers Pond			16.0	5.7	1680	(basin) 1	(basin) 1	Submerged Culvert	1-East-050
EOD Pond	9.3	9.3 to -8.7	8.0	6.6	2180	2	2	?Submerged Valve/Culvert	2-East-009
South Basin			7.0	4.4	2196	(5) 3	1	Spillway	2-East-003
North Basin			12.0	1.7	1280	1	1	Submerged Valve/Spillway	2-East-002
1500 Pond			8.0	0.6	1028	1	2	Spillway	2-East-004
G-2 Pond			8.0	3.6	2296	(4) 3	1	Passive Spillway	2-East-006
Gravel Dam Cove	14.6	14.6 to -16.4	10.0	7.7	3200	1	1	Culvert	2-East-007
Pyro Slough				0.4		?0	1	N/A	1-Valley-065
Pyro Pothole				0.1		0	0	N/A	1-Valley-041
1500 Slough				0.2		1	1	N/A	2-East-055
Stillwell Pond				0.3		1	1	?Spillway	2-East-005
Dnm Lk Slough 1				0.1		0	0	N/A	2-East-038
Dnm Lk Slough 2				0.1		0	0	N/A	2-East-039
Dnm Lk Slough 3				0.3		0	0	N/A	2-East-045
1200 Pond				4.9		basin	1	N/A	2-West-010
650 Pond				0.4		basin	1	N/A	2-West-016
Bear Swamp Pond				3.2		basin	1	N/A	1-West-013
20 (Stillwaters)	TOTALS			596.0					22 (12 are non-forested)

E

E2

PICATINNY BROOKS AND RUNS - LOTIC AREAS

LOTIC IDENTIFICATION	ELEVATIONS (FT NGVD)			DIMENSIONS (APPROXIMATE)			FLOWAGE (APPROXIMATE) <small>P= perennial I= intermittent E= ephemeral</small>				STAND DESIGNATION (adjacent forest)
	UP BED	DN BED	GRADE (%)	LENGTH (FT)	WIDTH (FT)	DEPTH (FT)	FLOW (CFS)	MIN/MAX (CFS)	FLOW TYPE	ORDER	
GREEN POND SUB-WATERSHED											
Upper GPB(reach 1) West Branch				5950					P	(3) 4	3-West-007
Upper GPB(reach 1) East Branch				6200					P	(3) 4	3-West-007
670 Waterfall				1600					E	4	2-West-034 / 2-West-030
Upper GPB (reach 2)				6150					P	3	2-West-034 / 2-West-014
Burnt Meadow Brook				1600					P	3	2-Valley-008
Middle GPB (reach 3)				1690					P	3	2-Valley-005
647 Waterfall				2725					E	4	2-West-015 / 2-West-001
641 Waterfall				1890					E	4	2-West-019 / 2-West-020 / 2-West-001 / 2-Valley-003
Basin Brook				2075					(E)I	4	2-East-016 / 2-East-014 / 2-East-015
Bear Swamp Brook (reach 1)				3110					P/I	4	1-West-013
Bear Swamp Brook (reach 2)				3710					P	4	1-West-010 / 1-West-018
Bear Swamp Brook (reach 3)				2110					P	4	Downtown Picatinny
Lower GPB (reach 4)				2000					P	3	1-Valley-022 / 1-Valley-021 / 1-Valley-024 / 1-Valley-023
Lower GPB(reach 5) Channel				2680					P	3	1-Valley-070 / 1-Valley-073
Lower GPB(reach 5) Meander				2250					P	3	1-Valley-070
Fisher Run				1890					I(P)	4	1-East-014
Robinson Run				3600					I(P)	4	1-East-012 / 1-East-011
1300 Run				1680					I	4	1-East-010

E

LOTIC IDENTIFICATION	ELEVATIONS (FT NGVD)			DIMENSIONS (APPROXIMATE)			FLOWAGE (APPROXIMATE) <small>P= perennial I= intermittent E= ephemeral</small>				STAND DESIGNATION (adjacent forest)
	UP BED	DN BED	GRADE (%)	LENGTH (FT)	WIDTH (FT)	DEPTH (FT)	FLOW (CFS)	MIN/MAX (CFS)	FLOW TYPE	ORDER	
Lower GPB (reach 6)				2625					P	3	Upper Golf Course
1400 Run				4900					I(P)	4	1-East-006

APPENDIX F

MAPS

LIST OF MAPS

Installation map Picatinny Arsenal

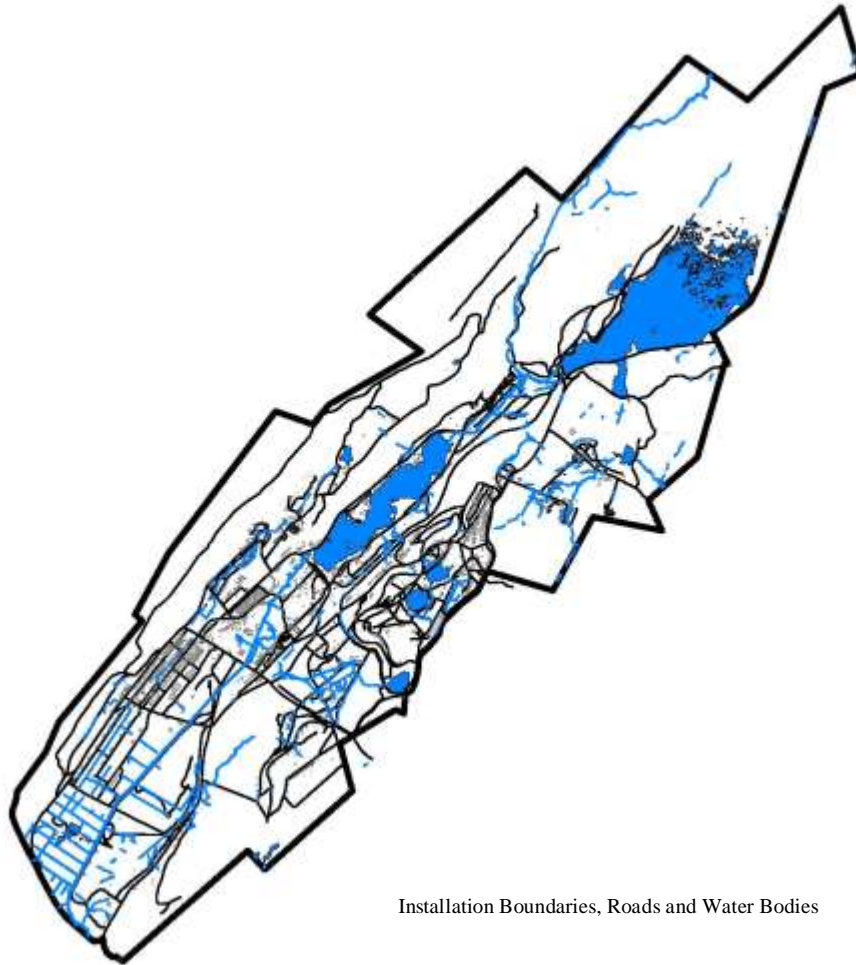
Location map for Connecticut, New York, New Jersey, Pennsylvania Highlands Area

Public Lands Adjacent to Picatinny Arsenal

Public Open Space in Watershed Management Area (WMA) 6

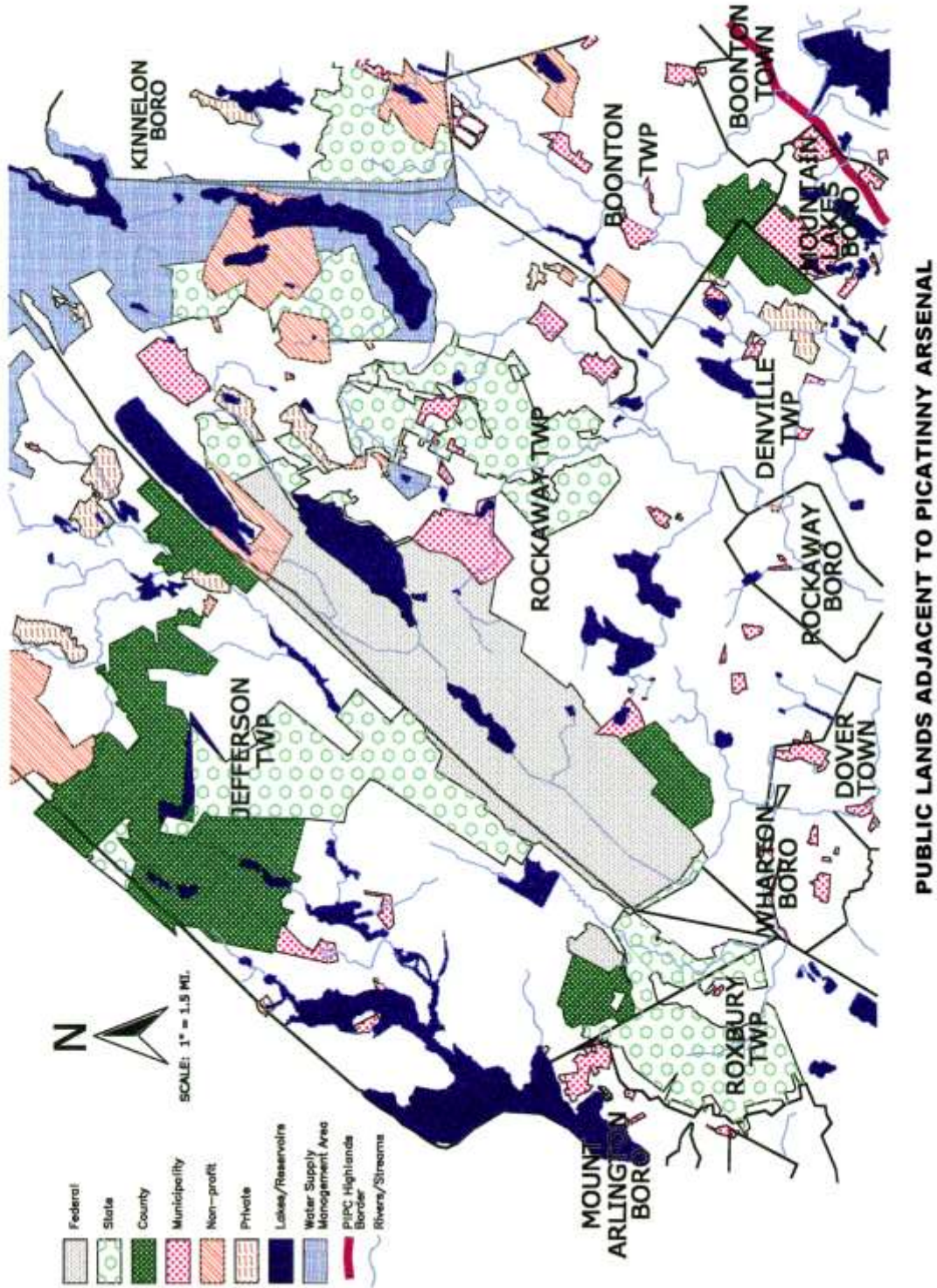
Resources Planning and Management Map of The New Jersey State Development And Redevelopment Plan

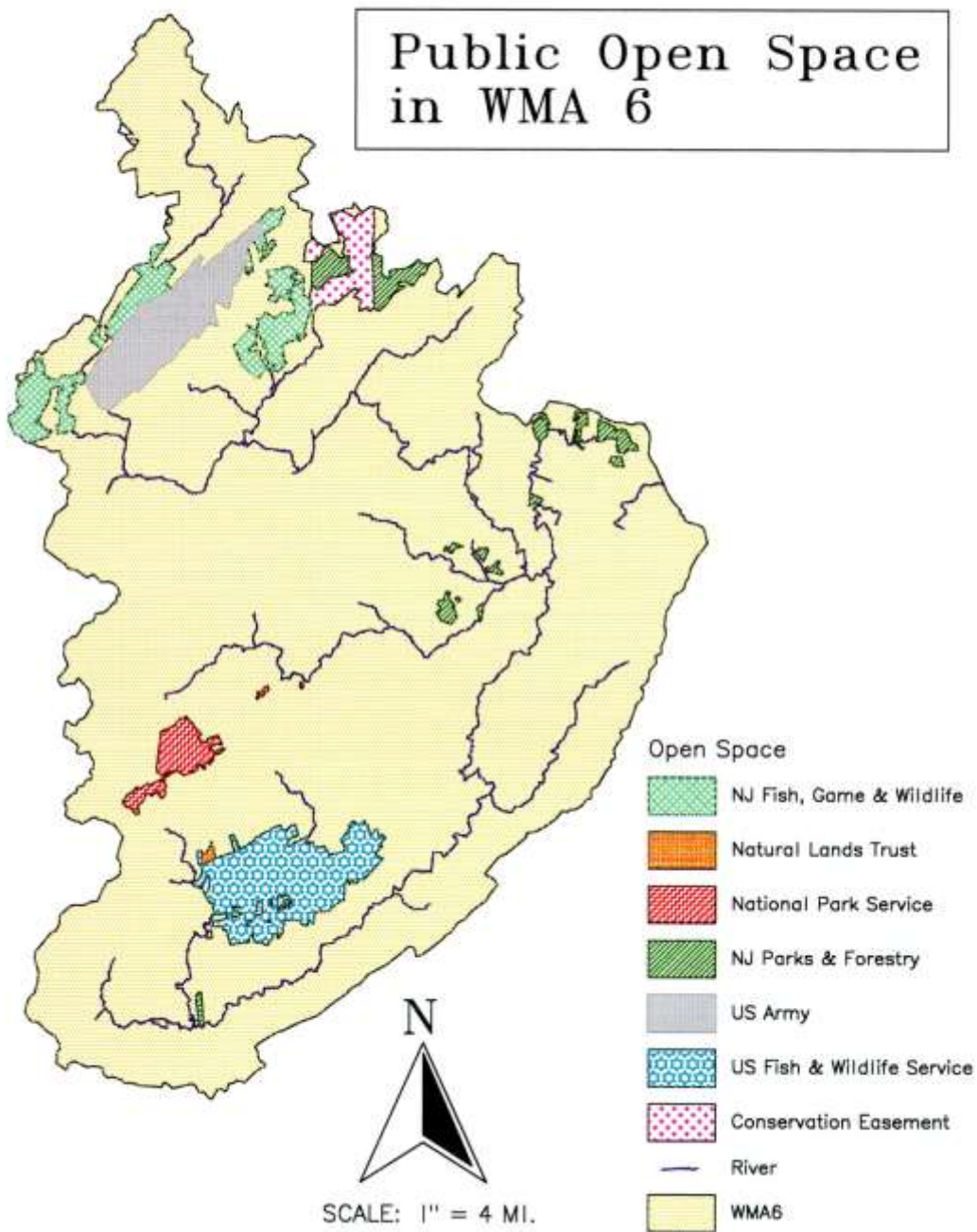
Morris County, New Jersey, State Planning Areas

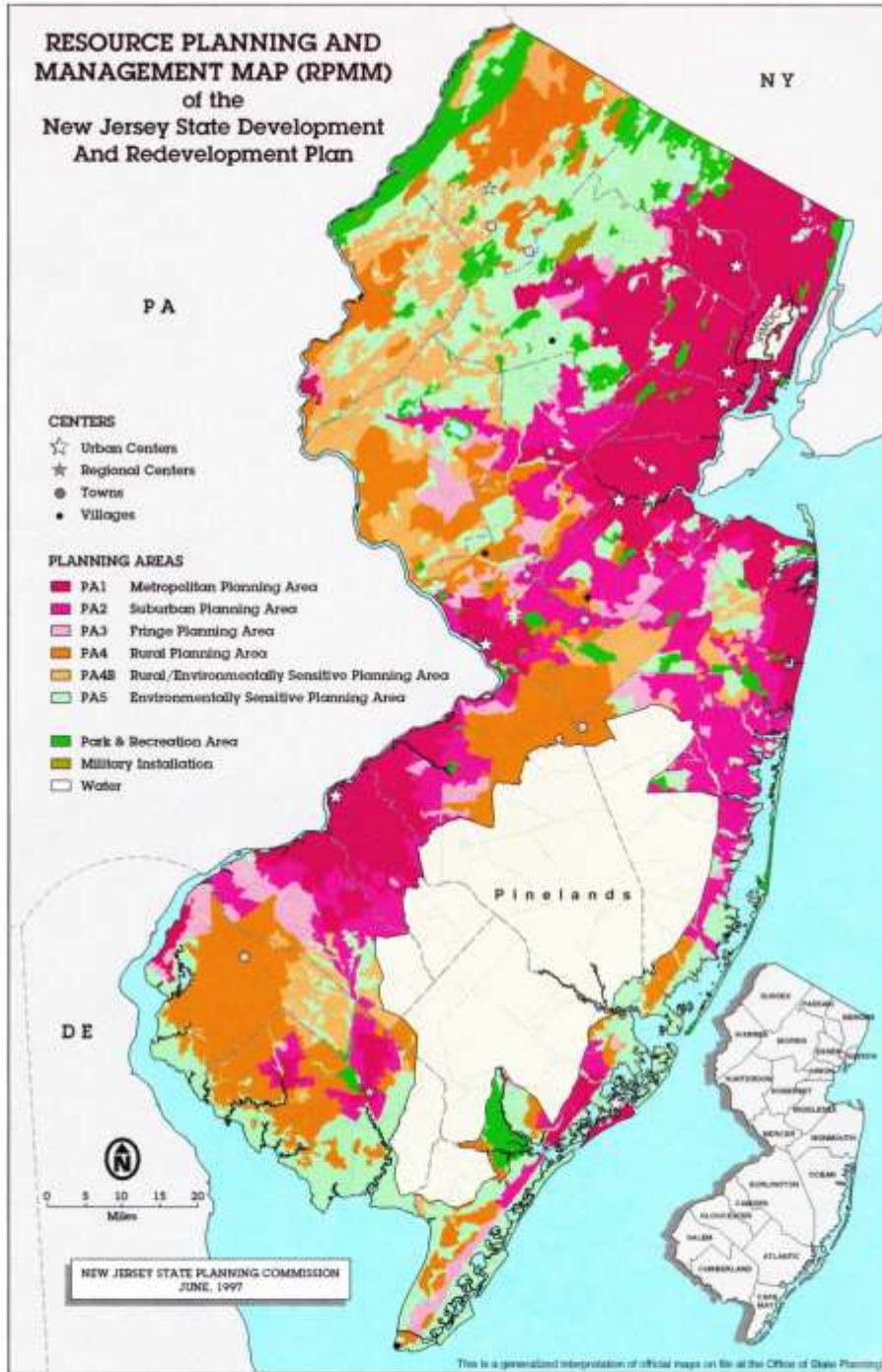


Installation Boundaries, Roads and Water Bodies

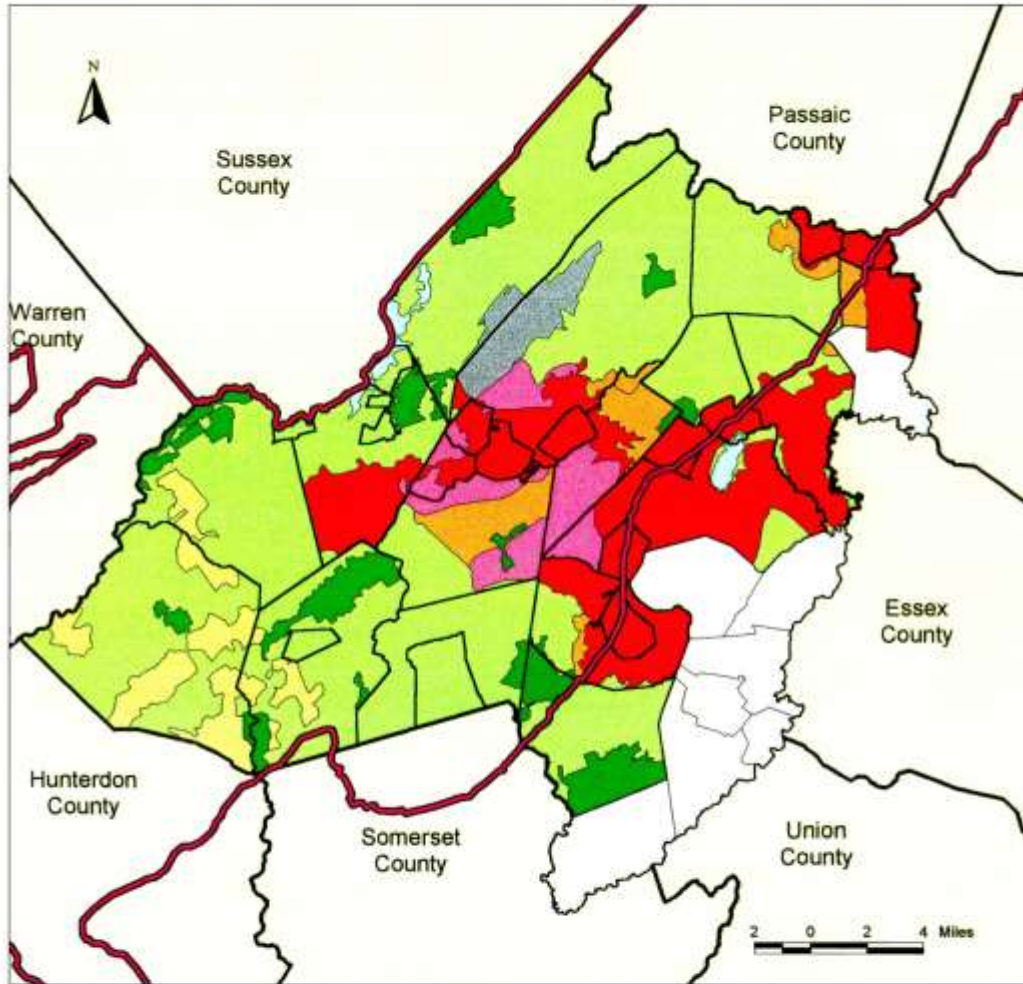




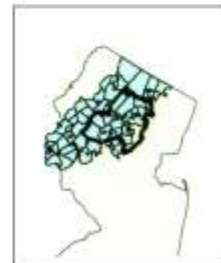




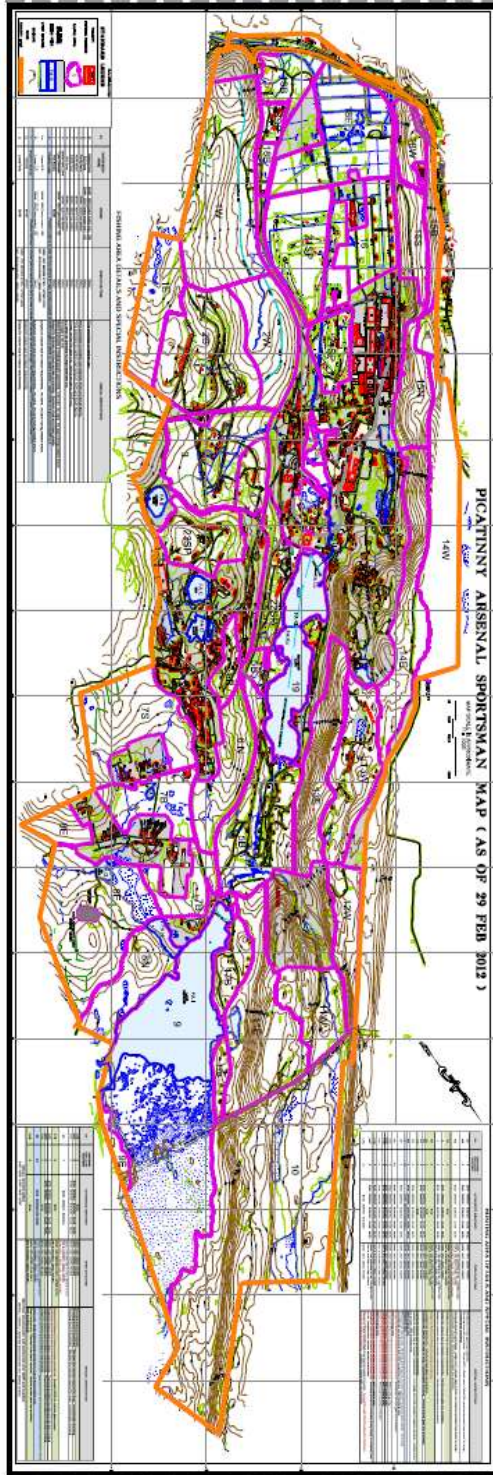
Morris County State Planning Areas



- | | |
|--|-----------------------------------|
| PA1 Metropolitan Planning Area | Parks |
| PA2 Suburban Planning Area | Military |
| PA3 Fringe Planning Area | Water |
| PA4 Rural Planning Area | Morris Non-Highlands Municipality |
| PA4B Rural/Environmentally Sensitive Planning Area | Highlands Geologic Border |
| PA5 Environmentally Sensitive Planning Area | |



This map was created, in part, using New Jersey Department of Environmental Protection Geographic Information System digital data, in conjunction with the Passaic River Coalition's work. J.L.Wollenberg, April 1999.



Picatinny Sportsman Map used by Hunters, Fishermen and Trappers is actually oversized for better legibility and scale. Tables on Right are Hunting Area (HA) conditions/constraints while the Table to lower left is for Fishing Areas (FA). HAs are numbered while FAs are lettered. This map is integral to the Sportsman Policy (aka Picatinny Arsenal Policy No. IMPI-MWR-006).

APPENDIX G

Indiana Bat Endangered Species Management Component

112 Pages
Main body = G-4 thru G-85

N.B. This plan (ESMP) dated 2007 will reference some Army regulations that have since been updated; however the recent changes did not alter the substantive elements of this plan. Similarly the task schedules although dated were either accomplished as indicated or might still be pending contingent upon funding.

Addenda since ESMP circa 2007 through 2014

- P. G-22: NJ counties = 2 with confirmed maternity colonies.
- P. G-32: Maternity roosts also confirmed in single family homes and artificial roost boxes in NJ.
- P. G-35: In recent years (since 2006) White Nose Syndrome (WNS) has also been decimating IBAT as well as most eastern (cave roosting) bat populations.
- P. G-37: Table 4; IBAT occurrences all types-counties=2; and summer-counties=2.

Addenda added 31 March, 2015

Note addendum 1 and 2 (see Appendix G-D-3)

ADDENDUM 1 clarifies how the federally threatened Northern Long Eared Bat (*Myotis septentrionalis*) will be managed under the present 4(d) rule of the ESA on Picatinny Arsenal (PICA).

ADDENDUM 2 (see Appendix G-D-7) acknowledges that the conservation needs and requirements for the **Threatened NLEB** are adequately covered by PICA adherence to the PICA IBAT ESMC.

**Endangered Species Management Plan
and Environmental Assessment
for the Indiana Bat, *Myotis sodalis***

**US Army
Picatinny Arsenal, New Jersey**

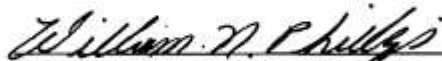
September 2007

Prepared by

Jonathan D. Van De Venter
Natural Resources Manager
&

TEAM PICATINNY

Approved by



William N. Phillips
Installation Commander

**Endangered Species Management Plan
&
Environmental Assessment
For the Indiana Bat, *Myotis sodalis***

**Picatinny Arsenal
Morris County, New Jersey**

**Signature Page
(Picatinny Arsenal)**


This Endangered Species Management Plan (ESMP) meets the requirements for ESMPs as outlined in AR 200-3. It sets appropriate guidelines and prescriptions for conserving and protecting the Indiana Bat on Picatinny Arsenal. This ESMP/EA was developed in consultation with appropriate Garrison staff and mission responsible stakeholders at Picatinny Arsenal.

APPROVED BY:



William N. Phillips
Brigadier General, U.S. Army
Commanding
Date 1 October 2007

REVIEWING OFFICIALS:

Reviewed by: 


John P. Stack
Lieutenant Colonel, U.S. Army, Garrison Commander
Date 9/19/07

Reviewed by: 

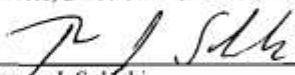
Larry Brady
Environmental Counsel, Legal
Date 9/19/07

Reviewed by: 

Robert E. Souders
Security Specialist, Directorate of Plans, Training, Mobilization and Security
Date 19 Sep 07

Reviewed by: 

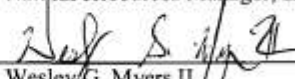
Richard A. Havrisko
Director, Directorate of Public Works
Date 19 Sept 07

Reviewed by: 

Thomas J. Solecki
Chief, Environmental Affairs Office
Date 19 Sept 07

Reviewed by: 

Jonathan D. Van De Venter
Natural Resources Manager, Environmental Affairs Office
Date 19 Sep 07

Reviewed by: 

Wesley G. Myers II
NEPA Program Manager, Environmental Affairs Office
Date

**Endangered Species Management Plan
&
Environmental Assessment
For the Indiana Bat, *Myotis sodalis***

**Picatunny Arsenal
Morris County, New Jersey**

**Signature Page
(United States Fish and Wildlife Service)**

This Endangered Species Management Plan (ESMP) meets the requirements for ESMPs as outlined in AR 200-3. It sets appropriate guidelines and prescriptions for conserving and protecting the Indiana Bat on Picatunny Arsenal. This ESMP was developed in consultation with appropriate staff biologists from the agency (Federal or State) listed below.

CONCURRENCE / AGREEMENT RECOMMENDED BY:

 _____ 27 Nov 07
J. Eric Davis Jr. Date
Supervisor, United States Fish and Wildlife Service
New Jersey Field Office

**OTHER REVIEWING STAFF:
(if necessary or advisable)**

Reviewed by:  _____ Senior Endangered Species Biologist
NAME Title Date

Reviewed by: _____
NAME Title Date

Reviewed by: _____
NAME Title Date

**Endangered Species Management Plan
&
Environmental Assessment
For the Indiana Bat, *Myotis sodalis***

**Picatunny Arsenal
Morris County, New Jersey**

**Signature Page
(New Jersey Division of Fish and Wildlife)**

This Endangered Species Management Plan (ESMP) meets the requirements for ESMPs as outlined in AR 200-3. It sets appropriate guidelines and prescriptions for conserving and protecting the Indiana Bat on Picatunny Arsenal. This ESMP was developed in consultation with appropriate staff biologists from the agency (Federal or State) listed below.

CONCURRENCE / AGREEMENT RECOMMENDED BY:



Mick Valent
Principal Biologist, New Jersey Division of Fish and Wildlife
Endangered and Non-Game Species Program

10/30/07
Date

**OTHER REVIEWING STAFF:
(if necessary or advisable)**

Reviewed by:

NAME	Title	Date
------	-------	------

Reviewed by:

NAME	Title	Date
------	-------	------

Reviewed by:

NAME	Title	Date
------	-------	------

CONTENTS

<u>Section</u>	<u>Page</u>
ACRONYMS AND ABBREVIATIONS	iv
EXECUTIVE SUMMARY	ES-1
1.0 INTRODUCTION.....	4
1.1 GOALS AND POLICIES	5
1.2 RESPONSIBLE AND INTERESTED PARTIES	5
1.3 NEPA COMPLIANCE AND INTEGRATION	6
1.4 INTERAGENCY COORDINATION AND REVIEW	6
1.4.1 Agency Review and Comment	6
1.4.2 Public Participation.....	6
2.0 BACKGROUND INFORMATION.....	7
2.1 PICATINNY ARSENAL DESCRIPTION AND MILITARY MISSION	7
2.2 AFFECTED ENVIRONMENT.....	9
2.2.1 Regional Physiography and Setting	9
2.2.2 Picatinny Landscape and Natural Resources	10
2.2.3 Picatinny Human Environment	17
3.0 SPECIES INFORMATION	20
3.1 PHYSICAL DESCRIPTION.....	20
3.2 DISTRIBUTION AND RANGE.....	20
3.3 LIFE HISTORY	23
3.4 HABITAT AND BEHAVIOR	27
3.4.1 Roosting Cohorts and Habitat Utilization	27
3.4.2 Foraging Habitats and Behavior	34
3.5 REASONS FOR DECLINE	35
3.6 CONSERVATION MEASURES.....	35
3.7 IBAT STATUS IN NORTHEAST REGION AND AT PICA AND NORTHERN NJ	37
3.7.1 Hibernia and Other Local Mine Studies.....	41
3.7.2 PICA Studies.....	42
3.7.3 Other Relevant Studies	47
3.8 CHRONOLOGICAL OVERVIEW.....	50

CONTENTS (Continued)

<u>Section</u>	<u>Page</u>
4.0 PICA CONSERVATION GOALS	51
5.0 MANAGEMENT PRESCRIPTIONS.....	53
5.1 MANAGEMENT PRESCRIPTIONS FOR PICA ACTIVITIES.....	53
5.1.1 Forest Management.....	53
5.1.2 Pest Management.....	56
5.1.3 Construction and Demolition and Environmental Remediation	58
5.1.4 Leasing of PICA Property.....	58
5.1.5 Test Range and Operations.....	58
5.1.6 Training Exercises	58
5.1.7 Hunting and Other Outdoor Recreation	59
5.1.8 Firewood Cutting	59
5.2 OTHER MANAGEMENT PRESCRIPTIONS	59
5.2.1 Monitoring of IBAT and Habitat	59
5.2.2 Protection of Water Quality	61
5.2.3 Protection and Inspection of Bat Roosts in Buildings, Mines, or Caves.....	62
5.2.4 Provision and Protection of Artificial Bat Roost Structures	62
5.2.5 Implementation of Employee and Community Awareness Program.....	63
5.2.6 Communication with USFWS	63
6.0 ENDANGERED SPECIES MANAGEMENT PLAN IMPLEMENTATION	64
6.1 COMPLIANCE AND REVIEW	64
6.2 TIME, COSTS, AND PERSONNEL	64
7.0 ENVIRONMENTAL ASSESSMENT.....	68
7.1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION	68
7.2 ALTERNATIVES CONSIDERED	68
7.2.1 “No Action” Alternative	68
7.2.2 Proposed Alternative.....	68
7.3 CUMULATIVE EFFECTS	76
7.4 CONCLUSIONS	76
8.0 REFERENCES.....	77

CONTENTS (Continued)

APPENDICES

Appendix

A	GLOSSARY
B	INDIVIDUALS CONSULTED DURING ESMP/EA PREPARATION
C	PICATINNY ARSENAL ENDANGERED SPECIES MANAGEMENT PLAN ANNUAL COMPLIANCE CHECKLIST
D	FINDING OF NO SIGNIFICANT IMPACT FOR IMPLEMENTATION OF THE ENDANGERED SPECIES MANAGEMENT PLAN FOR THE IBAT, MYOTIS SODALIS
E	INDIANA BAT AND NORTHERN LONG EARED BAT 4(d) RULE

FIGURES

<u>Figure</u>		<u>Page</u>
1	INSTALLATION LOCATION	7
2	INSTALLATION LAYOUT AND GEOGRAPHY	11
3	DISTRIBUTION OF THE IBAT (WINTER AND SUMMER RANGES COMBINED).....	21
4	LIFE CYCLE OF THE IBAT	24
5	PICATINNY IBAT CAPTURE SITES; ZONES OF CONCERN FOR ROOSTING AND FORAGING	46

TABLES

<u>Table</u>		<u>Page</u>
1	PICATINNY FOREST TYPES AND ACREAGE	15
2	U.S. IBAT OCCURRENCES AND ESTIMATED POPULATIONS	22
3	POTENTIAL IBAT ROOST TREES	30
4	NORTHEASTERN IBAT OCCURRENCES AND ESTIMATED POPULATIONS.....	37
5	ESTIMATED LEVEL OF EFFORT AND COST BY MANAGEMENT PRESCRIPTION	65
6	ESTIMATED OVERALL COST OF CONSERVATION ACTIONS	67
7	PROPOSED ACTIONS AND EXPECTED IMPACTS	70

ACRONYMS AND ABBREVIATIONS

aka	Also Known As
AR	U.S. Department of the Army Regulation
EA	Environmental Assessment
EIS	Environmental Impact Statement
dbh	Diameter at Breast Height
ENSP	Endangered and Nongame Species Program (NJDFW)
ESA	Endangered Species Act
ESMP	Endangered Species Management Plan
FNSI	Finding of No Significant Impact
ft	Feet
IAW	In Accordance With
IBAT	Indiana Bat (<i>Myotis sodalis</i>)
IMCOM	Installation Management Command (formerly Installation Management Agency - IMA)
INRMP	Integrated Natural Resources Management Plan
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum (for topographic elevations)
NRM	Natural Resources Manager
NJDFW	New Jersey Division of Fish and Wildlife
NJFO	New Jersey Field Office; Pleasantville, NJ (USFWS Region 5)
PICA	Picatinny Arsenal
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

Background: U.S. Department of the Army Regulation (AR) 200-3, “Natural Resources–Land, Forest, and Wildlife Management,” requires installations to implement programs and develop Endangered Species Management Plans (ESMP) to protect and conserve listed and proposed threatened and endangered species and critical habitat in order to comply with the Endangered Species Act (ESA). Biological surveys conducted at Picatinny Arsenal (PICA) reveal that the federally listed endangered Indiana Bat (*Myotis sodalis*) (hereafter referred to as IBAT) forages and roosts at the installation. Specifically the first ever post-lactating female IBAT in NJ was captured on PICA property on July 29, 1995, which represented the first confirmed summer record (Conserve Wildlife 1997) within the core maternity season (15 MAY -15AUG). This capture suggested that an actual maternity colony existed within 1-2 miles of the capture site and quite possibly on Army property. Subsequently, sampling and capture of 8 IBATs (5 male and 3 female) from mid-May 1997 through July 1998 documented summer roosting and foraging by 2 male IBATs (including one in a storage warehouse), as well as pre and post hibernation foraging activity by 3 male and 3 female IBATs. Tracking of these six bats after the spring emergence in 1998 was unsuccessful due to predation, apparent return into local mines, battery failure of the applied transmitters, and likely migration out of the local area.

In 1993 IBATs were verified by the United States Fish and Wildlife Service (USFWS) and New Jersey Department of Environmental Protection (DEP), Division of Fish and Wildlife, (NJDFW), Endangered and Nongame Species Program (ENSP) to be hibernating in Hibernia Mine, an abandoned horizontal iron ore tunnel (adit) about 1.5 miles from the eastern edge of installation property. A small wintering colony has been confirmed using the mine consistently over the past decade (USFWS 2000). Until recently, this colony was the only confirmed and monitored IBAT population in NJ. The number of individual IBATs found in this one winter colony has ranged from 18 to 107 individuals within the portion of the mine that can be safely accessed. In 1996, IBATs were netted near the entrance of two vertical mine shafts about 0.25 miles from the PICA Mt. Hope Gate, also on the eastern side of the Army installation. Safe entry and descent by professionals was only recently allowed by the landowner and performed. In February 2004, over 500 IBATs were observed (Butchkoski, Chenger, Craddock, Scherer, *pers.comm.* 2004) for the first time in roosting clusters in one chamber of this deep network of vertical shafts and lateral tunnels (drifts) known as the Mount Hope Mine(s). This population is significantly larger than the one in Hibernia Mine and validates this second hibernaculum as one of premier importance for this endangered species in NJ. Even so, other IBAT colonies may occupy winter roosts in other mines as yet unknown, thus making censuses difficult.

No maternity roost trees have yet been discovered on PICA property. Although roosting and foraging habitat at PICA may comprise only a relatively small fraction of the IBAT’s total summer range and is not considered to be “critical habitat” – that is, it is not listed in the September 24, 1976, *Federal Register* as habitat essential to the conservation of the species and requiring special management considerations or protection – the U.S. Army understands that this habitat is important to the local population and potentially to the long-term survival of the species (Tetra Tech 1999f). Especially important is the proximity of known winter hibernacula, which subjects all the forest cover on PICA to widespread foraging during pre and post hibernation activity. In fact, IBAT biologists consider all forest cover within 5 miles of known hibernacula as crucial for foraging purposes (Kiser and Elliott 1996, Scherer *pers.comm.* 1999, USFWS 2000, Clawson 2000, USDA-FS 2000). In NJ the ENSP recommends for its NJ Landscape Project, a 1.2-mile (2 km) radius around hibernacula to protect foraging areas (Craddock 2004). This ESMP and Environmental Assessment (EA) have been prepared to support PICA in meeting AR 200-3 requirements. The management prescriptions presented in this document are consistent with AR 200-3, current management guidelines for the IBAT, and the installation’s military mission and Integrated Natural Resources Management Plan (INRMP).

Current Species Status: The IBAT was first listed as a federal endangered species throughout its range on March 11, 1967, under the Endangered Species Preservation Act of 1966. Researchers have primarily attributed the decline of the IBAT population to direct and indirect actions of humans and to natural hazards. Based on censuses taken at hibernation sites, the total known population of the IBAT is estimated to have declined from 884,000 in 1970 to 383,000 in 2000 (USFWS 1983, 1999, Clawson 2002).

Habitat Requirements and Limiting Factors: The IBAT requires two distinct types of habitat: (1) winter hibernation sites and (2) summer roosting sites and foraging areas. During the winter, the IBAT generally hibernates in caves, although abandoned mines have also been used. During the summer, the IBAT roosts beneath slabs of loose bark of dead or dying large diameter trees (>8 inches diameter breast height) in semi-wooded areas in upland and bottomland forests or in open areas. Tree crevices, cavities, and hollows are also used. Suitable summer habitat consists of stands with a minimum of one large diameter snag per hectare (2.5 acres). Nursery colonies of IBATs consist primarily of females and their offspring, and they may be located over 200 miles away from the hibernacula (Tarr 1999). The IBAT has been observed to occupy two types of maternity roosts: primary (generally greater than ≥ 30 bats) and alternate (generally less than < 30 bats). Smaller trees with loose bark will be used as roosting sites by smaller groups of bats. A continuous supply of adequate roost trees is required for the reproductive success of the IBAT. It forages in upland, flood plain, and riparian forests or in open areas. Its diet primarily consists of small, soft-bodied insects such as small moths (*Lepidoptera*), flies (*Diptera*), caddisflies (*Trichoptera*), bees and wasps (*Hymenoptera*), stoneflies (*Plecoptera*), and lacewings (*Neuroptera*), as well as beetles (*Coleoptera*) and true bugs (*Hemiptera*). Water quality is important for sustaining populations and seasonal emergences of aquatic based insects. Foraging habitat can be preserved by observing restrictions concerning timber harvest activities near stream edges and by maintaining adequate stream buffers (Tarr 1999).

Insufficient data are currently available to conclude whether lack of availability of summer habitat is a limiting factor to the recovery of the IBAT. Until such information is obtained, national recovery guidelines include a conservative approach to evaluating the potential effects of land use practices on the summer habitat of the species.

Management Objectives and Conservation Goals: The primary objective of this ESMP and EA are to recognize the ecosystem elements present at PICA that support the IBAT and to present management practices that are important to the local IBAT population and potentially the long-term survival of the species. Therefore, the following conservation goals have been established at PICA:

- Conserve and maintain existing IBAT spring, summer, and fall foraging habitat at PICA by minimizing incremental or cumulative permanent loss of standing forest cover up to 7 percent or approximately 280 acres with up to 40 acres in riparian corridors.
- Conserve and maintain existing IBAT male summer roosting habitat; as well as potential maternity roosting habitat.
- Prevent disturbance to existing structures (or artificial roosts) and dead standing trees (aka snags) that may serve as potential IBAT roost sites.
- Protect and maintain existing riparian corridors, for vegetative cover and water quality.
- Construct and attract summer roosting bats (mainly Little Brown Bats and possibly IBATs) to artificial roosts in optimal safe and secure locations while excluding local colonies from old existing buildings or warehouses on post (mainly building 3236).
- Try to establish credible population structure and estimates for northern NJ through interagency cooperation and data sharing.
- Monitor and assess the IBAT population and habitat utilization at PICA through periodic surveys using a variety of capture or monitoring methods.
- Educate individuals who have a potential impact on the northern NJ IBAT population and its presence at PICA.
- Communicate with the USFWS regarding the status of the IBAT at PICA.

Compliance with this ESMP/EA is consistent with principles of ecosystem management used at PICA and supports applicable conservation goals outlined in the USFWS IBAT (national) Recovery Plan.

Actions Needed: The following general actions encompass the management prescriptions detailed in this ESMP and are consistent with the current Recovery Plan goals for the species.

- Incorporate IBAT habitat conservation guidelines into existing PICA activities that might impact the IBAT, including forest management, pest management, construction and demolition, environmental remediation, property leasing or transfers, training exercises, hunting and other outdoor recreation, and firewood cutting.
- Implement an IBAT population and habitat-monitoring program at PICA.
- Implement an education program for PICA residents, employees, contractors, and the community, to promote regional awareness and conservation of the IBAT and its foraging and roosting habitat.
- Report findings from IBAT species and habitat monitoring activities to the USFWS Region 5, Pleasantville, New Jersey Field Office (NJFO).

For activities that PICA is considering undertaking, funding, permitting, or authorizing that are outside the scope of management prescriptions or have a potential impact on the IBAT at PICA, PICA will engage in necessary ESA Section 7 consultation with the USFWS NJFO.

Total Estimated Cost of Conservation Actions: The total estimated cost of conservation actions over the first 5 years of this ESMP is presented in the chart below. Table 5 in this ESMP provides a more detailed description of the time, costs, and personnel needed to implement each management prescription.

Fiscal Year	Estimated Annual Cost
2006	*\$111,000
2007	\$13,000
2008	\$8,000
2009	\$8,000
2010	*\$104,000
5-Year Total	244,000

* Includes costs associated with biological survey and major ESMP/EA revision

Implementation of the management prescriptions presented in the ESMP portion of this ESMP/EA will not (1) adversely impact the quality of the environment at PICA or (2) result in other significant environmental impacts that require preparation of an Environmental Impact Statement under 32 CFR 651.41 (e). The ESMP also meets the requirements of AR 200-3 by presenting management prescriptions that aim to protect and conserve the endangered IBAT in order to comply with the ESA.

The intent of this ESMP is to find the balance between mission requirements and conservation of the IBAT. This ESMP/EA represents the U.S. Army’s commitment not only to IBAT conservation while PICA is under U.S. Army ownership, but also to the continued conservation of the species through current and future leasing of installation property. Beneficial impacts of implementing the management prescriptions include preservation and conservation of favorable IBAT habitat, conservation of water quality and riparian corridors, gathering of additional scientific data on the IBAT during monitoring, sharing of information among all responsible and interested parties, and promotion of regional awareness about the IBAT and its roosting and foraging habitat.

1.0 INTRODUCTION

U.S. Department of the Army Regulation (AR) 200-3, “Natural Resources – Land, Forest, and Wildlife Management,” requires installations to implement programs that protect and conserve listed and proposed threatened and endangered species and critical habitat in order to comply with the Endangered Species Act (ESA). Specifically, Chapter 11-5 of AR 200-3 requires that installations prepare Endangered Species Management Plans (ESMP) for listed and proposed threatened and endangered species on the installation. The IBAT (*Myotis sodalis*), a federally listed endangered species, was determined to be roosting and foraging at Picatinny Arsenal (PICA) in Morris County, New Jersey (USFWS 2000; Rinehart and Kunz 1998; Bickle 1995). Critical habitat has not been designated at PICA or the surrounding area at this time. In addition, no maternity roost trees have been discovered on PICA at this time. As a result, this ESMP has been prepared to support PICA IAW AR 200-3 requirements.

This ESMP and Environmental Assessment (EA) details management prescriptions for conservation of the endangered Indiana Bat (IBAT) at Picatinny Arsenal (PICA) in Morris County, NJ, and meets the requirements of the National Environmental Policy Act of 1969 (NEPA) for the actions proposed.

This document was prepared in accordance with (IAW) the “Manual for the Preparation of Installation Endangered Species Management Plans” (U S Army Environmental Center 1995) and is organized in the sections discussed below:

- Section 1.0, INTRODUCTION; discusses the goals and policies associated with this ESMP/EA, responsible and interested parties, compliance with and integration of NEPA requirements, and interagency coordination and review for the ESMP/EA.
- Section 2.0, BACKGROUND INFORMATION; describes PICA and its military mission as well as the affected environment at the installation and surroundings.
- Section 3.0, SPECIES INFORMATION; provides information on the IBAT, including its physical description, distribution, life history, habitat and behavior; the reasons for its decline; conservation measures; and its status at PICA and in surrounding areas.
- Section 4.0, PICA CONSERVATION GOALS; lists the installation’s goals as they relate to protecting the IBAT and its habitat at PICA.
- Section 5.0, MANAGEMENT PRESCRIPTIONS; presents management prescriptions that will be implemented at PICA to meet its conservation goals, mainly forest and stream protection practices to conserve foraging and roosting habitat(s).
- Section 6.0, ESMP IMPLEMENTATION; discusses how PICA will implement the plan in terms of compliance and updating; time, costs, and personnel; and review.
- Section 7.0, ENVIRONMENTAL ASSESSMENT; reviews the purpose of and need for the proposed action, discusses the alternatives considered, reviews the cumulative effects of ESMP, implementation, and summarizes the conclusions of the EA.
- Section 8.0, REFERENCES; lists the sources of information used to prepare this ESMP/EA.

The following appendices are included to supplement the ESMP/EA:

- Appendix A, GLOSSARY; defines key terms used in this ESMP/EA.
- Appendix B, PERSONS CONSULTED DURING ESMP/EA PREPARATION; lists the individuals who provided information for this ESMP/EA.
- Appendix C, PICA ESMP ANNUAL COMPLIANCE CHECKLIST; presents a questionnaire for PICA to use in evaluating its compliance with the management prescriptions (outlined in Section 5.0 of the ESMP).
- Appendix D, FINDING OF NO SIGNIFICANT IMPACT (FNSI) FOR IMPLEMENTATION OF THE ESMP FOR THE IBAT, *MYOTIS SODALIS*; provides supporting documentation for the conclusions of the EA.

1.1 GOALS AND POLICIES

As mentioned previously, AR 200-3 requires installations to implement programs that protect and conserve listed and proposed threatened and endangered species and critical habitat in order to comply with the Endangered Species Act (ESA) (U.S. Army 1995). Specifically, Chapter 11-5 of AR 200-3 requires that an installation prepare ESMPs for listed and proposed threatened and endangered species on the installation. The IBAT, a federally listed endangered species, was determined to be roosting and foraging at PICA (USFWS 2000; Rinehart and Kunz 1998; Bickle 1995). As a result, this ESMP/EA has been prepared to support PICA in meeting AR 200-3 requirements. The management prescriptions presented in this document are consistent with AR 200-3, current management guidelines for the IBAT, and the installation's military mission. In addition, this ESMP incorporates PICA's principles of ecosystem management; the objectives of which are to restore ecosystems where practical and create optimum habitat for all wildlife species, including the IBAT. Specifics regarding these objectives are presented in PICA's Integrated Natural Resources Management Plan (INRMP).

1.2 RESPONSIBLE AND INTERESTED PARTIES

Successful implementation of the management prescriptions outlined in this ESMP/EA requires a cooperative effort among various parties. PICA is the party directly responsible for implementing the ESMP/EA. Picatinny and its Army mission is overseen by an Installation Commander, however the Garrison Commander is directly responsible for operating and maintaining PICA and is legally liable for complying with the laws involved in implementing this ESMP/EA. The Natural Resources Manager (NRM) is responsible for managing the installation's land and natural resources. Specifically, the NRM develops and implements or coordinates the following:

- Integrated Natural Resources Management Plan (INRMP)
- Fish and Wildlife Management Program
- Forestry Management Program
- Water Conservation Program
- Activities of lessees or tenants on PICA property; and leasing or property transfers at PICA.

The NRM, through the Directorate of Public Works, has the delegated authority from the Garrison Commander to implement this ESMP/EA. Major partners in implementing the ESMP include the following parties:

- The U S Army Installation Management Command (IMCOM), Northeast Regional Office (NERO). Installation Management Agency oversees the natural resources management activities of installations across the country, including PICA through NERO.
- U. S. Fish and Wildlife Service (USFWS), the regulatory authority for the ESA that provides regulatory and technical guidance concerning conservation and protection of the IBAT and its habitat at PICA.
- The U.S. Army Corps of Engineers (USACE), specifically the New York District, which is overseeing any grants of easement, and leasing of PICA property.
- The New Jersey Division of Fish and Wildlife (NJDFW), which owns and manages adjacent and nearby property. The Endangered and Nongame Species Program (ENSP) staff provides advice and assistance as well.
- Lessees of PICA property, who will also be responsible for implementing the management prescriptions, presented in this ESMP/EA IAW their lease agreements.

1.3 NEPA COMPLIANCE AND INTEGRATION

Under NEPA federal agencies must consider the environmental consequences of proposed major actions. The intent of NEPA is to protect, restore, or enhance the environment through well-informed federal decisions. This Act is based on the assumption that providing timely information to the decision-maker and the public concerning the potential environmental consequences of proposed actions will improve the quality of federal decisions. The Council on Environmental Quality (CEQ) was established under NEPA to implement and oversee federal policy for this decision-making process. To this end, CEQ has issued "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act" (40 Code of Federal Regulations (1500-1508)). The CEQ regulations specify that an EA must be prepared to provide evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a FNSI for a proposed federal action. In addition, according to the CEQ regulation in 40 CFR (Code of Federal Regulations) 1500.2(c), NEPA requirements should be integrated "with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively." Based on this regulation, the EA is integrated into this document as Section 7.0.

1.4 INTERAGENCY COORDINATION AND REVIEW

Interagency participation is invited throughout the process of ESMP/EA development. Once the ESMP is drafted, the EA is used to inform decision-makers and the public of likely environmental and socioeconomic consequences of implementing the "no action" and proposed action alternatives. In addition, public participation in the NEPA process is encouraged to promote open communication and better decision-making. Agency review and comment and public participation in the development of the ESMP/EA are discussed below.

1.4.1 Agency Review and Comment

The responsible and interested parties described in Section 1.2 were provided with an opportunity to review and comment on the draft ESMP/EA completed in May 2004. Comments were addressed and incorporated into this final ESMP/EA document.

1.4.2 Public Participation

The public is notified of the findings and conclusions of the EA through an announcement in the local newspaper (Newark Star Ledger) and by making the ESMP/EA available for public review, by request, for 30 days at PICA before initiating the proposed action. See Appendix D for the FNSI for the implementation of this ESMP.

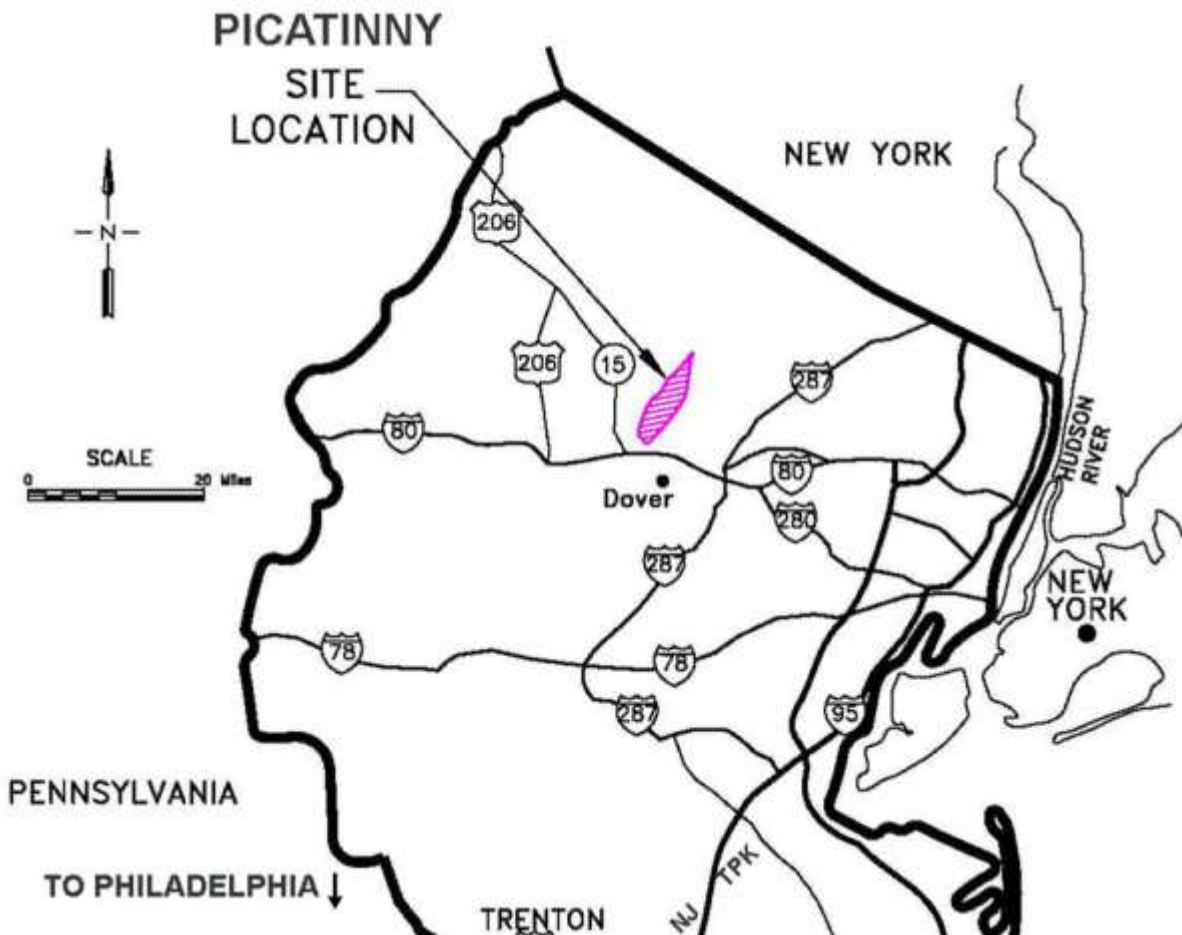
2.0 BACKGROUND INFORMATION

This section describes Picatinny’s location, military mission, and history; as well as the characteristic physiography, natural abiotic conditions, biotic resources, and human aspects and influences on the landscape that constitutes the affected environment addressed in this ESMP/EA.

2.1 PICA DESCRIPTION AND MILITARY MISSION

Picatinny Arsenal (aka Picatinny Garrison) is located near Dover, New Jersey in Morris County, and is 32 miles Northwest of Newark, NJ and 42 miles west of New York City (see Figure 1). The Delaware Water Gap is 45 miles west on Interstate-80. The installation is largely located in Rockaway Township. A small portion along the western ridge is located in Jefferson Township. The Arsenal is approximately seven miles long and one and a half miles wide covering an area of 5,850 acres. The Garrison (federal property) is under the jurisdictional responsibility of the U.S. Army Installation Management Agency, Northeast Regional Office (IMCOM-NERO). The Garrison is home to the Armament, Research, Development, and Engineering Center (ARDEC), which is part of the recently restructured Research, Development, and Engineering Command (RDECOM); as well as several other Department of Defense (DOD) tenant organizations and numerous private contractors. Military housing is provided on post for about 210 military personnel and dependents. The present workforce is approximately 4,200 including tenants and contractors.

FIGURE 1 INSTALLATION LOCATION



The installation encompasses a wide central valley (Picatinny Valley) which is approximately seven miles long and a narrower parallel intermontane valley (Green Pond Gorge) about two miles long. An easterly, as well as westerly ridge flanks both valleys. The total breadth across the installation averages 1 mile. Frequent outcroppings of bedrock occur.

About 80% of PICA property is classified as unimproved grounds, consisting mostly of lakes, ponds, brooks, other wetlands, and forests. About 70% of the land at PICA is forested. The scenic steep slopes of the adjacent hills surround most of the facilities dotting the valley floor. Most of the flat portions of PICA have been developed. About 20% of PICA property is classified as improved or semi-improved grounds. These areas include a private cemetery, roadsides, a golf course and urban style landscaping requiring recurring grounds maintenance and mowing. Refer to INRMP, Table 2.1, Picatinny Landscape Types and Acreage, for details.

The main man-made features on the installation are clusters of office buildings, lab and testing facilities, warehouses, support and service centers for military and employee's amenities, housing areas, and small outdoor live fire test ranges, as well as dispersed explosive storage bunkers. Many buildings or groups of structures are possibly eligible for listing as historic sites or districts under the National Historic Preservation Act (NHPA). Many buildings are concentrated within the cantonment; some such as housing are clustered in semi-improved areas, while most of the storage structures and test ranges are dispersed in undeveloped portions of the landscape.

The Arsenal officially dates from 1879 when Congress authorized the purchase of 1,875 acres of land in Morris County, New Jersey, for the establishment of a powder depot. Unofficially, the history dates from the days of the Revolutionary War when Picatinny, under private ownership, smelted iron that was further refined at the Mount Hope furnace to produce solid shot for the troops of General Washington's Continental Army.

Through the years, the Arsenal has come to be known as "the cradle of America's ammunition industry." Now Picatinny is known as a premier research center of firepower and lethality. The vision of ARDEC is to provide "America's advanced armaments for peace and war", through the integration of complex cutting edge technologies into guns, ammunition, and fire control methods from concept to acquisition and sustainment of weapons systems.

Although the Installation Commander oversees all activities, especially the research and development mission, the daily operations and maintenance functions are the full time responsibility of the Garrison Commander (IMCOM). Picatinny is considered a "restricted access installation", not open to the general public.

2.2 AFFECTED ENVIRONMENT

Through the Directorate of Public Works the stewardship mission encompassing 5850 acres of Garrison land and water resources are managed with habitat conservation and environmental issues in mind. The natural landscape features and forces, as well as the human activities and influences of PICA that comprise the affected environment are described below.

2.2.1 Regional Physiography and Setting

Highlands Ecosystem

Picatiny Arsenal is located in the New Jersey Highlands of northern New Jersey, a portion of the Reading Prong of the New England Physiographic Province, in a region known as the Green Pond Syncline. The New York-New Jersey Highlands are characterized by northeast-southwest trending ridges separated by long, wide valleys and consist of broad mountain ranges separated by deep valleys that are between 400 to 600 feet (ft) below the ridge crests. For general discussions of orientation or aspects, the ridges and valley(s) will be construed as running north and south.

New Jersey's geology harbors, filters, and conveys much of the water used in the Highlands Region. Half of the quantity used by man flows and collects as surface water in the watersheds. Water is a major component of the Picatiny landscape, evidenced by 2 large lakes, 18 ponds, 4 perennial brooks, several intermittent runs, 3 freshet waterfalls, and a few springs and seeps.

The installation is also centrally situated within the Farney Highlands watershed, which comprises five sub-watersheds located in northern Morris County. The Arsenal constitutes a major portion of one of these sub-watersheds; namely Water Management Area #6, which serves as the primary water supply for northern New Jersey. Although the Arsenal is the largest tract of public land within this watershed, public access is not permitted for safety and security reasons.

Roughly 50% of the Highlands Region (about 500,000 acres), including all of Picatiny, harbors substantial populations of fish and wildlife. Nearly 6000 acres of all public lands surrounding PICA are in fact contiguous with installation boundaries, facilitating fish and wildlife movements and connectivity. Since wildlife often depends on relatively large contiguous areas of habitat to survive or thrive, Picatiny and the many open space public parcels surrounding the installation promote connectivity rather than fragmentation or isolation of habitat. Conserving not only the Army property, but also the natural lands surrounding PICA protects the Garrison and its mission from elements of encroachment, since suburban sprawl is occurring at a steady pace east and south.

Land use is predominantly rural, west and north; yet suburban, east and south of PICA. A mix of hills and forested riparian corridors characterizes the landscape to the north and east and west.

Natural Resources Support Military Mission

Being located in a long valley with relatively steep sidewalls, the vast acreage of the installation provides a safety buffer for the surrounding neighbors from armament testing and associated noise. It also provides a security zone for the various research and testing facilities located on the federal property. In the main, except in those specific areas where facilities and roads have been located and constructed, the mission does not directly affect natural resources; rather this insulating type topography is advantageous to the current mission activities.

Natural Heritage Priority Site

A 1994 study of state and federal threatened and endangered (T&E) species mapped the natural vegetative communities in the region including the Arsenal. In conjunction with that study, the state established priority protection areas. One such area was the Green Pond Macro Site, which identifies areas important for rare plants, insects, birds, and animals, especially those associated with Denmark and Picatiny Lakes. This site includes part of the northern portion of Picatiny. Expanding the geographic boundaries of this Macro Site to include most of the eastern half of the Arsenal is justified by the recent documentation of the federally

endangered IBAT, as well as state endangered Bobcat. The Natural Heritage Priority Sites are identified as critically important natural areas for conserving and preserving New Jersey's biodiversity.

Climate

Northern New Jersey is characterized by a temperate, continental climate with warm summers and cold winters. The coldest month tends to be January and the hottest, July. Thunderstorms account for most of the summer rain. Snow cover can range from October through mid-April. The period from leaf-emergence to leaf-off typically spans from early-May through early-November. Seasonal last and first killing frosts occur in the beginning of May and October respectively. Detailed information on temperatures and precipitation can be found in the INRMP.

Currently, the State of New Jersey is in non-attainment of the standard for ozone. No monitoring stations operate in the vicinity of Rockaway Township, but all pollutants, with the exception of ozone, are presumed to be within the applicable standards because the air quality of Rockaway Township is classified as "better than national standards" (Lev Zetlin Associates 1992).

2.2.2 Picatinny Landscape and Natural Resources

Figure 2 depicts major geographic features of Picatinny Arsenal.

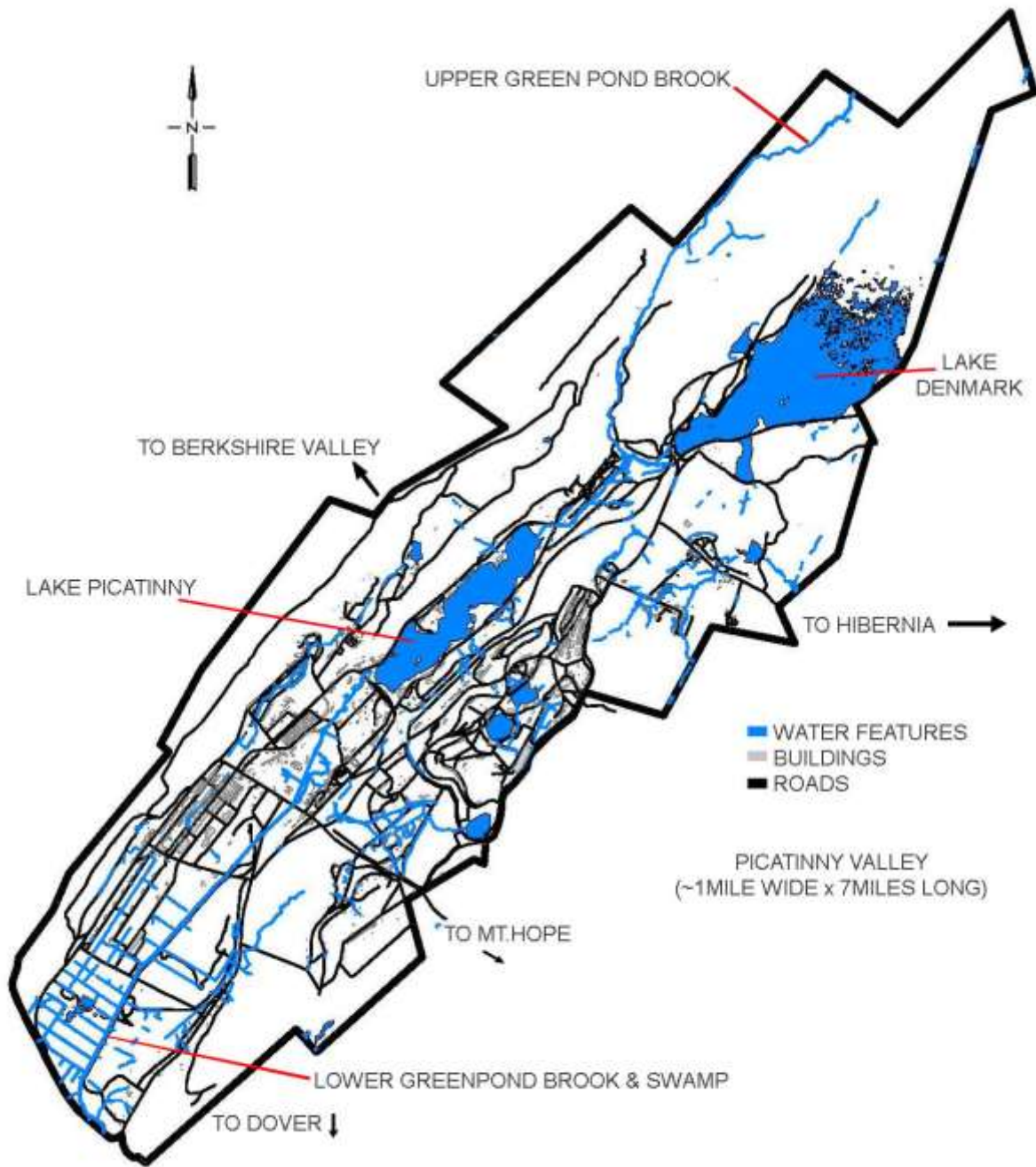
Topography and Relief

Elevations at PICA range from near 685 ft to over 1,287 ft National Geodetic Vertical Datum (NGVD). Elevations are generally lower to the south and east of the installation and higher to the north and west. The maximum elevations at the Arsenal occur on the westerly ridge known as Green Pond Mountain with summits ranging from 800-1,287 ft NGVD. The southern region of Copperas Mountain (1,220 ft) extends into the northern portions of the Arsenal and separates the Denmark Lake Basin to the east from the higher elevated Green Pond Brook Basin to the west. The easterly portion of the Arsenal is composed of knobs with summits ranging from 860 ft to 1,066 ft NGVD. Local relief rises between 150 and 250 ft above Picatinny Valley.

Soils

The soils at PICA are acidic and primarily derived from glacial deposits. The central portion of PICA has soils that consist of loamy, silty, and gravel clay pan soils, along with swampy areas, which have peat and muck. There are seven hydric soil types classified on Picatinny and three other types occur with hydric inclusions. To the northwest there exists a mountain range (Green Pond Mtn) with rough, stony land that formed on jagged, rocky slopes. Glacial till blankets the western and eastern flanks of the Arsenal. The southern end of the Arsenal consists of poorly sorted sands, gravels, and boulders bordered by a terminal moraine (WES-USACE 1995). The 26 recognized soil types on the installation are described in detail in the INRMP.

FIGURE 2 INSTALLATION LAYOUT AND GEOGRAPHY



Watersheds

The Arsenal comprises five main drainages:

- Green Pond Basin (Shrub Wetlands and Gorge; headwaters of Green Pond Brook).
- Denmark Lake Basin (Shrub Wetlands; headwaters of Burnt Meadow Brook).
- Middle Green Pond Brook and Picatinny Lake.
- Lower Green Pond Brook.
- Beaver Brook Sub-watershed. Ames Brook carries headwaters off of 250 acres of the eastern edge of the installation downstream into Beaver Brook.

All drainages at PICA empty into the Rockaway River south and east of the installation. The New Jersey Department of Environmental Protection (NJDEP) recognizes the Rockaway River as a high quality waterway.

Surface Waters

The surface water flow regime at PICA consists of numerous streams, ponds, lakes, reservoirs, and wetlands. There are about 620 acres of lakes, ponds, and their associated scrub-shrub wetlands on the installation. All lotic corridors comprise 24 miles on post. Water from Green Pond Brook, as well as Denmark Lake, discharge southerly through the Picatinny Valley (7 miles), including Picatinny Lake near the center of the installation.

The installation has two large lakes, Denmark Lake (174 acres) and Picatinny Lake (108 acres). Denmark Lake is located in the northeastern sector of the Arsenal. Historically, both of these lakes have been used as sources of industrial water, and as recreational areas. Green Pond Brook, from its origin to Picatinny Lake has been classified by the NJDEP as “trout production waters” -- those waters used by trout for spawning or nursery purposes during their first summer. Picatinny Lake has been classified by the NJDEP as non-trout waters (*State Water Classification and Trout Designation (Chap 7: 9B-1.15 NJAC)*).

Floodplains

The Green Pond Brook floodplain (100 year) is located in the southern half of the Picatinny Valley and has been highly disturbed by installation activities.

Wetlands

PICA contains approximately 1,250 acres of wetlands (WES-USACE 1995). These wetlands are primarily composed of muck and peat formed in poorly drained glacial soils. Excepting the open waters of lakes and ponds, the palustrine wetlands are nearly all red maple forests or scrub-shrublands. Wetlands distributed and scattered throughout the installation are very valuable to wildlife and serve as important ground water recharge sites. The largest tract of Red Maple swamp is near the southern end of the installation. Refer to INRMP, Table 6.2 Picatinny Wetland Types for more detailed information.

Ground Water, Surface Water, and Controls

Ground water movement at PICA is in response to hydraulic gradients. In Morris County, the direction and magnitude of the natural gradients mimic the local topographic profile except that the water table profile has less relief. Ground water is discharged directly to the streams wherever they intersect the water table and supports stream flow during periods of no precipitation. Ground water flow is primarily horizontal and upward in both the unconfined and confined glacial aquifers and discharges into Green Pond Brook. Picatinny’s ground water resides in the Upper Rockaway Aquifer and is a designated sole source aquifer.

Groundwater contamination has been identified at PICA in a number of areas. Past metal-plating operations and effluent from etching and plating processes have contaminated groundwater resources according to groundwater sampling and analysis conducted at PICA. Additional testing is still being conducted. Several New Jersey regulations have been adopted to preserve and maintain a high water quality standard for both ground water and surface water. Picatinny strives to maintain those standards and to remediate where necessary.

Storm Drainage

Due to the steep slopes, particularly on the northwestern side of the valley, runoff speeds tend to be high. Control structures at three dams and an extensive network of surface and subsurface conduits and culverts, especially in the low-lying areas of the valley, control storm water drainage.

Flora

PICA contains terrestrial and aquatic macrophytic species consisting of at least 630 species of flowering plants and 90 species of non-flowering plants (PICA 2001). Given the numerous wetlands on post, aquatic plant life is abundant and diverse. The most common types of terrestrial plant life include: upland forest/woodland type characterized by a close stand of trees in a natural area; transitional forest/woodland consisting primarily of native trees located in a forest or woodland stand; transitional urban/industrial vegetation, characterized by indigenous and exotic plants mixed with ornamental vegetation; and urban/industrial vegetation consisting of turfgrass, associated forbs with a predominance of ornamental herbaceous and woody plants.

Grasslands

There are no major grassland areas within the installation other than the mowed portions of the cantonment area and golf course.

Forest Types

The installation is approximately 70% forested and is representative of the forest types of the Highlands Region (Leck 1975). The woodlands have been categorized into two major groups: Palustrine Forests and Upland Forests. Palustrine forests are commonly referred to as swamps or riparian corridors and are associated with wetlands. The Palustrine forests are further subdivided into forests and shrublands. Upland forests are defined as those vegetative communities that comprise terrain lacking soils and the hydrology characteristic of wetlands. Table 1 lists Picatinny Forest Types and acreages.

Palustrine Shrublands

The shrublands are associated with the wetlands near Denmark Lake and the Green Pond Basin. The principle species of these palustrine shrublands, based on abundance, are: Smooth Alder (*Alnus serrulata*), swamp azalea (*Rhododendron viscosum*), maleberry (*Lyonia alnifolia*), high bush blueberry (*Vaccinium corymbosum*), swamp loosestrife (*Decodon verticillatus*) buttonbush (*Cephalanthus occidentalis*), meadowsweet (*Spiraea latifolia*), and swamp rose (*Rosa palustris*).

Palustrine Forests

The dominant tree species comprising the Palustrine forests are red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), and eastern hemlock (*Tsuga canadensis*). The understory is chiefly comprised of spicebush (*Lindera benzoin*) and arrowwood (*Viburnum spp.*).

The red maple forest type consists of almost pure red maple. Most of these stands are situated on the very moist or saturated soils. Some stands are located on organic soils—muck. Common associates of the red maple forest type include sugar maple, black gum (*Nyssa sylvatica*), elm (*Ulmus spp.*), and black birch (*Betula lenta*) (Chambers 1983). The red maple forest type located on moist soils at the installation is considered climax forest. Approximately 13% of installation's woodlands consist of this type.

Upland Forests

The upland forests of the installation are mostly mixed oak and northern hardwood. These stands are in second-growth stages having been logged historically. The mixed oak type is the most widespread and prevalent forest type on the installation. At present, most of these stands are in the pole-sized stage. This type covers 2,656 acres and represents 65% of the total forested area. Oak species in these stands consist primarily of chestnut oak (*Quercus montana*), red oak (*Quercus rubra*), white oak (*Quercus alba*), black oak (*Quercus velutina*), and scarlet oak (*Quercus coccinea*). Species composition in these stands varies with elevation, available soil moisture, site quality, and past management and stand origin. As a general rule, stands at the lower elevations are dominated by species of the red oak group, while chestnut oak dominates the poor sites near the ridge tops.

The northern hardwood forest type comprising 545 acres represents 13% of the total forested area. This forest type varies widely in species composition and can include upward of 20 species of trees; the single species common to all stands is sugar maple (Nyland *et al.* 1981). Other representatives in the canopy that may have occasional co-dominance are pignut hickory (*Carya glabra*), white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*), white oak, tulip tree (*Liriodendron tulipifera*), yellow birch, black birch, red maple, basswood (*Tilia americana*), black cherry (*Prunus serotina*), and hemlock (Nyland *et al.* 1981). Most northern hardwood stands are located in the Picatinny Valley and the eastern ridge of the installation.

Representative understory shrub species include mountain laurel (*Kalmia latifolia*), great rhododendron (*Rhododendron maximum*), maple-leafed viburnum (*Viburnum acerifolium*), witchhazel (*Hamamelis virginiana*), deerberry (*Vaccinium stamineum*), black huckleberry (*Gaylussacia baccata*), early low blueberry (*Vaccinium pallidum*), and spicebush.

The hemlock forest type is the only coniferous forest type located on the installation, except for some small pine clusters in the developed portion of the Arsenal. The hemlock type is found on 323 acres and represents 8% of the total forested area. Although the amount of hemlock forest type is low on the installation, it is of

great concern that a majority of the hemlock is dead or dying. The hemlock woolly adelgid (*Adelges tsugae*) and the elongated hemlock scale (*Fiorinia externa*) are killing hemlock throughout the Highlands Region. Hemlock is located mostly in uniform stands on the western boundary of the installation and at one location in the valley. Several hardwood stands on the installation have a hemlock understory. Whether or not these dead trees can or will be utilized by tree roosting bats (including IBATS) is yet to be determined.

TABLE 1 PICATINNY FOREST TYPES AND ACREAGE

Forest Type	Number of Stands	Acreage	% Total Forest Land
Mixed Oak	99	2,656	65%
Northern Hardwood	41	545	13%
Hemlock	7	322	8%
Red and White Pine	6	8	<1%
Red Maple* b/m	64	532	13%
Aspen/Gray Birch*	8	18	<1%
Hemlock (wet)*	(2)	1	<1%
TOTAL	225	4082	100%

* Palustrine Forest wetland cover type b/m includes Yellow Birch/Red Maple cover type

Source: (PICA 2001)

Significance Of Forest Holdings

Nearly 4,100 acres of forested land on the installation provide a safety barrier to the surrounding community. Additionally, the Army holds restrictive easements for 640 acres of private lands adjoining the Arsenal as safety buffers to ongoing operations and testing. In that these easements are on private property, timber activities are at the discretion of the landowner.

The forest holdings of PICA, due to extent, acreage and connection to other public lands are unique within the Highlands Region. The remainder of Highland Region’s forests is 75% privately owned and mostly in small lots. Over 85% of the Highlands tracts are less than 19 acres; 70% are tracts less than 9 acres. The Picatinny forested acreage (4,082 acres) is unique to the Highlands. The public lands adjoining or in proximity to the Arsenal provides significant forest area and green belt corridors in the New Jersey Highlands.

Fauna

Fauna present within PICA includes a wide variety of mammals, birds, reptiles, amphibians, fish, and insects, typical of the Northeastern U.S. Faunal diversity on the installation is better than average for North Central New Jersey. To date, 315 species of vertebrates are known to occur on the Arsenal. The large number of vertebrate species occurring on the Arsenal is in large part due to the diverse array of habitats present on the installation which includes dry forested ridge tops, talus slopes, bottomland hardwoods, mesophytic hardwoods, conifer stands, a few old fields, riparian corridors, wetlands, shrub stands, brooks, ponds, and lakes.

Invertebrates

Invertebrates are abundant although largely unknown and unidentified. Only the most commonly observed invertebrates – dragonflies, damselflies, butterflies and moths (Odonata and Lepidoptera) have been fairly well documented on the installation, as well as those associated with recurring pest control operations or periodic forest pest outbreaks. Some limited sampling of Plecopterans and Trichopterans has occurred as part of CERCLA ecological risk studies on post. It is apparent however that species diversity among these classes of animals is similar to that among the higher forms. The insect prey base for foraging bats is abundant and diverse at Picatinny.

Mammals

Mammals observed and occurring on post include bear, bobcat, coyote, white-tailed deer; raccoon, eastern cottontail rabbit, opossum, striped skunk, eastern gray squirrel, red squirrel, gray fox, red fox, woodchuck; muskrat and beaver; moles and shrews, mice and voles.

Bats

Bats represent approximately 20% of the potential mammalian fauna on the installation, which is similar to most mammalian communities of temperate zone terrestrial regions (Eisenberg 1981). Nine species of bats, all in the super family Vespertilinidae, all small-bodied insectivores, have ranges that include northwestern New Jersey (Humphrey 1982). Seven of these (including the IBAT) have been documented on the installation. Dozens of Eastern Pipistrels (*Pipistrellus subflavus*) were observed in an abandoned mine shaft, just off post, in January 1994 by the NRM. These bats probably forage on post during the summer months. One warehouse on post, building 3236, is used as a summer colony by thousands of Little Brown Bats (*Myotis lucifugus*).

Birds

208 species of birds are known to occur on the installation. They include permanent residents, summer breeders, winter residents, and migrants that only pass through during the spring and fall. About 47% are transient migrants. Of the 103 species inhabiting the Arsenal during the breeding season, 65 are confirmed breeders and 15 are probable breeders.

Indigenous upland game birds as well as waterfowl offer opportunities for hunters on post, although stocked pheasant is the prime quarry for most bird gunners.

Since 2000, dead birds suspected of having succumbed to West Nile Virus (WNV) have been noted. In 2003, U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) established a protocol for collection and testing of dead birds on Army installations as a program for sentinel monitoring of the WNV on or near Army bases.

Fish

There are 25 species known to occur on the installation, including nongame and forage types. Warm water species include largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), yellow perch (*Perca flavescens*), crappie (*Pomoxis spp*), and sunfish (*Lepomis spp.*). A self-sustaining population of native brook trout (*Salvalinus fontinalis*) occurs in the upper reaches of Green Pond Brook known as the Gorge. Other sections of Green Pond Brook and some ponds are suitable for stocking cool water species such as rainbow or brown trout (*Salmo gairdneri* or *trutta*).

Amphibians and Reptiles

Reptiles and amphibians observed and occurring on post include red spotted newt, green frog, bullfrog, American toad, and eastern painted turtle, snapping turtle, garter snake, and black rat snake. Two venomous snakes reside on the installation: northern copperhead is common, whereas the timber rattlesnake is rarely sighted.

2.2.3 Picatinny Human Environment

Cultural and Historic Resources

PICA contains archaeological remains of prehistoric Native American site activities and historic settlement and industries, as well as significant architectural properties related to its use as a powder depot, arsenal, and weapons and rocket testing facility. The history of Picatinny and the function and significance of the structures on the property have been well documented. A draft form was prepared to list these properties as a Multiple Resource Area on the National Register of Historic Places (NRHP), but registration was not finalized (Nolte and Steinback 1998b). At this time, there are no individual buildings or districts at PICA listed in the NRHP. However, all identified eligible buildings must be treated as if they may yet be placed on the Register until any proposed action determines its final disposition.

In contrast to the historic architectural properties, no inventory of archaeological resources has been undertaken across the entire installation, although nine historic archaeological sites have been identified within PICA (Fitch and Glover 1990; Rutsch *et al.* 1986).

A Phase I archaeological survey was undertaken in 1998 to evaluate and refine existing sensitivity models and resulted in the first well-documented prehistoric sites within the boundaries of PICA. The Phase I survey, lead to the identification of 11 prehistoric and two historic archaeological sites. The prehistoric sites are typically lithic scatters with few tools and no temporally diagnostic artifacts. The historic archaeological sites consisted of domestic refuse with no apparent structural features. As a result of the study, seven of the 53 former Sensitivity Areas were considered to have low archaeological potential based on the degree of soil disturbed or having slopes greater than 15%; the remaining 46 Sensitivity Areas are still considered to have some potential to contain intact cultural resources (Schieppati *et al.* 1998).

Public Utilities and Services

“Select Energy” furnishes electricity to PICA under a contract issued by the Defense Energy Support Center. The commodity is wheeled through the service territory of the local electric franchisee, Jersey Central Power & Light (JCP&L), and enters the through two (2) separate 34.5KV transmission lines. The entry point for one transmission line is at the southwest corner of the near the truck gate and the other entry point is at the east side of the near the Mt. Hope gate. The electrical power distribution system on the Arsenal itself is owned and operated by Sussex Rural Electric Cooperative (SREC).

Air Quality

Except for ozone, air quality over PICA is acceptable by existing standards.

Ambient Noise

The ambient noise environment varies greatly at PICA. It is relatively quiet along the lakeside recreation areas, noisy near the main gate, due to vehicular traffic, and loud during weapons testing. During the evening and nighttime hours, when activity and commuting are at a minimum, the noise levels are minimal.

Hazardous Waste Management

Picatinny Arsenal receives, produces, and stores hazardous materials during the course of daily operations and activities. The materials used include solvents, cleaning materials, pesticides, herbicides, fuels, oils, lubricants, and explosives. The total amount of hazardous wastes manifested by PICA is in excess of 100 tons per year.

Picatinny must abide by numerous federal and state laws and regulations designed to protect both workers and the general public from hazardous waste spills or accidents. Safety training for personnel working with hazardous materials is required, and the installation provides trained spill response teams in the event of accidents. The Installation Spill Contingency Plan also identifies outside emergency resources, such as local community fire, police, and medical centers, and notification procedures to be used in the event of spill emergencies.

Existing Contaminated Areas

Picatinny Arsenal is a National Priority List (NPL) site, as designated by the U.S. Environmental Protection Agency. Those sites with the highest relative risk to public health and the environment from substances in ground water, surface water, air, or soil are placed on the NPL. The Installation Restoration Program (IRP) is a DOD program to identify, characterize, and remediate environmental contamination on military installations. The IRP is a component of the Defense Environmental Restoration Program, which outlines restoration objectives.

A Remedial Investigation/Feasibility Study (RI/FS) has been prepared to identify appropriate restoration areas. The RI shows the areas of risks identified, whereas the FS addresses the alternatives available for the cleaning up of the site. There are 175 Remedial Investigation sites at Picatinny, which have been identified by personnel from PICA, the Army Environmental Command (AEC), and the Argonne National Laboratory. The investigative approach suggested by the RI Concept Plan was to break the 175 sites in 16 different RI Concept Areas and divide the areas into three different Phases (Phase I, II, and III). All RIs have been initiated and ecological and human health risk assessments have been performed on the Phase I and II related sites. The Phase III Risk Assessment is scheduled for FY 04.

Interface between the Picatinny's Natural Resource Program and all related requirements and the IRP are coordinated with the Picatinny's Natural Resource Manager (NRM) as appropriate and/or directly with USFWS. Activities can include the following:

- Planning and scoping of ecological risk assessments and other investigative activities. Ecological assessment plans and reports are reviewed by the technical staff of the USFWS as either part of the U.S. Environmental Protection Agency (EPA) Biological Technical Assistance Group or directly through the USFWS office. (i.e. the Phase II ecological risk assessment included evaluating the effect of contamination in caddisflies to the IBAT. The subsequent report was reviewed by the USFWS.)
- Re-vegetating excavated areas.
- Prohibition and/or coordination of cutting of trees in regard to the IBAT. This is coordinated with NRM.
- Assurance that the action meets all Natural Resources criteria in the Applicable or Relevant and Appropriate Requirements (ARAR) section of the feasibility study or in the remedial design of projects. Documents are sent for review to the USFWS, EPA and NJDEP. Coordination is required with the NRM

An update and more comprehensive description of the current IRP can be found in the Installation Action Plan (IAP) that is updated every year. The most-recent IAP is called *FY05 as of December 2003*.

Petroleum and Minerals

The installation does not have any extractable minerals. There are no known abandoned mines or cave formations on post.

3.0 SPECIES INFORMATION

This section provides an overview of what is currently known about the biological and ecological information on the IBAT: distinguishing physical characteristics; range and distribution; life history and behavior; summer and winter habitat requirements; as well as reasons for its decline, and conservation measures taken by various agencies and organizations. In general, additional study is needed to further delineate this species distribution, as well as to further define its summer habitat requirements and the reasons for its decline. A summary of the IBAT's current status at PICA is also presented.

3.1 PHYSICAL DESCRIPTION

The IBAT is a small, brownish bat with blackish wings (Kurta 1995). Dorsally, its fur is usually dull, dark pinkish-brown. Ventrally, the fur is slate-colored basally; has grayish-white tips; and is washed heavily with cinnamon brown, particularly at the flanks. The IBAT is similar in appearance to the Little Brown Bat (*Myotis lucifugus*) and the Northern Long-Eared Bat (*Myotis septentrionalis*). The IBAT can be distinguished from these two species based on the following characteristics: (1) the IBAT has smaller feet and shorter hairs on its toes (the hairs do not extend beyond the toenails) and (2) the IBAT has a distinct keel on the calcar, a spur on the membrane between the foot and the tail (Mumford and Whitaker 1982; Whitaker and Hamilton 1998). IBATs Head and Body measure from 1 to 1 $\frac{7}{8}$ inches (41- 49 millimeters (mm)); Forearm lengths tend to measure 1 $\frac{3}{8}$ to 1 $\frac{5}{8}$ inches (35–41 mm) (USFWS 1999). Male and female Head to Tail (total length) ranges from 3 to 3 $\frac{5}{8}$ inches (76–94 mm) and wingspans are typically 9 $\frac{1}{2}$ to 10 $\frac{1}{2}$ inches (240 to 267 mm). The average weight of a female is 7.4 grams (g); males are slightly smaller and average 7.1 g (Thomson 1982). The range for weights is between 0.18 to 0.28 ounces (5.1–7.9 g) (Tarr 1999).

3.2 DISTRIBUTION AND RANGE

The IBAT is a migratory species found throughout much of the eastern half of the United States. Figure 3 presents the range of the IBAT over its winter and summer habitat. The IBAT winters in at least 336 known hibernacula – caves, mines, tunnels, and even a hydroelectric dam, in 26 different states (Clawson 2002). Hibernacula (aka winter roosts) are mainly caves. Hibernacula have been ranked (Priority 1, 2, or 3) on the basis of the numbers of IBATs using these overwintering sites. Priority 1 (P1) hibernacula contain over $\geq 30,000$ IBATs (USFWS 1983); Priority 2 (P2) hibernacula contain at least =500 and up to <30,000 IBATs (USFWS 1999); and Priority 3 (P3) hibernacula contain less than <500 IBATs (USFWS 1983, Clawson 2002).

The main breeding and hibernating areas for the IBAT appear to be associated with the major cavernous areas in the Midwest and Eastern United States. Indiana has more IBATs than any other state (Johnson *et al.* 2002, Brack *et al.* 2002). In winter, large populations of IBATs hibernate in Indiana, Kentucky, and Missouri, which are the only three states with P1 hibernacula (8 total). More than 95% of the IBAT population hibernates in 15 caves; six of the caves are in Missouri, and the remaining nine are in the Eastern United States (Whitaker and Hamilton 1998). Eleven states have P2 hibernacula (5 in the southern part of range and 6 in northern region). As of February 2004, New Jersey should be added as the 12th state with a recently documented P2 hibernaculum (comprising 7 in the north region of IBAT range). All 26 states have P3 hibernacula (Clawson 2002). Smaller hibernating populations and individual IBATs have been reported in many other states as reflected in Table 2. Two IBAT hibernacula closest to PICA are vertical shafts of the Mount Hope Mine(s) in Morris County, NJ. These mine shafts are just outside the Mt. Hope gate (0.25 mile) east of PICA and will be referred to herein as MHW-shaft and MHE-shaft (Scherer *pers.comm.* 1997, Craddock *pers.comm.* 2004, 2006).

There are records of reproductively active individuals from 132 counties, and 82% of these occur outside counties containing hibernation sites (Gardner and Cook 2002). IBATs have a patchy distribution across their range (USFWS 1999).

**FIGURE 3 DISTRIBUTION OF THE IBAT
(WINTER AND SUMMER RANGES COMBINED)**

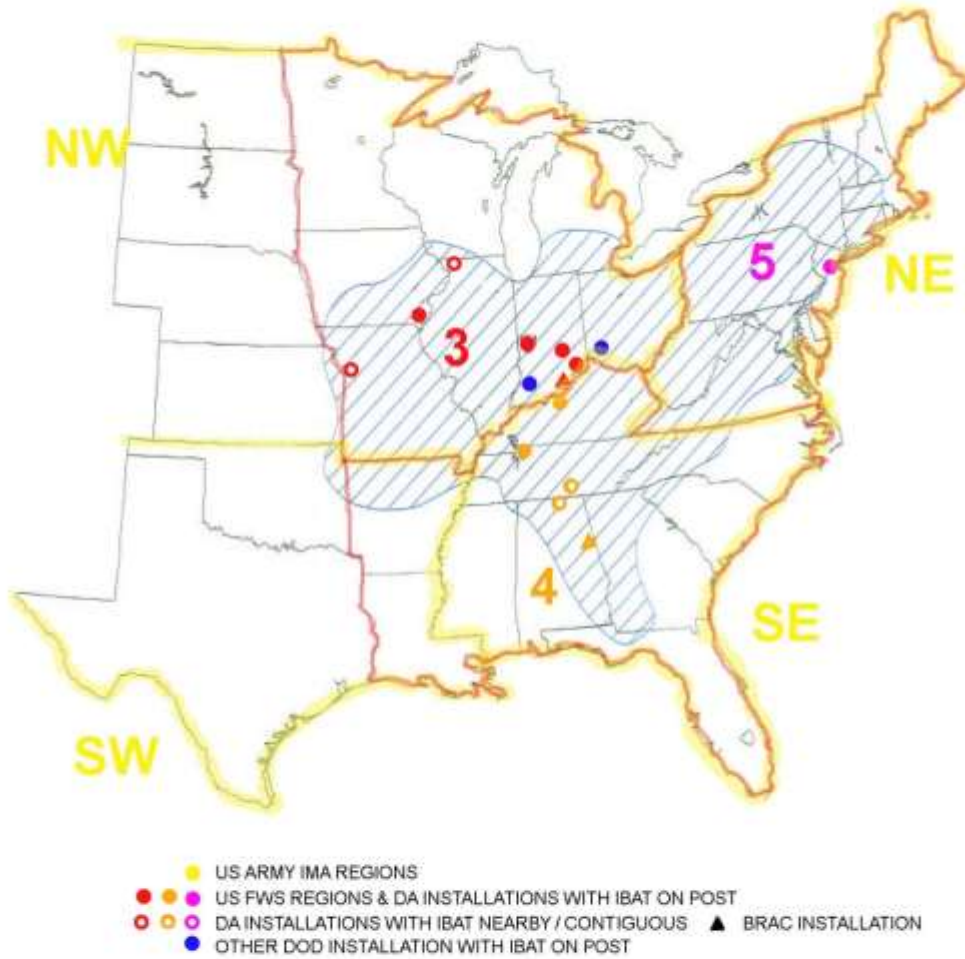


TABLE 2 IBAT OCCURRENCES and ESTIMATED POPULATIONS

N.B. Nearly all IBAT population estimates are based on winter (hibernacula) counts.

* = All monitored hibernacula in a state.

‡ = These are the “monitored hibernacula” for which clusters of IBATs can actually be observed and counted (or numbers present otherwise ascertained). Other hibernacula can exist and be known, yet remain inaccessible to surveillance. Conversely, some of these winter roosts can become inaccessible or altered adversely. The number of these hibernacula and their monitoring is not consistent over time.

+ = Records of isolated individuals or minimal occurrences during summer season.

STATES (Regions)	IBAT OCCURRENCES (Types)				POPULATION ESTIMATES
	No. of Counties ^b	Summer	Winter	No.* of Hibernacula‡	Hibernacula* counts 1999-2001
(NORTHERN)					
WI	1		✓	1	<100
IA	16	✓	✓	2	<100
IL	33	✓	✓	14	19,300
IN	51	✓	✓	32	173,100
MI	13	✓	✓	1	<100
OH	23	✓	✓	5	9,800
WV	7	✓	✓	8 (25 ^c)	9,700
MD	2		✓	2	<100
(NORTHEAST) See also TABLE 4					
PA	3 (4)	✓		3 (5 ^c)	700
NJ	1	✓ +	✓	1 (3)	<100
NY	6	✓	✓	6 (9 ^c)	34,000
CT	1		✓	1	<100
MA	1		✓	1	<100
VT	4	✓ +	✓	5	<100
NH	1	✓ ?			N/A
(SOUTHERN)					
OK	4		✓	4	<100
MO	37	✓	✓	67	73,000
AR	13	✓ +	✓	19	2,500
KY	44	✓	✓	96	47,900
TN	15	✓	✓	14	10,200
MS	1		✓	1	<100
AL	6	✓	✓	13	250
GA	1		✓	2	<100
FL	1		✓	1	<100
VA	5	✓	✓	5 (11 ^c)	1,000
NC	5	✓	✓	3	<100
SC	1		✓	1	<100
TOTALS					
27	296 (311 ^d)	17states	25states	308‡ (336 ^c)	≈383, 000 ^c

Adapted from: (USFWS 1983) (USFWS 2000)^b (Clawson 2002)^c (Gardner and Cook 2002)^d (Scherer *pers.comm.* 2004).

3.3 LIFE HISTORY

Longevity

Females can live at least 15 years, and males live at least 14 years (Humphrey *et al.* 1977). Banded Little Brown Bats in Hibernia Mine, in Morris County, NJ, document a span exceeding 20 years for that species (Valent and Dutko 1994).

Life Cycle

IBATs migrate between winter and summer habitats. Extensive banding by Hall (1962) and others supported the concept that a north-south seasonal migration is typical (Gardner and Cook 2002), although recent information from telemetry studies in Pennsylvania and New York has shown IBATs dispersing in easterly and southerly directions as well. In the winter, they hibernate in caves (or mines). They enter the caves during the early fall and continue to forage each night (Evans *et al.* 1998). In the winter, when hibernating, IBATs form large, dense clusters of individuals, although in some states, including NJ, IBATs in small groups and individually may cluster with large numbers of little brown bats. In March and early April, the wintering colonies disperse and migrate to areas where they forage throughout the summer.

Females emerge from hibernation ahead of males. Some males migrate with or after females and co-locate in the same areas as females (but not the same roosts); whereas some males remain near their hibernacula, or even use a cave or mine as a summer roost also. Males tend to roost individually or in small groups during the summer (USFWS 1999, Harvey *et al.* 1999). The nursery colonies of IBATs consist primarily of females and their offspring, and they may be located over 200 miles away from the hibernacula (Tarr 1999).

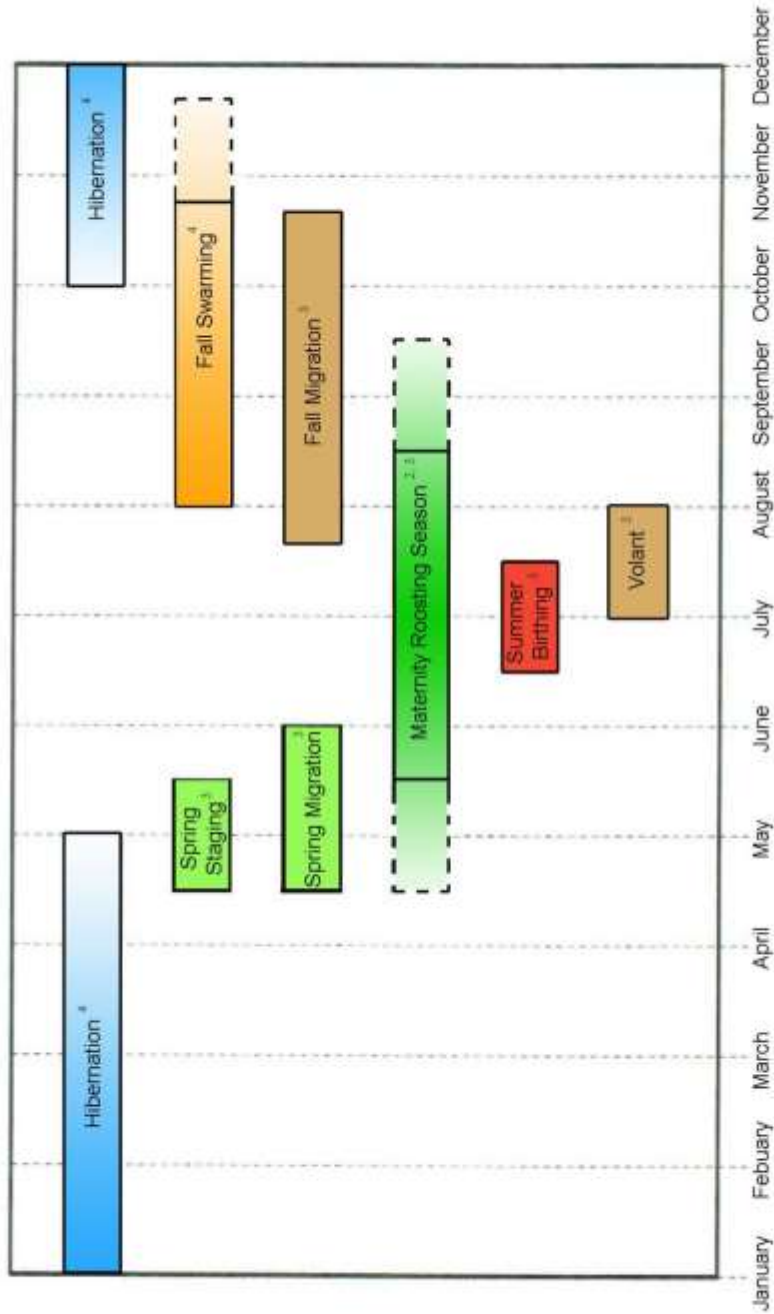
The IBAT annually repeats a cycle of six life history events:

- Spring “staging” period upon its emergence from hibernation,
- Spring migration,
- Summer birthing and rearing, (aka maternity season)
- Fall migration,
- Fall “swarming” prior to hibernation, and
- Winter hibernation.

Along with the IBAT’s foraging habits, these events are described below and are illustrated in Figure 4.

N.B. This information is generalized from observations primarily in the heart of the natural range. Patterns and dates may vary at the periphery of its range in the Northeastern U.S. (and New Jersey).

FIGURE 4 LIFE CYCLE OF THE IBAT ¹



Notes:

- 1 The Indiana Bat life cycle is estimated based on information available in literature.
- 2 This represents the Indiana Bat maternity roosting season as defined by USFWS (Tetra Tech 1999d, USFWS 2000)
- 3 Indiana Bat life cycle events likely to occur at PICA
- 4 Indiana Bat life cycle events likely to occur adjacent / near PICA

Spring Staging (aka Post-Hibernation Foraging)

The IBAT emerges from hibernation from late March to early May, depending on climatic conditions. The bats awake from torpor and stage at the hibernation site in spring before migrating to summer habitats. During the staging period, the bats begin their feeding forays, and some copulation may also occur (Whitaker and Hamilton 1998); although most fertilization is via sperm stored from the previous fall. Gestation period is 49-56 days. Female IBATs enter the staging period in late March to mid-April while most males remain in hibernation. Most females leave the hibernacula and begin migration by early May; most males leave the hibernacula by mid-May (Cope and Humphrey 1977). It is unclear how many non-reproductive females (or males) might migrate long distances with the pregnant females or stay relatively close to local hibernacula along with resident males (c.f. Section 3.7.3, Other Relevant Studies)?

Spring Migration to Summer Range and Roosts, Birthing and Rearing

Spring migration is generally northward, with the bats flying up to several hundred kilometers (Whitaker and Hamilton 1998) although recent information from telemetry studies in Pennsylvania and New York has shown IBATs dispersing in easterly and southerly directions as well. Maximum distance traveled based on banding returns is 300 miles. Pregnant females segregate from males in the summer, forming small maternity colonies at roosting sites (Humphrey *et al.* 1977). Males and nonbreeding females roost individually or form smaller colonies apart from pregnant females (Whitaker and Hamilton 1998). Unfortunately, it is not known whether some reproductively active females remain near their winter sites in summer, or if some summer records in counties with winter roosts represent females that migrated back to the vicinity of their hibernacula earlier than usual. The post-lactating female captured in July 1995 at PICA represents this enigma here in NJ.

Because IBATs exhibit strong site fidelity to their summer roosting and foraging habitat, traditional summer sites are essential to the reproductive success of local populations (Humphrey *et al.* 1977). In general, the core maternity roosting season occurs between May 15 and August 15; although some IBATs could be arriving on summer range as early as April 15 and/or leaving as late as September 15, depending on geographic latitude, longitude, or regional climatic conditions (Scherer *pers.comm.* 2004, USFWS 1999). Female IBATs give birth in late June or early July after they have grouped into maternity colonies (USFWS 1983). Each female IBAT usually bears one offspring per year, although two offspring have occasionally been reported (Cope and Humphrey 1977). Young bats are called pups and are dependent on their mother. After the young are born, maternity colonies can consist of up to about 130 bats (Humphrey *et al.* 1977). Young IBATs are volant (capable of flight), within a month of their birth. Early-born young may be flying as early as the first week of July (Clark *et al.* 1987); however, most probably begin flying from mid to late July.

Fall Migration to Winter Range and Roosts

After the young bats gain their independence, migration back to the hibernacula begins; the males tend to precede the females (Whitaker and Hamilton 1998). The first IBATs begin to arrive at their hibernacula in August (USFWS 1999). The number of bats arriving at the hibernacula peaks in September and October; in September, the numbers of males and females arriving are about equal (Whitaker and Hamilton 1998).

Fall Swarming (aka Pre-Hibernation Foraging)

Upon arriving at the hibernacula, the IBAT engages in a behavior known as fall swarming. Swarming is characterized by large numbers of IBATs coming together in a mating frenzy at the entrances of hibernacula before hibernating. The peak of this polygamous breeding activity is usually September and October. Sperm is transferred to the female during swarming, but ovulation and fertilization of the egg are delayed until after the end of hibernation in the spring. By late September, many females begin hibernation, and swarming bats are predominantly male. Males continue swarming until mid-October or later in an apparent effort to breed with late-arriving females (Cope and Humphrey 1977). In NJ most IBATs are in hibernation by the end of October, however if weather remains warm bats may continue to emerge and forage or swarm until mid-November. Foraging throughout the fall swarming period is also very important as the bats consolidate their fat stores prior to hibernation.

Hibernation

In general, the IBAT hibernates from October through April, depending on local weather conditions (Hall 1962; LaVal *et al.* 1980 as cited in USFWS 1983). This period of prolonged quiescence requires inactivity and minimal metabolism in a cool and stable temperature in order to conserve fat reserves.

Feeding Behavior

When the IBAT is not hibernating, it is nocturnal, usually foraging for 1 or 2 hours after sunset and before sunrise (Hofmann 1996). Erkert (2000) suggested that the most important environmental factor regulating emergence activity of a population throughout the year was light, which served as a zeitgeber to synchronize endogenous circadian rhythms, and which often had a direct intensity-dependent, inhibitory effect on level of activity (Viele *et al.* 2002). Perhaps, as Voûte *et al.* (1974) suggest, the zeitgeber is a combination of light levels at time of emergence and at time of return to the roost, i.e. a two-pulse zeitgeber (Pittendrigh 1981 as cited in Viele *et al.* 2002). Clark *et al.* (1987) report mist-netting IBATs as early as 14 minutes after sunset and as late as 22 minutes before sunrise.

Viele *et al.* (2002) corroborated that the timing of first emergence was correlated most closely with time of sunset and time of the end of civil twilight, whereas peak and average emergence were predicted best by time of first emergence. The first IBAT typically exited the roost 18–19 min after sunset, peak emergence occurred 21–26 min past sunset, and average emergence was 23–25 min after sunset. He also noted that first emergence occurred later, relative to sunset, near the summer solstice (Viele *et al.* 2002). These studies of evening exits at maternity roosts occurred in IA, IL, and MI. Once emergence commences it usually lasts from 10–20 minutes; however for male or non-reproductive females roosting individually or in small groups the roost exit can be a very short-lived event.

IBATs are insectivorous. The IBAT locates insects using echolocation, during which the bat emits high-frequency sound waves that bounce off potential prey. From the speed and direction of the returning sound waves, the bat can determine the location, the size, and potentially the identity of insects (Ohio Division of Wildlife 1996). Prey are captured and eaten during flight.

The IBAT's diet primarily consists of small, soft-bodied insects such as moths and flies, including small moths (*Lepidoptera*), flies (*Diptera*), caddis flies (*Trichoptera*), bees and wasps (*Hymenoptera*), stoneflies (*Plecoptera*), and lacewings (*Neuroptera*), as well as beetles (*Coleoptera*) and true bugs (*Hemiptera*) (Brack and Laval 1985; Whitaker and Hamilton 1998). Overall, the diet includes 12 taxonomic orders, with dipterans, lepidopterans, coleopterans, trichopterans, and hymenopterans accounting for 96% of prey taken (Murray and Kurta 2002).

Although the insects listed above are known components of its diet, the IBAT may also exploit other high-quality, easily digested food sources such as mayflies (*Ephemeroptera*) that are typically underrepresented in studies of fecal samples (Best *et al.* 1997). IBATs from northern colonies apparently consumed more aquatic-based insects (trichopterans and dipterans) than IBATs in southern portions of the range (Murray and Kurta 2002). Also the diet of the IBAT can vary within a night, seasonally, between years, and across its range (Murray and Kurta 2002). Fenton and Morris (1976) describe the IBAT as a “selective opportunist.”

Considering that the IBAT ingests mayflies, caddisflies, and stoneflies, it is noteworthy that all three flies are especially intolerant of aquatic pollution and siltation (Best *et al.* 1997). These three insect orders are well represented in Picatinny drainages so the need to maintain high water quality in riparian corridors is an important objective.

3.4 HABITAT AND BEHAVIOR

The IBAT requires the following two distinct types of habitat: (1) winter hibernation sites (hibernacula) and (2) summer roosting sites and foraging areas. IBATs forage primarily in closed canopy riparian woodlands or upland forests (Humphrey *et al.* 1982). IBATs prefer to forage around the crowns of large trees (Clawson 1987). Optimum summer habitat includes mature trees that serve as forage areas and dead, yet loose barked trees as roost sites. Preferred stream habitat appears to consist of streams lined on both banks with mature trees that overhang the water by at least 10 ft. Stream widths may vary from 10 to 70 ft. Typical forage areas consist of deciduous forest cover equal to or greater than 30%, with suitable roost trees located within a quarter mile of the foraging area and permanent water available within about a third of a mile from the roost. The dominant overstory is normally comprised of trees that measure 10 to 24 inches in diameter at breast height (dbh) (Evans *et al.* 1998).

Bats that repeatedly use the same site at different intervals, whether for foraging, roosting, or hibernating, display “site fidelity” (SF). “Roost-site fidelity” (RSF) is repeated, consecutive (for ≥ 5 days) or nonconsecutive use of a site for roosting (Gumbert *et al.* 2002). This concept can be applied to winter roosts, but most studies focus on summer roosting since this dynamic is more complex.

If site fidelity is registered for several individuals of the same species a subscript “s” is indicated to differentiate from records of repeated use by an individual bat (subscript “i”) (Gumbert *et al.* 2002). Fidelity to roost sites can be further discriminated and specified as Roost Areas (RAF) or even particular Roost Trees (RTF). Fidelity to particular Foraging Areas is also observed (FAF).

See Glossary for more information regarding site fidelity or philopatry.

Fidelity is considered short-term if a bat is observed during a single tracking period (typically 10–20 days) and long-term if observations encompass more than one tracking period (Gumbert *et al.* 2002). Bats that are observed and located in multiple tracking periods are referred to as “multi-period bats.” (Gumbert *et al.* 2002)

Most researchers agree that IBATs exhibit long term RAF (for winter and summer sites); FAF at summer sites; and some degree of RTF (although this is usually short term) (Gardner *et al.* 1991a, Kurta *et al.* 1996, Gumbert *et al.* 2002).

Another concept related to site fidelity is home range which Burt (1943) defined as the area traversed by an individual in its normal activities of food gathering, mating, and caring for young. White and Garrott (1990) refined this definition by referencing a period of time (Romme *et al.* 2002).

These concepts are very important when planning and conducting monitoring activities for a colony or local population of this species, which is still considered by most biologists as an enigma (Brack *et al.* 2002).

3.4.1 Roosting Cohorts and Habitat Utilization

Compared to the very stable and relatively static conditions associated with winter hibernation, the spring staging and subsequent dispersal(s) reflect more dynamic, variable, and differentiated behaviors.

For the sake of discussion of this patchily distributed species it is probably helpful to consider three different groups or sets of IBATs. One cohort, the long-distance migrants, consists primarily of pregnant females. Upon arrival in their established summer range this migrant cohort apparently segregates further into maternity colonies and non-maternity bands, yet probably share the same foraging habitat.

A second cohort, the non-migratory residents, is primarily males and non-pregnant females. Together, these IBATs comprise local non-maternity bands that occupy habitats relatively close to hibernacula. Maternity colonies present in summer using habitat not far from hibernacula could represent two possible cohorts – long-distance immigrants and/or local residents.

A third assemblage is the amassed and mixed cohorts (migrants and residents) immediately preceding and during the fall swarming period. This latter cohort and the non-maternity bands of summer residents will likely be the focus of future research and monitoring for this ESMP. If any maternity colonies are found then

efforts to determine their precise cohort affiliation will be of keen interest and relevance for continued management.

Most of the summer roosting information, which follows, pertains to maternity colonies (migrant cohorts).

Winter Roosting Habitat

During the winter, IBATs generally hibernate in caves, although abandoned mines have also been used. IBATs favor walls and ceilings in portions of the hibernaculum where temperatures are 2 to 5 °C (33 to 42 °F), the relative humidity is 66 to 95%, and there is some air movement (Whitaker and Hamilton 1998).

Of all the hibernacula which can be accessed or for which winter population estimates can be ascertained, as of 2001, there are: Eight (8) P1; 69 P2 (70 if NJ Mount Hope mine MHW-SHAFT is added); and 259 P3 (Clawson 2002). In some states other hibernacula are known or suspected but are inaccessible, and some may yet remain to be discovered or determined to be populated.

Both sexes are found in hibernating groups, usually in tightly packed clusters of 300 to 350 bats per square foot on walls and ceilings (Hofmann 1996). They are often clustered to the extent that only the faces, ears, and wrists show (Whitaker and Hamilton 1998).

Summer Roosting Habitat

As mentioned previously, most information presented in this subsection refers to maternity colonies, their summer habitats, roost sites and immediate foraging territories. As described by some recent research, there is some disparity between habitats in the midwestern (core) summer range of the IBAT and its niches in the North or Northeastern regions of summer range. Furthermore, characterizations of maternity colonies' roosting and foraging behaviors may represent a similar generic pattern for non-maternity bands; although the individual IBATs involved would be fewer in number, less gregarious, more dispersed, and likely more opportunistic or adaptive, especially near hibernacula.

When discussing summer roosts it is helpful to distinguish between the microhabitat "site" and the overall roosting habitat "area." The microhabitat obviously includes the tree(s) serving as the essential "shelter", whereas the roosting area, which includes alternate roost trees, serves analogously as "cover."

Dead or Dying Trees or Live Scaly Barked Trees

The most suitable roost sites are beneath the exfoliating bark of dead trees and have adequate space for air to circulate and for bats to change their position on the trunk (Garner and Gardner 1992). Trees that possess tenacious bark that springs away from the trunk as the trees die are optimal.

According to Rommé *et al.* (1995), roost tree characteristics (in approximate relevance and importance) include:

- Solar exposure and location in relation to other trees: Seemingly paradoxically exposure to direct sunlight and ample solar insolation to maintain warmth beneath the bark is important for some roost trees, yet shade is equally important to protect some roost sites from intense heat. Areas with large trees and closed canopies are preferable; however many roost trees are in semi-open areas or in ecotones.

Factors which diminish the suitability of roost trees include (1) an overarching canopy, (2) understory canopy within 6 feet of the bole, (3) a bole dressed with vines, or (4) less than 25% exfoliating bark (Farmer *et al.* 2002). See **Primary and Alternate Summer Roosts (Trees)** below.

In MI, roost trees ranged in height from 49-69 ft, and bats tended to exit these trees at a height from 26-39 ft up the bole (Kurta *et al.* 2002). Exits at levels as low as 6 ft have been observed (Kurta *et al.* 2002).

Proximity to water sources and foraging areas: Roosting areas also had more patches of water (ponds, lakes, etc.) (Carter *et al.* 2002).

- Tree condition (dead or alive): In a KY study 84% of roost trees were snags (dead or dying trees) (Gumbert *et al.* 2002). This was also corroborated in a MI study (Kurta *et al.* 2002). In limited cases, natural tree cavities, hollows, crevices or splits induced by decay, lightning, wind/ice breakage, or other damage have been exploited (USFWS 1999)

Live shagbark hickories have been identified as exhibiting favorable temperatures for roosting bats during cool periods due to their greater thermal mass, and effective protection from precipitation because of the structural characteristics of their bark (Humphrey *et al.* 1977).

No IBATs have been found roosting in downed trees (USFWS 1983, Gardner *et al.* 1991, Callahan 1993, Romme *et al.* 1995, Callahan *et al.* 1997, Tetra Tech 1999e).

- Quantity of exfoliating bark: Kurta *et al.* (2002) describe a system that rates the potential of a tree as a roost according to the amount of exfoliating bark that it possesses as: high ($\geq 25\%$), medium ($< 25\%$ but $\geq 10\%$), or low ($< 10\%$). A rating of zero indicates either a lack of bark on the trunk or that all bark remains firmly attached to the tree.

IBATs typically roost under exfoliating bark, but some individuals and even maternity colonies find shelter within tree crevices (Gardner *et al.* 1991a, Kurta *et al.* 2002, Brack *et al.* 2002). The IBAT has also been observed roosting in hollow portions of tree trunks and limbs (Kurta *et al.* 1993a and 1993b as cited in Whitaker and Hamilton 1998) and in cavities (seams and splits) in lightning struck and damaged trees (Tetra Tech 1999c).

In one study 68% of roosts were rated medium or high for peeling bark, and 89% were medium or high in amount of sunlight received (Kurta *et al.* 2002).

- Diameter: In KY, average diameter of roost trees (n=280 of 17 different species) at breast height was 12 inches dbh and they ranged from 2.5 to 30 inches dbh (Gumbert *et al.* 2002). A suitable tree in MI was defined as one that was at least 4 inches (10 cm) in diameter and possessed exfoliating bark under which bats might roost (Kurta *et al.* 2002). The majority of all types of roost trees tend to fall into a range of 6–18 inches dbh, although some old large diameter wolf trees have been recorded.

Male IBATs have been found roosting in trees as small as three inches in diameter (Romme *et al.* 1995). It is generally believed that males tend to use smaller trees.

- Species: The species of tree is probably less important than the structural and thermal conditions presented by the tree, due to its location and exposure, as well as proximity to foraging habitat.

Table 3 identifies tree species which have been or could be used as roost trees for the IBAT. These trees typically exhibit exfoliating bark when they are senescent, severely injured, or dead. As seen in Table 3, IBATs apparently exhibit a high degree of flexibility in the species that they utilize for roosts (Miller *et al.* 2002).

TABLE 3 POTENTIAL IBAT ROOST TREES*

Tree Family	Common Name	Scientific Name	IN	PA	NJ	NY	NE US
Beech	Red Oak	<i>Quercus rubra</i>	✓	✓			
	Post Oak	<i>Q. stellata</i>	✓				
	White Oak	<i>Q. alba</i>	✓			✓	
	Shingle Oak	<i>Q. imbricaria</i>	✓				
	American Beech	<i>Fagus grandifolia</i>					✓
Walnut	Bitternut Hickory	<i>Carya coridiformis</i>	✓				
	Shagbark Hickory	<i>C. ovata</i>	✓	✓	✓	✓	
	Shellbark Hickory	<i>C. laciniosa</i>	✓				
Elm	Slippery Elm	<i>Ulmus rubra</i>	✓	✓			
	American Elm	<i>U. Americana</i>	✓	✓	✓		
Olive	Green Ash	<i>Fraxinus pennsylvanica</i>	✓		✓		
	White Ash	<i>F. americana</i>	✓		✓		
Magnolia	Yellow Poplar	<i>Liriodendon tulipifera</i>			✓		
Maple	Silver Maple	<i>Acer saccharinum</i>	✓				
	Red Maple	<i>Acer rubrum</i>		✓	✓		✓
	Sugar Maple	<i>Acer saccharum</i>			✓		✓
Poplar	Eastern Cottonwood	<i>Populus deltoides</i>	✓				
	Quaking Aspen	<i>Populus tremuloides</i>				✓	✓
Legume	Black Locust	<i>Robinia pseudoacacia</i>	✓	✓		✓	
Pine	Eastern Hemlock	<i>Tsuga canadensis</i>				✓	✓
	White Pine	<i>Pinus strobus</i>					✓
Birch	Yellow Birch	<i>Betula alleghaniensis</i>			✓		
	Gray Birch	<i>Betula populifolia</i>			✓		

* Based on actual use of these species of trees by IBATs

Source for Indiana: USFWS 1998

Source for Pennsylvania: Butchkowski e-mail 2004

Source for New Jersey: USFWS 2000, Chenger 2006a

Source for New York: Hicks e-mail 2004, Sanders et al. 2001, Scherer pers.comm. 2004

Source for NE US: Scherer e-mail 2004

Interspecific Co-habitation

Several researchers have documented IBATs sharing summer roosts with other bats. Examples include IBATs with: Northern Long-Eared Bats in a variety of roost trees; Big Brown Bats in a Shortleaf Pine; and Little Brown Bats in buildings or constructed bat roosts (J. E. Gardner *pers.comm.* to Gumbert *et al.* 2002, Butchkoski and Hessinger 2002). Obviously, summer roosts of other tree dwelling species may also be high quality and suitable roosts for IBATs (Foster and Kurta 1999).

Summer Roosting Areas

What is known about summer roosting habitats (sites and areas) is based on seasonal or multi-year radiotelemetry studies of dozens of IBATs tracked to scores of roost trees (Gardner *et al.* 1991a, Carter *et al.* 2002).

Range-wide analysis corroborates studies in more localized areas that show IBATs establish maternity colonies in areas dominated by nonforested landscapes (75%) such as, cropland, grassland, and pasture (Callahan *et al.* 1997, Carter *et al.* 2002, Gardner *et al.* 1991a, Kurta *et al.* 1993a, 2002, Gardner and Cook 2002).

Brack *et al.* (2002) highlight one of a few enigmas concerning the IBAT; namely, the variability in summer habitats, which have been studied. Although the IBAT is considered a tree bat in summer, it is most common in portions of its range where large, open, unforested lands are interspersed with wooded areas (Gardner and Cook 2002). Roosts located in dead trees in open sites that are exposed to solar radiation throughout much of the day apparently provide a highly favorable thermal environment for females and young (Miller *et al.* 2002).

The IBAT typically is not common in heavily forested regions (Brack *et al.* 2002); yet Carter *et al.* (2002) report roosting habitats had fewer and smaller patches of urban development and more and larger patches of closed canopy deciduous forest.

Carter *et al.* (2002) contend that most roost trees were located within either closed-canopy deciduous forest or bottomland forest, which were however highly fragmented, and near a variety of patches of water.

Bottomland forests occur in low-lying areas that are inundated annually for varying amounts of time; such flooding occasionally leads to the death of trees, thus increasing the number of potential roosts (Carter *et al.* 2002).

In the case of forest-cover, it seems that the critical element is not amount of land covered by forest, but rather specific characteristics of the stand, that makes an area habitable (Miller *et al.* 2002).

One characteristic that does appear to affect quality of a site, especially for IBAT maternity colonies, apart from the landscape variables, is the number of trees of larger size (Miller *et al.* 2002).

Potential roosting habitat is destroyed or degraded by cutting large dead (wolf trees) or dying trees (snags).

Site Fidelity (Areas and Trees)

Gardner *et al.* (1991a) documented philopatry, long-term reuse of particular trees (RTFs), or areas (RAFs) by bats from year to year, which is more prevalent than strict RTFi (Gumbert *et al.* 2002).

The tendency for bats to roost in the same area, day after day, may relate to fidelity to nearby foraging habitat (Gumbert *et al.* 2002). It seems likely that these bats are choosing roosting habitat that is closer to preferred foraging areas than are random sites (see also Kurta *et al.* 2002) (Carter *et al.* 2002). This information strongly suggests that there is a nexus between RAF and FAF, even for individuals.

Ormsbee (1996) hypothesizes that tree-dwelling bats actually show fidelity to areas rather than to particular roost trees, since favored trees (snags) are temporary (Gumbert *et al.* 2002).

Other researchers similarly concede that IBATs are faithful to both areas and particular trees within those areas, though they are probably less dependent on the continued suitability of specific trees than on areas (see also Kurta and Murray 2002) (Gumbert *et al.* 2002).

In MI, the focal point of roosting activity shifted only 1.2 miles (2 km) across the landscape over a 3-year period (Kurta *et al.* 2002).

Switching

Suitable roost trees are ephemeral and can become unusable quite unexpectedly, so individual bats may use several trees to avoid being caught unprepared when a roost tree is destroyed (Kurta *et al.* 1996, 2002, Gumbert *et al.* 2002); and members of a colony must continually locate and establish new roosts (Kurta *et al.* 2002, Miller *et al.* 2002). This behavior is referred to as “switching” (aka roost changes) and occurs generally within one established roost area. In rare instances, bats that use two areas tend to stay in one main area, switching to another (secondary) area for only a few days (Gumbert *et al.* 2002).

Although particular trees probably provide higher quality roosting conditions than others (i.e. RTFi) (Gumbert *et al.* 2002), IBATs tend to switch trees every 2–4 days (Kurta *et al.* 1996, 2002, Gardner *et al.* 1991a).

Although distance moved for 74% of roost changes was less than .6 mile (1 km), other observations indicated that an IBAT might be found up to 4.8 miles (7.8 km) from a dayroost that it recently occupied (Kurta *et al.* 2002).

Switching occurred more frequently in summer and autumn than in spring, about once every two days versus every third day (Gumbert *et al.* 2002).

Maternity Colonies

Pregnant adult female IBATs establish maternity roosts beneath slabs of loose tree bark on trees, or in hollow trees. Such trees may be located at varying distances from foraging habitat.

Although maternity colonies appear to be formed mostly in riparian and floodplain forests near small to medium-sized streams (Clawson 1987), upland areas may be used extensively, especially those that contain dead trees (snags) that are near open areas, receive a significant amount of sunlight, and have loose bark that creates natural crevices (Evans 1998).

In MO, IL, IN, and MI, large-diameter snags tend to be located in open areas (Miller *et al.* 2002, Gardner *et al.* 1991a, Kurta *et al.* 1996, 2002).

As suggested previously, maternity colonies have been found roosting along tree-lined ditches; along the edge of woodlots and agricultural lands; in heavily logged woodlots; heavily grazed (savannah-like) woodlots and open pastures; and even pig lots (e.g., Gardner *et al.* 1991a, Kurta *et al.* 1993a, 1996, Brack *et al.* 2002).

Most of this maternity range of the IBAT is within rural, agricultural areas, where land is privately owned (Gardner and Cook 2002, Kurta *et al.* 2002)

Since snags used for nursery colonies generally remain suitable for only 4 to 8 years (Tarr 1999), stands near sites with maternity colonies contain significantly more large and medium trees, because a large number of old (large-diameter) trees likely contributes to long-term survival of a colony by providing future roost sites (Miller *et al.* 2002).

A maternity colony of IBATs apparently requires a number of primary and alternate roost trees located near one another (Miller *et al.* 2002).

Number of roost trees located for each colony in Missouri ranged from 10 to 20; however, these numbers probably were conservative (Miller *et al.* 2002).

Primary and Alternate Summer Roosts (Trees)

Female IBATs have been observed to occupy two types of maternity roosts, primary and alternate (Callahan *et al.* 1997, Miller *et al.* 2002). Although less frequently documented, roost switching undoubtedly occurs among non-maternity IBATs also.

Roosts are classified as “primary” or “alternate” based upon intensity of use, as indicated by evening exit counts (Miller *et al.* 2002). Primary maternity roosts are those used by 30 or more bats on more than one occasion (Miller *et al.* 2002); all other roosts are considered to be alternate maternity roosts.

Of possible relevance here in NJ and the northeast region are the observations of Kurta *et al.* (2002) that the number of adults at southern roosts frequently exceeded 40 bats, but emergence counts at northern trees (considered as Primary roosts) typically yielded less than 30 animals. Recent exit counts at maternity roost trees in VT and NY suggests numbers of IBATs similar to Kurta’s observations for southern roosts (Scherer *pers.comm.* 2004).

Primary roosts sheltered a large number of bats (colony) and typically were large-diameter snags with exfoliating bark, located along edges of forests or within openings with a warm microclimate caused by absorption of solar radiation (Miller *et al.* 2002). Primary maternity roost trees have been observed to range in size from 12 to 30 inches dbh (Callahan 1993 as cited in Romme *et al.* 1995).

As explained previously IBATs frequently switch trees within their roosting areas. Alternate roosts tend to receive only intermittent use by a small number of bats, generally sheltering less than 10 individuals (Miller *et al.* 2002). Differences in patterns of use between the types of maternity roosts are apparently influenced by weather conditions, with increased use of alternate maternity roost trees during periods of elevated temperatures and precipitation. Miller *et al.* (2002) suggest that use of dead trees in the forest interior increases significantly in response to unusually warm temperatures (where shading can mitigate); and that use of both interior live trees and snags increases during periods of precipitation (again where canopy cover can mitigate inordinate wetting of tree boles) (Miller *et al.* 2002). Alternate maternity roost trees range in size from 7 to 43 inches dbh (Garner and Gardner 1992; Callahan *et al.* 1997).

Many females and young comprise a maternity (aka nursery) colony. One such colony may utilize up to three primary roosts, usually snags, throughout the summer (Miller *et al.* 2002) and as many as 20 alternate (aka secondary) roost sites in live trees. Therefore, it is important that a variety of suitable roost trees be available within the colony’s summer habitat to ensure continued use of the area by the colony (Tarr 1999). In one study, it was observed that the radius of the smallest circle that would encompass all maternity roost trees for each maternity colony ranged from 0.5–0.9 miles (0.8 to 1.5 km) (Callahan *et al.* 1997).

Although roost tree fidelity (RTFi) by individual IBATs is an established fact, the most common pattern reveals frequent switching by individuals among the available diurnal roosts (i.e. nonconsecutive day use of a particular tree 78% of the time during a tracking period) (Gumbert *et al.* 2002). Consecutive use of a particular roost tree by an individual bat ranged from 2 to 12 days (maximum recorded) (Gumbert *et al.* 2002).

O’Donnell and Sedgeley (1999) label trees used for long periods of time or by many bats from the same population as “focal roosting trees,” and this was corroborated by Gumbert *et al.* (2002) in their five year KY study (1996-2000) of multiple bats ($n = 60$) over multiple tracking periods ($n = 9$).

Atypical or Adapted Summer Roosts (Non-Trees)

Observations and discoveries over the past 10 years have revealed that IBATs can and do exploit roost sites other than trees, even for maternity colonies. Twenty-nine IBATs were found using an attic roost, with possibly more hidden from view, in an abandoned church in central PA (Butchkoski and Hessinger 2002). These IBATs at Canoe Creek State Park not only shared their maternity site with hundreds of Little Brown Bats, but also routinely roosted in contact with them (Butchkoski and Hessinger 2002). Some of these same IBATs subsequently used a man-made bat roost condominium erected near the abandoned church (Butchkoski and Hessinger 2002). Another more recent example is the discovery of a huge maternity colony in a barn in IA near Iowa Army Ammunition Plant (Chenger *pers.comm.* 2004). At PICA, a male IBAT was tracked for 9 days (21-29 JUN 97) and was found to have roosted one day in an abandoned building (b296) and for eight days in a rarely used warehouse (b3236) about 1 mile away.

Although few papers have yet been published, there is a body of gray literature and numerous anecdotal examples, including telephone pole brackets, which substantiate that IBAT individuals and colonies will adapt to other available roosts and co-habit with other bat species.

3.4.2 Foraging Habitats and Behavior

Foraging areas and ranges of female and juvenile IBATs have been established through triangulation of radio-tagged individuals (Gardner and Cook 2002); and Gumbert *et al.* (2002) demonstrated long-term FAFi for IBATs by recapturing banded individuals in the same foraging areas over multiple years.

The IBAT forages in upland, flood plain, and riparian-forested areas. Tree species within such areas around which the bat has been observed to feed include the American sycamore (*Platanus occidentalis*), eastern cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), box elder (*Acer negundo*), silver maple (*Acer saccharinum*), river birch (*Betula nigra*), northern hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), black willow (*Salix nigra*), and oak (Humphrey *et al.* 1977; USFWS 1997). In PA, oak, hickories, maples, and elm stands comprise the main foraging areas (Butchkoski and Hessinger 2002). See also Section 3.7.3 Other Relevant Studies, Pennsylvania.

Streams, associated flood plain forests, and impounded bodies of water are the preferred foraging habitat for the IBAT (Gardner *et al.* 1991). Moist soils and standing water also presumably enhance populations of insects, thereby increasing the supply of food in these areas (Carter *et al.* 2002)

The IBAT also forages within the canopy of upland forests, in clearings, along the borders of croplands, along wooded fencerows, and over farm ponds in pastures (Clark *et al.* 1987; Gardner *et al.* 1991). The IBAT usually forages and flies from 2 to 30 meters above ground level (Humphrey *et al.* 1977). The distance between maternity roosts and the geometric center of foraging areas used by pregnant IBATs has been observed to average 7 miles (1.1 km) (Garner and Gardner 1992) and to extend up to 3 miles (5 km) (Whitaker and Hamilton 1998). Studies in Kentucky indicate that fall swarming cohorts of IBATs forage heavily in forested areas within 2.5 miles of hibernacula prior to hibernation. A kernel home-range analysis identified eight areas of repeated use within 3 miles of a hibernaculum (Gumbert *et al.* 2002). In another study a small maternity colony roosted and foraged within 1.5 miles of a local P2 hibernaculum (Butchkoski and Hessinger 2002). Thus, Romme *et al.* (2002) support guidelines of regulatory agencies restricting activities within 5 miles (8 km) of hibernacula.

3.5 REASONS FOR DECLINE

Based on censuses taken at hibernation sites, IBAT population declines are revealed by the following estimates over the past few decades: 1960-1970 => 884,000; 1975 => 459,000 Humphrey (1978); 1980 => 679,000; 1981 => 550,000 (U.S. Fish and Wildlife Service 1983, Tetra Tech 1999d); 1990 => 474,000; 1997 => 357,000 (USFWS 1999, Tetra Tech 1999d); 2000 => 383,000 (Clawson 2002). Overall in the past 40 years the population in the northern part of the range was up 30%, but the increases were not enough to offset losses in the southern region (Clawson 2002). Due to continuing declines in Priority One populations, Priority Two and Three hibernacula have become much more significant to recovery of the species (Clawson 2002, Johnson *et al.* 2002, Gardner and Cook 2002). Researchers have attributed the overall decline of the IBAT population primarily to direct and indirect actions of humans and to natural hazards. Human causes of the population decline include (1) hibernaculum disturbance and vandalism, (2) loss of forest cover, and potentially (3) pesticide poisoning. Recreational cave explorers and researchers who disturbed hibernacula were believed to cause bats to exhaust their limited fat reserves before spring, resulting in mortality. Vandalism and destruction of hibernacula and their occupants have also been documented (USFWS 1983). Loss of forest cover through tree removal or land clearing for agriculture, surface strip mining, road and utility construction, and other forms of development has adversely affected the IBAT throughout its range. Forest fragmentation that occurs when forests are cleared for farmland or urban development degrades bat habitat (Copeyon 1997). Although pesticide-related mortality has not been documented for the IBAT, several researchers regard agricultural pesticides as a possible cause of the decline in this species in certain regions (Evans *et al.* 1998; Garner and Gardner 1992). The use of pesticides may pose a direct threat through poisoning or an indirect threat by eliminating food sources. Natural hazards such as cave flooding, cave ceiling collapse, and severe weather have also resulted in destruction of IBAT habitat and in bat mortality (USFWS 1983). The fact that the IBAT hibernates in large clusters in a few caves makes it especially vulnerable; an extreme disturbance can destroy a significant percentage of the total species population (Mumford and Whitaker 1982; Whitaker and Gammon 1988). Deteriorating stream quality, insecticide use, chemical pollution, and siltation are all implicated in the habitat fragmentation and decline of insectivorous bat populations in North America (USFWS 1982).

3.6 CONSERVATION MEASURES

The IBAT was first listed as a federal endangered species throughout its range on March 11 1967 (32 *Federal Register* 4001), under the Endangered Species Preservation Act of 1966 (80 stat. 926; 16 *U.S. Code* 668aa[c]). A USFWS sponsored recovery team developed a recovery plan for the IBAT (USFWS 1983). The 1983 recovery plan establishes the following goals to meet the primary objective of removing the IBAT from its endangered status:

- Preventing disturbance to hibernacula
- Maintaining, protecting, and restoring foraging and summer maternity roost habitat
- Monitoring population trends
- Educating the public
- Conducting research

To date, conservation efforts have primarily featured protection of hibernacula and research into the life history of the IBAT. On September 24, 1976 (*Federal Register*, Volume 41, No. 187), thirteen winter hibernacula (11 caves and two mines) in six states as listed below, were designated as “critical” habitat for the IBAT (USFWS 1999). Critical habitat is defined as being essential to the conservation of the species and requiring special management considerations or protection (USFWS and National Marine Fisheries Service [NMFS] 1998). Critical habitat for the IBAT has not been designated on PICA.

- Big Wyandotte Cave in Crawford County, Indiana
- Ray’s Cave in Green County, Indiana
- Blackball Mine in LaSalle County, Illinois
- Bat Cave in Carter County, Kentucky

- Coach Cave in Edmonson County, Kentucky
- Cave 021 in Crawford County, Missouri
- Cave 009 in Franklin County, Missouri
- Cave 017 in Franklin County, Missouri
- Bat Cave in Shannon County, Missouri
- Cave 029 in Washington County, Missouri
- Pilot Knob Mine in Iron County, Missouri
- White Oak Blowhole Cave in Blount County, Tennessee
- Hellhole Cave in Pendleton County, West Virginia

No other hibernacula have been added to the list since September 24, 1976. Nevertheless, state and federal agencies have acquired several IBAT hibernacula for protection purposes; for example, 54 of the 127 caves and mines (43%) with populations of more than 100 bats are publicly owned, and 46 caves (36%), most of which are on public land, are gated or fenced (USFWS 1999).

Varying population trends throughout the range of the IBAT suggest that the protective measures taken to date have not resulted in the recovery of the species. Therefore, USFWS is currently revising its recovery plan for the IBAT (USFWS 1999).

Insufficient data are currently available to conclude whether availability of summer habitat is limiting IBAT recovery. Until such information is obtained, conservation measures include continued research on the summer habitat needs of the IBAT and a conservative approach during evaluation of the potential effects of land use practices on summer habitat. See Section 3.7.3, Other Relevant Studies.

Until more research and information establishes patterns of summer habitat use in peripheral regions of IBAT range, as well as near hibernacula, Virgil Brack *et al.* (2002) proffer that implementing standardized management practices across the entire range of the species, based on ecological parameters appropriate for the Midwest, may provide little benefit to the species in outlying areas. He points out that regulatory agencies almost uniformly require determination of presence/absence of reproductive females by mistnetting in areas of potential impact; however searching for reproductive female IBATs in summer in high and/or cool areas is unlikely to yield significant, positive results (Brack *et al.* 2002). Nevertheless, one maternity colony is recently reported from 2800 ft elevation in WV (Scherer *pers.comm.*2004).

He also notes that management for summer habitat almost uniformly is designed with the primary goal of providing more trees (i.e. more summer nursery roosts); yet providing more roost trees at higher elevations and on other cooler sites (e.g., north-facing slopes) is of questionable value to the IBAT, because more roosts trees in areas not thermally suited to the species simply will not result in more IBATs (Brack *et al.* 2002).

It remains to be determined whether his suggestions might be applicable or validated at PICA or in the Northeast. If the cohorts of IBATs at PICA eventually reveal a different ethology than what is currently understood, then his recommendation for regional customization of management plans and regulatory requirements to account for regional ecological constraints under which the species lives and reproduces seems reasonable (Brack *et al.* 2002).

3.7 IBAT STATUS IN NORTHEAST REGION AND AT PICA AND NORTHERN NJ

It is very important to consider what Gardner and Cook (2002) believe; namely, given current distribution records and the suspected maximum distance of migration for the species, they suggest that IBATs in Northeastern states are geographically isolated from major (i.e., Priority One) populations in the Midwest. More investigations are needed to understand fully patterns of distribution in peripheral portions of the IBAT’s range.

Although Region 5 of the USFWS includes 13 states covering the Northeast and Mid-Atlantic areas, for this and subsequent discussions of the IBAT at PICA, Northern NJ, and the wider Northeastern region, only the following seven states are considered: PA, NJ, NY, CT, MA, VT, and NH. To date there are no known records of IBATs from ME or RI or DE.

Hibernacula In Northeast Region

Most IBATs in the Northeast are known from local hibernacula as seen in Table 4. There have been 24 hibernacula in New England, New York, and New Jersey, in which IBATs roosted and were counted, but only 14 of these sites have records since 1996 (Hicks and Novak 2002). Seventeen of these hibernacula were discovered and inspected before 1980. Ten caves or mines in VT (-4), NY (-3), MA (-2), CT (-1), no longer have IBATs since the 1980s. Actively monitored populations in 14 Northeastern hibernacula comprise: 10 in NY, 1 in VT, 1 in CT, and now most recently, 2 (of 3) in NJ.

Table 4 NORTHEASTERN IBAT OCCURRENCES AND ESTIMATED POPULATIONS

N.B. Nearly all IBAT population estimates are based on winter (hibernacula) counts (in odd# calendar years).

* = All monitored hibernacula in a state.

‡ = These are the “monitored hibernacula” for which clusters of IBATs can actually be observed and counted (or numbers present otherwise ascertained). Other hibernacula can exist and be known, yet remain inaccessible to surveillance. Conversely, some of these winter roosts can become inaccessible or altered adversely. The number of these hibernacula and their monitoring is not consistent over time.

NE US	IBAT OCCURRENCES (Types)					POPULATION ESTIMATES		
	Winter			Summer	All	Hibernacula* counts		
	No. of Hibernacula‡			No. of counties				
	All	P2	P3			1990/91	2000/01	2002/03
PA	5	1	4	1	5	262	610	788
NJ	2 (3) ^d	1	1	1	1	<50 ^a	107 ^b	537 ^c
NY	11	6	5	0	6	13,724	29,175	32,923
CT	1		1	0	1	0	0	0
MA	1		1	0	1	<100	0	extirpd
VT	5		5	1	4 (?)	<10	0	17
NH	0	-	-	1?	1	N/A	N/A	N/A
(Totals)	26	8	17	4	≈20	≈14,200	≈30,000	≈34,300

Adapted from: (Clawson 2002) (Gardner and Cook 2002) (Hicks and Novak 2002).

a = unofficial census/estimates. b = 2002 census. c = 2004 initial descent and survey of MHW-SHAFT.

d = MHE-SHAFT, not yet monitored.

Until recently, hibernacula of the IBAT (*Myotis sodalis*) in the Northeast were of little importance because they were few in number, contained a small number of animals, and contributed little to the overall population of the species (Hall 1962, Humphrey 1978, Trombulak *et al.* 2001, Hicks and Novak 2002). Recent winter censuses indicated presence of ≈ 35,000 IBATs, or 9% of the rangewide population. The region is of growing importance for the continued existence of the species (Clawson 2002, Hicks and Novak 2002). Increased counts of IBATs are due to more surveys of existing mines or caves, as well as more thorough censusing of

additional passageways within known sites. Nearly 99% of the IBATs wintering in the Northeast occur in New York State.

Relevance and Distance to PICA

Out-of-state hibernacula populations that might possibly contribute summering cohorts to northern NJ or PICA include:

- Ulster Co., NY; 17,640 bats (59% of all IBATs in NY) from two P2 and two P3 hibernacula; about 84 miles from northern NJ.
- Albany Co., NY; 500 bats from one P3 hibernaculum; within 100 miles of northern NJ.
- Luzerne Co., PA; <100 bats from one P3 hibernaculum within 100 miles of northern NJ.
- Onandaga Co., Jefferson Co., Essex Co., NY; 10,400 bats from three P2 hibernacula about 250 miles from northern NJ.
- Blair Co., PA; 600 bats from one P2 hibernaculum about 250 miles from northern NJ.

Hibernacula from 1 county in CT, 1 county in MA and 4 counties in CT are believed to be inactive in the past 20-25 years or if any of these are active only a few to tens of bats may be roosting. Similarly the summer records of IBATs in VT and NH are best described as *de minimus*. These states and their populations probably do not contribute to the cohorts inhabiting northern NJ summer range or local hibernacula. This supposition can only be verified by banding and recaptures, or more likely by intensive radio-tracking efforts during spring or fall migration movements.

New Jersey IBAT Discoveries

Previously, in the winter and spring of 1993, hibernating IBATs were discovered in an abandoned mine about two miles from the Arsenal. The following year (1994), two more IBAT hibernacula were found in abandoned mines within a half a mile of the installation (PICA 2001). An historical discovery of a post-lactating female IBAT was made in July 1995. This federally listed Endangered species was netted and documented on PICA. The trapping effort was the result of an environmental assessment process for a requested grant of easement (power transmission line Right of Way) by Mount Hope Hydropower Inc. This IBAT capture in 1995 was the first summer resident of this species documented in New Jersey or the Northeastern U.S. in decades. Portions of the Arsenal may provide important summer breeding or at least pre-and post-hibernation foraging habitat for the IBAT. In fact, the only confirmed IBAT summer foraging habitat documented to date within New Jersey is on PICA.

Winter Roosts

IBATs have been documented to roost in mine shafts on private land immediately adjacent to the installation, as well as a mine adit now owned and protected by NJDFW. All three of New Jersey's known IBAT hibernacula sites are within 2.5 miles of the installation. Lack of adequate protection of the hibernacula on private land immediately adjacent to the installation is a serious threat to the IBATs in the vicinity of the Arsenal. No hibernaculum has been discovered on post. Bats associated with these hibernation sites have been documented to forage on the installation prior to hibernation.

Most accessible caves and mines (<200) in the Northeast (except for PA) with the greatest potential as hibernacula also have been surveyed (J. Dickson *pers.comm.*, T. French *pers.comm.*, K. Morris *pers.comm.*, S. Parren *pers.comm.*, M. Valent *pers.comm.*) to (Hicks and Novak 2002). According to Cal Butchkoski there are probably thousands of caves and mines in Pennsylvania, and many remain to be examined for overwintering bats (Hicks and Novak 2002). Melissa Craddock (NJDFW) and Annette Scherer (USFWS) believe there are several mines/shafts in NJ waiting direct counts or indirect (presence/absence) surveys.

As mentioned earlier and as seen in Table 4 virtually all IBATs in the Northeast, more than 99%, hibernate in the state of New York; and as in IL, most hibernate in abandoned mines (Kath 2002, Hicks and Novak 2002). Consequently, IBATs from hibernacula in NY may summer throughout NY and New England, in at least parts of PA and NJ, and perhaps in Quebec and Ontario (Hicks and Novak 2002).

Summer Roosts

Although no maternity colonies have been found to date in NJ or on PICA, there are ample forested areas that could potentially provide habitat. Potential roost trees are present on the Arsenal, but have not been methodically identified, quantified, or protected. Threats to such trees include fire, wind events, and possibly new construction.

Although a few captures of males has established that there are roosting IBATs on post, it is unknown how many actual roost sites may exist; and the summer resident IBAT population is unknown. However, IBATs are assumed to roost within the Arsenal's boundary, at least temporarily, preceding the fall swarming period and during the spring staging phase. Given the proximity of their winter hibernacula, at least some males (and perhaps non-reproductive females) are likely roosting through the summer months.

Telemetry studies of spring emerging bats from a hibernacula in northeastern NY showed female IBATs dispersing to the Champlain Valley region of NY and VT. In a similar spring telemetry study of female IBATs dispersing from a mine in Ulster County, NY, the bats moved south and east. While summering areas for more than half of the radioed bats from these mines were located within 30 miles of their hibernacula, the remaining radioed bats could not be relocated and are likely to have dispersed greater distances.

Unfortunately, there are no recaptures indicating patterns of movement from hibernacula in CT, NJ, PA, or VT; as well as some southern region states. Recent captures, however, of reproductively active adults and discovery of summer roosts in these states (e.g. Harvey 2002) could indicate that IBATs living there do not migrate long distances between summer and winter habitats (Gardner and Cook 2002).

Brack *et al.* (2002) raise the prospect that the probability that the IBAT reproduces [raises young] at higher elevations in WV, VA, or PA is low, although this supposition is challenged by the discovery of the maternity roost tree at 2800 ft in WV. In PA, the only known maternity colony of IBATs uses artificial roosts in buildings and man-made roosting structures (bat boxes), which probably provide thermal benefits. Members of this colony roost and preferentially forage at lower elevations, and foraging seems concentrated in areas with a southerly aspect (Butchkoski and Hessinger 2002, Brack *et al.* 2002). The smaller diameter trees, low amounts of incident solar radiation (7 hours versus 10 hours in a MI study), and small exit counts suggested that trees at Canoe Creek State Park were roosts of secondary importance compared to the church (Butchkoski and Hessinger 2002, Kurta *et al.* 2002). The church (primary roost) is located less than 1.5 miles from the state's largest hibernaculum, Hartman Limestone Mine (Butchkoski and Hessinger 2002).

Foraging

Overall, foraging habitat on the Arsenal and surrounding area is estimated to be good. Interior forest habitat is excellent. Nevertheless, there is a need to determine and document bat foraging habitat requirements.

The nearest study of foraging habitat that is somewhat similar to northern NJ was in central PA in 1999 at Canoe Creek State Park. That study of foraging IBATs was the first to occur in an area with significant changes in elevation, and it would be useful for future management to know whether IBATs in other hilly or mountainous areas behave in a similar manner (Butchkoski and Hessinger 2002). These researchers documented that the bats concentrated foraging in areas of unbroken forest with slopes less than 10° and ranged as far as 2.8 miles (4.5 km) from the church (their primary summer roost). All core areas, where a bat spent 50% of its foraging time, were located along intermittent streams or within hollows containing an intermittent stream, and all core areas had a southerly aspect (Butchkoski and Hessinger 2002).

A home range of about 1,544 acres was documented for one IBAT in western VA (Hobson and Holland 1995).

New Jersey IBAT Population Estimates (and NE Region)

WINTER COUNTS

Based on biennial counts since 1992, the number of IBATs in Hibernia Mine range from 18 to 107 individuals. A recent count of IBATs in the MHW-SHAFT of Mount (Mt) Hope mine tallied 537 individuals. Only portions of these two sites (Hibernia adit and Mt Hope MHW-SHAFT) have been surveyed. A third site, Mt Hope MHE-SHAFT has not been entered due to safety concerns, however IBATs are known to overwinter here also based on trapping/netting near the large opening. Among the three known hibernacula, the winter roosting population of IBATs is conservatively estimated to be about 600 to 700 individuals although actual numbers could be much higher within the inaccessible portions of this mine site. More studies at the mines using mist nets or Harp traps can possibly provide some estimates of the sex ratio and reproductive conditions of IBATs in these winter roosts. Until some dispersal information on spring migration numbers and distances traveled can be ascertained, no estimate of the percentage of wintering IBATS remaining in or leaving northern NJ can be made. Some assumptions using rates of dispersal from other regions or perhaps in nearby NY state might be helpful in this regard.

In 1975, Humphrey (1978) credited the Northeast region with only 500 IBATs; and by 1981, the area still contributed only 2,000 according to estimates of the USFWS (1983) (Hicks and Novak 2002). In 1990, PA and NY hibernacula alone accounted for about 27,000 IBATs. In 2000, NY alone claimed about 35,000 IBATs in its 11 monitored hibernacula, while PA had 700. Recent increases (or discovery of new roosts) inside five mines that have been monitored since 1985 in the NE account for 76% of all IBATs that winter in the Northeast (Hicks and Novak 2002). Four of these mines are in NY; 2 in Ulster County, and 1 each in Warren and Essex Counties. The other site is Hibernia Mine in Morris County, NJ. The recent observation of over 500 IBATs in one of the Mt Hope mine shafts in Morris County will revise hibernacula counts upward significantly in NJ.

Summer Occurrences

Although summer records for IBATs in counties with hibernation sites are mostly males and nonreproductive females, there are 23 records of reproductively active females from winter counties (Gardner and Cook 2002). Nevertheless, records of reproductively active females from winter counties generally consist of one or a few individuals (Hicks and Novak 2002), as noted for VT, NH, PA, and NJ. Summering females from Blair County, PA and Morris County, NJ are the representatives in this tally nearest to PICA.

Based on the 1995 capture of a single female IBAT which had just finished weaning her young of the season, a maternity colony (roost site) was presumed to be on or adjacent to Picatinny property. Maternity colonies typically consist of 25 or more pregnant females or up to 200 individuals. A minimal population estimate on Picatinny property might assume 1 maternity colony of 24 reproducing females (co-habiting with the one captured female in 1995); and perhaps a couple dozen local male cohorts of the two previously captured in 1997; and a few non-reproductive females. Such assumptions would suggest the possibility of at least 60 IBATs roosting and foraging on or just outside the installation. Add to this number the possibility of 25 pups, which renders a late summer population of 85 animals, not to mention an influx of what is now believed to be several hundreds of fall migrants. Annette Scherer (USFWS) proffers the possibility of one maternity colony in the vicinity with perhaps 20-50 females. When pups are volant, at least 40-100 IBATs could be foraging at PICA, not to mention the cohorts of males and no-reproductive females on range at the same time.

3.7.1 Hibernia and Other Local Mine Studies

Hibernia Mine History

The mine working known as Hibernia began in 1722. Around 1765 iron ore from this mine (fourth ranked in NJ for overall production) was processed at forges located on nearby property that later became the federal military reservation known as Picatinny Arsenal. The mine was abandoned in 1913. Bats were documented in this mine as early as 1939 by two Cornell University researchers, H. Trapido and J. Kezer. Little Brown Bats (*Myotis lucifugus*) and Northern Long Eared Bats (*Myotis septentrionalis*) were noted at that time. Some specimens, including the Eastern Small Footed Bat (*Myotis leibii*) existed in the collection of the American Museum of Natural History circa 1946-47. Dr. John Hall (Albright College) banded thousands of bats in this mine in the 1960s and 1970s (Leffler *et al.* 1978); three of which were rediscovered in the years 1990-91.

Hibernia IBATs

NJ nongame zoologist Rick Dutko first reported IBATs in the mine in 1992. The following year (1993) IBATs were verified by the USFWS and NJ Division of Fish and Wildlife, Endangered and Nongame Species Program (NJDFW ENSP) biologists to be hibernating in Hibernia Mine; about 1.5 miles from the eastern edge of installation (PICA) property. A small wintering population has been confirmed using the mine consistently over the past decade (USFWS 2000, Hicks and Novak 2002).

Over the years of winter sampling in Hibernia Mine, 7 species have been documented adding the Eastern Pipistrelle, Big Brown Bat, and most recently the Silver Haired Bat (Valent and Dutko 1994, Scherer *pers comm.* 2004). The mine hosts primarily Little Brown Bats and between 20 to 120 IBATs (Scherer, Valent *pers.comm.* 2004). The variation in the number of IBATs counted may be attributed to identification difficulties, difficulty in picking them out of clusters of Little Brown Bats, and observer bias. Total number of bats (all species) counted within the portion of the Hibernia mine that can be safely accessed by biologists have been as high as 27,000 bats; however, the Hibernia mine workings are extensive and it is likely that additional bats (including perhaps IBATs) also use the unsurveyed portions of the mine for hibernation.

Through the 1960s and 1970s many shafts and chambers were forever closed or sealed by blasting and bulldozing. In 1989 the main entrance to Hibernia Mine was walled shut to exclude vandals and partiers. Bats were also excluded to a large degree despite some small holes near the top of the walled entrance (Valent and Dutko 1994). The issue of bat access for continued use of this well established winter roost site became the focus of mutual cooperation among the private landowners, the American Cave Conservation Association, and state and federal agencies. On July 9, 1994, a well-designed Bat Conservation Gate was installed to effectively exclude persons yet allow normal bat ingress and egress to the mine adit (Valent and Dutko 1994).

Mount Hope Mines (More IBATs)

Subsequently, with funding from the USFWS, ENSP began to survey abandoned mines in Northern NJ. Also a complex of mine shafts near Mt. Hope, NJ, even closer to PICA, were recommended for inspection by the environmental consultant for a proposed hydropower project (Balzano 1994). A few could be entered safely and counts conducted. A few are potentially unsafe, yet mist nets and captures during swarming activities occurred in October 1996. Two of three potential sites near Mt. Hope yielded a few IBATs, which suggested presence of a hibernating population (Hicks and Novak 2002), and likely New Jersey's second and third known hibernacula (Conserve Wildlife 1997). In the spring of 1998, six IBATs were captured while leaving one of the vertical shafts (USFWS 2000), which further verified the expected use of this site as a winter roost.

Absolute confirmation, as well as an inaugural count occurred in February 2004, when over 500 IBATs were observed for the first time in winter roosting clusters in one gallery of this deep network of vertical shafts and lateral drifts at multiple levels known as the Mt Hope Mine(s). These shafts are about 0.25 mile from the installation's Mt. Hope Gate, also on the eastern side of the federal property. As mentioned above, IBATs had been netted near the entrance of these two vertical shafts since 1996; however safe entry and descent by professionals was only recently allowed by the landowner and performed (in MHW-SHAFT) (Scherer *pers.comm.* 2004).

Although hibernacula have been documented only in Morris County, none have been documented at PICA. As discussed in Section 3.2, the IBAT hibernaculum closest to PICA is the Mt Hope Mine MHW-SHAFT in Morris County, NJ.

NY and PA Mines

In 2001, from 10 APR – 5 MAY, the spring exodus of IBATs from mines in Ulster County, NY were tracked and documented for several days by researchers of the private company Bat Conservation and Management, and NY and CT state biologists (Sanders *et al.* 2001). This was the first concerted effort to follow migrating IBATs in the Northeast U.S. Four female IBATs were trapped from two sites near Williams Lake (Rosendale, NY). One IBAT seems to have stayed in the local area and probably re-entered a mine site. One IBAT crossed the Hudson River and probably remained in CT. Two IBATs moved east to the Hudson River, then traveled south to near Newburgh and West Point, NY; and towards the NY / NJ border suggesting possible movement into northern NJ. These IBATs were documented as foraging in wetlands and in suburban sites; and roosting in a dead oak in standing water, a dead oak in an upland habitat, trees in orchards, and under the deck attached to a small home in a woodland setting. Despite three ground crews, more reliance on aerial tracking was recommended, since a couple of bats averaged sustained flight speeds of at least 25 mph.

In mid April 2004, NY Department of Environmental Conservation staff captured and released 20 transmittered female IBATs from Kingston NY (Ulster County which is less than 100 miles from PICA), eventually recovering 11. All 31 roosts were within 35 miles south and east of the hibernacula in Orange and Dutchess counties, and under 607 ft in elevation. Most roosts were shagbark or black locust trees, but also included a house, where bats were repeatedly observed exiting over the summer. The other nine IBATs may have traveled farther distances, and possibly into northern NJ.

In 2003, from 12-20 APR, a single female Indiana bat was captured emerging from its hibernaculum, an abandoned limestone mine (Hartman) in Canoe Creek State Park, Blair County, PA and tracked around the clock for four nights and days (Chenger 2003). This bat led trackers on an odyssey easterly through the Allegheny mountains, having easily crossed Blue, Blacklog, and Shade mountains, (each with elevation changes between 600 to 1,400 feet) in under an hour. After moving 37 miles in four days it settled into a dead white oak tree on a wooded upland slope. Several other bats were also observed during subsequent dusk counts, suggesting that this was a maternity colony in a primary roost tree. Aerial tracking was key to the successful monitoring of this migrating female IBAT.

3.7.2 PICA Studies

Besides the trapping and identification efforts mentioned previously in conjunction with the local mines by the NJDFW ENSP and USFWS NJFO staff, two summer field surveys have been conducted on PICA.

Figure 5 depicts capture sites and roost sites and zones of concern for conservation and management of IBATs on PICA.

Survey by Mt. Hope Hydro Inc. (1995)

The Mt. Hope Waterpower Project (aka Mt. Hope Hydro Inc) was conceived nearly two decades ago as a self-contained underground pumped water storage concept. The design involved installation of turbine generators deep (2800 feet) within existing iron ore mine shafts, to be flooded and activated during peak electrical usage hours. The water source would be a large above ground manmade reservoir. After flooding the turbines, the water-stored underground would be pumped back up into the reservoir over night (off-peak hours) for reuse the next day. Several such cycles of release and back pumping can occur in a 24-hour period if necessary. Based on the EIS prepared years earlier, the private investors ultimately would have to seek and receive a Grant of Easement for a Right of Way (RoW) to cross PICA with their transmission lines. Forest clearing for such a corridor on federal property necessitated an EA under NEPA. Mt. Hope Hydro Inc. pursued this task in the early 1990s. Since IBATs were known from at least one nearby winter roost in Hibernia Mine, there was concern that winter roosts may occur in other local mines, near or along the proposed project site and RoW. As presented previously, this fact was substantiated in the mid 1990s.

As part of the EA for the proposed RoW across PICA for Mt. Hope Hydro Inc., a summer survey, to be conducted by IBAT experts from KY, along the anticipated transmission line corridor was scheduled on and near the installation. In 1993, Hal Bryan of Eco-Tech Inc. pointed out that there were no documented maternity colonies of IBATs within several hundred miles of NJ – mainly because no mist netting or radio tracking had been undertaken in the (Mt. Hope Hydro Inc.) project area or elsewhere in NJ (Bryan 1993). On 29 JULY 1995 (the first good night of sampling after a rainout on 28 JUL 95), Mr. Bryan and his team mist netted a post-lactating female IBAT on Picatinny property. This represented the first confirmed summer record in NJ (Valent 1995) within the core maternity season (15 MAY –15 AUG). This capture suggested that an actual maternity colony existed within 1-2 miles of the capture site (Hal Byan et al. *pers.comm.* 1995), quite possibly on Army property.

Survey by Boston University and USFWS NJFO (1997-1998)

Subsequent biological surveys at PICA indicate that the installation currently supports the summer habitat needs of a local IBAT population (Rinehart and Kunz 1998, USFWS 2000). In the summer of 1997 (14 MAY-15 AUG), four graduate students from Boston University (BU) and one from Albright College, conducted nightly surveys to assess whether the IBAT forages or roosts in the natural habitat at PICA. Staff from the USFWS NJFO assisted them periodically. Additionally, for continuity of the IBAT seasonal movements and behaviors, after the students returned to college, the NJFO personnel were contracted to perform surveys in the fall of 1997; as well as the following spring 1998. The following chart summarizes:

Bat Captures at PICA (and nearby Mt. Hope Mines) from 14 MAY 97 through 17 JUL 98

	Bat Captures		Recaptures		Individual bats		Bats banded	# species	
	PICA	Mines	PICA	Mines	PICA	Mines		PICA	Mines
(May-Aug)	383	233	23	0	360	233	558	7	4
BU	616		23		593				
(Sep)	4	162	0	1	4	161	510	2	2
(Apr-May)	43	297	1	1	42	296		2	4
(Jun-Jul)	65	38	3	1	62	37		4	3
USFWS	609		7		602				
Totals	1225		30		1195		1068	7	

- All the bats recaptured by USFWS personnel were bats banded the previous summer by the BU team.
- 719 of these captures occurred during the summer maternity season, and IBATs comprised < 1% during this period.

Summer 1997

Twenty-six (26) different sites on the installation were sampled fairly evenly over the summer months for a total of 64 trap-nights. Seven of nine possible bat species in northern NJ were documented. Five sites, mostly in the northwestern portion of the installation, recorded four or more species. The capture rate was considered low when compared to the capture rate in 1995. Four trap-nights were spent off post at the Mt Hope mine MHW-SHAFT and MHE-SHAFT. Most of the 233 bats caught at these shafts were Little Brown Bats; no IBATs were caught.

All captured bats were banded using silver colored incoloy #1 size bands, serially numbered from 15001 - ~16001. A few bats and larger bats were banded with red colored incoloy #2 size bands, serially numbered from 6001~ 6102. All bands bear the prefix “THK”. Males received bands on their right forearms; and females on the left. IBATs were fitted with tiny transmitters (temporarily glued to back) for tracking (up to 14 days). Four Northern Long Eared Bats were similarly tracked – mainly as a test of the method in PICA terrain.

The telemetry equipment and methods worked well. Acoustic detection of ultrasonic echolocation calls of bats was utilized as an adjunct surveillance tool. The day roosts of tracked bats were identified and characterized. Evening dusk counts were made to record the time of the marked bat's exit, as well as numbers of other bats emerging.

During the BU survey, among the 360 bats caught on post, two male IBATs were captured (see Figure 5); one (IBAT 15119) while foraging at South Basin on 21 JUN 97, and the other (IBAT 15462) along the overgrown roadway near G-2 field on 12 AUG 97 (Rinehart and Kunz 1998).

IBAT 15119 (Building 3236)

IBAT 15119 was tracked for 9 days. Its first day roost after release was in an abandoned building (bldg 296); about 0.9 mile west of the capture site. The next day and all subsequent days it was roosting in a warehouse (bldg 3236); about 0.1 mile east of the capture site. This warehouse is perennially used as a summer roost site for hundreds of Little Brown Bats. Many of these bats banded that summer have been observed in this roost site in years since then. IBAT 15119 seemed to roost in the northwest corner of the building, away from most of the other bats. This male IBAT exemplified atypical or adapted summer roosting behavior, as well as co-habitation discussed previously in Section 3.4.1.

IBAT 15462 (G-2 Pond)

IBAT 15462 registered 13 bat-days of roosting and switching among 6 different roost trees over a total tracking period of 16 days. All of the roost trees were in the vicinity of the small G-2 Pond less than 0.25 mile south of the capture site. Most of the trees around the margin of this pond had been drowned by high water levels induced by a beaver dam constructed in the spillway of G-2 Pond a few years earlier. This cluster of roost trees had very similar characteristics. All had high bark cover (70-95%); heights ranged from 44 - 75 ft; and dbh ranged from 9 - 17 inches dbh.

On 29 AUG 97 it was determined that the transmitter was no longer on the bat, but apparently lodged under the bark of a red maple tree (USFWS 2000). This transmitter produced a signal for a total of 18 days. Attempts to retrieve the device for recycling were unsuccessful. This IBAT exhibited RAFi and RTFi by using one particular red maple for a total of 8 bat-days.

Dusk counts revealed that only 1, 2 or 3 other bats would exit with or after the tagged IBAT. Roost exit occurred at 2017 on 14 AUG 97 and at 1950 on 28 AUG 97 paralleling the progressively earlier time of civil sunset as described by Viele et al. (2002).

On one occasion, immediately after evening roost exit, IBAT 15462 was tracked from a ridgetop vantage as having circled the shoreline of Lake Denmark in a counterclockwise circuit for about 20 minutes before returning nearly precisely to the G-2 pond roost area.

Post Hibernation Emergence 1998

USFWS conducted harp trapping activities at both the MHW-shaft and MHE-shaft near PICA during spring of 1998 and additional mist netting on PICA in mid summer. Six IBATs (3 females and 3 males) were captured on three different nights in April at the shaft(s). This capture site was near the location of the proposed reservoir for the Mt. Hope Hydro project. One of these IBATs sustained a trapping injury to a wing and was transferred to a NJ Wildlife rehabilitator. IBAT 15821 was recovered on the same night of its release, having been killed by a local raptor near the Mt Hope Pond. Of the remaining 4 transmitted bats, two likely remained in the local area until the transmitter signals failed and two likely migrated out of the local area. Female IBAT 15683 was located on three nights foraging near the mineshafts and nearby rock quarry and after re-entering the mine on 6 APR 98, was not relocated again. Male IBAT 15855 was tracked from its release on 30 APR 98 through 5 MAY 98. This bat foraged nightly in the vicinity of Mt Hope Pond, located just south of the mine(s). Early battery failure of the applied transmitters and signal interference limited the information collected from these bats. Female IBAT 15750 left the local area immediately upon release. Male IBAT 15749 foraged at a pond on PICA for about 1 hour and 20 minutes and then is believed to have left the local

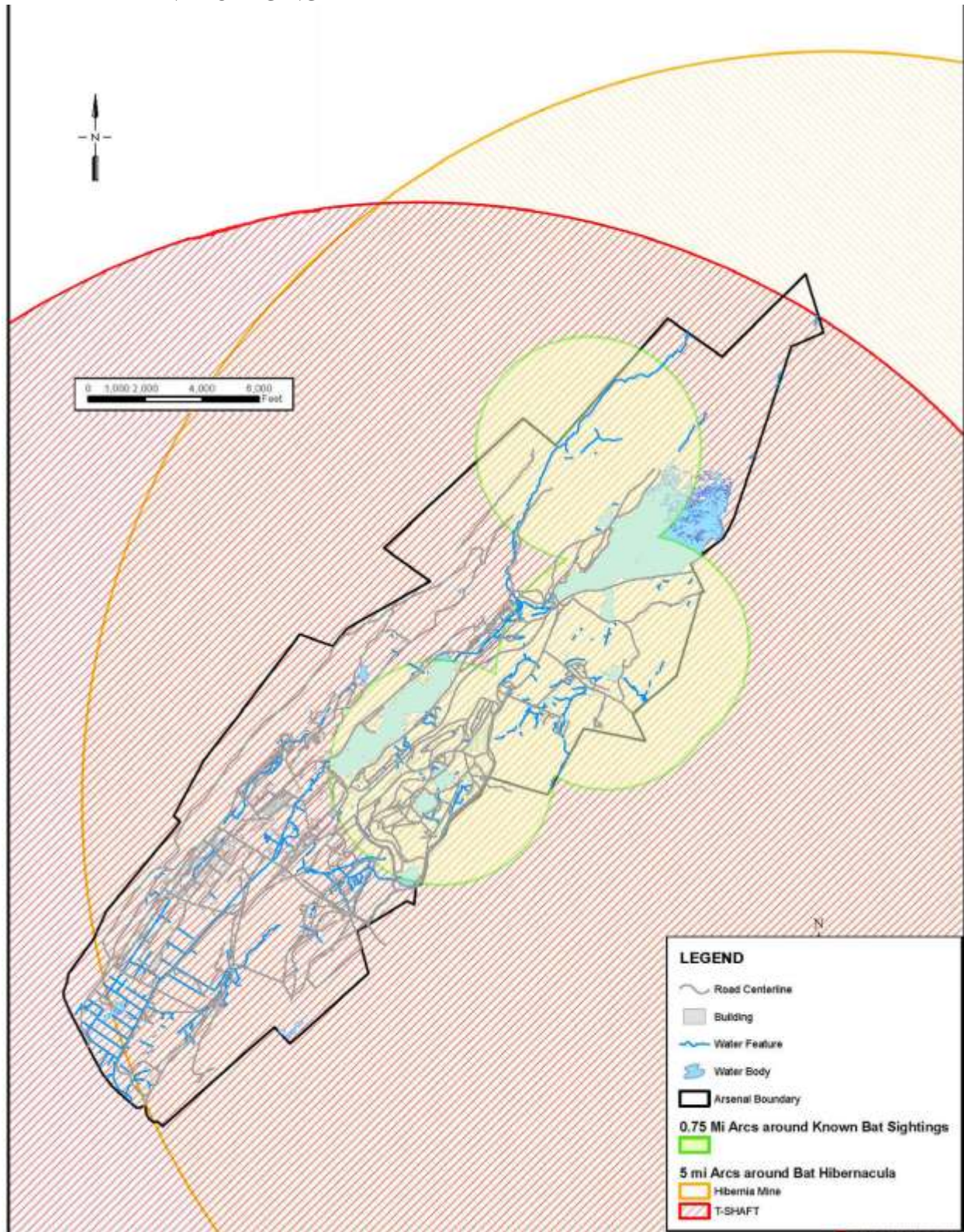
area. Efforts to locate signals of bats dispersing from the shafts by automobile were unsuccessful (USFWS 2000).

These intensive survey efforts revealed that the IBAT forages and roosts on PICA property and that the Little Brown Bat was the species most commonly encountered/captured (Rinehart and Kunz 1998, USFWS 2000). Although the Little Brown Bat is the most often observed species in the cantonment and semi-improved grounds, the Northern Long-Eared Bat is most prevalent in the forested portions of the Arsenal. Tree foraging and roosting behaviors are similar to those of the IBAT. Several tree roosts of each of these forest-adapted species were located on the eastern side of the Arsenal during the summer survey in 1997.

Survey by Bat Conservation and Management, Inc. (2006)

(intentionally left blank at this time – 27 AUG 07 – due to time and space limitations. A synopsis of the most recent IBAT survey at PICA will be appended here at the next subsequent ESMP review period).

FIGURE 5 PICATINNY IBAT CAPTURE SITES; ZONES OF CONCERN FOR ROOSTING AND FORAGING



3.7.3 Other Relevant Studies

Summer Habitats Outside Core (Midwest) Range

Gardner and Cook (2002) reviewed many studies of summer habitat of known maternity colonies in most of the natural range in order to characterize and perhaps highlight essential parameters and variables at the landscape scale. Quite germane to this ESMP are their following qualified caveats.

Only one county record (Morris County, New Jersey) of a reproductively active female fell outside the maximum migration distance from the eight major (Priority One) hibernacula. However, there were winter records for thousands of IBATs from the Northeastern states and suitable summer maternity habitats undoubtedly occurred in at least portions of this northward extension of the IBAT's range. Unfortunately, lack of knowledge of summer habitats used by reproductively active females in this area precluded inclusion of additional types of forest cover from these areas in our range-wide predictive model (Gardner and Cook 2002).

Brack *et al.* (2002) compared detailed climatological maps, which indicate that the core portion of IBAT maternity range is typically warmer in summer than parts of the bat's range to the east and northeast.

Michigan

Kurta *et al.* (2002) studied the roosting ecology of a group of IBATs in southern MI over 4 years. All roosts were in palustrine wetlands (Cowardin *et al.* 1979), except (one) the shagbark hickory. The fact that 37 of 38 roosts (97%) were located in wetlands suggested that bats actively selected wetlands for roosting purposes. Also, the relative proximity of roost trees to one another indicated clumping, since the average distance from a roost to a neighboring roost was 981 ft (299 m), but the median was only 105 feet (32 m) (Kurta *et al.* 2002).

Superficially, the wetland habitats and tree characteristics in southern MI (Vermotville) are similar to those at PICA and northern NJ. Rockaway Township, NJ latitude (40.5°N) is only 2.1° more southerly. The USDA Hardiness Zone comparisons are "5a" in the MI county, and slightly warmer ("6a" and "6b") in Morris County.

Pennsylvania

The only studies of summering IBATs in PA have been in the central part of the state at approximately 40.3°N latitude and in the USDA Hardiness zone "6a". Canoe Creek and the Frankstown Branch of the Juniata River wind through limestone valleys flanked with ridges covered by forests of mixed oaks (*Quercus* spp.) and hickories (*Carya* spp.), as well as northern hardwoods (birch, *Betula* spp.; maple, *Acer* spp.; and beech, *Fagus* spp.). Valley bottoms are a mosaic of riparian woodlands, old fields, pastures, croplands, and rural residential sites (Butchkoski and Hessinger 2002). Even with the diversity of landscape types, these IBATs used the largest block of continuous forest for their activities and mainly foraged in interior forest stands (Butchkoski and Hessinger 2002). Again, the PA upland summer habitat is similar to northwestern and north central NJ, although the slopes at PICA are steeper.

In summer of 1997 while PICA was being surveyed for IBATs, students of Albright College under the direction of professor Karen Campbell were also surveying federal property in the Delaware Water Gap National Recreation Area. No IBATS were caught in their 90-100 net-nights of effort between May and July on the west side of the Delaware River. This survey was repeated in 1998, including net sites on the NJ side of the Delaware River, however no IBATs were captured.

Habitats Near Hibernacula (MO, IN, VA, KY, PA, NY, NJ)

Romme *et al.* (2002) tracked the staging area activities of IBATs on and near Fort Leonard Wood, MO. Home ranges of IBATs appear short-lived in spring and fall. Size of home range averaged 93 - 464 acres (113 ± 75 ha) for females and 410 – 850 acres (255 ± 89 ha) for males. In springtime they documented a maximum distance of travel of 6.4 miles (10.3 km) for one female. Male bats in Indiana have been found almost 10 miles from hibernacula during spring staging (3D/International 1998). In autumn bats traveled up to 3.9 miles (6.4 km) from the cave where they were captured. Staging areas near hibernacula in spring and autumn may vary from year to year with proximity and quality of available roosts, weather conditions, and availability of prey (Romme *et al.* 2002).

Although bats have been found up to 4.2 miles from hibernacula in the fall (3D/International 1996), most of the bats tracked in summer and fall have stayed within two to three miles of hibernacula (Clawson and Titus 1992, Hobson 1993, Kiser and Elliott 1996). Work is still needed to determine how far male bats will roost and forage.

Hobson and Holland (1995) used telemetry to track two IBATs in spring near a hibernaculum in western Virginia (Romme *et al.* 2002). They documented a home range of about 1544 acres (625 ha); however Romme *et al.* (2002) believe Hobson and Holland were witnessing movements in a maternity cohort.

In central PA, recaptures and observations of banded IBATs documents at least 8 females using both the summer roosts at Canoe Creek State Park and the nearby winter roost in Hartman Mine (Butchkoski 2003).

New Paltz, NY near the hibernacula in Ulster County with thousands of IBATs is located at 41.7°N latitude and comprises USDA Hardiness zones “5b” and “6a”.

Bat Band Returns

In February 1999, three Little Brown Bats banded in 1997 were observed hibernating in Hibernia Mine. One of these bats (THK 15143) was banded on PICA in early JUL 97, another (THK 15388) was banded at the MHW-SHAFT in early AUG 97, and the third (AC710) had been captured and was banded 31 AUG 97, while swarming at a mine near Quakertown, PA by Dr. Karen Campbell of Albright College. In March 2002, two banded bats were observed in Hibernia Mine: a Little Brown Bat (THK15197) was first caught and banded on 22 JUL 97 at the spillway of Lake Denmark on PICA; and the other, a Big Brown Bat was first caught and banded on 18 MAY 98 at the MHW-SHAFT of Mt Hope mine. Again in February 2004, two different banded Little Brown Bats were seen in Hibernia Mine: one (THK 15170) had been banded on 14 JUL 97 as an adult male near the railroad bed to the northeast of Lake Denmark; and the other (THK 15327) had been captured as a juvenile male on 27 JUL 97 at the Mt Hope Mine.

Summer Habitat Models

In summer of 2000, PICA funded a study by the USACE Waterways Experiment Station to compare and evaluate two Summer Habitat Suitability Index (HSI) Models for possible use by the PICA NRM in developing this ESMP. One HSI model developed by Romme *et al.* (1995) for the Indiana Department of Natural Resources was compared with a recently released model developed by the U.S. Fish and Wildlife Service (Farmer *et al.* 1997). Both models were developed for the “core” maternity range in the Midwest. Similar habitat variables were measured in each model, including density of suitable roost trees and percent area with forest cover, for three different and spatially separated areas across the installation. The Romme model was more complex, using 9 “life requisite” variables, versus 3 “landscape” variables in the USFWS model. The final report (Webb *et al.* 2001) concluded that the simpler model was less sensitive to habitat quality differences due to the generic landscape scale variables employed, whereas the other model might provide better ‘resolution’ and sensitivity, but only at the expense of more intensive data collection and application. The most limiting variable (for NJ habitat) in the USFWS model was “cover types” and in the Indiana model it was “tree dbh.” It was also noted that the calculated numerical indices’ values representing high, medium, or low suitability did not seem to corroborate field experience with regard to capture rates, documented roosting, and overall bat activity areas.

In a follow up evaluation of their own model, Farmer et al. (2002) were quite explicit that the utility of the model is based on a single component— density of suitable roost trees, which can be used to assess potential habitat at sites of interest, yet only in the core maternity range. Miller *et al.* (2002) seem to concur that density of roost trees is a key factor for IBATs occupying suitable habitat.

The NRM, after consultation with the local USFWS biologist, decided to defer use of any summer habitat model until their utility and reliability in the northeast might be improved.

Food Sources and Contamination

As part of the ongoing Environmental Remediation Program and recommendations of the USFWS, a baseline ecological risk assessment was performed to evaluate potential exposure pathways for contaminant uptake in IBATs near contaminated sites. Dr. Frank Carle, Rutgers University, and Shaw Environmental, Inc conducted prey tissue analysis on biomass samples of collected Trichopterans. Although bioaccumulative chemicals are present in some brook and pond sediments, as well as in emergent insects from those locales, the calculated levels extrapolated by the food chain model are sufficiently low to imply that no adverse effects to the IBAT are expected. Species richness was high over the collection months and locations.

Stream sampling of Dipteran -Chironimids by a Drew University undergraduate student, led by Dr. Leland Pollack, also revealed fairly high species diversity in all reaches of Green Pond Brook.

The species diversity of these invertebrates also indicates above average water quality despite known contaminants in some pond or lake sediments. The diversity of Lepidopterans is also high and no pathways of contamination are suspected for moth species. There has been no spraying for gypsy moths since the 1980s.

Regional and Professional Bat Working Groups

Two bat organizations well known among bat managers are Bat Conservation International (BCI) and Bat Conservation and Management, Inc. (BCM). BCI (<batcon.org>) is a nonprofit organization based in Austin, TX, founded by Dr. Merlin Tuttle, which promotes research and conservation of bats worldwide. BCM (<batmanagement.com>) is a private company based in Carlisle, PA, started by John Chenger, specializing in bat management solutions for homeowners, as well as assistance to public land managers.

Encouraged by BCI, the North American Bat Conservation Partnership (NABCP) includes four Regional Working Groups: the Northeastern Bat Working Group (NEBWG), the Southeastern Bat Diversity Network (SBDN), the Western Bat Working Group (WBWG), and the Mexico Bat Working Group.

The NEBWG (formed 1998) comprises a Steering Committee, 22 State Coordinators, and Special Committees to address specific bat conservation issues. The goal of the NEBWG is to conserve bats and their habitats in northeastern North America through collaborative research, education, and management.

The National Military Fish and Wildlife Association (NMFWA), chartered in 1983 by DOD resource management professionals, is a non-profit organization consisting of resource managers working to protect and manage wildlife and other natural resources on DOD lands. These individuals recognize the critical need for awareness of natural resource conservation requirements in order to provide for both long-term sustainability of resource diversity and the successful accomplishment of the military training mission on public lands administered by the DOD. Chester Martin of U.S. Army Engineer Research And Development Center (USACE-ERDC), Vicksburg, MS, chairs a Bat Working Group of this organization. Some of the issues of concern to this working group are: (1) The need for proper bat inventories and what constitutes an adequate survey; (2) bat exclusion measures in old structures; (3) consideration of bat conservation and management in installation Integrated Natural Resources Management Plans; and (4) difficulties obtaining funds for bat surveys and management when there are no threatened or endangered species involved.

3.8 CHRONOLOGICAL OVERVIEW (IBAT Benchmarks)

- 1913 Unknown or misidentified bats from Nickwackett Cave in Brandon, VT identified decades later as IBATs; thus 1st collected and (subsequently) vouchered specimen of IBAT.
- 1928 1st IBAT Discovered and described as a separate species by Miller and Allen in Indiana.
- 1940s (mid) 1st Reproductively active female IBAT was collected during maternity season; central IN (Kirkpatrick and Conaway 1948).
- 1950s (late) Caves and mines (winter roosts) surveys in Midwest Karst regions.
- 1962 J. S. Hall classic work on *Myotis sodalis*.
- 1964 1st Winter census inside hibernacula (Ozark Plateau) [R. F. Myers].
- 1967 (March 11) IBAT listed Endangered under ESA.
- 1969 1st Distribution map [Barbour and Davis].
- 1971 1st Maternity colony (~50 bats) discovered accidentally after dead American Elm tree bulldozed over in west-central IN (Cope *et al.* 1974).
- 1976 1st Recovery Plan for IBAT [USFWS].
- 1976 (September 24) Critical Habitat designated for IBAT under ESA.
- 1977 S. R. Humphrey landmark study of roosting behavior and summer habitat in west-central IN.
- 1970s (late) Nocturnal and foraging behavior studies [LaVals', R.K. and M.L.].
- 1970s (late) IBATs banded in MO hibernacula recaptured in IA indicating long distance migrations to summer range.
- 1981 Second distribution map [E.R. Hall].
- 1983 1st Revision IBAT Recovery Plan [USFWS]; mostly winter ecology information.
- 1980s (mid) 1st Radio telemetry studies conducted by IL Department of Natural Resources after transmitters miniaturized sufficiently for bats.
- 1986 1st Maternity roost found using radio telemetry in IL (Gardner *et al.* 1987).
- 1992 (February) 1st Winter roosting IBATs documented in NJ; Hibernia Mine, Morris County.
- 1994 (Summer) Bat gate effectively installed on Hibernia Mine entrance.
- 1995 (July 29) 1st Reproductively active female IBAT documented during maternity season in NJ; on PICA, Morris County. 1st PICA IBAT survey. Also, year of 1st Summer Habitat Suitability Model (Romme *et al.*).
- 1996 (July 8) 1st Maternity colony (34-(66)) documented in OH; inadvertent discovery when old dead tree cut down 75 feet from an occupied house in a residential subdivision.
- 1996 (October) Other winter hibernacula (mines) evaluated in NJ; including 1st vertical shafts in U.S. IBATs present in pre-hibernation swarms. Amateur spelunkers descend and disturb bats in MHW-SHAFT before Christmas; unable to exit, rescued by PICA and volunteer fire departments.
- 1997 (Summer) 1st Maternity colony (29 bats) in NE US (PA); and 1st in a building (abandoned church). Also, year of 2nd Summer Habitat Suitability Model (Farmer *et al.*).
- 1997 (Summer) 1st Male IBATs roosting during summer season documented in NJ; on PICA, Morris County. Tree roosts; as well as 1st documented roosting in a building (warehouse) in NJ. 2nd PICA IBAT survey
- 1998 (Spring) Continuation of 2nd PICA IBAT survey (1st Spring emergence and staging survey in NJ). Six IBATs from MHW-SHAFT of Mt Hope Mine confirms 2nd hibernaculum in Morris County, NJ.
- 1999 (February) 1st banded bats (Little Brown Bats) observed in Hibernia Mine during winter census; suggesting nexus between summer range from nearby PICA (NJ) and eastern PA to winter roost at Hibernia (NJ).
- 1999 (March) Draft Revised Recovery Plan [USFWS].
- 2001 (Spring) 1st tracking of NY female IBAT migration patterns (Sanders *et al.*).
- 2001 (Summer) 1st Summer record of IBAT in VT.
- 2003 (July) Largest maternity colony in a building in U.S; an IA barn built circa 1880s.
- 2003 (April) 1st tracking of PA female IBAT migration pattern (Chenger 2003 *et al.*).

- 2004 (February 26) 1st Entry / Descent down vertical mine shaft to inspect IBAT hibernaculum in NJ. Over 500 IBATs present representing confirmation of 1st P2 hibernaculum in NJ; Morris County.
- 2005 (summer) Female IBATs discovered in Great Swamp National Wildlife Refuge.
- 2006 (April) PICA spring migration survey. Maternity roosts documented well south of PICA in Morris County; as well as in Somerset and Sussex Counties (Chenger 2006a).
- 2006 (July) PICA summer woodland survey. Two male IBATs captured, and one new IBAT roost documented (Chenger 2006b).
- 2006 (summer) Maternity roosts documented in Great Swamp National Wildlife Refuge; and 1 female IBAT discovered near Morris County municipal airport.
- 2007 (June) Maternity colony discovered in Sussex County, NJ
- 2007 (???) Revised (2nd) National IBAT Recovery Plan.
-

Sources: (Gardner and Cook 2002) (Hicks and Novak 2002) (Butchkoski and Hassinger 2002) (Belwood 2002) (Dutko 1994) (Butchkoski *e-mail*; Scherer, Craddock, Chenger *pers.comm.*2004)

4.0 PICA CONSERVATION GOALS

Natural resources at PICA are managed based on the principles of ecosystem management, the objectives of which are to restore ecosystems where practical and create optimum habitat for all wildlife species, including the IBAT. Specifics regarding these objectives are presented in PICA's INRMP (PICA 2001).

Unique habitats are frequently divided into the following classes: a) federally designated "critical habitats," b) areas supporting high concentrations of wildlife, c) areas critical to particular species, d) concentrated migration routes, e) land forms or areas of unusual vegetation associations that support unusual wildlife species, and f) areas that were significant as wildlife habitat in the past (Chambers 1983). Federally designated critical habitats are ascertained and described by the USFWS. No "critical habitat" for the IBAT exists on or near PICA; however, habitats used by IBATs throughout its range are provided protection under the E S A. Due to the proximity of three separate hibernacula, PICA provides summer and pre-and post-hibernation roosting and foraging habitat for the IBAT. Although no maternity colonies have yet been discovered, it is presumed that they can occur on the federal property, and it is established that males do roost and forage on post in a variety of areas. IBAT protection at PICA must be predicated on both the widespread spatial use and the extended temporal use of the available habitat throughout the Non-hibernation season (1 APR – 15 NOV). From the state perspective, because of high wildlife concentrations, diversity, and connectivity, Picatinny comprises a major portion of a NJ Natural Heritage Priority Site known as Green Pond Macro Site.

As discussed in Section 3.7, the IBAT has been found to forage at PICA and males are known to roost in the trees (or buildings) on post. Although IBAT habitat requirements, are generally discussed in Chapter 8.8.2 of the INRMP these are more specifically addressed in this ESMP.

The 1983 recovery plan for the IBAT establishes the following national goals to meet the primary objective of removing the IBAT from its endangered status:

- preventing disturbance to hibernacula,
- maintaining, protecting, and restoring foraging and summer maternity roosting habitat,
- monitoring population trends,
- educating the public,
- and conducting research (USFWS 1983).

Although the roosting and foraging habitat at PICA is not considered to be critical to conservation of the IBAT and may make up only a relatively small fraction of the bat's total summer range, the U.S. Army understands that this habitat, especially being within 5 miles of known hibernacula (Kiser and Elliott 1996, Scherer *pers.comm.* 1999, USFWS 2000, Clawson 2000) is an important "area of influence" (USDA-FS 2000) to the local bat population and potentially to the long-term survival of the species. Gumbert *et al.* (2002) proffer two recommendations relevant to this ESMP: (1) biologists must consider various types of fidelity by IBATs when developing management plans for areas near hibernacula; and (2) sites of repeated use by individuals or by the species likely provide high-quality roosting conditions and should be preserved (Gumbert *et al.* 2002). Therefore, the following conservation goals have been established at PICA:

- Conserve existing foraging and (male or non-reproductive female) roosting habitat at PICA.
- Identify and conserve potential IBAT summer maternity roosting; as well as non-maternity roosting habitat at PICA.
- Estimate the IBAT population at PICA and monitor trends periodically.
- Educate individuals who have a potential impact on the IBAT regarding the species and its presence at PICA and local mines (including possible lessees on PICA property).
- Communicate with USFWS regarding the status of the IBAT at PICA and in the local area.

Conservation goals and management prescriptions in this ESMP will be reviewed by PICA's NRM on an annual basis and updated and coordinated with PICA organizations, if necessary. As discussed in Section 3.6, USFWS is currently revising its recovery plan for the IBAT. USFWS has done much work on the draft revision (MAR 1999) of the 1983 IBAT recovery plan (Scherer *pers.comm.* 2004). Hopefully a new recovery plan will be finalized within the next 2-3 years. When the revised recovery plan is available, conservation goals and management prescriptions outlined in this ESMP will be reviewed for consistency with the revised recovery plan.

Since 1996, most of the aforementioned conservation goals have been actively promoted through adherence to the following interim policies:

- Restrict / Prohibit tree trimming or cutting from 1 APR – 15 NOV (spring, summer, fall).
- Scope and schedule all anticipated projects well in advance of seasonal restrictions.
- All in house or contract work involving tree removal or pruning must be coordinated with Natural Resources Manger, even during winter season (16 NOV--31 MAR).
- Favor retention or creation of snags during any forest management. Strive for 24 suitable roost trees (>9 inches dbh) per acre.
- Retain all Shagbark Hickories and mature Sugar Maples and White Oaks.
- Minimize incremental or cumulative permanent loss of forest cover over entire installation.
- Establish 0.75 mile buffer zone around documented capture / roost sites. Within these 0.75-mile perimeters: no permanent loss of forest cover; maintain or increase snag densities; informal consultation with USFWS required for all proposed projects.

These will be carried forward in the specific management prescriptions discussed in Section 5.0 following, which will be implemented to support PICA's current conservation goals.

Compliance with this ESMP is consistent with principles of ecosystem management used at PICA and supports applicable conservation goals outlined in the IBAT recovery plan (USFWS 1983). Although compliance with this ESMP will contribute to the success of the specific IBAT population at PICA as well as the overall recovery of the species, it is important to consider that certain negative impacts may occur that are beyond the control of the installation. For example, harm to the population may be caused at off-site winter hibernacula, during spring or fall migration, or at the installation by activities on surrounding properties.

5.0 MANAGEMENT PRESCRIPTIONS

This section discusses management prescriptions that will be implemented by PICA to meet the conservation goals set forth in Section 4.0 so as to conserve existing IBAT summer foraging and roosting habitat. If a new installation activity is initiated that may impact the IBAT, PICA will review and update this ESMP as necessary and will engage in ESA Section 7 consultation with the USFWS Region 5, Pleasantville, New Jersey Field Office (NJFO). For activities that PICA is considering undertaking, funding, permitting, or authorizing that are outside the scope of these prescriptions and have a potential impact on the IBAT at PICA, PICA will engage in necessary ESA Section 7 consultation with the USFWS NJFO.

N.B. Any lessees of PICA property are subject to these goals and prescriptions, which will be specified in lease or easement agreements, as appropriate.

In addition, other management prescriptions that are not directly related to an ongoing or future PICA activity will be taken by PICA to meet the conservation goals, such as ongoing monitoring of the IBAT population at PICA and implementation of an employee and community awareness program.

5.1 MANAGEMENT PRESCRIPTIONS FOR PICA ACTIVITIES

This section presents prescriptions for activities that take place at PICA that might impact the IBAT. To facilitate implementation of these prescriptions, they are categorized according to general types of ongoing and future PICA activities that are most likely to impact the IBAT. These activities include forest management, pest management, construction and demolition, environmental remediation, leasing of PICA property, training exercises, hunting and other outdoor recreation, and firewood cutting.

N.B. Any bats that are trapped at roosts sites for identification purposes (as specified in the following prescriptions) will be banded prior to release; and record maintained by the NRM.

5.1.1 Forest Management

No commercial timber harvesting currently occurs at PICA. The forest management program at the installation consists of hazard tree removal, some urban forestry and plantings in the improved grounds and occasional timber stand improvement (TSI) is possible.

The presence of the IBAT will affect the type, location, and frequency of any possible timber harvests in future years. The main goal of forest management is to protect and conserve IBAT foraging habitat within the perimeter of the Arsenal during the IBAT spring staging, maternity roosting, and fall swarming seasons (April 1 through November 15 – aka Non-hibernation Season), due to nearby hibernacula.

N.B. For the past several years, a 0.75mile buffer zone around capture sites has been employed as an administrative tool for quantifying and qualifying known and likely habitat used by IBATs to assure that any new projects, operations, or forestry actions in such areas receive at least informal consultation review with the USFWS NJFO.

Under the principles of ecosystem management, the PICA forest management plan promotes the health and vigor of all forested tracts where the IBAT may be present. A complete description of suitable and potential bat habitat, including snag density, snag bark cover, tree density, and size classes, at PICA will be developed through implementation of the forest management section of the INRMP. Forest management practices will reflect USFWS IBAT guidelines for forest management and, if applicable, ESA Section 7 consultation.

Management of habitat near hibernacula of IBATs should include the conservation, creation, and maintenance of mixed-forest types, ages, and stand conditions, while maintaining a continuing supply of suitable roost trees (Gumbert *et al.* 2002) and areas; although Brack *et al.* (2002) may dispute this approach? See Section 3.7.3, Other Relevant Studies. Managing for roost trees may involve implementing cutting regimes that maintain multi-aged stands and retain a component of mature trees following harvest, leaving dead and damaged trees standing, and leaving all trees previously used by IBATs. Tarr (1999) suggests that management within the

summer range should apply even and uneven-aged management that allows large (>20 inches dbh) trees to grow and retains large diameter (>8 inches dbh) snags.

Gumbert *et al.* (2002) also recommend including long-term population assessments to identify core roosting areas, because evidence from MO and MI indicate that colonies may use the same geographic areas for at least 14–18 years (Kurta *et al.* 1993b, 1996, Miller 1996). Miller *et al.* (2002) reiterate that for a long-term philopatric species that depends upon persistence of an ephemeral resource (snags), a continuous supply of roost trees is needed. Farmer *et al.* (2002) cite a study in IA that reports a density of 4 -10 potential roost trees / acre in areas surrounding successful netting sites.

Forest management prescriptions and actions that will be implemented by the PICA NRM to identify and preserve summer habitat (1 APR – 15 NOV) for the IBAT are described below.

1. Restrict / Prohibit tree trimming or cutting from 1 APR – 15 NOV (spring, summer, fall).

Tree cutting will not occur at PICA during the active IBAT roosting season (April 1 through November 15) unless this is necessary to maintain forest health or safety conditions (for example, control of a disease or insect outbreak or removal of storm damage). Pre-coordinated and scheduled selective tree cutting will be limited to the period when IBATs would be hibernating (November through March) whenever feasible.

2. Coordinate unavoidable tree cutting during the PICA IBAT Non-hibernation season.

Any tree cutting activities during the Non-hibernation season, or within 0.75 miles of known roost or capture sites, or determined by PICA to have a potential impact on the IBAT will be coordinated with the USFWS NJFO and will undergo any necessary ESA Section 7 consultation to avoid and minimize impacts on the IBAT and on known and (potential maternity) roost trees. As part of Section 7 consultation, the PICA NRM will provide a detailed description of the tree(s) (species, dbh, and condition of tree, condition of bark, presence of cavities or crevices, presence of dead limbs), along with an explanation of the need to remove the trees, to the USFWS NJFO. Based on this information, a determination will be made on whether the trees provide potential IBAT roosting habitat.

If it is determined that the trees provide potential roosting habitat, then the trees will have to be monitored for the presence of bats prior to removal. Tree removal will take place the day immediately following two consecutive nights of dusk counts (in good weather) in which no bats are observed. If tree removal is not practical immediately after the second dusk count, a pre-dawn count will be conducted using a bat detector the next available day to verify that bats are still not roosting in the tree; and the tree will be removed that day. If bats are present, then netting near the tree at/after dusk will be necessary for 2 consecutive nights to identify the bat species.

If IBATs are documented the tree will not be removed without consultation with USFWS NJFO (the need for an incidental take statement will be evaluated). If bats other than IBATs are present then the tree may have to be removed after dark and bat emergence, or bark removed after dark to encourage returning bats to occupy alternate roost trees prior to removal of that tree. Felling a tree after dark will need to be evaluated and authorized by the safety office.

Trees posing an imminent threat to public safety may be trimmed or felled; however if IBATs are found to be present, are injured or killed, an “emergency after-the-fact” consultation MUST be initiated immediately (by phone AND in writing) with the USFWS. If at all possible, the NRM must be consulted/notified PRIOR to such a determination of imminent risk/hazard; and alternative or temporary options considered.

3. Forest management will promote a diversity of age and size classes with emphasis on retention of adequate stocks of large, mature and overmature trees in each stand. The range of acreage of stands at PICA is presented in the forest management section of the INRMP. As individuals in the latter age class die and become snags (trees with less than 10% live canopy), they will provide a continuing supply of potential maternity roost trees (typically those listed in Table 3) for IBATs. Reforestation efforts will favor planting tree species native to regional ecological communities and local IBAT roost tree species where practical.

The following forest management prescriptions will be implemented to maintain a suitable component of habitat for the IBAT at PICA. Because of heterogeneity both within and between stands, not all the conditions noted are necessarily evenly distributed across the landscape or currently present in each stand. Attainment of habitat management goals will be evaluated, therefore, on an average (per acre), stand-wide basis and will be attained through the life cycle of forest management activities in each stand

- An average of at least three live potential maternity roost trees per acre with a dbh greater than >20 inches (preferably >26 inches) will be maintained in the stand. These will be the largest potential maternity roost trees in the stand.
 - An average of at least six additional live potential maternity roost trees per acre with a dbh greater than 10 inches will be maintained in the stand.
 - If the stand does not contain trees larger than 20 inches dbh, then at least 20 live potential maternity roost trees per acre will be maintained in the stand. These will be the largest potential maternity roost trees in the stand.
4. Shagbark Hickory (*Carya ovata*) is recognized for its high value as potential maternity roost trees. Mature Sugar Maple and White Oak trees also possess scaly bark suitable for roosting. The PICA timber inventory will determine the density and distribution of Shagbark Hickory in each stand, as well as the two maple and oak species. The harvest of these species may be allowed subject to (1) density thresholds that would otherwise inhibit their reproduction and (2) compliance with other forest management prescriptions described in this ESMP. PICA will engage in ESA Section 7 consultation with the USFWS NJFO regarding cutting of such trees at the installation during the Non-hibernation (roosting) season or that has a potential impact on the IBAT. Retain all Shagbark Hickories and mature Sugar Maples and White Oaks. Although Black Locust (*Robinia pseudoacacia*) is considered an invasive species, mature specimens on post in suitable bat habitat will be retained.
 5. Snag (and wolf) tree management

Protect and retain snags for roosting habitat. Snags will be defined as any dead, partially dead, or defective live (cull) tree at least 10 ft tall and at least six (6) inches dbh. Retain large dead (wolf) trees that are potential nursery sites. Snags will not be removed except where they pose a threat to safety or forest health (for example, a threat of disease or insect outbreak). In the event that snag removal is necessary during the IBAT roosting season, the removal will take place immediately after two consecutive nights of dusk counts (and two net nights if necessary) in which no IBATs are identified. If snag removal is not practical immediately after the second dusk count, a pre-dawn count using a bat detector will be performed the next available day to verify that bats are not roosting in the snag, and the tree will be removed that day. If IBATs are present, PICA will engage in ESA Section 7 consultation with the USFWS NJFO to evaluate the need for an incidental take statement. Where practical, snags will be retained in groups with live trees to prevent wind-throw. Favor retention or creation of snags during any forest management activities. Strive for 20 suitable roost trees (>10 inches dbh) per acre.

6. Active roost tree (site or structure) protection.

As active roost trees (including maternity) are identified at PICA, they will be protected until they no longer serve as roosts (e.g. loss of exfoliating bark, cavities, blow-down, or decay). As discovered, roost trees may be discreetly marked, as appropriate. Timber harvest and disturbances will be prohibited within at least 300 ft of sites containing bats. If necessary, exclusion zones or boundaries of roost clusters will be visibly marked to preclude disturbance (U.S. Army 1995). Installation base maps will depict a 0.75-mile buffer zone around known roost trees or capture sites on post, as well as off post if within 0.75-miles. Similarly, non-tree roost sites (and hibernacula) found on the installation, will be protected in like manner. All trees meeting the criteria in prescriptions 3, 4, and 5 above in forest stands within 0.75-mile buffer zones will be retained.

7. Canopy cover will be maintained at or above 60% in each forest stand after any forest management activities. The percentage of canopy cover will be evaluated on an average stand basis, not as continuous cover.
8. Minimize incremental or cumulative permanent loss of standing forest cover up to 7 percent or approximately 280 acres with up to 40 acres in riparian corridors. A key objective is to minimize permanent loss of forest cover due to the installation's proximity (within 5 miles) of New Jersey's three known hibernacula (Kiser and Elliott 1996, Scherer *pers.comm.* 1999, USFWS 2000, Clawson 2000, USDA-FS 2000, Romme *et al.* 2002).
9. Up to 40 acres of riparian corridor may be cut for mission activities. Tree cutting within 150 ft of wetlands (other than the aforementioned 40 acres), including on both sides of perennial and intermittent streams will be limited to activities that maintain or improve the quality of IBAT habitat and are IAW other forest management prescriptions described in this ESMP. PICA will engage in ESA Section 7 consultation with the USFWS NJFO before conducting tree-cutting activities in designated riparian corridors. Most riparian areas on the installation consist of second-growth hardwood forests in moderately sloping or level brook corridors.
10. Although controlled burning of woodlands has not been practiced at PICA, if this method of fuel and fire management is determined to be necessary and has a potential impact on the IBAT, PICA will engage in ESA Section 7 consultation with the USFWS NJFO prior to any action. For any roost trees, wild fire prevention measures will be taken.
11. Pesticides will be applied IAW the prescriptions outlined in the IPMP at PICA (IPMP 2004). During the IBAT Spring-Fall foraging and roosting seasons, any mosquito or forest pest spraying will comply with the guidance received from USFWS-NJFO (USFWS 2004). Only U.S. EPA approved pesticides will be used.
12. Scope and schedule all anticipated projects well in advance of seasonal restrictions. Additionally, since the activities later described in subsection 5.1.3 can be reasonably scheduled well in advance, these prescriptions (5.1.1 (1)-(9) herein) will apply similarly for any affected trees.

5.1.2 Pest Management

The primary IBAT concern related to pest management is the impact of pesticides on the prey resources at PICA. Legally acceptable and scientifically based pesticide applications in support of pest management operations on the installation is set forth in the Integrated Pest Management Plan (IPMP) which is administered by the Pest Management Coordinator (PMC), presently a government contractor.

Pesticide applications mainly to be considered in relation to IBATs and their prey base at PICA are mosquito, forest pests (e.g. gypsy moth), and invasive (plant) species control.

Only herbicides, insecticides, and fungicides approved by EPA, USFWS, and the PICA Pest Management Coordinator (PMC) will be used at the installation, and the method and rate of each such chemical's application will be consistent with provisions presented on the container label. The PICA PMC will coordinate with USFWS to develop an approved list of pesticides for use at PICA. In developing this list, consideration will be given to bioaccumulation potential, degradation half-life, and water solubility. The management prescriptions presented below will be implemented to minimize the impact of pesticides on the IBAT.

General Application of Pesticides

1. Pesticides (or herbicides) will be applied only after the use of other integrated pest management techniques have been considered and are deemed insufficient.
2. Limited and routine application of registered pesticides is allowed as long as the application is performed IAW labels.
3. Pesticides (or herbicides) will be applied by certified applicators and in strict accordance with product label directions as required by federal law.
4. Pesticide application in gusty winds or when the wind speed exceeds 5 miles per hour will be avoided.

Aerial Application of Pesticides

1. PICA will complete NEPA documentation on the impact of aerial application of pesticides should it become necessary for forest pest suppression.
2. Any request for aerial application of pesticide will be submitted to the U.S. Army Environmental Command (AEC), by PICA, where an entomologist certified in aerial application determines approval or rejection of the request.
3. If aerial application of pesticides is approved by AEC, the application will be conducted at least 300 ft away from known roost trees, through coordination with the NRM.

Ground Application of Pesticides

1. Ground application of insecticides will follow the general guidance outlined above, as well as any limitations or constraints within the IPMP.
2. Ground application of herbicides will be prohibited within 300 ft of known roost trees, roost buildings, or artificial roost structures, through coordination with the NRM. Invasive plant species close to roost sites will be controlled or removed by mechanical methods and with minimal disturbance.

Mosquito and other Aerial Spraying

1. For mosquito control a program of larvicides will be undertaken to the maximum practicable extent.
2. If West Nile Virus monitoring indicates a human health risk condition exists on post, then the protocols necessitating adulticide use will be implemented IAW USFWS letter (2004).
3. In areas of suboptimal bat foraging habitat (namely developed uplands near residences, security gates, or public gathering locations) spraying (fogging) may be conducted until dusk with Ultra Low Volume dispensers.
4. Spraying or fogging at other portions of the installation must be curtailed 2 hours before sunset.

5.1.3 Construction and Demolition and Environmental Remediation

The primary IBAT management concerns related to these activities are potential alteration or disturbance of forest cover, and impairment of water quality in drainages. Under this ESMP a major construction, demolition, or environmental remediation activity is one that may have an impact on the forested riparian or upland areas at PICA that are suitable for roosting sites or foraging habitat.

Construction and Demolition

Picatiny has a program of ongoing demolition of abandoned or obsolete facilities, as well as renovation and new construction. These are addressed through appropriate NEPA documents (REC, EA, EIS). Major construction and demolition activities include but are not limited to construction and demolition of dams, buildings, pipelines, and roads; and water resource developments or improvements. The PICA NRM will determine the need for ESA Section 7 consultation with regard to such activities. Standing Operating Procedures For: Flashing/Decontamination To 5X Degree and Demolition of Contaminated Buildings outlines a process which takes into account possible use of abandoned buildings by bats and impacts to any nearby trees which could be affected by the heat, fire, or smoke associated with these burn events.

Environmental Remediation

Although environmental remediation, known as Installation Restoration Program at PICA, does not require specifically issued permits, compliance with most state and federal ENV statutes is expected by what are known as “permit equivalents” (in documentation). Yet any activity that may potentially impact IBAT or not be in conformance with this ESMP will be subject to Section 7 consultation with the USFWS NJFO.

As mentioned previously in Section 5.1.1 (6), if any major construction, demolition, or environmental remediation projects are planned within 0.75 miles of known roost trees or roost structures. PICA will engage in Section 7 consultation with the USFWS NJFO.

5.1.4 Leasing of PICA Property

PICA will consult with USFWS to consider and resolve how IBATs will be protected in leased areas. PICA has leased portions of its property to public and private entities for use and partnerships synergistic to the installation mission. A “Development Plan” is being considered for about 120 acres near the main entrance (Dave Banashefski *pers.comm* 2004). Eventually a lease will turn over these acres to one or more private entities that will operate the land as lessees. The land will still be owned by PICA. The management prescriptions detailed in this ESMP/EA will be referenced in all lease agreements.

5.1.5 Test Range and Operations

If any maternity roost trees discovered are located within 0.5 miles of existing test ranges and/or operations which are known to present a fire hazard or which have caused spot fires in the past, then a modification to any fire suppression plan will address protection of the roost site(s) during the summer season.

5.1.6 Training Exercises

PICA is not used intensively for training exercises. Recurring, yet infrequent training exercises conducted at PICA involve small scale USMC (Marine) and U.S. Army reserve components, National Guard units and other Government agencies. When such training does occur, it is coordinated in advance and is conducted in designated areas of the installation. Past training exercises have generally prohibited pyrotechnic devices, although small arms or charges using blanks has been allowed. PICA police, security guards, force protection personnel, and fire personnel, also conduct various emergency response-training exercises, primarily in non-forested areas or along existing patrol roads in the woods.

The PICA NRM will determine whether any proposed training exercises may have a potential effect on the IBAT or IBAT habitat at PICA; and after PICA coordination, will engage in ESA Section 7 consultation with the USFWS Region 5 Pleasantville Field Office as necessary.

5.1.7 Hunting and Other Outdoor Recreation

Although hunting of deer, small game, and wild turkey is allowed on PICA property IAW state established seasons and game laws, impacts or interactions with bats would be negligible. PICA allows controlled hunting of most game species for recreation, as well as to manage the population of white-tailed deer at the installation. Deer hunting with guns mostly occurs in December. Nearly all small game hunting occurs after mid-November until mid-February. Few if any gun hunters are afield during the summer (maternity) roosting period for the IBAT. Furthermore, no night hunting (e.g. raccoon, coyote) of any sort is allowed on the installation.

Both Spring (mid-April to late-May) and Fall (late-October) turkey hunting seasons overlap with the Non-hibernation Season; Spring dispersal of the IBAT on PICA property, as well as Fall swarming nearby with possible transitory roosting on post. Turkey hunters will be advised to exercise caution by shooting only (1) when their target is close to the ground (not in flight) and (2) preferably during daylight hours (after civil sunrise). If maternity roost trees are discovered, turkey hunting will be excluded from an area at least 300 ft around the tree(s); or a portion of the Hunting Area (HA) may be closed for the season.

Other innocuous and non-noisy outdoor recreation activities, such as mushroom collecting or birdwatching, will be allowed. However, individuals who engage in these activities will be advised to minimize activities in forest stands where roosting and foraging are known to occur. Under the awareness program described in Section 5.2.5, hunters and other outdoor recreationists will be informed about the IBAT and how they can minimize disturbance.

5.1.8 Firewood Cutting

Although PICA has a fuelwood salvage program, harvesting standing timber to generate firewood does not occur. Permits are issued to allow cutting and loading of firewood from established storage areas or designated temporary staging areas. Because IBATs do not roost in downed trees (Tetra Tech 1999a), and permittees are not allowed to salvage wood from forest stands, the potential impact of firewood cutting and collection on the IBAT is negligible.

5.2 OTHER MANAGEMENT PRESCRIPTIONS

This section describes other management prescriptions that will be taken by PICA to protect the IBAT. These prescriptions, which are not directly related to ongoing or future PICA activities, include monitoring the IBAT and its habitat, maintaining high water quality, protecting any roosts found in buildings, providing and protecting artificial roost structures, implementing an awareness program, and communicating with USFWS.

5.2.1 Monitoring of IBAT and Habitat

Research needs for the bat community include: identifying major foraging areas; identifying species and relative abundance; and locating roosting sites/hibernacula.

Frequent roost-switching, large home ranges, and changes in activity centers between years create challenges for detection, monitoring, and management of the IBAT (Kurta *et al.* 2002). Wildlife biologists should initiate longterm studies that emphasize radiotracking individual bats over multiple seasons and years (Gumbert *et al.* 2002).

Monitoring the IBAT and understanding more about its summer habitat will be a priority at PICA.

Biological Surveys

Population monitoring requirements under AR 200-3 can be fulfilled only if IBAT biological surveys are scheduled on the installation. Monitoring activities will include biological surveys to identify any active IBAT maternity roosts or new non-maternity roosts at PICA; long-term monitoring of IBAT foraging habitat; and identification of potential IBAT roost trees at the installation.

A biological survey that includes mist netting will be conducted at least once every 5 years to monitor IBAT activity at PICA. Before each 5-year survey, the NRM will consult with USFWS to clarify the most up-to-date protocols, field techniques, technologies, and sampling biometrics available or recommended. At a minimum, the following information for each bat captured will be consistently recorded:

- Species
- Capture location
- Time of capture
- Gender
- Age class
- Reproductive condition (lactating or pregnant), if applicable
- Weight
- Flight direction(s) (into net and away from release site)
- Location of maternity roost site (if known)

Notwithstanding the analysis of Brack *et al.* (2002) that summer netting is consistently unproductive, and that cost of such work can exceed \$210,000 per IBAT radio tracked, each biological survey will be conducted IAW USFWS mist netting guidelines (USFWS 1999) and will likely include use of radio-telemetry. Mist netting is the primary sampling method and requires experienced and approved handlers, since collecting permits are usually required, especially for radio-telemetry work.

Small radiotransmitters are short-lived, and researchers may need to radiotrack the same bats multiple times before obtaining sufficient data to describe fidelity in a particular species (Gumbert *et al.* 2002). According to Romme *et al.* (2002) spring and autumn tracking can be particularly vexing and bats difficult to locate. Such studies should anticipate the need for aerial telemetry, and if possible, utilize more than three mobile receivers (Romme *et al.* 2002). Somewhat offsetting the initial high investment of radio-tracking surveys is the prospect that Gumbert *et al.* (2002) point out; namely that as long as a roost is suitable, it is likely to be used in future tracking periods.

Electronic bat detectors are available and technology and computer software programs are progressing in discriminating some calls of bats to discern species identification. Bat “call libraries” (frequencies and patterns) that have been established to develop the model are typical of animals that are flying in open areas (e.g., over fields or ponds and in open flyways); but types of calls that bats emit when flying near environmental clutter (e.g., vegetation or dense forest) are not well represented. As Tibbels (2000) points out, structure of calls recorded in open areas may not be the same as structure of calls obtained in cluttered areas; therefore Britzke *et al.* (2002) recommend caution when using their model to identify bats in areas of structural complexity, such as the interior of forests. At PICA there are few open areas (other than lakes or ponds), so bat detectors will be used mostly for preliminary field reconnaissance or roost site verification (presence/absence) rather than species identification.

Forest Inventories

Long-term monitoring of summer habitat conditions for the IBAT at PICA will be accomplished through collection of information on stocking levels of suitable and potential maternity roost trees and snag density in relation to the forest management prescriptions specified in Section 5.1.1. These inventories will be conducted at least every 10 years as part of forest resource inventories.

N.B. Although measuring size of trees within a stand is somewhat labor-intensive, this approach may have some utility in identification of potential maternity sites (Miller *et al.* 2002).

Alternatively, it is possible, in many areas, to estimate density of potential roost trees, based on forest inventories for the region. Such an approach requires development of a list of forest types and the likely density of suitable roost-sized trees in each type (Farmer *et al.* 2002).

As part of the forest resource inventories, information will be collected on snags with a dbh characteristic of primary and alternate maternity roost trees as specified in Section 3.4.1 (6 inches dbh or larger, depending on the size class used during the inventories). The inventory will include evaluation of the following for individual snags:

- Tree species
- dbh
- Total height
- Cavity presence and location
- % bark cover
- Number of branches
- Crown condition

This information will be used to categorize snags into the following five different stages of decay (Dingledine and Haufler 1983):

- Stage 1—100% bark cover, many branches, crown intact
- Stage 2—50 to 99% bark cover, fewer branches, crown intact
- Stage 3—50 to 100% bark cover, few branches, crown broken
- Stage 4—Less than 50% bark cover, few branches, crown broken
- Stage 5—Zero% bark cover, no branches, crown broken

The number of snags per acre will also be recorded. When analyzed in conjunction with data from biological surveys, long-term monitoring information will permit PICA to evaluate the effectiveness of this ESMP in meeting IBAT recovery goals

N.B. PICA will ensure in its lease agreements that USFWS or contracted consulting biologists will be allowed access to forested and riparian areas, if necessary, to monitor IBAT activity after coordination with the Installation Commander and Lessee.

5.2.2 Protection of Water Quality

Water quality conservation practices already espoused in the INRMP for the entire installation includes, protection of riparian and stream habitats from degradation; and preserving forest cover along streams by maintaining bands of vegetation (closed canopy) at least 300 ft wide.

A riparian corridor on the installation is defined as natural cover within the jurisdictional wetland associated with a perennial or intermittent stream, plus a 150 ft transition zone, per NJDEP Freshwater Wetland Rules (2001), namely (N.J.A.C. 7:7A-2.4(b)2).

Based on (1) the importance of forest cover to protect IBAT habitat, (2) the limited forest management activities occurring at PICA, and (3) the fact that some PICA property has been leased, PICA will implement the following prescriptions:

- Prohibit timber harvest and firewood cutting in riparian corridors except where catastrophic events such as fire, flooding, wind, or insect damage have resulted in degraded riparian conditions.
- Prohibit or severely restrict earth moving activities and disturbance of natural vegetation within

riparian corridors at PICA.

- Limit any permanent loss of forest cover within riparian corridors to a goal of less than 40 acres. Avoid potential habitat and stream alteration unless neutral or beneficial to species.
- Maintain wetland buffers to reduce sediments and delivery or transport of pollutants.
- Allow beaver activity wherever possible if not causing undue flooding or maintenance of established storm water control structures or spillways.

These prescriptions will indirectly benefit the IBAT by protecting water quality through erosion and sedimentation prevention, preserving water conditions which support the insect fauna that serve as food for the IBAT, and thereby providing foraging and possibly roosting habitat.

5.2.3 Protection and Inspection of Bat Roosts in Buildings, Mines, or Caves

IAW SOP AR-XP-WO19 regarding demolition of buildings, inspections are made prior to burning and razing of structures. If bat signs are evident, the NRM will be notified and a thorough survey and assessment of bat use will be made. Trapping and identification of bats will also be performed if IBAT roosting is suspected. Any bat roost suggesting site fidelity for a colony of bats, rather than for merely a handful of bats roosting temporarily will be protected until the bats (non-IBAT) may be relocated or the colony has vacated the building for the winter season. If only a few (<10) non-IBAT individuals are involved, their roost spot(s) will be made uninhabitable (deconstructed) at some time when they are absent and before sunrise of the day of the scheduled burn and demolition. A final inspection of the roost spot(s) will be made prior to ignition.

Similarly, if bat colonies are discovered in vacant or occupied buildings, the identity and size of the colony will be evaluated and protected until a plan for exclusion (and possibly relocation) can be formulated and implemented. If a heretofore unknown mine or other natural site is discovered, it will be evaluated for its potential as a possible roost site, and protected if appropriate.

All known colonies, such as the large one in Building 3236; or any which may become established in specially constructed artificial bat roosts, will be inspected on at least a biennial basis to record a census count and check for presence of any IBATs.

5.2.4 Provision and Protection of Artificial Bat Roost Structures

Building 3236 is a long established summer roost site for up to 800 Little Brown Bats. An IBAT was documented roosting inside this warehouse in the summer of 1997. Any alterations to this building which could affect its use as an annual summer roost will require consultation with the USFWS. To accommodate the several hundreds of bats that may be displaced from this present roost, bat condominiums in the near vicinity are recommended. Siting of any future bat condominium or bat boxes will be coordinated through the USFWS, as well as with PICA master planning personnel, Residential Communities Initiative (RCI) contractors, or any other lessees in proximity to possible site locations. Building 3236 will remain as a local roost site, until an adequate plan for constructing and verifying occupancy of alternate artificial bat roost(s) is accomplished. All tenants using this warehouse will be advised of the significance of this structure for the local bat population, including possible IBATs.

If an artificial bat roost is conceived and constructed or installed, due consideration will be given to methods of deterring any possible vandalism, attractiveness of the structure in the local setting, and possible accessibility for census and maintenance purposes. Any other bat boxes or condominiums will be designed and installed with the same considerations in mind.

5.2.5 Implementation of Employee and Community Awareness Program

PICA will promote awareness of the presence and status of the IBAT at the installation as well as the regulatory requirements driving its protection by developing an informational brochure or by using available electronic media or forums on post. The PICA NRM will be responsible for distributing the information to PICA military residents, employees, tenant organizations, government contractors, private developers or lessees, hunters, or other individuals whose activities may impact IBAT roost sites or foraging areas.

The PICA NRM will also engage in outreach efforts focusing on the surrounding community and will explore opportunities to participate in regional conservation efforts. These activities are based on the premise that stakeholders around the installation, such as area landowners, must also practice conservation to ensure successful long-term recovery and protection of the IBAT. For example, roost trees near Norvell, MI are on property controlled by 11 different entities, and when identifiable foraging areas are also considered (Murray 1999), the number of landowners involved with this one summer colony increases to over 35. Monitoring of maternity colonies, management of summer habitat, and recovery of the IBAT can only be achieved by educating the general public and obtaining cooperation from numerous private landowners (Kurta *et al.* 2002).

As appropriate, community awareness of the species and its habitat will be promoted through information exchange and interaction with local schools, community events, and through publication of articles in local newspapers. Also, PICA will support and encourage similar stewardship actions and cooperative efforts by other public land managers outside the installation, especially those within a 5-mile radius of known hibernacula.

To protect the IBAT, the exact locations of IBAT foraging and roosting sites at PICA or the names of the mines used as hibernacula will not be specified in the informational media described above or during any associated outreach programs.

As Belwood (2002) pointed out, an awareness program should also address rabies and bats per the recommendations of the Centers for Disease Control (1999). Rabies prophylaxis would be a standard work safety requirement for any researchers on post.

5.2.6 Communication with USFWS

The PICA NRM will update, in coordination with PICA staff, USFWS on the status of the IBAT at the installation by reporting findings from species and habitat monitoring activities to the USFWS NJFO. As discussed in Section 5.1, PICA will also engage in ESA Section 7 consultation with the USFWS NJFO when necessary. Currently, ongoing or anticipated ESA Section 7 consultations involve the following matters:

- INRMP updating scheduled to begin in fiscal year 2006
- Anticipated development and leasing of property, particularly near the main entrance.

6.0 ESMP IMPLEMENTATION

This section describes how PICA will implement the ESMP. Specifically, this section describes the process of complying with the ESMP portion of this document; and describes the review process for the ESMP.

6.1 COMPLIANCE AND REVIEW

To evaluate PICA compliance with this ESMP and the effectiveness of the ESMP itself, the PICA NRM will complete an annual compliance checklist. This checklist addresses the management prescriptions presented in Section 5.0. The checklist, which is presented in Appendix C, is the primary tool used in assessing installation compliance with the ESMP.

The PICA NRM will be responsible for completing the checklist during the fourth quarter of each calendar year. The PICA Environmental Quality Control Committee (EQCC) will review the ESMP compliance checklist. The PICA Installation Commander (or Garrison Commander) will then approve and sign the ESMP compliance checklist and forward it to IMCOM-NERO by December 31.

If the ESMP compliance checklist concludes that PICA is not in full compliance with the ESMP or that the ESMP is not effective in meeting installation conservation goals, the NRM will discuss the deficiencies with the EQCC and make recommendations for resolving them. The PICA NRM will review the IBAT ESMP annually and revise it as necessary to meet conservation goals. This review will be conducted concurrently with the preparation of the ESMP compliance checklist.

The ESMP will be subject to major revision every 5 years in conjunction with major revisions to the PICA INRMP. If significant information becomes available during the 5-year period, the ESMP will be rewritten; otherwise, it will be continually revised through the annual updating process.

Annual revisions of a substantive nature or shifts in programmatic implementation will be coordinated with both USFWS and NJDFW ENSP, as will major rewrites of the ESMP.

ESMP/EA will also be revised upon issuance of the new IBAT recovery plan, as appropriate.

6.2 TIME, COSTS, AND PERSONNEL

Table 5 provides estimates of the time, costs, and personnel needed to implement the management prescriptions described in Section 5.0. The PICA Installation Commander (and Garrison Commander) is responsible for ensuring that adequate professional staff and funds are provided for these management prescriptions. The total estimated cost of conservation actions over the first 5 years of this ESMP is presented in Table 6.

TABLE 5
ESTIMATED LEVEL OF EFFORT AND COST BY MANAGEMENT PRESCRIPTION

PRESCRIPTION CATEGORY	ANNUAL LEVEL OF EFFORT (LOE) REQUIRED	COST	FREQUENCY
Forest Management	Forest management prescriptions will largely become integrated into PICA's forestry management program.	\$0	N/A
(Bat Detectors)	An initial one-time cost will be for the purchase of bat detector(s) for roost exit or pre-dawn counts.	\$3,000 (\$150-\$2,000 ea)	1x / 5yrs
(Forest Stand Surveys)	Long-term monitoring of summer habitat conditions will become part of PICA's forest management program. LOE to collection and compile snag density counts, condition assessment, and to map known or likely roost trees / sites will be necessary every other year.	\$12,000 (\$6,000 x ea)	2x / 5yrs
Construction and Demolition (ESA consultation)	LOE to conduct Section 7 consultation / coordination for proposed construction and demolition activities will likely average two occurrences per year.	\$0 - \$1,000 (\$500 x ea)	2x / yr
Environmental Remediation (ESA consultation)	LOE to conduct Section 7 consultation / coordination for proposed environmental remediation activities may average once every other year.	\$0 - \$1,000 (\$500 x ea)	2x / 5yrs
Leasing PICA property (ESA consultation)	Additional LOE to conduct Section 7 consultation for proposed leasing activities which may occur once in 5 years.	\$0 - \$500 (\$500 x ea)	1x / 5yrs
Training exercises	Prescriptions associated with training exercises are not expected to require additional LOE.	\$0	N/A
Hunting and other outdoor recreation	Hunting and other outdoor recreation prescriptions are not expected to require additional LOE beyond that associated with routine natural resource management activities.	\$0	N/A
Firewood cutting	Firewood cutting prescriptions are not expected to require additional LOE beyond that associated with routine natural resource management activities.	\$0	N/A

TABLE 5 (Continued)

ESTIMATED LEVEL OF EFFORT AND COST BY MANAGEMENT PRESCRIPTION

PRESCRIPTION CATEGORY	ANNUAL LEVEL OF EFFORT (LOE) REQUIRED	COST	FREQUENCY
Monitoring of IBAT population and habitat (recon roosting and foraging)	Costs and LOE associated with contracting a comprehensive (70 day) biological survey once every 5 years will be required.	\$95,000	1x / 5yrs
(Monitor known roosts – tree or box)	LOE to inspect roosts and note findings will be an annual task	\$2,000	1x / yr
Implementation of Awareness program (Picatinny personnel)	Notices, announcements, training, and presentations to work force and residents on post will occur as part of NRM overall duties.	\$0	1x / yr (or as needed)
(brochures, video, webpage)	An initial one-time cost will be to develop and reproduce an informational brochure and/or electronic media presentation.	\$15,000	1x / 5yrs
(external community relations)	Additional LOE will be required for activities associated with outreach programs presented offsite; interagency and peer information exchange; and local media articles.	\$1,200 (\$300 x ea)	4x / 5yrs
Protection of water quality	Protection of water quality will become part of PICA’s routine natural resource management activities.	\$0	N/A
Provide and maintain artificial roosts	Additional LOE and periodic costs for construction or purchase of prefabricated bat boxes or condominiums and site installation and maintenance will be required.	\$3,000 (\$250-\$2,500 ea)	2x / 5yrs
Communication with USFWS and other agencies (ESA consultation)	Additional LOE may be required for unanticipated activities requiring Section 7 consultation perhaps once in 5 years.	\$0 - \$500 (\$500 x ea)	1x / 5 yrs
ESMP/EA compliance and updating	Additional LOE will be required for NRM to complete the ESMP annual compliance checklist and minor updates to the ESMP.	\$500	1x / yr
	Additional LOE will be required to complete major revisions to the ESMP and associated EA.	\$2000	1x / 5yrs (or as required)

N/A= Not Applicable

TABLE 6**ESTIMATED OVERALL COST OF CONSERVATION ACTIONS**

Fiscal Year	Routine / Periodic Costs	Special Projects Costs	Estimated Annual Cost
2006	4,000	*107,000	\$111,000
2007	4,000	9,000	\$13,000
2008	4,000	4,000	\$8,000
2009	4,000	4,000	\$8,000
2010	4,000	*100,000	\$104,000
5-Year Total	20,000	224,000	244,000

* Includes costs associated with biological survey and major ESMP/EA revision

7.0 ENVIRONMENTAL ASSESSMENT

This section meets the EA requirement under NEPA. Specifically, this section presents a description of the purpose and need for the proposed action: the alternatives considered, including the “no action” alternative and the proposed alternative; the cumulative effects of ESMP implementation; and the conclusions of this EA. A FNSI is included in Appendix D. Details about the affected environment at PICA are presented in Section 2.2 and in PICA’s INRMP (PICA 2001).

7.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

NEPA requires federal agencies to determine whether a proposed action is a “major federal action significantly affecting the quality of the human environment” (42 U.S. Code 4332). An EA is normally required for activities, such as preparation of an ESMP, that may affect any federal or state listed or proposed threatened or endangered species (32 CFR 651.41 (e); AR 200-3, paragraph 11-6(f)). An EIS may be required if an ESMP will significantly affect a listed or proposed species, a critical or proposed critical habitat, or the human environment. Habitat that is considered “critical” is described in the September 24, 1976, Federal Register as habitat essential to the conservation of the species and requiring special management considerations or protection. This EA has been developed IAW NEPA and 32 CFR 651.41 (e) to determine whether the ESMP for the IBAT proposed by PICA poses significant environmental impacts.

7.2 ALTERNATIVES CONSIDERED

This section presents an evaluation of the two alternatives considered for this EA: the “no action” alternative and the proposed alternative of ESMP implementation.

7.2.1 “No Action” Alternative

“No action” was also considered as an alternative to ESMP implementation. The “no action” alternative reflects the current state of activity at the installation, which involves some generic conservation and best management practices, and interim policies for IBATs, yet no approved, prescriptive, or funded actions specifically designed for IBAT recovery. This alternative is not feasible because it violates AR 200-3, which requires U.S. Army installations to develop and implement ESMPs in order to protect and conserve listed and proposed threatened and endangered species and critical habitat in order to comply with the ESA. In addition, the IBAT population at PICA may be adversely impacted over the long term if appropriate protection and conservation measures are not implemented at the installation. For example, the IBAT population at PICA could be impacted by loss of suitable roosting and foraging habitat.

7.2.2 Proposed Alternative

To meet requirements set forth in AR 200-3, the proposed alternative is implementation of this ESMP for the IBAT, which establishes five conservation goals for PICA:

- Conserve existing foraging and (non-maternity) roosting habitat at PICA.
- Identify and conserve potential IBAT summer maternity roosting; as well as non-maternity roosting habitat at PICA
- Estimate the IBAT population at PICA and monitor trends periodically.
- Educate individuals who have a potential impact on the IBAT regarding the species and its presence at PICA and local mines (including possible lessees on PICA property).
- Communicate with USFWS regarding the status of the IBAT at PICA and in the local area.

These goals recognize the ecosystem elements present at PICA that support the IBAT. The ESMP also presents management prescriptions that are important to the local IBAT population and potentially to the long-term survival of the species. These management prescriptions are described in detail in Section 5.0; and were

developed in cooperation with the local USFWS and NJDEP offices, as well as Picatinny Master Planning Office(s).

Compliance with the ESMP supports applicable conservation goals outlined in the USFWS IBAT recovery plan (USFWS 1983). The general actions and impacts associated with the proposed alternative are presented in Table 7. These actions are consistent with the conservation goals listed above. Potential impacts would primarily be on ecological and economic conditions.

The ESMP also provides for PICA's NRM engaging in ESA Section 7 consultation with the USFWS NJFO as necessary with regard to activities outside the scope of the management prescriptions.

Although compliance with this ESMP will contribute to the success of the specific IBAT population at PICA, as well as the overall recovery of the species, it is important to consider that certain negative impacts may occur that are beyond the control of the installation. For example, harm to the population may be caused at the hibernacula, during spring or fall migration, or at the installation by activities on surrounding properties.

TABLE 7
 PROPOSED ACTIONS AND EXPECTED IMPACTS OF THE PROPOSED ALTERNATIVE

TABLE 7 (Continued)	
PROPOSED ACTIONS AND EXPECTED IMPACTS OF THE PROPOSED ALTERNATIVE	
PROPOSED ACTIONS	EXPECTED IMPACTS
<p>Incorporate the following IBAT habitat management prescriptions into existing PICA activities to avoid or minimize impacts on the IBAT:</p> <p>Forest Management (see Section 5.1.1).</p> <ul style="list-style-type: none"> • Restrict / Prohibit tree trimming or cutting from 1 APR – 15 NOV, except when absolutely necessary. Consult with USFWS NJFO as appropriate. • Forest management will promote a diversity of age and size classes with emphasis on retention of adequate stocks of large, mature and overmature trees in each stand; and canopy cover maintained at $\geq 60\%$. Shagbark Hickory, Sugar Maple, White Oak, and Black Locust will be favored and retained. • Sufficient numbers and sizes of suitable snag trees will be retained for roosting habitat. • Known roost sites (trees or structures) will be protected, as well as potential roost trees within 0.75-mile radius of known roosts. • Minimize incremental or cumulative permanent loss of forest cover over entire installation. A key objective is no permanent loss (or up to 7%) of forest cover. 	<ul style="list-style-type: none"> • Implementation of the ESMP is not expected to result in significant impacts on the environment. • Implementation of the ESMP is not expected to adversely affect IBAT habitat at PICA. • Beneficial impacts are expected to occur as a result of protection of suitable roost trees and prudent management of forest habitats. • In addition to preserving favorable IBAT habitat, conservation of vegetative cover and water quality in the forested riparian areas are expected to benefit other wildlife.

TABLE 7 (Continued)

PROPOSED ACTIONS AND EXPECTED IMPACTS OF THE PROPOSED ALTERNATIVE

PROPOSED ACTIONS	EXPECTED IMPACTS
<p>Pest Management (see Section 5.1.2).</p> <ul style="list-style-type: none"> • Only herbicides, insecticides, and fungicides approved by EPA, USFWS, and the PICA Pest Management Coordinator (PMC) will be used at the installation. • During the IBAT Spring-Fall foraging and roosting seasons, any mosquito or forest pest spraying will comply with the guidance received from USFWS after consultation. • If aerial application of pesticides is approved by AEC, the application will be conducted at least 300 ft away from known roost trees. • For mosquitoes an aggressive program of larviciding will be undertaken to the maximum practicable extent. If WNV monitoring indicates a health risk condition exists on post, then the protocols for adulticide (fogging) will be implemented IAW USFWS-NJFO recommendations. • Ground application of herbicides will be prohibited within 300 ft of known roost trees, roost buildings, or artificial roost structures. 	<ul style="list-style-type: none"> • Implementation of these and other Pest Management practices IAW IPMP should limit any exposures / risks to all crepuscular and nocturnal bats, including the IBAT. • Consultation and coordination with USFWS will balance human health risks from insect vectors with appropriate safeguards to local bat populations.

TABLE 7 (Continued)	
PROPOSED ACTIONS AND EXPECTED IMPACTS OF THE PROPOSED ALTERNATIVE	
PROPOSED ACTIONS	EXPECTED IMPACTS
<p>Construction, Demolition, and Environmental Remediation (see Section 5.1.3).</p> <ul style="list-style-type: none"> • RECs / EAs / SOPs are reviewed routinely by NRM for any impacts to trees on post. • Environmental Restoration Program “permit equivalents” are reviewed by NRM for any impacts to trees on post. • PICA will always engage in Section 7 consultation with the USFWS NJFO if any major construction, demolition, or environmental remediation projects are planned within 0.75 miles of known roost sites. <p>N.B. PICA will pursue Section 7 consultation with the USFWS NJFO if any environmental assessment for any proposed project poses a possibility for adverse effects to the IBAT.</p>	<ul style="list-style-type: none"> • Restrictions on construction. Demolition, and environmental remediation activities are not expected to result in significant impacts on human health. • Sufficient review procedures and precautions are in place to prevent impacts to IBATs. • Tree trimming and cutting will be proactively scheduled in winter months.
<p>Leasing of PICA Property (see Section 5.1.4).</p> <ul style="list-style-type: none"> • Reference management prescriptions detailed in this ESMP/EA in lease agreements. 	<ul style="list-style-type: none"> • Any leasing of PICA property is not expected to result in significant impacts on the IBAT or human health.
<p>Training Exercises, Hunting and Firewood Programs (see Sections 5.1.5, 5.1.6, and 5.1.7).</p>	<ul style="list-style-type: none"> • Routine limitations and controls preclude impacts to IBATs on post.

TABLE 7 (Continued)

PROPOSED ACTIONS AND EXPECTED IMPACTS OF THE PROPOSED ALTERNATIVE

PROPOSED ACTIONS	EXPECTED IMPACTS
<p><u>OTHER MANAGEMENT ACTIVITIES</u></p> <p>Implement an IBAT population and habitat-monitoring program at PICA (see Section 5.2.1).</p> <ul style="list-style-type: none"> • Identify major foraging areas; relative abundance; and locate roosting sites/hibernacula. • Monitoring the IBAT and understanding more about its summer habitat will be the top priority at PICA. • Biological Surveys: Monitoring activities will include biological surveys to identify any active IBAT maternity roosts or new non-maternity roosts at PICA; long-term monitoring of IBAT foraging habitat; and identification of potential IBAT roost trees at the installation. • A biological survey that includes mist netting will be conducted at least once every 5 years. Surveyor/biologist must have NJ Scientific Collecting Permit for IBATs, and may need similar authorization via USFWS. • Forest Inventories: These inventories will be conducted at least every 10 years as part of forest resource inventories. 	<ul style="list-style-type: none"> • Population monitoring activities, including mist netting and bat capture will be conducted in strict accordance with applicable federal and state regulations for threatened and endangered species. These activities are not expected to result in significant adverse impacts on the IBAT or other species. • Habitat monitoring activities will be nonintrusive and therefore are not expected to have significant impacts on the environment. • Minor beneficial impacts may be realized as additional scientific data on the IBAT is gathered during monitoring.
<p>Incorporate the following IBAT management practices into the existing water quality protection program at PICA (see Section 5.2.2):</p> <ul style="list-style-type: none"> • Water quality conservation practices already espoused in the INRMP for the entire installation includes, protection of riparian and stream habitats from degradation; and preserving forest cover along streams by maintaining bands of vegetation (closed canopy) at least 300 ft wide. • Prohibit or severely restrict earth moving activities and disturbance of natural vegetation within riparian corridors at PICA. • Prohibit timber harvest and firewood cutting in riparian corridors except where catastrophic events such as fire, flooding, wind, or insect damage have resulted in degraded riparian conditions. • Prohibit or severely restrict earth moving activities and disturbance of natural 	<p>Beneficial impacts are expected to occur as a result of protection of Riparian Corridors and water quality.</p> <ul style="list-style-type: none"> • In addition to preserving favorable IBAT habitat, conservation of the natural vegetation and water quality in the forested riparian areas are expected to benefit other wildlife. • Sedimentation and erosion will be prevented or minimized. • Maintaining favorable instream conditions should assure continuing reproduction and recharge of the insect prey base.

TABLE 7 (Continued)

PROPOSED ACTIONS AND EXPECTED IMPACTS OF THE PROPOSED ALTERNATIVE

PROPOSED ACTIONS	EXPECTED IMPACTS
<p>vegetation within riparian corridors at PICA.</p> <ul style="list-style-type: none"> • Limit any permanent loss of forest cover within riparian corridors to a goal of less than 40 acres. Avoid potential habitat and stream alteration unless neutral or beneficial to species. • Maintain wetland buffers to reduce sediments and delivery or transport of pollutants. • Allow beaver activity wherever possible if not causing undue flooding or maintenance of established storm water control structures or spillways. <ul style="list-style-type: none"> • Avoid potential habitat and stream alteration unless neutral or beneficial to species. • Maintain wetland buffers to reduce sediments and delivery or transport of pollutants. • Allow beaver activity wherever possible if not causing undue flooding or maintenance of established storm water control structures or spillways. • Up to 40 acres of riparian corridor may be cut for mission activities. Tree cutting within 150 ft of wetlands (other than the aforementioned 40 acres), including on both sides of perennial and intermittent streams will be limited to activities that maintain or improve the quality of IBAT habitat and are IAW other forest management prescriptions described in this ESMP. <p>PICA will engage in ESA Section 7 consultation with the USFWS NJFO before conducting tree-cutting activities in designated riparian corridors.</p> <ul style="list-style-type: none"> • Prohibit activities that may impair the wetlands created by beaver dams. Retain and maintain beaver dams when possible. 	<ul style="list-style-type: none"> • These prescriptions will indirectly benefit the IBAT by protecting water quality through erosion and sedimentation prevention, preserving water conditions which support the insect fauna that serve as food for the IBAT, and thereby providing foraging and possibly roosting habitat. • Beaver and associated wetland wildlife benefit from this animal induced and created wetlands, and moreover drowned trees eventually supply numerous roost sites over time.
<p>Protect all non-tree IBAT roosts on post. (see Sections 5.2.3 and 5.2.4):</p> <ul style="list-style-type: none"> • Protect and Inspect all Bat Roosts in Buildings, Mines, or Caves. Provide protection for caves, mines, and abandoned buildings that might be discovered as roost sites for bats. • Provide and Protect all Artificial Bat Roost Structures as appropriate. Develop ways to deter human visitation or vandalism to bat boxes or condominiums, which may be erected. 	<ul style="list-style-type: none"> • Beneficial impacts are expected as a result of providing new and more summer bat roosting options and capacity. • Reduced rates of occupancy by bats in habitable quarters or buildings.

TABLE 7 (Continued)

PROPOSED ACTIONS AND EXPECTED IMPACTS OF THE PROPOSED ALTERNATIVE

PROPOSED ACTIONS	EXPECTED IMPACTS
<p>Implement an awareness program (see Section 5.2.5)</p> <p>Implementation of Employee and Community Awareness Program</p> <ul style="list-style-type: none"> • An informational brochure or by using available electronic media or forums on post. • The PICA NRM will also engage in outreach efforts, including news releases or articles in local newspapers. • Support and encourage similar stewardship actions and cooperative efforts by other public land managers outside the installation, especially those within a 5 mile radius of known hibernacula. 	<ul style="list-style-type: none"> • Beneficial impacts are expected because the educational program is expected to promote regional awareness and conservation of the IBAT and its roosting and foraging habitat.
<p>Communicate with the USFWS NJFO and other agencies or organizations, including NJDFW ENSP, about the local and overall status of the IBAT population (see Section 5.2.6).</p>	<ul style="list-style-type: none"> • Beneficial impacts are expected because PICA, USFWS, NJDFW ENSP, and other organizations, will be kept informed of the status of the IBAT at PICA and the surrounding areas. The joint findings will provide more data on the species and its range and contribute to recovery plan efforts.

7.3 CUMULATIVE EFFECTS

A cumulative effect in the context of endangered species management is defined as an effect on the environment that results from the incremental effect of a proposed action when added to other past present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions occurring locally or regionally over a period of time. Implementation of the ESMP would result in the following cumulative effects:

- An environmental strategy for PICA that complies with the requirements of AR 200-3.
- Protection of the IBAT and its habitat.
- Improvement and refinement to existing natural resource management at the installation.

The prescriptions presented in the ESMP collectively aim to simultaneously manage existing PICA activities while avoiding or minimizing impacts to the IBAT.

7.4 CONCLUSIONS

Based on this EA, implementation of the management prescriptions presented in the ESMP portion of this ESMP/EA will not: (1) adversely impact the quality of the environment at PICA or (2) result in other significant environmental impacts that require preparation of an Environmental Impact Statement under 32 CFR 651.41 (e). The ESMP also meets the requirements of AR 200-3 by presenting management prescriptions that aim to protect and conserve the endangered IBAT in order to comply with the ESA. This ESMP/EA represents the U.S. Army's commitment to IBAT conservation. Beneficial impacts of implementing the management prescriptions include preservation of favorable IBAT habitat, conservation of water quality, gathering of additional scientific data on the IBAT during monitoring, sharing of information among all responsible and interested parties, and promotion of regional awareness about the IBAT and its roosting and foraging habitat.

* A **Finding of No Significant Impact** is hereby prepared to document this finding.

8.0 REFERENCES

- 3D/International. 1996. Biological Assessment of the Master Plan and Ongoing Mission, U.S. Army Engineer Center and Fort Leonard Wood. Cincinnati, OH.
- 3D/International. 1998. Mist Net Survey and Telemetry Study of Indiana Bats (*Myotis sodalis*) on the Tell City Ranger District of the Hoosier National Forest in Crawford and Perry Counties, Indiana. Cincinnati, OH. 38 pp. + Appendices.
- Balzano, Steve. 1994. Letter from S. Balzano of Environmental Resource Specialists Inc., Stockholm, NJ to USFWS, Pleasantville, NJ.
- Bickle, Gary. 1995. Report on a Survey for Indiana Bats near the existing PSE&G Transmission Line on Picatinny Arsenal. July 28-30. (unpublished). Study sponsored by Mt. Hope Hydro, Inc. Prepared by Gary Bickle and Associates.
- Belwood, J. J. 2002. "Indiana Bats In Suburbia: Observations and Concerns for the Future." *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Best T L *et al.* 1997 "Variation in the Diet of the Gray Bat (*Myotis grisescens*)." *Journal of Mammalogy*. Volume 78. Pages 569 through 583.
- Brack, V., Jr., and R.K. Laval, Jr. 1985. "Food Habits of the Indiana Bat in Missouri." *Journal of Mammalogy*. Volume 66. Pages 308 through 315.
- Brack, V., Jr., C. W. Stihler, R. J. Reynolds, and C. M. Butchkoski. 2002. Effect of climate and elevation on distribution and abundance in the mideastern United States. *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Britzke, E. R., K. L. Murphy, J. S. Haywood, and L. W. Robbins. 2002. "Acoustic Identification." *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Bryan, Hal. 1993. Results of a Preliminary Assessment of Potential Habitat for the Federally Endangered Indiana Bat in the Vicinity of the Proposed Mt. Hope Hydro Project Electric Transmission Line, Mt. Hope, NJ. October 15. (unpublished). Prepared for Mt. Hope Hydro, Inc. by Eco-Tech Inc., Frankfort, KY.
- Burt, W. H. 1943. "Territoriality and Home Range Concepts as Applied to Mammals." *Journal of Wildlife Management* 30:215-235. As Cited in Rommé *et al.* 2002.
- Butchkoski, Calvin. 2003. "Indiana Bat (*Myotis sodalis*) Investigations at Canoe Creek, Blair County Pennsylvania." Unpublished in Annual Job Report of Pennsylvania Game Commission Bureau of Wildlife Management Research Division Project No.: 06714; Job Code No.: 71402 (1 July 2002 to 30 June 2003).
- Butchkoski, C. M., and J. D. Hassinger. 2002. "Ecology of a Maternity Colony Roosting in a Building." *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

- Callahan, E. 1993. "Indiana Bat Summer Habitat Requirements." M.S. Thesis. University of Missouri-Columbia. As Cited in Rommé *et al.* 1995 (and Hoosier National Forest Planning Document).
- Callahan, Edward V., Ronald D. Drobney, and Richard L. Clawson. 1997. "Selection of Summer Roosting Sites by Indiana Bats (*Myotis sodalis*) in Missouri." *Journal of Mammalogy*. Volume 78, Number 3. Pages 818 through 825. And as Cited in Gardner and Cook. 2002.
- Carter, T. C., S. K. Carroll, J. E. Hofmann, J. E. Gardner, and G. A. Feldhamer. 2002. "Landscape Analysis of Roosting Habitat in Illinois." *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Centers for Disease Control. 1999. "Human Rabies Prevention—United States, 1999. Recommendations of the Advisory Committee on Immunization Practices (ACIP)." *Morbidity and Mortality Weekly Report*, 8 January 1999/48 (RR-1):1–2. Also available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00056176.htm> > As Cited in Belwood 2002.
- Chambers, R.E. 1983. "Integrating Timber and Wildlife Management Handbook." S.U.N.Y., College of Environmental Science and Forestry, N.Y. Department of Environmental Conservation.
- Chenger, John. 2003 "One Sodalis from the Hartman Mine." Hartman Mine Migration Study; April 21. From < <http://www.batmanagement.com/Projects/ibattrack2003/CCbatmigrationSCREEN.pdf> >
- Chenger, John. 2006a. "Mount Hope and Hibernia Mines Indiana Bat Spring Migration 2006." Picatinny Arsenal (Morris County) NJ female Indiana Bat Migration project; April 12 – June 1. Bat Conservation and Management, Inc.
- Chenger, John. 2006b. "Summer Woodland Bat Survey Picatinny Arsenal 2006." Picatinny Arsenal, NJ bat trapping, and Indiana Bat tracking project; July 18 – July 23. Bat Conservation and Management, Inc.
- Clark, Byron K., John B. Bowles, and Brenda S. Clark. 1987. "Summer Status of the Endangered Indiana Bat in Iowa." *The American Midland Naturalist*. Volume 118, Number 1. Pages 32 through 39.
- Clawson, R. L. 1987. "Indiana Bats: down for the count." *Bats Magazine*. Vol. 5, No. 2: Spring, Pages3-5. Bat Conservation International, Austin, Texas.
- Clawson, R. L. 2000. "Implementation of a Recovery Plan for the Endangered Indiana Bat." *In Proceedings: Bat Conservation and Mining: A Technical Interactive Approach*. 14-16 November 2000. St. Louis, Missouri.
- Clawson, R. L. 2002. "Trends in Population Size and Current Status." *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Clawson, R.L. and R.R. Titus. 1992. Management Plan for the Indiana and Gray Bat in Missouri. Missouri Department of Conservation, Jefferson City. 39 pp.
- Cope, J. B., A. R. Richter, and R. S. Mills. 1974. "Concentrations of the Indiana bat, *Myotis sodalis*, in Wayne County, Indiana." *Proceedings of the Indiana Academy of Science* 83:482–484. As Cited in Gardner and Cook 2002.
- Cope, James B., and Stephen R. Humphrey. 1977. "Spring and Autumn Swarming Behavior in the Indiana Bat, *M. sodalis*." *Journal of Mammalogy*. Volume 58, Number 1. Pages 93 through 95.

- Copeyon, C. K. 1997. Proposal to List the Northern Population of the Bog Turtle as Threatened. U.S. Fish and Wildlife Service 50 CFR Part 17 RIN 1018-AD05. State College, Pennsylvania: Department of Interior U.S. Fish and Wildlife Service.
- Conserve Wildlife. 1997. "Bats: More Hibernation Mines Located" – Annual Report 1996. *In* Spring Newsletter of the NJ Department of Environmental Protection, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program (DEP, NJDFGW, ENSP).
- Cowardin, L. M., V. Carter, F. G. Golet, and E. T. LaRoe. 1979. "Classification of Wetlands and Deepwater Habitats of the United States." U.S. Fish and Wildlife Service, FWS/OBS-79/31:1–103. As Cited in Kurta *et al.* 2002.
- Dingledine, John V., and Jonathan B. Haufler. 1983. "The Effect of Firewood Removal on Breeding Bird Populations in a Northern Oak Forest." U.S. Department of Agriculture (USDA) Forest Service General Technical Report RM-99. Snag Habitat Management: Proceedings of the Symposium, June 7 through 9. Pages 45 through 50.
- Dutko, Rick. 1994 "Protected at Last: The Hibernia Mine." *Bats* magazine. Vol. 12, No. 3: Fall, Pages 3-5. Bat Conservation International, Austin, Texas. From:
< <http://www.batcon.org/batsmag/v12n3-1.html> >
- Eisenburg, J.F. 1981. "The Mammalian Radiations: An Analysis of Trends in Evolution, Adaptation, and Behavior." University of Chicago Press. Chicago.
- Erkert, H. G. 1982. "Ecological Aspects of Bat Activity Rhythms. Pp. 201–242 in Ecology of bats (T. H. Kunz, ed.). Plenum Press, New York, New York. As Cited in Viele *et al.* 2002.
- Evans, D.E., W.A. Mitchell, and R.A. Fischer. 1998. "Species Profile: Indiana Bat (*Myotis sodalis*) on Military Installations in the Southeastern United States." U.S. Army Corps of Engineers (USACE) Waterways Experiment Station. Vicksburg, Mississippi. Technical Report SERDP-98-3. 23 Pages.
- Farmer, A., B. Cade, and D. Stauffer. 1997. A habitat suitability index model for the Indiana bat (*Myotis sodalis*). U.S. Department of the Interior, Geological Survey, Midcontinent Ecological Science Center, Fort Collins, CO 14 pages.
- Farmer, A. H., B. S. Cade, and D. F. Stauffer. 2002. "Evaluation of a Habitat Suitability Index Model." *In* The Indiana Bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Fenton, M. B., and G. K. Morris. 1976. "Opportunistic Feeding by Desert Bats (*Myotis* spp.)." *Canadian Journal of Zoology* 54:526–530. As Cited in Murray and Kurta 2002.
- Fitch, Virginia A., and Suzanne Glover. 1990. "Historic and Prehistoric Reconnaissance Survey, Picatinny Arsenal, New Jersey." *In* Army Materials Technology Laboratory Closure with Transfers to Detroit Arsenal, Michigan, Picatinny Arsenal, Fort Belvoir, Virginia: Supporting Documentation. Prepared by the Public Archaeology Laboratory, Inc., Pawtucket, Rhode Island, for the Daylor Consulting Group, Boston, and the U.S. Army Corps of Engineers, New England Division, Waltham, Massachusetts.
- Foster, R. W., and A. Kurta. 1999. "Roosting Ecology of the Northern Bat (*Myotis septentrionalis*) and Comparison with the Endangered Indiana Bat (*Myotis sodalis*)." *Journal of Mammalogy* 80:659–672. As Cited in Gumbert *et al.* 2002.

- Gardner, J. E., J. E. Hofmann, and J. D. Garner. 1987. "Discovery of Indiana Bat (*Myotis sodalis*) Maternity Roost Trees in Western Illinois." Transactions of the Illinois State Academy of Science, Supplement 80:59. As Cited in Gardner and Cook 2002.
- Gardner, J.E., J.D. Garner, and J.E. Hofman. 1991. "Summary of *Myotis sodalis* Summer Habitat Studies in Illinois." Illinois Natural History Survey, Illinois Department of Conservation. Champaign, Illinois. Final Report. 28 Pages.
- Gardner, J. E., J. D. Garner, and J. E. Hofmann. 1991a. "Summer Roost Selection and Roosting Behavior of *Myotis sodalis* (Indiana bat) in Illinois." Unpublished report, Illinois Natural History Survey. Champaign, Illinois. As Cited in Gardner and Cook 2002.
- Gardner, J. E., and E. A. Cook. 2002. Seasonal and Geographic Distribution and Quantification of Potential Summer Habitat." In The Indiana Bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Garner, James D., and James E. Gardner. 1992. "Determination of Summer Distribution and Habitat Utilization of the Indiana Bat (*M. sodalis*) in Illinois." Final Report: Project E-3. March.
- Green Mountain National Forest. 2003. "Indiana Bat Fact Sheet." Last modified: December 4, 2003. From: < http://www.fs.fed.us/r9/gmfl/resource_management/ibatfacts.htm >
- Gumbert, M. W., J. M. O'Keefe, and J. R. MacGregor. 2002. "Roost fidelity in Kentucky." In The Indiana Bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Hall, J.S. 1962. "A Life History and Taxonomic Study of the Indiana Bat (*Myotis sodalis*)." Reading Public Museum and Art Gallery. Sci. Publ., 12:1-68. As Cited in U.S. Fish and Wildlife Service (USFWS) 1983; and in Gardner and Cook 2002.
- Harvey, M. J., J. Scott Altenbach, T.L. Best. 1999. "Bats of the United States." Arkansas Game and Fish Commission.
- Harvey, M. J. 2002. "Status and Ecology in the Southern United States." In The Indiana bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas. As Cited in Gardner and Cook 2002.
- Hicks, A., and P. G. Novak. 2002. "History, Status, and Behavior of Hibernating Populations in the Northeast." In The Indiana Bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Hobson, C.S. 1993. "Status, Distribution, and Summer Ecology of Bats in Western Virginia: A survey for the Endangered Indiana Bat, *Myotis sodalis*." Report to Virginia Department of Game & Inland Fisheries, Non-game Division. Richmond, VA. 18 pp.
- Hobson, C. S., and J. N. Holland. 1995. "Posthibernation Movement and Foraging Habitat of a Male Indiana bat, *Myotis sodalis* (Chiroptera: Vespertilionidae), in Western Virginia." *Brimleyana* 23:95-101. As Cited in Rommé *et al.* 2002.
- Hofmann, Joyce. 1996. "Indiana Bats in Illinois." Center for Biodiversity. August. On-Line Address: <http://www.inhs.uiuc.edu/chf/pub/surveyreports/mar-apr96/bats.html>.

- Humphrey, Stephen R., Andreas R. Richter, and James B. Cope. 1977. "Summer Habitat and Ecology of the Endangered Indiana Bat, *Myotis sodalis*." *Journal of Mammalogy*. Volume 58, Number 3. Pages 334 through 346.
- Humphrey, S. R. 1978. "Status, Winter Habitat, and Management of the Endangered Indiana Bat, *Myotis sodalis*." *Florida Scientist* 41:65–76. As Cited in Clawson 2002.
- Humphrey, S.R. 1982. Bats. *Wild Mammals of North America* (Eds. J.A. Chapman and G.A. Feldhamer). John Hopkins University Press, Baltimore.
- IPMP (Integrated Pest Management Plan). 2004. "Integrated Pest Management Plan." Prepared by Johnson Controls, Inc. for PICA.
- Johnson, S. A., V. Brack, Jr., and R. K. Dunlap. 2002. "Management of Hibernacula in the State of Indiana." In *The Indiana bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas. As Cited in Brack *et al.* 2002.
- Kath, J. A. 2002. "An Overview of Hibernacula in Illinois, with Emphasis on the Magazine Mine." In *The Indiana bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas. As Cited in Hicks and Novak 2002.
- Kirkpatrick, C. M., and C. H. Conaway. 1948. "Some Notes on Indiana Mammals. *American Midland Naturalist* 39:130. As Cited in Gardner and Cook 2002.
- Kiser, J.D. and C.L. Elliott. 1996. "Foraging Habitat, Food Habits, and Roost Tree Characteristics of the Indiana Bat (*Myotis sodalis*) During Autumn in Jackson County, Kentucky." Unpublished report to the Nongame Program, Kentucky Department of Fish and Wildlife Resources, Frankfort, KY. 58 pp.
- Kurta, Allen. 1995. *Mammals of the Great Lakes Region*. University of Michigan Press.
- Kurta, A., J. Kath, E.L. Smith, R. Foster, M.W. Orick, and R. Ross. 1993a. "A Maternity Roost of the Endangered Indiana Bat (*Myotis sodalis*) in an Unshaded, Hollow Sycamore Tree (*Platanus occidentalis*)." *American Midland Naturalist*. 130:405-407. As Cited in Whitaker and Hamilton 1998.
- Kurta, A., D. King, J.A. Teramino, J.M. Stribley, and K.F. Williams. 1993b. "Summer Roosts of the Endangered Indiana Bat (*Myotis sodalis*) on the Northern Edge of Its Range." *American Midland Naturalist*. 129:132-138. As Cited in Whitaker and Hamilton 1998.
- Kurta, A., K. J. Williams, and R. Mies. 1996. "Ecological, Behavioral, and Thermal Observations of a Peripheral Population of Indiana bats (*Myotis sodalis*)." Pp. 102–117 in *Bats and Forests Symposium* (R. M. R. Barclay and R. M. Brigham, eds.). Research Branch, British Columbia Ministry of Forests, Victoria, British Columbia, Canada. As Cited in Gumbert *et al.* 2002.
- Kurta, A., S. W. Murray, and D. Miller. 2002. "Roost Selection and Movements Across the Summer Landscape." In *The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Kurta, A., and S. W. Murray. 2002. "Philopatry and Migration of Banded Indiana Bats (*Myotis sodalis*) and Effects of Using Radio Transmitters. *Journal of Mammalogy* 83:585–589. As Cited in Gumbert *et al.* 2002.

- Lawrence, Eleanor. 1989. *Henderson's Dictionary of Biological Terms*. Tenth edition, John Wiley & Sons, New York, NY.
- LaVal, R.K., R.L. Clawson, W. Caire, L.R. Wingate, and M.L. LaVal. 1977. "An Evaluation of the Status of Myotine Bats in the Proposed Meramec Park Lake and Union Lake Project Areas, Missouri." USACE St. Louis District. 136 Pages. As Cited in USFWS 1983.
- Leck, C. 1975. *The Birds of New Jersey*. Rutgers University Press, New Brunswick.
- Leffler, J. W., L. T. Leffler, and J. S. Hall. 1978. "Effects of Familiar Area on the Homing Ability of the Little Brown Bat, *Myotis lucifugus*." *Journal of Mammalogy* 60:201–204. As Cited in Hicks and Novak 2002.
- Lev Zetlin Associates. 1992. "Future Development Master Plan for U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, New Jersey: Commander's Summary." Prepared by Lev Zetlin Associates, New York, for the U.S. Army Corps of Engineers, New York District, New York.
- Miller, N. E. 1996. Indiana bat summer habitat patterns in northern Missouri. M.S. thesis, University of Missouri, Columbia, Missouri. As Cited in Miller *et.al.* 2002.
- Miller, N. E., R. D. Drobney, R. L. Clawson, and E. V. Callahan. 2002. "Summer Habitat in Northern Missouri." *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Mumford, R.E., and J.O. Whitaker, Jr. 1982. *Mammals of Indiana*. Indiana University Press.
- Murray, S. W., and A. Kurta. 2002. "Spatial and Temporal Variation in Diet." *In The Indiana Bat: biology and management of an endangered species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- New Jersey Department of Environmental Protection (NJDEP). 2001 . "New Jersey Department of Environmental Protection Freshwater Wetland Protection Act Rules, N.J.A.C. 7:7A." From: < <http://www.state.nj.us/dep/landuse> >
- Nolte, Kelly, and Mark A. Steinback. 1998a. "Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey." Revised Draft. Prepared by Panamerican Consultants, Inc., Depew, New York, for the U.S. Army Corps of Engineers, New York District, under Contract No. DACW51-95-D-0024, Work Order No. 19.
- Nolte, Kelly, and Mark A. Steinback. 1998b. "Definition of Historic Districts for Picatinny Arsenal, Morris County, New Jersey." Revised Draft. Prepared by Panamerican Consultants, Inc., Depew, New York, for the U.S. Army Corps of Engineers, New York District, under Contract No. DACW51-95-D-0024, Work Order No. 19.
- Nolte, Kelly, and Mark A. Steinback. 1998c. 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." Prepared for the U.S. Army Corps of Engineers, New York District, under Contract No. DACW51-95-D-0024, Work Order No. 19.

- Nyland, R.D. D.A. Maquis, and D.K. Whittemore. 1981. "Northern Hardwoods." *In* Choices in Silviculture for American Forests. Society of American Foresters. Washington, D.C.
- O'Donnell, C. F. J., and J. A. Sedgeley. 1999. "Use of Roosts by the Long-Tailed Bat, *Chalinolobus tuberculatus*, in a Temperate Rainforest in New Zealand." *Journal of Mammalogy* 80:913–923. As Cited in Gumbert *et al.* 2002.
- Ohio Division of Wildlife. 1996. "Wildlife Notes: Indiana Bat."
- Ohio Department of Natural Resources, Division of Wildlife. 2003 "Life History Notes: Indiana Bat." From: < <http://www.dnr.state.oh.us/wildlife/resources/wildnotes/pub370.htm> >
- Ormsbee, P. 1996. "Characteristics, Use, and Distribution of Day Roosts Selected by Female *Myotis volans* (long-legged myotis) in Forested Habitat of the Central Oregon Cascades." Pp. 124–131 in *Bats and Forests Symposium* (R. M. R. Barclay and R. M. Brigham, eds.). Research Branch, British Columbia Ministry of Forests, Victoria, British Columbia, Canada. As Cited in Gumbert *et al.* 2002.
- Picatinny Arsenal (PICA). 2001. "Integrated Natural Resources Management Plan." Prepared in conjunction with U.S. Army Environmental Center. May.
- Rinehart, J.B. and T.H. Kunz. 1998. "Biological Survey For The Federally Listed Endangered Indiana Bat (*Myotis sodalis*), Picatinny Arsenal, Morris County, New Jersey" – Final Report. Center for Ecology and Conservation Biology. Boston University. December.
- Rommé, Russell C., Karen Tyrell, and Virgil Brach, Jr. 1995. "Literature Summary and Habitat Suitability Index Model: Components of Summer Habitat for the Indiana Bat, *Myotis sodalis*." Federal Aid Project E-1-7, Study No. 8. Report Submitted to the Indiana Department of Natural Resources, Division of Wildlife, Bloomington, Indiana, by 3D/Environmental, Cincinnati, Ohio. 43 Pages.
- Romme, R. C., A. B. Henry, R. A. King, T. Glueck, and K. Tyrell. 2002. "Home Range near Hibernacula in Spring and Autumn." *In* The Indiana Bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Rutsch, Edward S., William Sandy, Richard F. Porter, and Leonard G. Bianchi. 1986 "Cultural Resource Investigation of the Proposed Mt. Hope Pumped Storage Hydroelectric Facility and Transmission Lines Rockaway and Jefferson Townships, Morris County, New Jersey." Prepared by Historic Conservation and Interpretation, Inc., Newton, New Jersey, for Tippetts-Abbett-McCarthy-Stratton, New York.
- Sanders, Chris, J. Chenger, B. Denlinger. 2001. "Williams Lake Telemetry Study; New York Indiana Bat Spring Tracking." *Bat Conservation and Management*, April-May. From: < www.batmanagement.com/Projects/kings/WilliamsScreen.pdf >
- Schieppati, Frank J., Michael A. Cinquino, Robert J. Hanley, Peter J. Gorton, Mark A. Steinback, Edward V. Curtin, and Kerry Nelson. 1998 "Field Inspection of 53 Areas Sensitive for Cultural Resources and Phase IB Archaeological Surveys of Eight Sensitive Areas at Picatinny Arsenal, Morris County, New Jersey." Prepared by Panamerican Consultants, Inc., Depew, New York, for Northern Ecological Associates, Inc., Canton, New York, and the U.S. Army Corps of Engineers, New York District, under Contract No. DACW51-97-D-0010, Work Order No. 2.

- Tarr, Matthew D. 1999 “Wildlife Profiles Indiana Bat (*Myotis sodalis*).” *In* Habitats; Fall Newsletter of the University of New Hampshire Cooperative Extension Forestry, Wildlife and Water Resources Programs.
- Tetra Tech EM Inc. (Tetra Tech). 1999a. Fax Regarding How to Manage Missouri Forests for the Indiana Bat. From Matthew Schramm, Environmental Scientist. To Jack Brunner, Environmental Scientist. January 13.
- Tetra Tech. 1999c. Record of Telephone Conversation Regarding the Indiana Bat in the Daniel Boone National Forest. Between Matt Schramm, Environmental Scientist, and John MacGregor, Wildlife Biologist, Daniel Boone National Forest. February 12.
- Tetra Tech. 1999d. Record of Telephone Conversation Regarding Status of the Indiana Bat in Indiana. Between Eric Monschein, Environmental Scientist, and Robin McWilliams-Munson, USFWS Region 3 Bloomington Field Office. February 12.
- Tetra Tech. 1999e. Record of Telephone Conversation Regarding Indiana Bat Habitat. Between Jack Brunner, Environmental Scientist, and Lori Pruitt, USFWS Region 3 Bloomington Field Office. June 24.
- Tetra Tech. 1999f. Endangered Species Management Plan for the Indiana Bat, *Myotis sodalis*, Newport Chemical Depot, Vermillion County, Indiana.”
- Thomson, Christine. 1982. “*Myotis sodalis*.” *Mammalian Species*. Volume 163. Pages 1 through 5.
- Tibbels, A. 2000. “Do call libraries reflect reality?” *Bat Research News* 40:153–155. As Cited in Britzke *et al.* 2002.
- Trombulak, S. C., P. E. Higuera, and M. DesMeules. 2001. “Population Trends of Wintering Bats in Vermont. *Northeastern Naturalist* 8:51–62. As Cited in Hicks and Novak 2002.
- U.S. Army. 1995. “Natural Resources - Land, Forest, and Wildlife Management.” Army Regulation 200-3. Headquarters, Department of the Army. Washington, DC.
- U.S. Army Environmental Center. 1995. “Manual for the Preparation of Installation Endangered Species Management Plans.” Prepared by Science Applications International Corporation. March 13.
- United States Department of Agriculture, Soil Conservation Service. 1976. *Soil Survey of Morris County, New Jersey*. August.
- United States Department of Agriculture, Forest Service. 2001. “Summary of Proposed Forest Plan Amendment for Threatened & Endangered Species.” Monongahela National Forest. Elkins, West Virginia.
- U.S. Fish and Wildlife Service (USFWS). 1982. “Gray Bat Recovery Plan.” Fish and Wildlife Reference Center. Denver, Colorado. July 8.
- U.S. Fish and Wildlife Service (USFWS). 1983. “Recovery Plan for the Indiana Bat.” Cooperators: Brady, J.T., R.K. LaVal, T.H. Kunz, M.D. Tuttle, D.E. Wilson, and R.L. Clawson. Rockville, MD. 80 Pages.
- U.S. Fish and Wildlife Service (USFWS). 1999. “Agency Draft: Indiana Bat (*Myotis sodalis*) Revised Recovery Plan.” Region 3. Fort Snelling, Minnesota. 53 Pages.

- U.S. Fish and Wildlife Service (USFWS). 2000. "A Survey For the Federally Listed Endangered Indiana Bat (*Myotis sodalis*) Picatinny Arsenal, Morris County, New Jersey"-- Final Report. Preparer: Annette Scherer. New Jersey Field Office, Ecological Services, Pleasantville, NJ. June.
- USFWS. 1997. Fax Transmission of "Guidelines for Netting Indiana Bats." From Mike Litwin. To Jack Brunner, Environmental Scientist, Tetra Tech. January 16.
- USFWS. 1998. Fax Transmission of "Draft Working Notes on Indiana Bat Guidelines for Forest Management." From Lori Pruitt. To Eric Dohner, Environmental Scientist, Tetra Tech, Inc. May 20.
- USFWS and National Marine Fisheries Service (NMFS). 1998. "Endangered Species Consultation Handbook, Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act." Final Report. March.
- USFWS. 2004. Response Letter concerning "Mosquito Control at PICA." From John Staples. To Richard Williams, PICA Pest Manager, Johnson Controls, Inc. February 4.
- Valent, Mike, and R. Dutko. 1994. "Bat Conservation Gate Protects State's Largest Hibernaculum". *In* Conserve Wildlife, Spring/Summer Newsletter of the DEP, NJDFGW, ENSP.
- Valent, Mike. 1995. "Rare Bat Find at Picatinny Arsenal". *In* Conserve Wildlife, Fall/Winter Newsletter of the DEP, NJDFGW, ENSP.
- Viele, D., A. Kurta, and J. A. Kath. 2002. "Timing of Nightly Emergence." *In* The Indiana Bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Voûte, A. M., J. W. Sluiter, and M. P. Grimm. 1974. "The influence of the Natural Light Cycle on the Activity Rhythm of Pond Bats (*Myotis dasycneme* Boie, 1825) During Summer." *Oecologia* 17:221–243. As Cited in Viele *et al.* 2002.
- Webb, Antisa C., K. A. Burks-Copes, D. E. Evans. 2001. Indiana Bat Habitat Assessment on the U.S. Army TACOM Armament Research, Development, and Engineering Center, Picatinny Arsenal, New Jersey. USAE Engineering Research and Development Center. Vicksburg, Mississippi.
- WES (Waterways Experiment Station), U.S. Army Corps of Engineers. 1995 "Identification and Analysis of Wetlands, Floodplains, Threatened and Endangered Species and Archaeological Geomorphology at Picatinny Arsenal, NJ." Vol. 1: Text. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. Prepared for the U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland and the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey.
- White, G. C., and R. A. Garrott. 1990. "Analysis of Wildlife Tracking Data." Academic Press. San Diego, California. As Cited in Rommé *et al.* 2002.
- Whitaker, J.O., Jr., and J.R. Gammon. 1988. "Endangered and Threatened Vertebrate Animals of Indiana: Their Distribution and Abundance." The Indiana Academy of Science. Indianapolis, Indiana.
- Whitaker, J.O., Jr., and W.J. Hamilton, Jr. 1998. *Mammals of the Eastern United States*. Cornell University Press. Ithaca, New York. Third Edition.

APPENDIX A

GLOSSARY

(Three Pages)

GLOSSARY

Bat-Day. A “bat-day” represents use of a tree by one bat for 1 day (Kurta *et al.* 1996, Gumbert *et al.* 2002).

Calcar. A spur of cartilage or bone that projects from the ankle of many bat species and helps support the tail membrane.

Conservation. Use of all methods and procedures necessary to bring a listed species to the point where it does not require special protection under the Endangered Species Act.

Critical habitat. The specific areas within a listed species’ range that consist of physical or biological features essential to the conservation of the species and potentially requiring special management conditions or protection.

Dusk count. **Observation of a potential roost tree for emerging bats at dusk (1 hour before sunset to 0.5 hour after sunset).**

Echolocation. Use of a reflected sound emitted from an animal and returned to its ears or other sensory receptors in order to locate objects. Most bat sounds are high pitched and outside human hearing range.

Endangered species. Pursuant to the ESA, any species that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Preservation Act. The 1966 precursor to the ESA and the first federal act that declared a national policy to protect species threatened with extinction and that prohibited the taking of species on federal lands.

ESA Section 7 Consultation. Various processes carried out under Section 7 of the ESA, including formal and informal consultation. (see below)

Family. A taxonomic category within an order. A family consists of one or more genera.

Foraging. All behavior that is associated with the obtaining and consumption of food which the animal must search or hunt.

Formal Consultation. A process between USFWS and another federal agency that (1) determines whether a proposed federal action is likely to jeopardize the continued existence of a listed species or destroy or adversely modify designated critical habitat, (2) begins with a federal agency’s written request and submittal of a complete initiation package, and (3) concludes with the issuance of a biological opinion by USFWS.

Girdling. Removal of a section of bark and cambium layer all around a tree with either an axe or chainsaw to discontinue the supply of nutrients to the tree.

Hibernaculum. The resting place or shelter of an animal during periods of winter when the animal achieves a state of reduced activity and metabolism because of lowering of its body temperature.

Home Range. The area traversed by an individual in its normal activities of food gathering, mating, and caring for young. (Burt 1943); often qualified by a specific time period or season.

Informal Consultation. A process that includes all discussions and correspondence between USFWS and another federal agency before a formal consultation. Informal consultation is used to determine whether a proposed federal action may affect listed species or designated critical habitat. If a proposed federal action may affect a listed species or designated critical habitat, formal consultation is required.

Intermittent Stream. A stream starting and stopping at intervals. An intermittent stream is identified by a dashed, blue line on U.S. Geological Survey topographic maps.

Keeled Calcar. A calcar with an obvious extension of membrane, or keel, between the calcar and the outside edge of the membrane.

Listed Species. Any species of fish, wildlife, or plant that has been determined to be threatened or endangered under Section 4 of the ESA.

Maternity Roosting Colony. A group of female bats that live together for the purpose of bearing and raising their young.

Maternity Roosting Season - Core. (15 MAY – 15 AUG). As defined by the U.S. Fish and Wildlife Service, the time period acceptable for documenting summer populations, especially when female IBATs congregate in maternity colonies at summer roost trees.

Migration. The process or act of moving periodically from one region or climate to another.

Mist netting. A field study that involves stretching thin, nylon nets between trees to catch bats or birds in flight. Mist nets come in various widths and heights. A standard “net set” is often 2 or 3 nets (60 ft wide) “stacked on top of one another totaling about 20 ft high.

Net-Night. One net set up for one night.

Non-hibernation Season. (1 APR – 15 NOV). Due to an “area of influence” within 5 miles of known IBAT hibernacula, IBAT activity is prolonged beyond the core maternity season because of immigration and emigration and the attendant pre-and post-hibernation foraging and roosting needs.

Perennial Stream. A stream present in all seasons of the year. A solid, blue line on U.S. Geological Survey topographic maps identifies a perennial stream.

Philopatry. Tendency of an organism to stay in or return to its home area. See also **Site Fidelity**.

Pre-Dawn Count. Observation of a potential roost tree for returning bats at dawn (1 hour before sunrise to 0.5 hour after sunrise).

Primary Roost / Alternate Roost (tree). . Tree roosts are classified as “primary” or “alternate” based upon intensity of use, as indicated by exit counts (Miller *et al.* 2002). Primary roosts are defined as those occupied by more than 30 individuals (generally same species implied) (Miller *et al.* 2002). Others qualify the distinction based upon the proportion of bats in a colony occupying the roost site, as well as location in relation to forest canopy cover (Callahan *et al.* 1997, Kurta *et al.* 1996).

Radiotelemetry. Use of radio transmitters and receivers to track the movements or determine the den locations of individual animals. A radio transmitter is affixed to the animal to be tracked.

Recovery Plan. A document that delineates, justifies, and schedules research and management actions necessary to support the recovery of a species, including those actions that, if successfully undertaken, are likely to permit reclassification or delisting of the species.

Riparian Corridor. A perennial or intermittent water body, generally its lower banks and upper banks, and the vegetation that stabilizes the slopes, protects the waterway from erosion and sedimentation, provides cover and shade, and maintains the fish and wildlife habitat. At PICA the defined width will be 150 ft on either side of the stream bank or 150 ft upland of a delineated wetland boundary (aka transition zone); whichever is farther from midchannel.

Roost. A perch or other place used by bats for hanging, resting, and lodging.

- **Maternity.** A roost comprising adult reproductive females and juvenile pups.
- **Non-Maternity.** A roost comprising adult non-reproductive females and/or males.

Site. References to “site” to can be as specific and limited as a single piece of bark, an entire tree, a single cave or mine, or specific locations within. Also, a “site” can be a large foraging area that is used repeatedly, or a route that is followed repeatedly by one or more bats as they travel among and between foraging areas and roost areas (Gumbert et al. 2002).

Site Fidelity (SF). . Gumbert *et al.* (2002) formulated standardized definitions of Fidelity for IBATs (as well as other tree dwelling species). Bats that repeatedly use the same site at different intervals, whether for foraging, roosting, or hibernating, display “site fidelity” (SF). Site Fidelity is further classified as:

- **Roost Site Fidelity (RSF).** “Roost-Site Fidelity” (RSF) is repeated, consecutive (for ≥ 5 days) or nonconsecutive use of a site for roosting.
- **Roost Tree Fidelity (RTF).** “Roost-Tree Fidelity” (RTF), is repetitive use of a particular roost tree.
- **Roost Area Fidelity (RAF).** “Roost Area Fidelity” (RAF), is repeated use of a group of roost trees in a particular area by one or more bats. N. B. Fidelity includes return to a previously used roost tree by a single bat after using a different tree.
- **Foraging Area Fidelity (FAF).** “Foraging-Area Fidelity” (FAF) is recurring use of a particular foraging site or travel corridor by one or more individuals.

N.B. Fidelities of the same species or of an individual bat are notated as RSFs, RTFs, RAFs, FAFs; and RSFi, RTFi, RAFi, FAFi, respectively (Gumbert et al. 2002).

Snag. A tree with less than 10% live canopy.

Species. A group of interbreeding natural populations that is reproductively isolated from other such groups.

Stand. A contiguous area of woodland containing trees of similar species, sizes, and ages.

Threatened Species. Pursuant to the ESA, any species that is likely to become an endangered species throughout all or a significant portion of its range within the foreseeable future.

Volant. Capable of flight.

Zeitgeber. A synchronizing agent, as environmental cues responsible for keeping circadian rhythms in tune with the daily 24-hour light-dark cycle.

APPENDIX B

PERSONS CONSULTED DURING ESMP/EA PREPARATION

(One Page)

PERSONS CONSULTED

Brack, Virgil. Environmental Solutions and Innovations, Inc.
Butchkowski, Cal. PA Game Commission
Chenger, John. Bat Conservation and Management, Inc.
Clewell, Richard. U.S. Army, IMCOM-NorthWest Regional Office
Cox, Phillip. Mason and Hanger Corporation (Newport Chemical Depot – U.S. Army)
Craddock, Melissa. NJDFW-ENSP
Hicks, Alan. New York Department of Environmental Conservation
Hohmann, Matt. USACE- CERL
Martin, Chester. USACE- ERDC (formerly WES)
Kapoor, Vinod. PICA
Scherer, Annette. USFWS-NJFO
Valent, Mick. NJDFW-ENSP
Williams, Richard. Johnson Controls, Inc.
Woodson, Bill. DOD

ESMP/EA PREPARER

Van De Venter, Jonathan. PICA Natural Resources Manager N.B. JVDV was the primary author and preparer of this plan.

ESMP REVIEWERS / EDITORS

Banashefski, Dave. PICA
Berkowicz, Chris. PICA
Craddock, Melissa. NJDFW-ENSP
Kahn, Stanley PICA
Leondi, Kevin. PICA
Rubinoff, Jay. Booz Allen Hamilton
Scherer, Annette. USFWS-NJFO
Sekscienski, Steve. U.S. Army Environmental Command
Solecki, Thomas. PICA
Thies, Paul. U.S. Army Environmental Command

APPENDIX C

**PICATINNY ARSENAL
ENDANGERED SPECIES MANAGEMENT PLAN
ANNUAL COMPLIANCE CHECKLIST**

(Seven Pages)

Completed by: _____

Date: _____

Approved by: _____
Installation Commander

Date: _____

If any of the answers to the questions below indicate a deviation from the ESMP management prescriptions, provide a detailed explanation and describe actions taken to correct the situation.

FOREST MANAGEMENT (Section 5.1.1 of ESMP)		
1	Did PICA refrain from forest management activities during the IBAT Non-hibernation season (1 APR to 15 NOV)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
2	Did forest management at PICA promote the following goals? <ul style="list-style-type: none"> • An average of at least three live potential maternity roost trees (>20 inches dbh) per acre maintained in the stand; these being the largest potential maternity roost trees in the stand. • An average of at least six additional live potential maternity roost trees per acre with a dbh greater than 10 inches will be maintained in the stand. • If the stand does not contain trees larger than >20 inches dbh, then at least 20 live potential maternity roost trees per acre will be maintained in the stand; these will be the largest potential maternity roost trees in the stand. 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No
3	Did PICA leave shagbark hickory (<i>Carya ovata</i>), sugar maple (<i>Acer sacharrum</i>), white oak (<i>Quercus alba</i>), and black locust (<i>Robinia pseudoacacia</i>) trees standing during forest management activities?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4	Was 60% or more canopy cover maintained in each forest stand after forest management activities?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5	Were snags left standing during forest management activities?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6	If PICA engaged in forest management activities within 150 ft of a stream, did the activities maintain or improve the quality of the IBAT habitat? (If so, explain below.)	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
7	Were known maternity roost trees protected until they were no longer standing?	<input type="checkbox"/> Yes <input type="checkbox"/> No
8	Did PICA refrain from controlled burning of woodlands from 1 APR to 15 NOV?	<input type="checkbox"/> Yes <input type="checkbox"/> No

EXPLANATION/COMMENTS:

PROTECTION OF WATER QUALITY (Section 5.2.2 of ESMP)		
24	Did PICA protect Riparian Corridors from:	
	a. Timber harvesting activities?	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
	b. Heavy equipment activities or impacts?	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
	c. Any permanent loss of forest cover (acres)? If so, explain below and estimate acres and percent of forest cover lost / changed.	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
	d. Stream alteration, sediment or pollution discharges? If so, explain below.	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
25	Did PICA alter/disrupt non-nuisance beaver activities? If so, summarize results below.	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
(NON-TREE) IBAT ROOSTS (Sections 5.2.3 and 5.2.4 of ESMP)		
26	Did PICA discover any IBAT roosts in buildings? Or other atypical sites? If so, describe below and specify building and location within building.	<input type="checkbox"/> Yes <input type="checkbox"/> No
27	Did PICA construct or provide any artificial bat roost(s)? If so, describe below and indicate location.	<input type="checkbox"/> Yes <input type="checkbox"/> No
28	Did PICA NRM inspect known sites? If so, summarize findings below. Date of last inspection:	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
29	Did PICA NRM make counts at known sites? If so, summarize findings below. Date of last count:	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable

EXPLANATION/COMMENTS:

EMPLOYEE AND COMMUNITY AWARENESS PROGRAM (Section 5.2.5 of ESMP)		
30	Did PICA develop an informational brochure to promote awareness of the presence and status of the IBAT at the installation as well as the regulatory requirements driving its protection?	<input type="checkbox"/> Yes <input type="checkbox"/> No
31	Was the brochure distributed to appropriate PICA employees, lessees, hunters, and other individuals whose activities might impact the IBAT?	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
32	Did PICA NRM meet with installation supervisors and promote discussion and dissemination of IBAT information to their staff as appropriate?	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
33	Did PICA's NRM seek opportunities to participate in regional conservation efforts and to promote community awareness of the IBAT? (If so, explain below.)	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
COMMUNICATION WITH USFWS (Section 5.2.6 of ESMP)		
34	Did PICA report findings from species and habitat monitoring activities to the USFWS NJFO?	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
35	Did PICA engage in ESA Section 7 consultation with the USFWS NJFO? (If so, explain below.)	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable
ESMP COMPLIANCE AND UPDATING (Section 6.0 of ESMP)		
36	Did the PICA NRM review the ESMP compliance report and make minor ^a or major ^b revisions to the ESMP? (If so, explain below.)	<input type="checkbox"/> Yes <input type="checkbox"/> No
37	Have ESA violations been documented this year? (If so, explain below.)	<input type="checkbox"/> Yes <input type="checkbox"/> No Not <input type="checkbox"/> Applicable

EXPLANATION/COMMENTS:

Notes:

^a Minor revisions are changes that will have no effect (considered together with all previous minor changes to the current ESMP), beneficial or adverse, on the IBAT and its habitat.

^b Major revisions are changes that will impact the IBAT and its habitat.

APPENDIX D

**FINDING OF NO SIGNIFICANT IMPACT FOR IMPLEMENTATION
OF THE ENDANGERED SPECIES MANAGEMENT PLAN FOR THE
IBAT, MYOTIS SODALIS**

(Two Pages)

FINDING OF NO SIGNIFICANT IMPACT

For the

**Endangered Species Management Plan
For the Indiana Bat, *Myotis sodalis*
Environmental Assessment**

Picatinny Arsenal, NJ 07806-5000

JANUARY 2005

Description of Proposed Action and Alternatives Considered

The Proposed Action, for which an environmental assessment has been prepared resulting in this Finding of No Significant Impact (FNSI), is the implementation of the Endangered Species Management Plan (ESMP) for the federally listed Indiana bat (*Myotis sodalis*). U.S. Department of the Army Regulation (AR) 200-3, "Natural Resources—Land, Forest, and Wildlife Management", requires U.S. Army installations to implement programs and develop ESMP's to protect and conserve listed and proposed threatened and endangered species and critical habitat in order to comply with the Endangered Species Act. Biological surveys conducted at Picatinny Arsenal (PICA) in Morris County, NJ, have shown that the Indiana bat (IBAT) forages and roosts at the installation. Pursuant to the regulations implementing the procedural provisions of the National Environmental Policy Act of 1969 as amended in 1975 (40 Code of Federal Regulations Parts 1500 through 1508), the U.S. Department of the Army gives notice that it has prepared an ESMP for the IBAT with an integrated environmental assessment (EA) for PICA.

The ESMP for PICA presents management prescriptions for various installation activities that are important to the local IBAT population and potentially to the long-term survival of the species. No mitigation is required by the EA. Alternatives considered in the EA include "no action" and implementation of the ESMP. Implementation of the ESMP includes the following actions and would benefit management of natural resources at the installation:

- Incorporate conservation guidelines into existing PICA activities, including forest management; pest management; construction, demolition, and environmental remediation; and any leasing of PICA property
- Implement a water quality protection program
- Implement an IBAT population and habitat monitoring program
- Implement an awareness program regarding the IBAT and its habitat
- Communicate with the U.S. Fish and Wildlife Service Region 5, Pleasantville, New Jersey Field Office and other agencies, including NJDFW ENSP, about the local and overall status of the IBAT population

The "no action" alternative would place the installation in noncompliance with AR 200-3. In addition, the IBAT population at PICA may be adversely impacted over the long term if appropriate protection and conservation measures are not implemented at the installation.

Anticipated Environmental Effects

Based on the EA, implementation of the proposed ESMP will have no adverse effects on the natural environment. All management prescriptions presented in the ESMP will be implemented in accordance with applicable state and federal environmental laws.

Facts and Conclusions Leading to the FNSI

The elements of the Proposed Action have been evaluated in the Environmental Assessment to identify potential environmental impacts. No significant adverse environmental impacts have been identified, nor have conflicts with land use plans, policies, or controls been discovered. It is the conclusion of the Environmental Assessment that the implementation of the Indiana Bat Endangered Species Management Plan will not have a significant effect on the environment, and therefore is not subject to the preparation of an Environmental Impact Statement. As a result, this Finding of No Significant Impact (FNSI) has been prepared.

Public Comment Period

The deadline for the general public to comment on this project or to submit requests for further information is 30 days from the date of public notification of this integrated ESMP/EA and FNSI. The point of contact is Mr. Peter Rowland, Public Affairs Office, U.S. Army JM&L LCMC, Attn: AMSRD-AAR-AO, Picatinny Arsenal, New Jersey 07806-5000.

APPENDIX E

Indiana Bat and Northern Long Eared Bat 4(d) Rule

ADDENDUM 1

4(d) Rule—Northern Long Eared Bat

Addendum 1 to Integrated Natural Resources Management Plan, Department of the Army, Installation Management Command, Headquarters, United States Army Garrison, Picatinny Picatinny Arsenal, NJ

07806-5000 31 MAR 2015

1. PURPOSE. This document seeks to clarify how the federally threatened Northern Long Eared Bat (*Myotis septentrionalis*) will be managed under the present 4(d) rule of the ESA on Picatinny Arsenal

(PICA). The "4(d) rule", applicable to some Threatened species, can supplant the normal protections of

the ESA for all Endangered or other Threatened species and may either increase or decrease the ESA's

normal protections. The ESA specifies that 4(d) rules must be "necessary and advisable to provide for

the conservation of such species." With respect to this Threatened bat species the normal ESA restrictions were in fact relaxed by the USFWS in both their interim and final 4(d) rules.

2. BACKGROUND. The Northern Long Eared Bat (NLEB) was a very common species on PICA until the

advent of White Nose Syndrome (WNS) circa 2006-07, a fungal disease infecting hibernating bats. See

species profile information regarding threats as well as basic life history elements in paragraphs 6 and 7

below; extracted from

< <https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=A0JE#status> >. This species was proposed for listing as Endangered in December 2013, but the listing deadline was granted a 6 month

extension to postpone a decision until April 2015.

a. The Picatinny Integrated Natural Resources Management Plan (INRMP), which had been being revised throughout CY 2014 and prior, was reviewed by both the USFWS-NJFO, as well as the NJDFWENSP

as part of the tri-partite agreement, before being approved and implemented on 31 MAR 2015.

The pending status of the NLEB was mentioned in this INRMP.

b. Due to substantial declines in the populations of NLEB, the USFWS listed this species as Threatened

on 2 APR 2015 with interim management guidance under the 4(d) rule.

c. Concurrently and separately a Biological Evaluation by the Army Environmental Command had been

developed in cooperation with the USFWS and was finalized and promulgated as: "Informal Conference

& Management Guidelines on the Northern Long-eared Bat (*Myotis septentrionalis*) for Ongoing

Operations on Installation Management Command Installations - May 2015.” This is the guidance that

has been followed to date with the NJFO Ecological Services biologists; previously with Mr. Jeremy Markuson, and presently with Ms. Alicia Protus.

d. On 14 JAN 2016 the Final 4(d) rule was published in the Federal Register and implemented by USFWS. Reference USFWS Interagency Formal Consultation on the NLEB via

< <https://www.fws.gov/midwest/endangered/mammals/nleb/s7.html> >, especially link to

“Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions – 5 JAN 2015”; as well as link to “Key to the Northern Long-Eared Bat

4(d) Rule for Federal Actions that May Affect Northern Long-Eared Bats”

e. In early OCT 2016 an external Environmental Program auditor indicated that the INRMP needed to

be updated to reflect management of the NLEB, notwithstanding that such management was already

being implemented satisfactorily via the AEC-USFWS Programmatic BE.

3. ADDENDUM 1 to 2015 INRMP regarding NLEB. This document will be referred to hereafter as NLEB

Management Component or simply NLEB Mgt. See also ADDENDUM 2 to 2015 INRMP regarding Indiana

Bat (IBAT).

a. Whereas the AEC-USFWS Programmatic BE will expire (sunset) in MAY 2018, PICA can either follow

the USFWS Optional Framework to Streamline Section 7 Consultation for the Northern Long-Eared Bat

or formulate and adopt an appropriate method with the NJFO for managing this species while fulfilling

our (ESA) Section 7 consultation requirements.

b. Whereas PICA must always and already does adhere to and follow the normal ESA protections and

Section 7 requirements for the federally Endangered IBAT; and...

c. Whereas the NJFO has already approved and is satisfied with the longstanding Picatinny Arsenal Indiana Bat Endangered Species Management Component (PICA IBAT ESMC) of the INRMP, which provides for the full protection and conservation of this species of bat (namely: “No Effect” or “Not Likely to Adversely Affect”, nor “cause prohibited take”); PICA proposes to adopt these same conservation measures for the Threatened NLEB.

4. RATIONALE.

a. Whereas the NLEB share substantially similar life history requirements and habitat foraging and roosting patterns as the IBAT; and...

b. Whereas the PICA IBAT ESMC affords more stringent protections than nearly all of the Final NLEB 4(d) rules; and...

c. Whereas the PICA IBAT ESMC agreements effectively trump any lesser management allowances under the Final NLEB 4(d) rules or streamlined Section 7 consultation requirements, future management

and Section 7(a)(1) consultation for the NLEB is thereby covered and even exceeds minimum 4(d) rule

provisions.

d. Whereas the PICA IBAT ESMC further fulfills PICA Section 7(a)(1) requirements via additional voluntary conservation measures which match or exceed those listed for the NLEB in the USFWS Programmatic BO – 5 JAN 15, this NLEB Mgt fulfills all conditions necessary and advisable to provide for the conservation of this Threatened bat species.

5. CONDITIONAL CONSIDERATIONS. The only provisions of the Final NLEB 4(d) rules which are not explicitly or perhaps adequately addressed in the longstanding PICA IBAT ESMC are the following:

a. Tree removal within 150 feet of a known NLEB maternity roost tree during the roosting season. (1) Under the IBAT ESMC, tree removal is deferred until well after the roosting and hibernacula swarming periods, unless Hazard tree or other immediate tree removal is necessary – and then, section

7 consultation always occurs.

(2) If a NLEB maternity roost tree is ever identified on the installation, then the provisions of the Final

NLEB 4(d) rule will apply, in addition to or supplemental to the standing IBAT ESMC.

b. Tree removal within 0.25 miles of a hibernacula at any time of year. Although this is highly unlikely

in the PICA context, it is remotely possible, yet not specifically addressed in the IBAT ESMC.

Whereas

the IBAT ESMC requires informal (written) consultation anytime a tree is affected within certain IBAT

Zones of Concern (ZoCs), these ZoCs were only circumscribed around known IBAT summer capture and/or summer roosting sites – not hibernacula. PICA hereby amends the IBAT ESMC to include the Mt

Hope West Shaft (known to harbor hibernating NLEB) as a new NLEB ZoC with a radius of 0.25 miles;

thus requiring similar Section 7 consultation as for our other IBAT ZoCs. This will be reflected also within

Addendum 2 of the INRMP for the IBAT ESMC.

c. If any other condition or situation may arise which is not already covered in either the longstanding

PICA IBAT ESMC or the USFWS Final NLEB 4(d) rules, and which “may affect” the NLEB, then PICA will

exercise its Section 7 consultation requirement with the NJFO.

6. NLEB PROFILE and THREAT. The Northern Long-Eared Bat is a medium-sized bat about 3 to 3.7 inches

in length but with a wingspan of 9 to 10 inches. As its name suggests, this bat is distinguished by its long

ears, particularly as compared to other bats in its genus, *Myotis*, which are actually bats noted for their

small ears (*Myotis* means mouse-eared). The northern long-eared bat is found across much of the eastern and north central United States and all Canadian provinces from the Atlantic coast west to the

southern Northwest Territories and eastern British Columbia. The species’ range includes 37 states.

White-nose syndrome, a fungal disease known to affect bats, is currently the predominant threat to this bat, especially throughout the Northeast where the species has declined by up to 99 percent from prewhite-nose syndrome levels at many hibernation sites. Although the disease has not yet spread throughout the northern long-eared bat's entire range (white-nose syndrome is currently found in at least 25 of 37 states where the NLEB occurs), it continues to spread. Experts expect that where it spreads, it will have the same impact as seen in the Northeast.

7. NLEB LIFE HISTORY.

a. Habitat Requirements. During summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting

roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also

been found, rarely, roosting in structures like barns and sheds. Northern long-eared bats spend winter

hibernating in caves and mines, called hibernacula. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. Specific areas

where they hibernate have very high humidity, so much so that droplets of water are often seen on their

fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible.

b. Food Habits. Northern long-eared bats emerge at dusk to fly through the understory of forested hillsides and ridges feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. This bat also feeds by gleaning motionless insects from vegetation and water surfaces.

c. Reproductive Strategy. Breeding begins in late summer or early fall when males begin swarming near hibernacula. After copulation, females store sperm during hibernation until spring, when they emerge from their hibernacula, ovulate, and the stored sperm fertilizes an egg. This strategy is called

delayed fertilization. After fertilization, pregnant females migrate to summer areas where they roost in

small colonies and give birth to a single pup. Maternity colonies, with young, generally have 30 to 60

bats, although larger maternity colonies have been observed. Most females within a maternity colony

give birth around the same time, which may occur from late May or early June to late July, depending

where the colony is located within the species' range. Young bats start flying by 18 to 21 days after birth.

Adult northern long-eared bats can live up to 19 years.

8. USFWS CONCURRENCE. Approval of this ADDENDUM 1 (aka NLEB Mgt) to the PICA INRMP acknowledges that Section 7(a)(1) consultation has occurred and may recur as necessary at the informal level with respect to the NLEB. Furthermore approval of this ADDENDUM 1 acknowledges that the conservation needs and requirements for the Threatened NLEB is being afforded the same considerations and protections as the Endangered Indiana Bat per the pre-established and standing PICA IBAT ESMC.

ADDENDUM 2

ADDENDUM 2 acknowledges that the conservation needs and requirements for the **Threatened NLEB** are adequately covered by PICA adherence to the PICA IBAT ESMC.

Addendum 2 to Integrated Natural Resources Management Plan (INRMP), Department of the Army, Installation Management Command, Headquarters, United States Army Garrison, Picatinny Picatinny

Arsenal, NJ 07806-5000 31 MAR 2015

1. PURPOSE. This document seeks to update information about the Indiana Bat (*Myotis sodalis*) regarding population statistics across the entire range and current trends, before and since the onset (circa winter 2006-07) of White Nose Syndrome (WNS), a fungal disease infecting hibernating bats.
2. BACKGROUND. The Indiana Bat (IBAT) was first documented on Picatinny Arsenal in 1995. Coordination and informal Section 7 consultations with the New Jersey Field Office of the USFWS commenced immediately and have continued to present with at least three local office bat biologists.
 - a. After months of mist net surveys in the summer of 1997 and spring of 1998 using the protocols of that era, the IBAT was a documented species on PICA (although mostly all males). Mist netting in the spring of 2006 at nearby hibernacula (Mt. Hope Shaft West) and summer of 2006 (on PICA installation) again documented IBAT presence; although the females which were tracked, did not establish maternity colonies on PICA, whereas a lone male was again recorded as summer roosting in a dead snag.
 - b. In 2007 an Endangered Species Management Plan (ESMP) was approved IAW Army Regulations at that time – just prior to the very first observations and initial discovery of WNS in New York state hibernacula circa JAN-FEB 2007. This PICA IBAT ESMP has been and still is the standard guidance document for IBAT management, now known as the Endangered Species Management Component (ESMC) of the INRMP. Nearly all of the data in this ESMC was derived and presented prior to the advent of WNS and subsequent declines of bat populations in this area, as well as range-wide.

3. ADDENDUM 2 to 2015 INRMP regarding IBAT. This document will be referred to hereafter as IBAT

ESMC ADDENDUM - 2017. See also ADDENDUM 1 to 2015 INRMP regarding Northern Long Eared Bat.

a. Whereas the existing PICA IBAT ESMC has been adopted by USFWS and PICA as sufficient for meeting or exceeding the conservation needs of the Threatened Northern Long eared Bat (NLEB) per

Addendum 1 to the INRMP; yet did not address tree clearing in close proximity to hibernacula as specifically as the Final 4(d) rule for NLEB; PICA hereby amends the IBAT ESMC to include the Mt Hope

West Shaft (known to harbor hibernating NLEB) as a new NLEB ZoC with a radius of 0.25 miles; thus requiring similar Section 7 consultation as for our other IBAT ZoCs.

b. Whereas the PICA IBAT ESMC is dated and presents information prior to WNS in the Northeast US,

that document is hereby supplemented with recent data and trends collated by the USFWS via one of

their websites. See updated IBAT population and hibernacula information pre and post WNS via

<

<https://www.fws.gov/Midwest/endangered/mammals/inba/pdf/2017IBatPopEstimate5July2017.pdf>

>

4. USFWS CONCURRENCE. Approval of this ADDENDUM 2 (aka IBAT ESMC ADDENDUM - 2017) to the

PICA INRMP acknowledges that IBAT conservation measures and management procedures at PICA are

still status quo regardless of the downward trends in populations of IBATs across the range and in this

region. Furthermore approval of this ADDENDUM 2 acknowledges that the conservation needs and requirements for the Threatened NLEB are adequately covered by PICA adherence to the PICA IBAT ESMC.

APPENDIX H

Bog Turtle Endangered Species Management Component

27 Pages

Main body = H-1-1 thru H-9-1

N.B. This plan (ESMP) dated 2004 will reference some Army regulations that have since been updated; however the recent changes did not alter the substantive elements of this plan. Similarly the task schedules remain in abeyance, since this plan is contingent upon the state ENSP verifying that here is an extant population of bog turtles inhabiting the Green Pond Brook wetlands complex, specifically the Lake End Wetlands just north of PICA property boundary.

Endangered Species Management Plan for the Bog Turtle, *Clemmys muhlenbergii*

**Picatinny
Morris County, New Jersey**

November 2004

Prepared by

The Louis Berger Group, Inc.
East Orange, NJ
and
Jonathan D. Van De Venter
Natural Resources Manager
Picatinny AMSTA-AR-PSE

Approved by

Paul S. Izzo
Installation Commander

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	<i>ES-1</i>
1.0 INTRODUCTION.....	1-1
1.1 Background.....	1-1
1.2 Responsible and Interested Parties	1-3
2.0 SPECIES INFORMATION	2-1
2.1 Description.....	2-1
2.2 Distribution	2-1
2.3 Habitat/Ecosystem.....	2-1
2.4 Life History/Ecology	2-1
2.5 Reasons for Listing.....	2-2
2.6 Conservation Measures.....	2-2
3.0 CONSERVATION GOALS	3-1
4.0 MANAGEMENT PRESCRIPTIONS AND ACTIONS	4-1
4.1 Phase I: Pre-Requisite Actions (non-Army)	4-1
4.2 Phase II: Immediate (Interim) Actions	4-1
4.3 Phase III: Restoration Actions	4-1
4.3.1 Establishment of Bog Turtle Habitat Restoration Area	4-2
4.3.2 Habitat Restoration and Management Techniques	4-2
4.4 Phase IV: Conservation Actions	4-4
4.5 Management Techniques Considered but Not Recommended	4-4
4.6 Future Recommendations	4-5
5.0 MONITORING PLAN	5-1
5.1 Habitat	5-1
5.2 Bog Turtle Population	5-2
6.0 TIME, COSTS, AND PERSONNEL	6-1
7.0 CHECKLIST.....	7-1
8.0 REFERENCES.....	8-1
9.0 INDIVIDUALS AND ORGANIZATIONS CONTRIBUTING TO THE PLAN	9-1
9.1 Picatinny Arsenal ESMP Team.....	9-1
9.2 The Louis Berger Group, Inc.	9-1
9.3 Individuals Contacted	9-1

TABLE OF CONTENTS (CONTINUED)

Page

LIST OF FIGURES

Figure 1	Project Location Map	1-4
Figure 2	Historic Sighting Locations	1-5
Figure 3	Surveyed Areas	3-3
Figure 4	Surveyed Areas	3-4
Figure 5	Bog Turtle Habitat Restoration Area	4-3

LIST OF TABLES

Table 1	Five-Year Restoration / Conservation Costs	ES-3
Table 2	Annual Costs.....	6-1
Table 3	Estimate of Required Resources by Activity by Year	6-2

EXECUTIVE SUMMARY

Background: Army Regulations (AR 200-3) require the preparation of Endangered Species Management Plans for listed and proposed threatened and endangered species and critical habitat present on installations. All Army land uses are subject to these regulations. Compliance with Chapter 11 of AR 200-3 involves coordination with other Federal agencies responsible for the protection of these species. Failure to implement this management plan can lead to violation of the Endangered Species Act of 1973 (ESA) and result in the costly disruption of military operations.

Current Species Status: The bog turtle (*Clemmys muhlenbergii*) is listed as threatened by the U.S. Fish and Wildlife Service (USFWS) and as state endangered by the New Jersey Department of Environmental Protection, Division of Fish and Wildlife Endangered and Nongame Species Program. One area within Green Pond Brook Swamp on Picatinny Arsenal is known to have supported bog turtles in the past. The current population status of this species is undetermined as recent surveys failed to confirm the presence of bog turtles at Picatinny Arsenal. The species is vulnerable to habitat loss on the installation through advanced natural plant community succession from suitable emergent bog habitat to unsuitable shrub swamp habitat. The species is also vulnerable to unauthorized collection by individuals with access to unsecured portions of Green Pond Brook Swamp.

Habitat Requirements and Limiting Factors: The primary limiting factor is the availability of suitable wetland habitat. Suitable wetland habitat types include fens, sphagnum bogs, and wet meadows with open canopies and a soft mucky substrate. Bog turtle wetlands are typically fed by ground-water springs or seeps and have pockets of shallow surface water that may form slow-flowing rivulets. Bog turtles prefer early to mid-successional stage wetlands, with a mix of areas with an open canopy and less than 60 percent shrubs and trees.

Bog Turtles on or Adjacent to Picatinny Arsenal: Green Pond Brook Wetlands Complex encompasses approximately 20 acres within Picatinny Arsenal property (East Branch Green Pond Brook Swamp –EBS) and about 25-30 acres on private property owned by Lake End Corporation (Lake End Wetland - LEW). Of the 20 acres on government property (EBS), less than one-half acre is marginally suitable habitat for bog turtles; the remainder is unsuitable. Approximately 5 acres within the southerly portion of Lake End Wetland, including a corridor for potential recruitment back into EBS (Arsenal property), could possibly be restored to suitable bog turtle habitat conditions. Portions of Green Pond Brook Wetlands Complex may be established as a Bog Turtle Habitat Restoration Area, if and when a remnant population is determined to be extant south of Green Pond (the open water lake).

Based on surveys conducted on the Arsenal in June 2000, there is not a substantial population of bog turtles on the Arsenal, if any. A population estimate cannot be made because presence of this species was not confirmed, and historical population estimates do not exist. For the purposes of this plan, the bog turtle population on Picatinny Arsenal is assumed to be de minimus or extirpated. This projected number is simply a conservative target, subject to revision if new evidence of a turtle population is established. The bog turtle population goal for the Arsenal following implementation of this plan has been established at 15 individuals.

Management Objectives: Management will be for protection and enhancement of the existing population on the Arsenal, if and when determined to be present, as well as expansion into areas of currently unsuitable habitat. This will be accomplished by restoring areas of unsuitable habitat to conditions suitable for bog turtles and by providing connections between areas already populated to those that are depauperate.

Conservation Goals:

PHASE I. Pre-Requisite Actions (non-Army): Before committing any resources of the Department of the Army (DA) pursuant to restoration or management projects on behalf of the bog turtle; documentation of actual turtles or demonstration that a small population is surviving either on government property or the private holdings upstream of the Army owned wetlands shall be required.

- 1) Survey repeatedly and intensively in appropriate remaining habitats south of Green Pond (primarily Lake End Wetland) to document presence or absence of this species. New Jersey Division of Fish and Wildlife and United States Fish and Wildlife biologists to solicit cooperation of Green Pond community representatives should undertake initiatives. Once presence is demonstrated the Army stewardship elements and initiatives of this plan will be updated, revised as necessary, and implemented forthwith.
- 2) Determine to some degree the historical hydrologic conditions, which prevailed within the Wetland Complex prior to 1930.
- 3) Determine as best as possible any hydrologic impacts or changes, if any, from activities of private landowners, as well as Picatinny Arsenal (DA) personnel after 1930.

PHASE II. Immediate (Interim) Actions : Picatinny Garrison personnel can assist with discussions or efforts initiated in PHASE I. Picatinny personnel can also monitor beaver activity and help maintain higher than normal water levels within the East Branch Green Pond Swamp in order to deaden woody vegetation; then eradicate or control beaver to reinstate normal water levels when sufficient canopy cover reduction is achieved.

PHASE III. Restoration Actions Needed: The major steps needed to satisfy restoration objectives are:

- 1) Remove red maples from a minimal total of 5-10 acres comprising at least two units within the Green Pond Brook Wetlands Complex (private, as well as government property units). Initially this will be pursued through beaver induced inundation and drowning; or if necessary or additionally by using mechanical techniques and spot-treatments of herbicide.
- 2) Reduce shrub species (*Clethra*, *Vaccinium*) density in same area, as mentioned above, such that overall canopy cover is approximately 30%.
- 3) As above, thin out woody species to create a five to ten foot wide corridor of suitable habitat that will connect the restored area to suitable wetland habitats on either side of the common boundary line yet within the Green Pond Brook Wetland Complex.
- 4) Determine the optimum hydrologic conditions to be maintained within the Wetland Complex (technical expertise); and find consensus among the private landowners, installation Garrison command, and NJDEP on how to achieve and maintain such conditions (cooperative efforts).

PHASE IV. Conservation Actions : The major steps needed to achieve conservation goals are:

- 1) Redesignate Restoration Area (once populated) as Bog Turtle Habitat Conservation Area (HCA), including any revised or updated Memoranda of Agreement / Understanding among cooperating parties.
- 2) Disallow Picatinny research, testing, or training activities within the HCA that will be incompatible with bog turtle conservation.
- 3) Maintain optimum hydrologic and habitat conditions via cooperative agreements. Control / prevent beaver activity as necessary.
- 4) Conduct trapping for bog turtles in EBS after restoration activities.
- 5) Implement multi-year monitoring program that will include annual bog turtle trapping and surveys, vegetation cover monitoring, ground level photo stations, and aerial photographs.

Total Estimated Cost of Restoration /Conservation Actions: Projected costs for five years of this plan (when triggered by documentation of a viable population of bog turtles within the Wetland Complex) are provided in the table below which provides a breakdown of cost (circa CY 2000) per year by activity.

TABLE 1 FIVE YEAR RESTORATION / CONSERVATION COSTS

Labor Expenses						
Tasks	Total by Year					Overall Total
	Year 1	Year 2	Year 3	Year 4	Year 5	
1. Trapping	\$15,200.00	\$15,960.00	\$16,758.00	\$17,595.90	\$18,475.70	\$83,989.60
2. Presence/Absence Survey	\$8,150.00	\$8,557.50	\$8,985.38	\$9,434.64	\$9,906.38	\$45,033.89
3. Vegetation Monitoring	\$6,540.00	\$6,867.00	\$7,210.35	\$7,570.87	\$7,949.41	\$36,137.63
SUB-TOTAL COSTS	\$29,890.00	\$31,384.50	\$32,953.73	\$34,601.41	\$36,331.49	\$165,161.12
Tasks 4 & 5 below may not be necessary if beaver induced high water inundation deadens woody vegetation						
4. Tree & Shrub Removal	\$8,210.00	\$4,105.00				\$12,315.00
5. Herbicide Application	\$4,420.00	\$2,210.00				\$6,630.00
TOTAL COSTS	\$42,520.00	\$37,699.50	\$32,953.73	\$34,601.41	\$36,331.48	\$184,106.12

1.0

INTRODUCTION

The purposes of this Endangered Species Management Plan (ESMP, Plan) are: (1) to present information on the bog turtle, a federally-listed threatened species previously present at Picatinny Arsenal (hereinafter referred to as Picatinny Garrison); (2) to discuss some historic activities of man which may have altered hydrologic conditions in the Wetland Complex comprising both federal (DA) property as well as private property; (3) to discuss the threats it faces on the installation; (4) to define conservation goals; and (5) to outline a plan for management of the species and its habitat that will enable achievement of conservation goals. Cost of the conservation efforts and impacts to other installation activities will also be discussed. The location of the project area is depicted in Figure 1.

The bog turtle (*Clemmys muhlenbergii*) is a small (3.0-4.5 inch long) turtle with a brown/black shell and a conspicuous orange neck-patch that inhabits wet meadows and bogs. This species is sparsely distributed over a discontinuous range that extends from southern New England to northern Georgia. A 250-mile gap divides the species into two distinct northern and southern populations. In the northeastern U.S., bog turtles occur in Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Delaware and Maryland. In New Jersey, extant populations of bog turtles are known from Burlington, Gloucester, Hunterdon, Monmouth, Morris, Ocean, Salem, Somerset, Sussex, Union, and Warren counties (USFWS 1997).

Population decline is the reason this species is federally listed as threatened and state-listed as endangered. Habitat loss and degradation due to development, agriculture, pollution, and other human-induced factors as well as natural plant community succession have contributed to the decline. Another factor in the decline of bog turtle populations is the unauthorized collection (poaching) of this species for the black-market pet trade. On Picatinny Garrison, previously suitable sphagnum bog habitat has succeeded into unsuitable shrub swamp habitat. The last known record of a bog turtle on the Arsenal is from 1987 (NJDEP Natural Heritage Database; and letter from J. Tesauro, 27 OCT 98, NJDFW ENSP). A map depicting the approximate location of the sighting is included as Figure 2.

This ESMP is based on and is consistent with the following laws, regulations and guidelines: the Endangered Species Act of 1973 (ESA); and Army Regulation (AR) 200-3. An Environmental Assessment (EA) that analyzes the potential consequences of implementing this Plan in compliance with the National Environmental Policy Act (NEPA) has been prepared as a separate document.

1.1 Background

Picatinny Arsenal as a federal military reservation began with the acquisition of nearly 2000 acres in 1879 to establish a powder depot in Morris County, NJ. Property acquisitions continued throughout our nation's history in war and peacetime. The Arsenal has been a repository and center for ammunition and weapons development throughout its existence. One of the last, if not the last, property acquisition occurred on 8 JAN 57. A parcel known as the Phineas Sprague Memorial Foundation, comprising 204 acres was a small intermontane valley between Green Pond Mountain and Copperas Ridge, south of Green Pond. This purchase increased the Arsenal's fee simple holdings to 5853 acres.

USGS topo maps to this day (Dover quad) inaccurately depict the true northwesterly boundaries of Picatinny property by excluding this tract of land and wetlands. This inaccuracy of the federal boundaries led NJ Endangered and Nongame Species Program (ENSP) staff to believe that historic sightings of Bog Turtles were off of the military installation, when in fact they were well within property borders. This misinformation was only revealed and rectified in the NJ Natural Heritage database in OCT 98, when state and federal biologists verified the historic site with Picatinny's Natural Resources Manager.

Just upstream from the Arsenal's northerly boundary line across this valley the flowage from the southern outlet of Green Pond moves through open wetlands (hereinafter referred to as Lake End Wetland) and the Main stream forks into the West and East Branches of Green Pond Brook (GPB). West Branch GPB is constricted and funneled through a small weir which dates back to at least the 1930s, then flows immediately onto and through the westerly portion of this former Phineas Sprague tract as a narrow and shallow brook typical of the hills and highlands of northern NJ. The East Branch GPB and the bulk of the flowage from Green Pond outlet turns easterly around a head of land thence southerly again to eventually flow over the aforementioned northerly boundary line across a 500' wide wetland known as East Branch Green Pond Brook Swamp (EBS). A well defined stream channel known as East Branch GPB shoulders against the terra firma embankment on the west side of this elongated and narrowing swamp. The remaining volume of water moves as sheet flow down through the East Branch GPB Swamp.

Green

Pond is a very large, roughly rectangular, lake abutting the easterly aspect of Green Pond Mountain whose axis aligns NE – SW, like most of the Highlands region ridge and valley physiography. The lake and property surrounding it is privately owned by two business entities. Green Pond Corporation represents homeowners in the northern half, while residents and property owners in the southern half are represented by Lake End Corporation (Don Gulliksen, pers. comm.).

Much of the Lake End Wetland as well as terra firma on the west and east sides (Green Pond Mountain and Copperas Ridge respectively) are subject to a DA easement which encumbers the private land owner(s) from building any structures or allowing more than 25 persons to congregate on the subjected easement in order to limit risk and liability from any potential catastrophic explosion or event associated with the military mission on the nearby installation. These easements are tantamount to safety buffer zones.

This plan or any part of it will almost necessarily involve the cooperation of these two substantial private communities since their lake is the primary source of the constituent Wetland Complex (Lake End Wetland—LEW and East Branch GPB Swamp—EBS) which may yet harbor a population of bog turtles – either on their property or federal property or perhaps both. Any meaningful progress in furtherance of conservation measures or management for this federally threatened species will require a reasonable and informed partnership approach. To this end, a brief chronology, admittedly imprecise, will be manifestly relevant in any future mutual endeavors.

Gaps in past decades may be salient to future discussions and determinations or estimations of the underlying hydrology of this 40-50 acre Wetland Complex.

- 18??-19??: Schauger (Shawger) family holdings, hotel, Green Pond history?
- 19??: Legal incorporation of Green Pond and/or Lake End entities?
- 19??: “Corduoy Road” constructed in & across mouth (breadth) of East Branch GPB and the Lake End wetlands to access an “existing dam” at an outlet point for West Branch GPB, just north of the neighboring property?
- Same era as above: How would the Wetland Complex at that time be classified today?
- 1933: Old Corduroy road replaced or not; if so how? Sawmill slabs laid in the mucky shallow wetland to maintain a surficial or sometimes submerged trail tread. Present weir constructed?
- 1957: Phineas Sprague Memorial Foundation tract acquired by DA.
- 1960s: East Branch GPB Swamp reportedly an open non-canopied [emergent type] wetland per Green Pond lifelong resident, K.P.
- Late 1960s-Mid 1970s: Bog Turtle sighting by K.H. (Rutgers University).
- 1974: National Wetland Inventory Map classifies the entire Wetland Complex south of the Green Pond “Main Outlet” (LEW as well as EBS further south) as PSS1 = Palustrine Scrub Shrub Wetland with Broad-leaved Deciduous type woody vegetation.
- 1975-79: Bog Turtles reportedly found, enjoyed, collected? in EBS by children during summer vacations at Green Pond and/or Lake End communities.
- Late 1970s-Mid 1980s?: Picatinny Arsenal command authorized hemlock timber harvest as well as boundary line marking, clearing, including use of mechanized “ducks” (amphibious type vehicles/vessels) plowing across the wetland. This observed activity was reportedly on government property south of the corduroy trail and nearly parallel to it.
- 1981: Aerial Photo of Green Pond and Picatinny Arsenal reveals sharp ecotone between advanced woody succession south of common boundary line (EBS) and minimal encroachment or canopy cover changes north of the line (LEW).
- 1979-1987: Reliable observer, D.A., reports dramatic acceleration of woody succession in EBS.

- 1987: Three Bog Turtles sighted by D.A. in EBS. Last sighting of record in NJ Natural Heritage database.
- 2000: Picatinny Arsenal Bog Turtle Survey conducted by professional herpetologists in EBS and LEW within DA easement tract. No bog turtles or sign of bog turtles observed.
- 2001: Site visit and additional reconnaissance of EBS and other pockets of wetlands downstream of weir along West Branch GPB with state, federal and contract biologists. No turtles sighted. No suitable habitat conditions. Higher water levels due to recent beaver dams at south end of EBS as well as at Weir at West Branch GPB. Consensus was to allow beaver to inundate EBS to drown woody vegetation.
- 2003: NJDEP Dam Safety Section reports recordation of a “dam” on government property apparently near southwest corner of EBS; yet no dam or weir recorded on Lake End property at West Branch GPB. Real property history of the purported dam on Army lands should be researched, as well as private control of the weir on Lake End property. Both structures affect discharges downstream through Army property and both could be instrumental in future regulation / manipulation of the optimum hydrologic regime.

1.2 Responsible and Interested Parties

Lake End Corporation. Homeowners in the southern half of Green Pond are represented by this entity.

Green Pond Corporation. Homeowners in the northern half of Green Pond are represented by this entity.

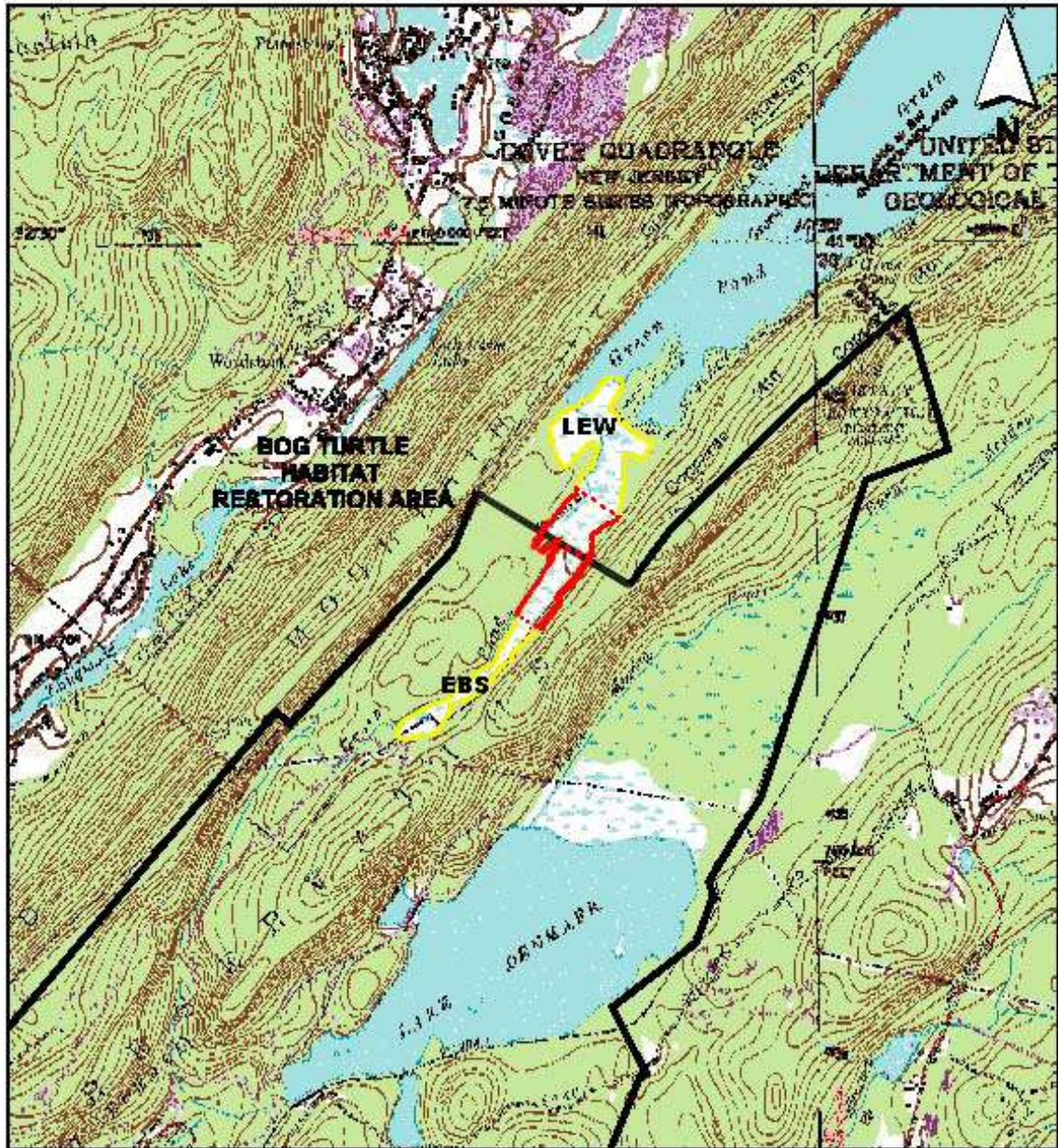
Picatinny Garrison. Public Works and Environmental Affairs Offices.

United States Fish and Wildlife Service—USFWS

New Jersey Division of Fish and Wildlife; Endangered and Nongame Species Program—
NJDFW ENSP

New Jersey Department of Environmental Protection—NJDEP Dam Safety Section of Natural and Historic Resources Division.

FIGURE 1 PROJECT LOCATION MAP



LEGEND

- STUDY AREA
- PICATINNY ARSENAL BOUNDARY

SCALE

2000 0 2000 Feet

Source:
Base Map: USGS 7.5 Minute Topographic Maps,
Franklin and Dover, NJ Quadrangles


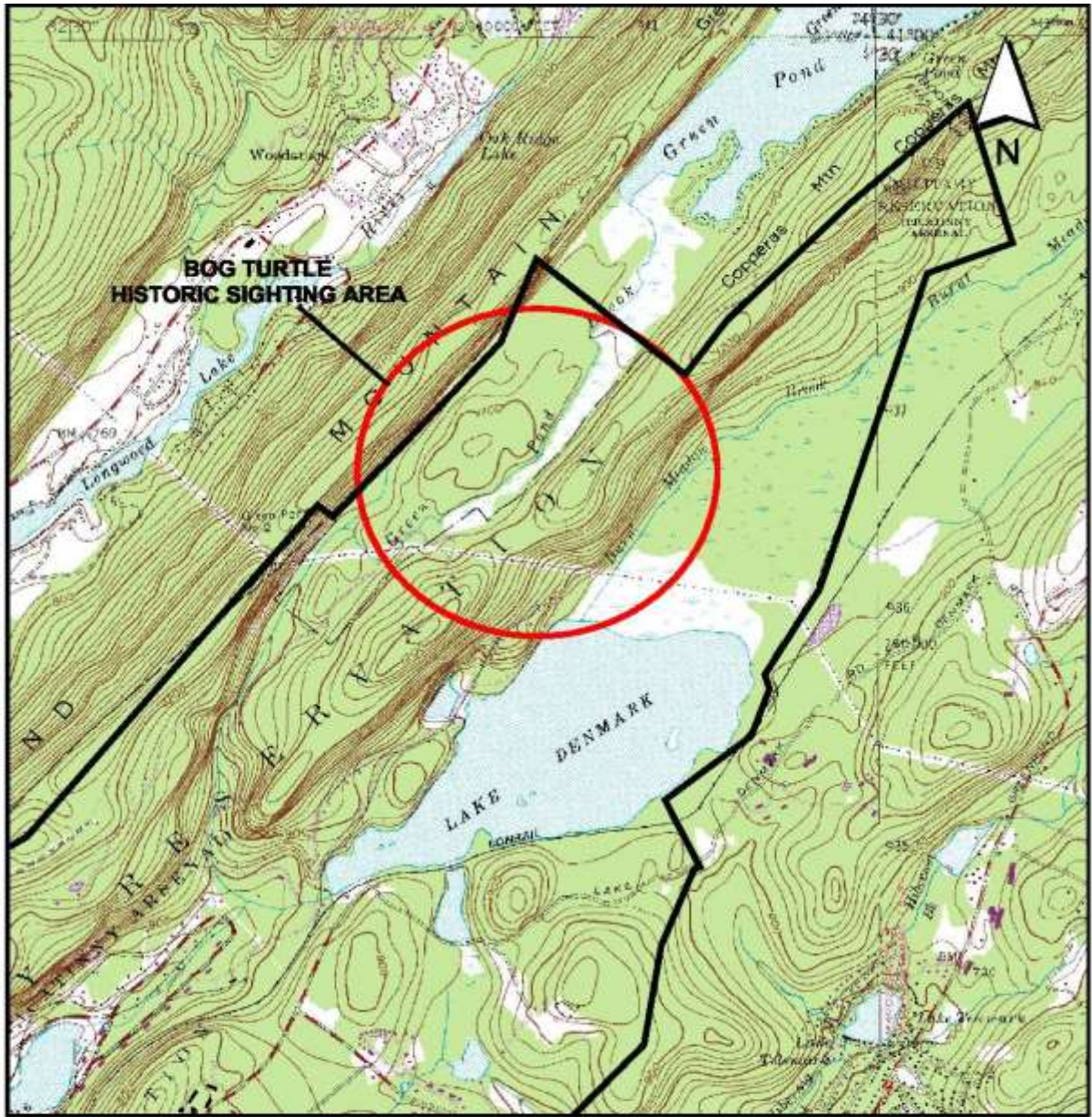
TITLE	
FIGURE 1 BOG TURTLE HABITAT RESTORATION AREA PROJECT LOCATION	
LOCATION	
PICATINNY, NJ	
CLIENT	
US ARMY PICATINNY ARSENAL	
DATE	FILE ID
MARCH 2001	JAC01 kaha rest mhaa.spr
 THE LOUIS BERGER GROUP, INC. 100 HALSTED STREET EAST ORANGE, NJ 07015	

FIGURE 2 HISTORIC SIGHTING AREA



LEGEND

- BOG TURTLE HISTORIC SIGHTING AREA
- PICATINNY ARSENAL BOUNDARY

SCALE

2000 0 2000 Feet

Source:
 Base Map: USGS 7.5 Minute Topographic Maps,
 Franklin and Dover, NJ Quadrangles

TITLE	
FIGURE 2 HISTORIC SIGHTING AREA	
LOCATION	PICATINNY, NJ
CLIENT	US ARMY PICATINNY ARSENAL
DATE	MARCH 2001 FILE ID jr023 turtle restoration.spr
THE LOUIS BERGER GROUP, INC. 100 HALSTED STREET EAST ORANGE, NJ 07018	

2.0

SPECIES INFORMATION

This section provides a description of the species, including distribution, habitat/ecosystem, life history, evidence for its decline, and conservation measures taken by various agencies or organizations.

2.1 Description

The bog turtle is a small turtle ranging from 3 to 4 1/2 inches long. Formerly called “Muhlenberg’s turtle”, it is darkly colored with a domed carapace that ranges from light to dark brown and almost black. The bog turtle’s distinguishing characteristic is a head patch that is orange or sometimes yellow and the large scutes of the carapace may have yellowish or reddish centers. The plastron is brownish black with creamier yellow inclusions along the midline. (Carr 1995).

The bog turtle, which is the smallest member of the genus *Clemmys*, has a similar appearance to the spotted turtle (*Clemmys guttata*). The spotted turtle is slightly larger with a carapace that is spotted with yellow dots. Although it lacks the orange head patch, the spotted turtle occasionally will lack spots on its carapace and may have some spotting on the head and neck, which could cause some confusion with the bog turtle. However, the spotted turtle’s neck and head markings are not as large and pronounced as those of the bog turtle allowing for separation of the two species (Conant and Collins 1991).

On November 4th, 1997 the U.S. Fish and Wildlife Service listed the bog turtle (*Clemmys mulhlenbergii*) as threatened pursuant to the Endangered Species Act of 1973 (50 CFR Part 17 Vol. 62 No. 213). The turtles were listed as state endangered in New Jersey as early as 1974.

2.2 Distribution

The bog turtle has been found over an extended range from New England south to northern Georgia. The animals are sparsely distributed throughout that range, with a large 250-mile gap between Maryland and Virginia separating the northern population from the southern population.

In New Jersey there were 18 counties with historic records of bog turtles. Since 1975 there have been no sightings in 5 of those 18 counties, and of the 18 counties only half had a documented occurrence. From 1993 to 1995, the New Jersey Endangered and Nongame Species Program conducted extensive surveys to locate and document bog turtle habitat. Of the 473 wetlands investigated, only 77 sites contained potentially suitable bog turtle habitat and bog turtles were found at only 8 of those wetlands (USFWS 1997).

2.3 Habitat/Ecosystem

Spring-fed wetlands with shallow water, fen bogs, wet meadows that have muddy bottoms are the general habitat types for bog turtles. The vegetative communities typically include tussock sedges (*Carex stricta*), alder (*Alnus* spp.), willows (*Salix* spp.), sphagnum moss (*Sphagnum* spp), skunk cabbage (*Symplocarpus foetidus*), bulrushes (*Juncus* and *Scirpus* spp) and jewelweed (*Impatiens capensis*). Habitat typically consists of a mosaic of upland dry patches and saturated areas, lower wetland channels and springs that are inundated perennially. The substrate consists of a soft muck, allowing the turtles to burrow into the mud to escape heat and cold as well as predators when necessary. Often times the wetlands are spring fed and surface water is shallow with tussock sedges and trees such as alders and willows that create cover for the turtles and the invertebrate prey they feed on. The vegetation in such habitats tend to have exposed roots, hanging branches and leaves that provide burrows, channels that form a network of rivulets that offer travel corridors and cover for turtles. The water on the sites being spring fed or from small streams tends to be cool offering the turtles escape from the desiccating effects of the sun during the summer month (Carr 1995).

2.4 Life History/Ecology

Bog turtles in the northern part of their range are primarily active during late spring and summer months and hibernate during the fall and winter months. Generally the turtles are out of hibernation by mid-April and do not

return

to hibernation until mid-October. Utilizing the soft substrate of their habitat the turtles burrow under the surface of the mud to spend their winter months and hibernate. Depending on the severity of the winter the turtles may burrow deeper in the mud to escape the freezing temperatures (USFWS 1997). Bog turtles also over winter under the roots of trees such as alder or willow, and in tunnels created by small mammals or underground springs. During the active months the turtles feed on a wide variety of invertebrates such as beetles, caddisflies, stoneflies, dragonfly larva and a wide array of other invertebrates such as centipedes and millipedes. In addition they also feed on aquatic vegetation seeds and carrion.

Breeding takes place from May to July, during which mature turtles of 5 to 8 years of age deposit 2 to 6 white eggs atop a tussock sedge, moss mat, or some other elevated plant mass that keeps the eggs dry. Nest areas generally have open canopies that allow the eggs to be incubated by the sun's heat. After a period of 42 to 56 days the eggs hatch with young turtles emerging in August or September. Hatchling turtles are 25mm to 30mm long. The turtles spend vast amounts of time basking during the summer months and toward the end of summer when the wetlands become drier the turtles may aestivate to escape heat. When the temperatures begin to decline the turtles bury themselves during the cooler hours and on the cloudy days when basking opportunities are low (Bury 1979).

2.5 Reasons for Listing

The loss and degradation of sphagnum bogs, slow moving meadow streams with muddy bottoms, and swamps that compose the wetland habitats that the turtles utilize in the United States is a major reason for their decline. These habitat losses are due to agriculture, development, natural succession and the introduction of exotic plants; all resulting in a decline in bog turtle populations. In addition, unauthorized collecting of the animals for the pet trade is a significant threat. The southern population of bog turtles, ranging from southern Virginia to northern Georgia, was determined to have threatened status due to similarity of appearance to the northern population.

2.6 Conservation Measures

The Bog Turtle (*Clemmys muhlenbergii*) Northern Population Recovery Plan was completed by USFWS in 2001. Critical habitat has not been designated because disclosing known locations of bog turtle habitat exposes these populations to potential extirpation due to poaching (USFWS 1997). As with any wetland that supports a special-status species, bog turtle habitats in New Jersey are designated as exceptional value (EV) wetlands. These EV wetlands are subject to more stringent permitting and buffer requirements (NJDEP *New Jersey Freshwater Wetland Protection Rules*, N.J.A.C. 7:7). Bog turtle surveys are required to be carried out by qualified individuals who are recognized by the USFWS and the appropriate state agency (i.e. NJDEP Division of Fish and Wildlife; Endangered and Nongame Species Program).

3.0

CONSERVATION GOALS

The ultimate goal of this ESMP is to improve habitat for bog turtles on Picatinny Garrison so that any existing population is protected from decline and its numbers enhanced in the future. Four phases are envisioned to achieve this goal. These are outlined below and amplified in section 4.0 -- Management Prescriptions and Actions.

- 1) Document presence of bog turtles in order to activate and implement all action elements of this plan. This is a reasonable and fiscally prudent pre-requisite (Phase I).
 - Survey repeatedly and intensively in appropriate remaining habitats south of Green Pond (primarily Lake End Wetland) to document presence or absence of this species. Once presence is demonstrated the Army stewardship elements and initiatives of this plan will be updated, revised as necessary, and implemented forthwith.

- 2) Allow beaver activity to continue on federal property swamplands (and if possible on private property wetlands) until unwanted woody vegetation is sufficiently stressed, deadened and/or removed from formerly suitable bog turtle habitats (Phase II). Failing this natural method to halt or reverse seral succession, manual labor and herbicidal methods should be employed to reclaim and restore former habitat conditions (Phase III).
 - Encourage and maintain beaver induced inundation effects to cause deadening of several acres of advanced woody succession, nearly all of which is pronounced in EBS within Garrison property. Cooperation and coordination with Lake End (and perhaps Green Pond) homeowners associations is anticipated and desirable insofar as water level control at their community weir on the West Branch GPB.

- 3) Restore the hydrologic, edaphic, and hydrophytic conditions optimal for the Wetland Complex south of Green Pond (Phase III). Eventually designate and maintain a sufficient portion as a Habitat Conservation Area for the bog turtle's continued existence (Phase IV).
 - A better understanding of the historic hydro-geography and phyto-geography of this GPB Wetland Complex and any man induced alterations over the past 75 years (especially any significant event(s) in the decade from mid 1970s- late 1980s) seems essential in order to formulate and propose an optimum hydrologic regime conducive to bog turtle survival and recovery, and consonant with other goals and objectives within the entire Green Pond drainage.

3.1 Green Pond Wetlands Complex (private and federal property)

Green Pond Brook Wetlands Complex encompasses approximately 20 acres within Picatinny Garrison property (East Branch Green Pond Brook Swamp –EBS) and about 25-30 acres on private property owned by Lake End Corporation (Lake End Wetland—LEW). . Of the 20 acres on government property (EBS), less than one-half acre consists of marginally suitable habitat for bog turtles (study area 1 of Figure 3); the remainder is unsuitable. Approximately 5 acres within the southerly portion of Lake End Wetland (near study area 3 of Figure 4), including a corridor for potential recruitment back into EBS (Garrison property) , could possibly be restored to suitable bog turtle habitat conditions. This portion of Green Pond Brook Wetlands Complex may be established as part of a Bog Turtle Habitat Restoration Area, if and when a remnant population is determined to be extant south of Green Pond (the open water lake). If deemed successful, this area should be re-designated as a Bog Turtle Habitat Conservation Area (HCA).

A complete survey of those portions of Green Pond Brook Wetlands Complex that historically supported bog turtles was completed in June of 2000 to determine the amount of suitable bog turtle habitat on the Arsenal and to confirm the presence of bog turtles (The Louis Berger Group, 2000). The areas surveyed are depicted in Figures 3 and 4.

Based

on surveys conducted on the Arsenal in June 2000, it is not likely that bog turtles still occur in EBS, although a surviving population may yet inhabit LEW. A population estimate cannot be made because presence of this species was not confirmed, and historical population estimates do not exist. For the purposes of this plan, the bog turtle population in the Wetlands Complex is assumed to consist of 5-10 individuals. This assumption is based on the combined experience and discussions between Ms. Deborah Poppel (a NJDFW Qualified Bog Turtle Surveyor and ecological consultant) and Mr. Jason Tesauro (NJDFW Bog Turtle biologist). The estimate is derived from the survey of 5 acres assuming a presence of 1-2 individuals per acre. At another location, Ms. Poppel had documented 30-40 individuals being supported in a similar size and slightly better quality habitat. Given the vagaries of coordination, time frames to assess or remediate hydrology, implement or maintain beaver control measures, and other elements of this plan, recruitment of individuals from LEW into the EBS portion of the Wetlands Complex could be slow and tentative; therefore the Garrison bog turtle population goal has been established at 15 individuals. In the past (1970's), the entire Green Pond Brook drainage supported a substantial population of bog turtles (J. Tesauro, NJDEP ENSP, pers. comm.). Suitable bog turtle habitat still exists outside the Garrison property from which recruitment could occur via the proposed corridor of restored habitat. It is hoped that any habitat enhancement will also encourage recruitment across the common boundary.

FIGURE 3 SURVEYED AREAS

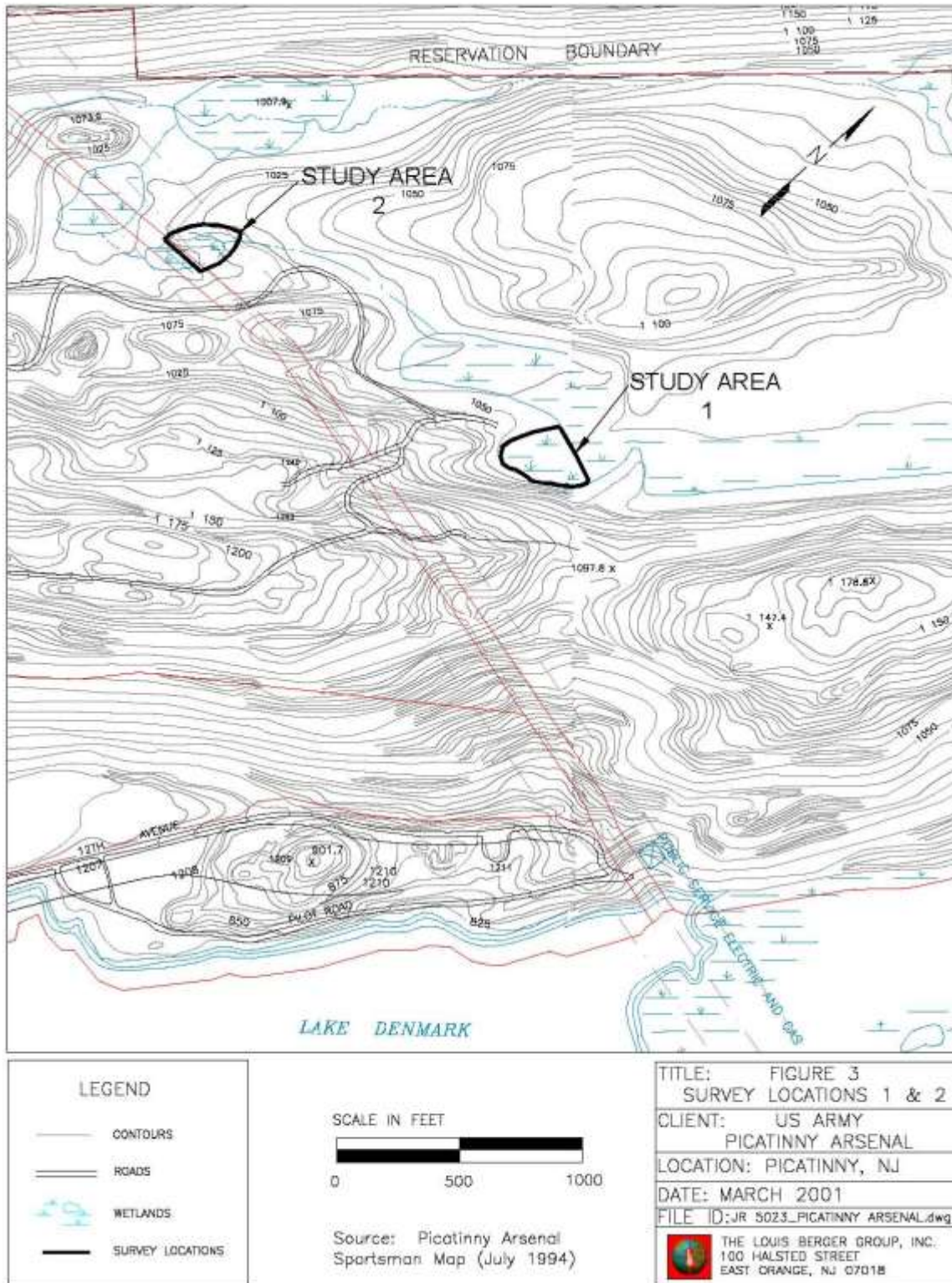
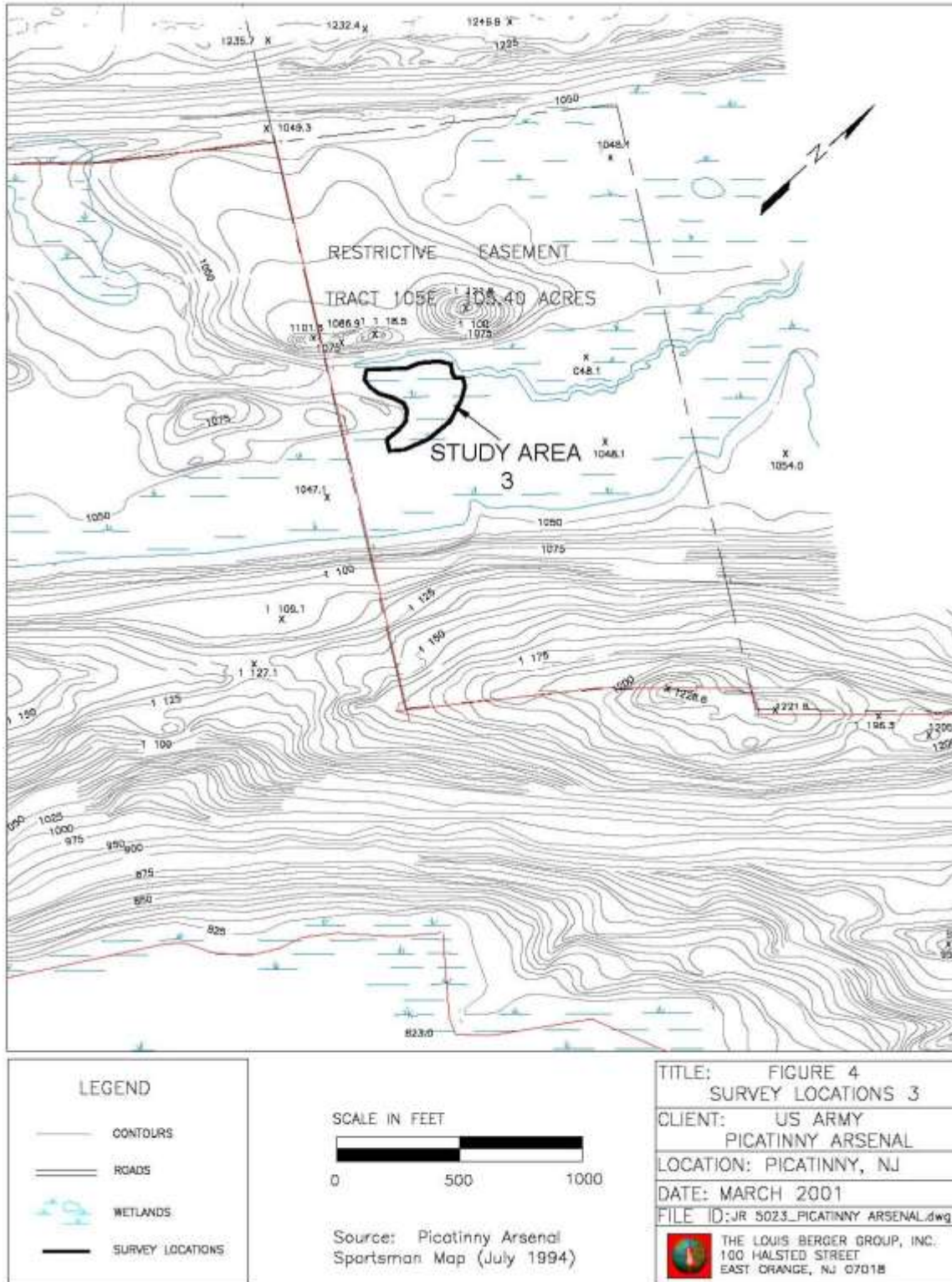


FIGURE 4 SURVEYED AREAS



4.0

MANAGEMENT PRESCRIPTIONS AND ACTIONS

The primary goal of the habitat restoration plan is to reduce the canopy cover within a dense shrub swamp that was once an open sphagnum bog and former bog turtle habitat, and to retard its succession into a forested red maple swamp. These activities are expected to improve habitat conditions for bog turtles.

Prior to intensive restoration activities (Phase III), some pre-requisite actions must be accomplished and documented. Some interim actions can and ought to be pursued immediately at minimal federal expense.

4.1 Phase I: Pre-Requisite Actions (non-Army)

Before committing any resources of the Department of the Army (DA) pursuant to restoration or management projects on behalf of the bog turtle; documentation of actual turtles or demonstration that a small population is surviving either on government property or the private holdings upstream of the Army owned wetlands shall be required.

- 1) The USFWS and/or NJDFW (ENSP) personnel should contact the respective homeowners' Associations governing Green Pond. The southern half of the lake, nearest the wetlands complex where turtles may still inhabit, is represented by Lake End Corporation. Green Pond Corporation represents the northern half of the lake.
- 2) Assuming the private landowners are cooperative, arrangements should be made to conduct informal or formal presence/absence surveys in the Wetland Complex immediately south of the Green Pond "outlet."
- 3) Determine to some degree the historical hydrologic conditions, which prevailed within the Wetland Complex prior to 1930.
- 4) Determine as best as possible any hydrologic impacts or changes, if any, from activities of private landowners, as well as Picatinny Arsenal (DA) personnel after 1930.

4.2 Phase II: Immediate (Interim) Actions

Steps, which can be implemented without incurring added costs to the Picatinny Garrison, are listed below.

- 1) Encourage periodic, seasonal visual surveys and/or conduct trapping for bog turtles, in suitable wetlands north of Picatinny property, prior to restoration activities.
- 2) Encourage and maintain higher than normal water levels, by local beaver population, for a period sufficient to deaden a majority of woody canopy species in the EBS and southern most portions of LEW. Normal levels were those, which occurred prior to CY 2001.
- 3) If beaver induced inundation achieves a natural reduction of woody species to an overall canopy cover approximating 30%, then beaver eradication /control and removal of beaver dams should be undertaken to lower and stabilize water levels to normal conditions.

4.3 Phase III: Restoration Actions

The major steps needed to satisfy restoration objectives are:

- 1) Remove red maples from 3-5 acre area in southeastern corner of LEW, as well as 2-4 acres in the middle to southerly end of EBS through beaver induced inundation and drowning; or by using mechanical techniques and spot-treatments of herbicide.
- 2) Reduce shrub species (*Clethra*, *Vaccinium*) density in same area, as mentioned above, such that overall canopy cover is approximately 30%.

- 3) As above, thin out woody species to create a five to ten foot wide corridor of suitable habitat that will connect the restored area to suitable wetland habitats outside of the northern boundary of Picatinny property but within the Green Pond Brook Wetland Complex.
- 4) Determine the optimum hydrologic conditions to be maintained within the Wetland Complex (technical expertise); and find consensus among the private landowners, installation Garrison command, and NJDEP on how to achieve and maintain such conditions (cooperative efforts).

4.3.1 Establishment of Bog Turtle Habitat Restoration Area

A three to five acre area within the southeastern portion of LEW (private property) as well as a 2-4 acre area within EBS (federal property) shall be designated as a Bog Turtle Habitat Restoration Area (Figure 5). This area has been selected due to the fact that earlier surveys for bog turtles (June 2000) revealed some areas of open canopy and potentially suitable habitat, and it is the location where bog turtles were once observed on the Arsenal. In addition, a five to ten foot wide corridor in the center of the swamp will be restored that connects the two units of the Restoration Area as well as with suitable habitats outside the Garrison property boundary to the north. The corridor will provide a route by which bog turtles can migrate within the restored habitat.

4.3.2 Habitat Restoration and Management Techniques

The locations of a three to five acre area in LEW as well as 2-4 acres in EBS for habitat restoration and management activities will be selected as the initial Bog Turtle Habitat Restoration Area. A qualified herpetologist, USFWS, NJDEP and the Arsenal Natural Resource Manager should perform a field review of the existing wetland habitat to establish the limits of the management area(s). Concurrence of representatives of Lake End Corporation will be necessary within the LEW sector. Any Memoranda, which seem reasonable and prudent should be negotiated and executed as necessary among or between cooperating parties. The limits should be clearly marked in the field and surveyed to obtain a set of known coordinates for the management area boundary. This will allow the limits of the work area for restoration and management activities to be clearly defined on plans for future reference. This activity may need to be repeated if the program proves successful and expansion of the management area is warranted. To achieve the goals described above, woody species (trees and shrubs) need to be removed from the selected habitat restoration management area. All red maples should be removed or deadened, and shrub species sweet pepperbush, (*Clethra alnifolia*), and highbush blueberry (*Vaccinium corymbosum*) should be thinned out such that there is approximately 30 percent shrub canopy cover over the entire restoration area.

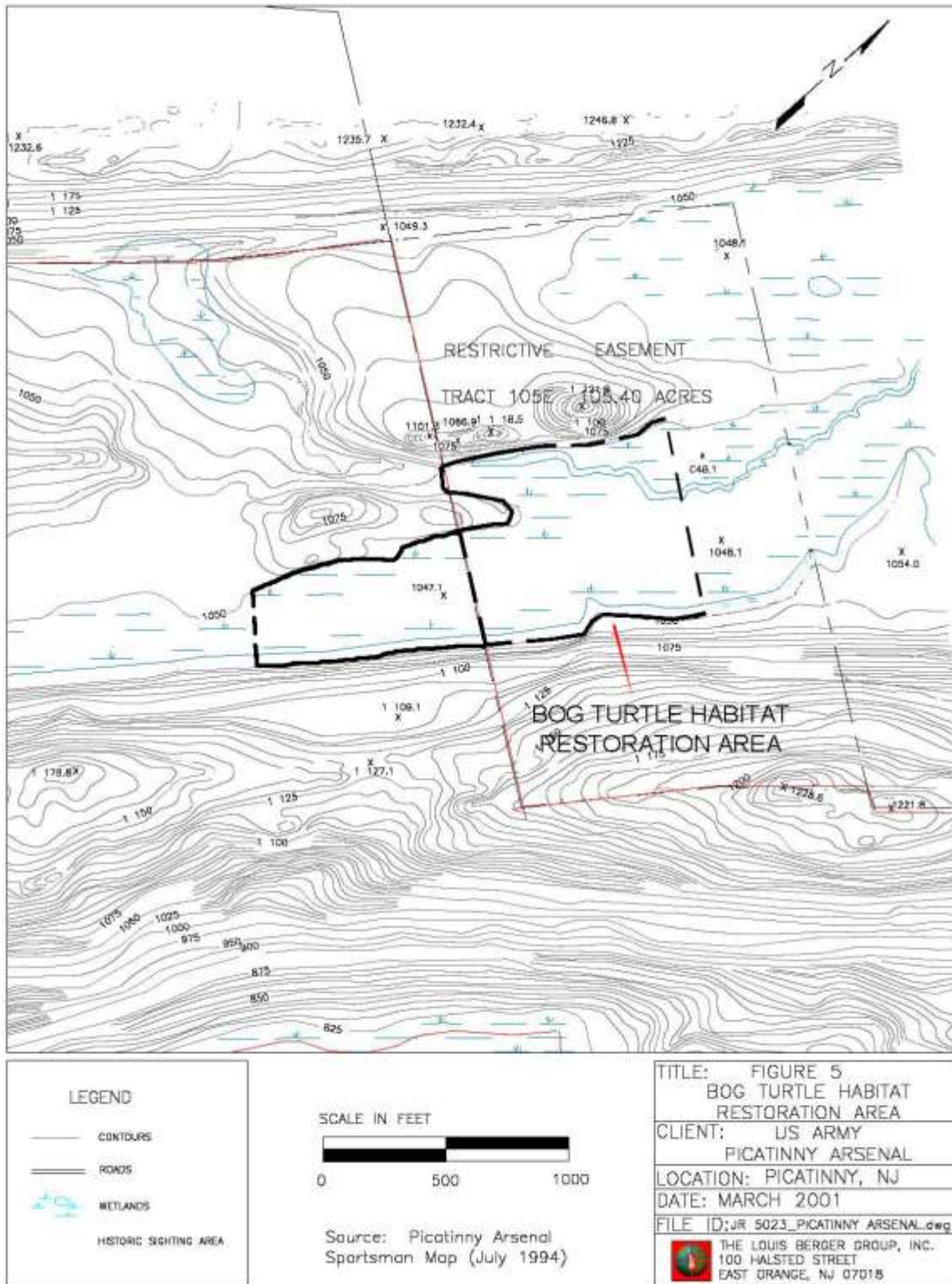
The recommended techniques to achieve the desired restoration parameters are a combination of mechanical removal (loppers, chainsaw) and spot application of a systemic herbicide (e.g. Roundup™ or Rodeo™). Tree and shrub removal would be performed during the winter months (January to February) when ground conditions are typically frozen to prevent unnecessary disturbance to wildlife and herbaceous vegetation. Small trees (DBH < 10 inches) and shrubs can be cut as low as possible and removed from the management area. The woody debris can be used to create brush piles along the upland/wetland margins to benefit other wildlife species. Larger trees (DBH > 10 inches) can be girdled around their base by cutting away the cambium layer in a complete circle. Without further treatment, the tree will die within one or two seasons and create a snag for wildlife use.

The application of herbicides to stumps should be conducted between April and September to minimize stump sprouts. The application of a systemic herbicide, such as glyphosate, will kill the below ground root system, prevent root sprouts, and increase the overall effectiveness of the first year of management activities. To minimize the exposure of desirable vegetation to the herbicide, the recommended application method is to paint the tree and shrub root stumps. Trees that are girdled can also be treated with herbicide by a direct application to the exposed trunk. This will hasten the loss of foliage and minimize root sprouts.

To achieve the desired density of woody species during restoration activities, at least 25 feet of cleared area should exist between each remaining shrub, and all trees should be removed or girdled.

Dependent upon the results of habitat monitoring (see Section 5), these activities may need to be repeated at least once each year for the first two years, and then at a lower frequency as determined by monitoring activities.

FIGURE 5 BOG TURTLE HABITAT RESTORATION AREA



4.4

Phase IV: Conservation Actions

The major steps needed to achieve conservation goals are:

- 1) Redesignate Restoration Area (once populated) as Bog Turtle Habitat Conservation Area, including any revised or updated Memoranda of Agreement / Understanding among cooperating parties.
- 2) Disallow research, testing, or training activities within the HCA that will be incompatible with bog turtle conservation.
- 3) Conduct trapping for bog turtles in both LEW, as well as EBS after restoration activities.
- 4) Implement multi-year monitoring program that will include periodic bog turtle trapping and surveys, vegetation cover monitoring, ground level photo stations, and aerial photographs.
- 5) Control / prevent beaver activity as necessary.
- 6) Maintain optimum habitat conditions, improve or suppress any deteriorating influences, and/or expand acreage of suitable habitat within Wetland Complex.

4.5 Management Techniques Considered but Not Recommended

The following endangered species habitat management techniques were considered but are not recommended as part of this plan.

1) Mechanical Removal Only

Mechanical removal without the use of herbicides, alone was considered to be an option for the restoration activities. However, this method is problematic because the trees and shrubs will re-sprout from the stumps each year, often with even more vigorous growth. With out the use of herbicides physical cutting and clearing would be required more frequently to maintain the desired degree of openness in the restoration area.

2) Broadcast Herbicide Application

A less labor-intensive method of using herbicides is broadcast application, whereby the herbicide is sprayed from the air or by using a non-targeted spray method from the ground. This method is problematic in that the desired percentage of clearing cannot be accurately controlled and there is more potential for impacting non-targeted species, including state rare plants that are present in the surrounding area (i.e. featherfoil, *Hottonia inflata*; mountain holly, *Ilex montana*).

3) Reintroduction of Bog Turtles

The possibility of re-introducing bog turtles to Picatinny Garrison was considered. However, upon consultation with the NJDFW Endangered and Nongame Species Program (J. Tesauro, pers. comm.), this action is not recommended. It is possible that a small remnant population of bog turtles remains somewhere within the Wetland Complex. Opening up the habitat will facilitate future surveys and trapping that can be conducted to confirm presence of this species. In addition, it is hoped that the proposed habitat restoration will encourage natural recruitment of bog turtles from suitable wetlands located outside the Garrison boundaries. Reintroduction of this species is untested and would be fraught with problems related to population genetics and locating a legal source that would not adversely impact another population.

At the present time, there is insufficient evidence available to suggest a need to translocate individuals. Natural expansion of remaining populations from within and outside Picatinny Garrison may be sufficient to promote growth in the regional population of the species. Reintroduction from populations outside the area is not

recommended due to potentially adverse genetic consequences, not to mention currently unsuitable or marginal habitat conditions.

4) Education Program

No education programs regarding the Management Plan should be conducted at the Garrison. Advertising the presence of bog turtle habitat on the Garrison would be detrimental to the goals of this Plan due threats to this species by unauthorized collection.

4.6 Future Recommendations

To maximize the effectiveness of this Plan, the following activities are recommended. These activities are not components of this Plan, but may be parts of future plans or may be carried out as budget and schedules allow.

- 1) Cultivation of interest and cooperation among key representatives of the Green Pond Communities will be paramount from the outset and essential for continuing progress.
- 2) An intensive yet targeted education program may be necessary for Green Pond and/or Lake End communities to ensure protection of turtles from collection by trespassers, or infrequent non-resident guests or visitors.
- 3) A thorough bog turtle habitat assessment of all wetlands in the Green Pond Brook Wetlands Complex should be conducted to determine all potential suitable areas where bog turtles may inhabit the Garrison or where future restoration activities may be warranted. If turtles are found, radio-telemetry will be considered to determine the prime areas of utilization so as to refine the habitat assessment.
- 4) A low fly-over aerial photo of Green Pond Brook Wetlands Complex that allows for stereoscopic photo-interpretation should be taken to identify additional areas that are potentially suitable bog turtle habitat or that would be good candidate areas for restoration.
- 5) Depending on the success of this Plan, the habitat restoration area may be expanded to encompass ten acres or more.
- 6) Hydrology management may be deemed necessary if it is determined that Green Pond water management activities are adversely affecting the habitat within the Garrison's EBS.

5.0

MONITORING PLAN

The monitoring plan is designed to ensure the long-term viability of the selected management area(s) within the Bog Turtle Habitat Restoration Area. Qualitative and quantitative evaluation techniques will be used. The primary purposes of monitoring the Management area are to document the degree of success or failure in achieving the goals of this Plan, and to identify the need for additional management or remedial actions. Monitoring also serves to identify needed adjustments in monitoring and maintenance methods, to evaluate the effectiveness and suitability of the restoration procedures and performance standards used at the site, to broaden knowledge of habitat restoration procedures, and to document baseline conditions for long-term habitat monitoring at the site.

5.1 Habitat

A goal of 30 percent shrub canopy closure has been established for this plan. Within the proposed restoration area, canopy cover currently averages 90 percent. Bog turtles prefer open wetlands that have no more than 60 percent canopy closure (USFWS 2000). A small scrub-shrub component is desirable. Bog turtles are known to rest/aestivate/hibernate beneath the roots of alders and willows.

The following monitoring techniques should be conducted prior to the implementation of restoration activities, as well as once each year for the duration of the three-year monitoring plan.

Qualitative Assessments

Hydrology and Substrate

A qualitative assessment as to the pre- and post-restoration characteristics of hydrology and substrate should be made within the management area(s). Hydrologic characteristics should include presence/ absence of surface water, approximate depth, overall distribution of surface water, presence/absence and location of spring upwellings and groundwater seeps, presence/absence and location of flowing surface water, and presence/absence and location of subsurface flow. A patchy distribution of surface water and drier areas is desirable. Any significant increase or decrease in water levels could adversely impact the success of the restoration activities within the management area(s).

The desired texture of the substrate is soft muck. The existing organic substrate is supersaturated and unconsolidated. A slightly drier and firmer substrate would be desirable. Observations of the substrate within the selected management area should be recorded and monitored for changes.

Vegetation

Photo stations should be established at a number of locations that are evenly distributed throughout the management area(s). Before and after restoration activities, photographs should be taken during the same time of year from these established stations. The photographs will be used to make a comparative visual assessment over the course of the monitoring program to determine the degree to which woody species have been reduced.

- #

Quantitative Assessments

Aerial Photos

Low-level aerial photos taken before and after the restoration activities (each year for three years) will allow a quick assessment as to the overall percent cover of woody species vs. open canopy areas that are dominated by herbaceous vegetation. Photos should be stereoscopic to allow for photo-interpretation that will distinguish between shrub and herbaceous plant species. Aerial photographs will also allow the calculation of specific acreages of the restored area and of open-canopy areas, as long as the scale of the photograph is known.

Line Intercept

The Line Intercept methodology (USFWS 1981, Kent and Coker 1992) is recommended to determine the percent herbaceous ground cover and may be modified to estimate percent canopy cover of shrubs and trees. Three parallel transect lines should be established across the length of the site. The transects should be sampled using the Line Intercept Method following the procedures described in *Estimating Wildlife Habitat Variables* (USFWS 1981). A cumulative percent canopy cover can then be computed for the entire restoration area. The analysis of the data over the course of several years will determine if the desired reduction in percent canopy cover is achieved and if cover from trees and shrubs is increasing, requiring further intervention.

5.2 Bog Turtle Population

In addition to assessing whether the habitat goals are being achieved, it should be determined whether the bog turtle population goals are being achieved. Based on surveys conducted on the Arsenal in June 2000, there is not a substantial population of bog turtles on the Arsenal. A population estimate cannot be made because presence of this species was not confirmed, and historical population estimates do not exist. For the purposes of this plan, the bog turtle population on Picatinny Garrison is assumed to be de minimus or extirpated within the EBS portion of the Wetlands Complex. The Garrison bog turtle population goal has been established at 15 individuals.

- # Pre-Restoration

Presence-Absence Surveys

Pre-restoration presence/absence surveys were conducted for bog turtles in June of 2000. Survey methodology followed guidelines prescribed for New Jersey by the U.S. Fish and Wildlife Service (USFWS) and the New Jersey Department of Environmental Protection (NJDEP) Endangered and Nongame Species Program (USFWS, 2000). Sites were visited three times between June 15th and June 30th, 2000. Surveys were conducted at least three days apart, between the hours of 10:00 am and 2:00 pm. Surveys were not conducted during rain events or on very cloudy days when the temperature was below 70 degrees. Survey techniques included searching visually for exposed individuals and probing/searching by hand in mud, tunnels, under vegetation, in pockets of standing water, and other microhabitats likely to support bog turtles. An assessment of the wetland and its suitability as potential bog turtle habitat was made during the initial site visit and was supplemented with information gathered during the surveys.

Presence of bog turtles on the Arsenal was not confirmed during the June 2000 surveys. It is likely that diminished habitat quality due to succession within Green Pond Brook Swamp, combined with unauthorized collection of turtles, has caused the population to be reduced to such an extent that standard survey methods may not be sufficient to document the presence of this species.

Trapping

In order to confirm presence of this species on the Garrison, and to get some sense of the population size under the existing habitat conditions, it is recommended that trapping for bog turtles be conducted prior to restoration activities. If the timing of habitat management activities necessitates, trapping may be conducted during the spring concurrent with or immediately following restoration. Trapping methodology is described below.

Post-Restoration

Presence-Absence Surveys

Once each year throughout the three-year monitoring period, post-restoration presence/absence surveys for bog turtles, following the methodology described above, should be conducted in the spring within the Restoration Area.

Trapping

Once each year throughout the three-year monitoring period, post-restoration trapping should be conducted concurrent with presence/absence surveys to assess the status of the bog turtle population. Trapping methodology is described below.

It is recommended that at least five drift-fence/funnel trap arrays be distributed evenly throughout the management area. Additional areas outside the management area may be trapped as well as time/personnel allows. The drift fence should consist of eight to ten inch high aluminum flashing buried approximately six inches into the ground so as to be self-supporting. The "fence", about 100 feet long, guides animals into one of two traps placed at both ends of the fence. Traps are rectangular boxes made of hardware-cloth with a funnel or trap door entrance where it meets the fence and closed off at the opposite end. An alternative to drift fences that has been used with success in other bog turtle studies (e.g. Morrow et. al. *in press*) are box traps with "wings" that serve the same function of guiding animals into the trap. Traps should be placed in rivulets, runs, between tussocks, and other places that turtles are likely to use as travel corridors. Traps should not be baited as this attracts predators. Traps must be placed in shallow water, covered with vegetation and checked at least once a day and should be closed during hottest part of day if used in summer. Trapping should be conducted for at least 10 consecutive days. Permits from the NJDEP Division of Fish and Wildlife are required to trap bog turtles and trapping must be conducted under the supervision of a qualified bog turtle specialist.

Population Estimates

Any individuals caught during presence/absence surveys or by trapping should be marked (by notching certain marginal scutes of the carapace, as described in Plummer 1989) so that estimates of the population size can be made. A number of mathematical formulas for estimating wildlife population sizes based on mark/recapture studies exist (e.g. Petersen, Schnabel, Jolly-Seber, as described in Krebs 1989).

6.0 TIME, COSTS, AND PERSONNEL

The initial planning and funding period for the implementation of this ESMP is 5 years, though some components of the plan may extend beyond 5 years. Projected annual costs for implementation are summarized in Table 2. Table 3 provides an estimate of the required resources by proposed activity by year.

TABLE 2 FIVE YEAR RESTORATION / CONSERVATION COSTS

Labor Expenses						
Tasks	Total by Year					Overall Total
	Year 1 (Y)	Year 2 (Z)	Year 3 (A)	Year 4 (B)	Year 5 (C)	
1. Trapping	\$15,200.00	\$15,960.00	\$16,758.00	\$17,595.90	\$18,475.70	\$83,989.60
2. Presence/Absence Survey	\$8,150.00	\$8,557.50	\$8,985.38	\$9,434.64	\$9,906.38	\$45,033.89
3. Vegetation Monitoring	\$6,540.00	\$6,867.00	\$7,210.35	\$7,570.87	\$7,949.41	\$36,137.63
SUB-TOTAL COSTS	\$29,890.00	\$31,384.50	\$32,953.73	\$34,601.41	\$36,331.49	\$165,161.12
Tasks 4 & 5 below may not be necessary if beaver induced high water inundation deadens woody vegetation						
4. Tree & Shrub Removal	\$8,210.00	\$4,105.00				\$12,315.00
5. Herbicide Application	\$4,420.00	\$2,210.00				\$6,630.00
TOTAL COSTS	\$42,520.00	\$37,699.50	\$32,953.73	\$34,601.41	\$36,331.48	\$184,106.12

TABLE 3 ESTIMATE OF REQUIRED RESOURCES BY ACTIVITY BY YEAR

Fiscal Year		Activities	Personnel (Man Hours)	Cost				Total
				Personnel	Materials	Equipment	Contract	
PHASE I & PHASE II								
FY 2005	2-4Q 2005	Intro / Coord Mtgs w/ LEC & GPC	PICA: 8 NJDFW: ? USFWS: ?					
FY 2005	2-4Q 2005	Sprague tract / PICA land-wetland history	PICA: 8					
FY 2005	2-4Q 2005	Note beaver activity & water levels	PICA: 12					
FY 200?	3-4Q 2005-200?	Pre-Confirmation Trapping and/or Y-N surveys	PICA: ?assist NJDFW: ? Contract: 80 USFWS: ?					
FY 200Y	4Q 200Y	Assess % Woody cover reduction	PICA: 8					
PHASE III								
FY 200Y	3-4Q 200Y	Conduct Pre-Restoration Trapping	Contract: 80					
FY 200Y	3-4Q 200Y	Conduct Pre-Restoration Y-N Surveys	Contract: 80					
FY 200Y	4Q 200Y	Ground Level Photographs						
FY 200Y	4Q 200Y	Aerial Photographs	Contract: ?					
FY 200Y	3-4Q 200Y	Conduct Vegetation Cover Analysis						
FY 200Z	2Q 200Z	Mechanical Removal of Trees and Shrubs	Contract: ?					
FY 200Z	3Q 200Z	Herbicide Application	Contract: ?					
FY 200Z	3-4Q 200Z	Continue Restoration Trapping	Contract: 80					
FY 200Z	3-4Q 200Z	Continue Restoration Y-N Surveys	Contract: 80					
FY 200Z	4Q 200Z	Vegetative Cover Analysis						
FY 200Z	3-1Q 200Z	Control water levels. Modify hydrology?						
FY 200A	2Q 200A	(Mechanical Removal of Trees and Shrubs)?						
FY 200A	3Q 200A	Herbicide Application						

TABLE 3 ESTIMATE OF REQUIRED RESOURCES BY ACTIVITY BY YEAR

Fiscal Year		Activities	Personnel (Man Hours)	Cost				Total
				Personnel	Materials	Equipment	Contract	
PHASE III & PHASE IV								
FY 200A	3-4Q 200A	Post Restoration Trapping	Contract: 80					
FY 200A	3-4Q 200A	Presence/Absence Surveys	Contract: 80					
FY 200A	4Q 200A	Vegetation Cover Analysis						
FY 200B	2Q 200B	(Mechanical Removal of Trees and Shrubs)?						
FY 200B	3Q 200B	(Herbicide Application)?						
FY 200B	3-4Q 200B	Post Restoration Trapping	Contract: 80					
FY 200B	3-4Q 200B	Presence/Absence Surveys	Contract: 80					
FY 200B	4Q 200B	Vegetation Cover Analysis						
FY 200C	2Q 200C	(Mechanical Removal of Trees and Shrubs)?						
FY 200C	3Q 200C	(Herbicide Application)?						
FY 200C	3-4Q 200C	Post Restoration Trapping	Contract: 80					
FY 200C	3-4Q 200C	Presence/Absence Surveys	Contract: 80					
FY 200C	3-4Q 200C	Ground Level Photographs						
FY 200C	4Q 200C	Vegetation Cover Analysis						
FY 200D	2Q 200D	(Mechanical Removal of Trees and Shrubs) extra?						
FY 200D	3Q 200D	(Herbicide Application) extra?						
FY 200D	4-1Q 200D	Next 5Y Revision ESMP	PICA: 40					

TABLE 3 ESTIMATE OF REQUIRED RESOURCES BY ACTIVITY BY YEAR

Fiscal Year	Activities	Personnel (Man Hours)	Cost				Total
			Personnel	Materials	Equipment	Contract	

7.0 CHECKLIST

Schedule	Activity	Implemented	
		Date	Signature
PHASE I & PHASE II			
Spr/Sum/Fal 2005	Introductory and Working Meetings with LEW representatives – Concept, scope, access, agreements, history		
Spr/Sum/Fal 2005	Sprague tract / Picatinny Arsenal history		
Spr/Sum/Fal 2005	Monitor beaver activity; note water levels		
Spr/Sum 2005-200?	Pre-Confirmation Trapping		
Spr/Sum 2005-200?	Pre-Confirmation Presence/Absence Surveys		
Spr/Sum 200X	PRESENCE CONFIRMED...		
Sum 200X-200Y	% Woody cover canopy reduction Evaluation		
PHASE III (Pre-Restoration)			
Spr/Sum 200Y	Trapping		
Spr/Sum 200Y	Presence/Absence Surveys		
Spr/Sum 200Y	Ground Level Photograph Stations		
Sum 200Y	Aerial Photograph		
Sum 200Y	Vegetation Cover Analysis		
Win 200Z	Beaver trapping / control; lower water levels		
Win 200Z	Mechanical Removal of Trees and Shrubs, if needed		
Spr 200Z	Herbicide Application		
PHASE III (Restoration)			
Spr/Sum 200Z	Trapping		
Spr/Sum 200Z	Presence/Absence Surveys		
Sum 200Z	Vegetative Cover Analysis		
Spr -Fal 200Z	Control water levels. Modify hydrology?		
Win 200A	Mechanical Removal of Trees and Shrubs, if needed		
Spr 200A	Herbicide Application		
PHASE III & PHASE IV (Post-Restoration)			
Spr/Sum 200A	Trapping		
Spr/Sum 200A	Presence/Absence Surveys		
Sum 200A	Vegetative Cover Analysis		
Win 200B	Mechanical Removal of Trees and Shrubs, if needed		
Spr 200B	Herbicide Application, if needed		
Spr/Sum 200B	Trapping		
Spr/Sum 200B	Presence/Absence Surveys		

Schedule	Activity	Implemented	
		Date	Signature
Sum 200B	Vegetative Cover Analysis		
Win 200C	Mechanical Removal of Trees and Shrubs, if needed		
Spr 200C	Herbicide Application, if needed		
Spr/Sum 200C	Trapping		
Spr/Sum 200C	Presence/Absence Surveys		
Spr/Sum 200C	Ground Level Photograph Stations		
Sum 200C	Vegetative Cover Analysis		
Win 200D	Mechanical Removal of Trees and Shrubs; expansion		
Spr 200D	Herbicide Application; expansion		
Sum/Fal 200D	Next 5Y Revision ESMP		

8.0 REFERENCES

- Bury, R.B. 1979. *Review of the Ecology and Conservation of the Bog Turtle, Clemmys muhlenbergii*. U.S. Fish and Wildlife Service Spec. Sci. Rep. Wildlife 219. 9 pp.
- Carr, Archie Fairly. 1995. *Handbook of Turtles: The Turtles of the United States, Canada, and Baja California*
- Conant, R. and JT Collins. 1991. *A Field Guide to Reptiles and Amphibians: Eastern and Central North America*. Houghton Mifflin Co., Boston, MA. 450 pp.
- De Graaf, R.M. and A Shigo. 1985. *Managing Cavity Trees for Wildlife in the Northeast*. Gen. Tech. Rep. NE-101.
- Kent, M. and Coker, C. 1992. *Vegetation Description and Analysis*. CRC Press, Boca Raton, FL. 363 pp.
- Krebs, C.J. 1989. *Ecological Methodology*. Harper Collins Publishers, New York. 654 pp.
- Morrow, J.L., J.H. Howard, S.A. Smith, and D.K. Poppel. 2001. "Home Range and Movements of the Bog Turtle (*Clemmys muhlenbergii*) in Maryland." *Journal of Herpetology*, 35(1): 68-73.
- NJ Division of Fish and Wildlife; Endangered and Nongame Species Program. 200?. *NJ Bog Turtle Conservation Summary*.
- Plummer, M.V. 1989. "Collecting and Marking". pp. 45-60 in: Harless and Morlock (eds.) *Turtles: Perspectives and Research*. John Wiley and Sons, Inc. New York.
- The Louis Berger Group, Inc. 2000. *Picatinny Arsenal Bog Turtle Survey Report*. Prepared for Department of the Army, Armament Research, Development and Engineering Center, Picatinny Arsenal, New Jersey. July 2000.
- U.S. Fish and Wildlife Service. 1981. *Estimating Wildlife Habitat Variables*. FWS/OBS-81/47. September.
- U.S. Fish and Wildlife Service. 1997. *Final Rule to List the Northern Population of the Bog Turtle as Threatened and the Southern Population as Threatened due to Similarity of Appearance*. 50 CFR, Part 17. Federal Register, Vol. 62, No. 213, Nov. 4, 1997.
- U.S. Fish and Wildlife Service. 2000. *Bog Turtle (Clemmys muhlenbergii) Characteristics and Survey Guidelines*. 4 pp. New Jersey Field Office, Pleasantville, New Jersey. May 2000.
- U.S. Fish and Wildlife Service. 2001. *Bog Turtle (Clemmys muhlenbergii) Northern Population, Recovery Plan*. Hadley, MA, 103 pp.

9.0 INDIVIDUALS AND ORGANIZATIONS CONTRIBUTING TO THE PLAN

9.1 Picatinny Arsenal ESMP Team

Jonathan Van De Venter- Natural Resources Manager

9.2 The Louis Berger Group, Inc.

Andrew Schueller- Contract Manager

Mark Renna- Vice President of Environmental Sciences

Ed Samanns- Principal Environmental Scientist

Bill Mullin- Environmental Analyst

9.3 Individuals Contacted

Lisa Arroyo- USFWS, New Jersey Ecological Services Field Office

John Jensen- State Herpetologist, Georgia Nongame-Endangered Wildlife Program

Scott Smith- Maryland Department of Natural Resources, Wildlife and Heritage Division

Jason Tesauro- NJDEP Division of Fish & Wildlife, Endangered and Nongame Species Program

Don Gulliksen- Lake End Homeowners Association

Deborah Poppel- Environmental Consultant, ENSR Services.

APPENDIX I

Picatinny Arsenal (Sportsman) Policy IMPI-MWR-006

Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

19 December 2014

Approved 3 MAR 15

17 Pages



**DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON
PICATINNY ARSENAL, NEW JERSEY 07806-5000**

REPLY TO
ATTENTION OF

IMPI-ZA

MEMORANDUM FOR All Picatinny Arsenal Employees and anyone who will hunt, fish, trap, boat, or participate in any other outdoor activity on Picatinny Arsenal.

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

1. PURPOSE: This policy sets forth restrictions and procedures for hunting, fishing, trapping, and other outdoor recreational activities on Picatinny Arsenal.
2. REFERENCES:
 - a. 10 U.S.C. 2671 United States Code 2671 Military, Reservations and facilities Hunting, Fishing and Trapping 1 July 1984
 - b. 18 U.S.C. 13 Laws of States Adopted for Areas within Federal Jurisdiction 9 December 2014
 - c. AR 190-45 Law Enforcement Reporting 30 March 2007
 - d. AR 190-56 the Army Civilian Police and Security Guard Program 15 March 2013
 - e. AR 200-1 Environmental Protection and Enhancement 13 December 2007
 - f. AR 215-1 Military Morale, Welfare, and Recreation Programs and Nonappropriated Fund Instrumentalities 24 September 2010
 - g. AR 350-19 the Army Sustainable Range Program 30 August 2005
 - h. AR 385-63 Range Safety 30 January 2012
 - i. DA PAM 385-63 Range Safety Pamphlet 16 April 2014
 - j. AMC-R 385-100, AMC Safety Manual 26 September 1995

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

- k. ARDEC 190-4 Local (ARDEC) Reference to PA- 200-1 (Camera Passes)
- l. Integrated Natural Resources Management Plan (INRMP)
- m. Picatinny Arsenal Sportsmen Map (to be located on Rod & Gun web site):
<http://www.pica.army.mil/outdoor/RodGun.htm>
- n. PGR 190-11 Control of Ammunition, Privately Owned and Prohibited Weapons
- o. New Jersey State Police Boating Safety Manual

3. SCOPE: This policy applies to all personnel, Military and Civilian, who engage in outdoor recreational activities on Picatinny Arsenal. A copy of this policy will be posted on all official bulletin boards, official websites and made available upon request. Corrective action will be taken in the case of any violation of this policy.

a. Eligibility: Picatinny Arsenal recognizes three categories of sportsmen – Primary, Associate, and Guest. Authorized activities for each are listed below:

Primary Sportsman	Sponsor Guest	Number of Guests per Outing		
		Hunt	Trap	Fish
<i>Active Duty Military (Unit Fund Eligible)</i>	<i>Yes</i>	<i>1</i>	<i>1</i>	<i>3</i>
<i>Federal Civilian employee (DoD, NAF) assigned to Picatinny Arsenal</i>	<i>Yes</i>	<i>1</i>	<i>1</i>	<i>3</i>
<i>Active Guard Reserve(AGR) Assigned to Picatinny Arsenal (Title10 or Title 32)</i>	<i>Yes</i>	<i>1</i>	<i>1</i>	<i>3</i>
<i>Retired Military Personnel</i>	<i>Yes</i>	<i>1</i>	<i>1</i>	<i>3</i>
<i>100% Disabled Veterans and Medal of Honor Recipients.</i>	<i>Yes</i>	<i>1</i>	<i>1</i>	<i>3</i>
<i>Federal civilian personnel retired from this installation with at least 15 years of total federal service</i>	<i>Yes</i>	<i>1</i>	<i>1</i>	<i>3</i>

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

Associate Sportsman	Sponsor Guest	Hunt	Trap	Fish
<i>National Guard / Reserves</i>	<i>No</i>	<i>Small Game</i>	<i>No</i>	<i>Yes</i>
<i>Federal Contractor assigned to Picatinny (In possession of a Picatinny issued Photo ID or CAC)</i>	<i>No</i>	<i>Small Game</i>	<i>No</i>	<i>Yes</i>
<i>DEERS-registered Dependent of Active Duty Military personnel assigned to Picatinny - 17 or older</i>	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Active Duty Military (Not Unit Fund Eligible)</i>	<i>No</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>

b. Garrison Commander approval is required for anyone not falling into one of the three categories listed above. These may include community leaders, key outdoor recreation volunteer personnel, wounded warriors, or escorts to primary-eligible personnel requiring escort due to an existing medical condition.

c. All guests must have valid FMWR card, national passport, or current state driver’s license, or other government issued photo identification. All personnel are subject to police vetting at any time.

d. Guest hunters of Primary Sportsmen may only hunt small game, except for Active Duty military, whose guest may hunt deer (6-day firearms season) and black bear season, when allowed by the Command. Command authorizations for big game hunting by Active Duty Military guests will be determined annually.

4. POLICY:

a. General Information and Restrictions

1. Hunting, fishing, trapping, and other recreational use of Picatinny Arsenal will be in accordance with New Jersey State laws, applicable Federal laws, this policy and supplemental orders issued by the Commanding General or Garrison Commander. Any supplemental instructions will be posted at Outdoor Recreation, the Leisure Travel Services “Take Off” Center and the Picatinny Arsenal Police Station, building 173 and will be brought to the attention of persons applying for a recreational permit.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

2. Picatinny Arsenal, and any part thereof, may be closed without notice at the discretion of the Commanding General or Garrison Commander. Recreational use of the installation is secondary to requirements of the military mission.

3. Failure to comply with lawful orders, posted signs, or written notices is illegal.

4. Violation of this policy may result in apprehension, prosecution and/or loss of recreational privileges on Picatinny Arsenal.

5. By entering Picatinny Arsenal Military Installation, individuals have consented to the search of their person or vehicles by law enforcement personnel, and the confiscation of all evidence of unauthorized activities.

6. All observed violations of federal or state laws, or Picatinny Arsenal regulations or policies must be reported to the PAPD at 973-724-6666.

7. An annual unexploded ordnance (UXO) briefing is a mandatory requirement for hunters and trappers as part of the annual hunting briefing. Other recreationists who would like more information or a short briefing on the identification and hazards of UXO should contact the Outdoor Recreation office for a brief. No person shall touch suspected unexploded ammunition and will report its location to PAPD at 973-724-6666.

8. All hunting, fishing, trapping, and other recreation will be conducted in designated areas (as depicted on the Sportsman Map). Sportsman Maps are available from Outdoor Recreation and Leisure Travel Services "Take Off" Center for a nominal fee, or online at <http://www.pica.army.mil/outdoor/RodGun.htm>, or reviewed at Outdoor Recreation and the Picatinny Arsenal Police Station, building 173

9. Accidents and lost persons must be immediately reported to PAPD at 973-724-6666.

10. Open fires are prohibited.

11. No person shall injure, deface or disturb any part of a building, range structure, sign, equipment or property found on Picatinny Arsenal.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

12. No person shall discard, bury or leave behind of any trash, waste or litter on Picatinny Arsenal. This includes the use of flagging, cat eyes, or other items used to mark trails or hunting locations. Trail markers must be biodegradable or removed after use. Recreationists must carry out everything that is carried in. Entrails are biodegradable and do not constitute litter unless placed in such a manner to create a nuisance or unauthorized bait/attractant during bear hunting season.

13. The collection of any artifact (such as old bottles, coins, arrowheads, etc.), disturbance of any feature related to past human activity (including stone walls), and the collection of paleontological specimens on Picatinny Arsenal is prohibited. The use of metal detectors on Picatinny Arsenal for recreational purposes is strictly prohibited. Violators can be prosecuted under both the civil and criminal provisions of the Archeological Resources Protection Act, 16 USC Sections 470ee-470ff.

14. Excavation or digging of any kind; and cutting, removal, or defacing of trees is prohibited.

15. Feeding, harassing, or molesting of any wildlife is prohibited.

16. Picking up, disturbing or taking Government equipment, ordnance, munitions, or parts of the same is prohibited.

17. Disturbing, molesting, or removing the traps and/or trapped animals of trappers are prohibited.

18. Check with Outdoor Recreation and www.NJFishandWildlife.com for seasonal hunting periods and detailed information about hunting, fishing, and trapping areas.

b. Picatinny Arsenal Sportsman Permit (PASP) and Passes. This section deals with the administration and application procedures for permits and passes required by recreational hunters, fishermen, and trappers. The PASP is the form that documents proof of eligibility, possession of required Federal/State license(s), personal data, attendance at mandatory briefing, and waiver of liability.

1. Federal and state game managing agencies set forth standard licenses, fees, and licensing procedures for hunting, fishing, and trapping. Whenever a federal or state license is required for such activities, a PASP with appropriate authorizations (See sub-paragraph f.) is also required to exercise that privilege on this installation.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

2. There are three PASP authorizations and they are issued only to sportsmen possessing current New Jersey licenses and stamps. Each authorization has an age requirement.

3. The authorized age according to New Jersey State law is as follows:

- Hunting - age 10 and older.
- Trapping - age 12 and older.
- Fishing - age 16 and older.

4. PASPs will be issued at the Leisure Travel Services "Take Off" Center. Applicants must provide proof of eligibility as a Primary or Associate Sportsman and provide valid New Jersey licenses in order to receive their PASP. Primary Sportsmen sponsoring a Guest must personally accompany the Guest applicant, or personally apply for and receive the PASP on behalf of their Guest.

5. Annual fees for each PASP authorization are established by the Garrison Commander. Check, money order, or cash will be accepted for these fees. Checks and money orders will be made payable to: "I M W R F." Fees are nonrefundable, even if PASP is subsequently suspended, revoked, or invalidated. An exception to authorize a refund may be made if an administrative error led to the issuance of a PASP to an ineligible person.

6. Only one PASP per calendar year will be issued to each eligible person. Authorizations reflecting federal and state licenses and other conditions will be specified and marked on the PASP. Once issued, a PASP is valid until the end of the calendar year. The entire one page form (blocks A-H) constitutes the PASP. **DO NOT CUT OR REMOVE ANY PORTION OF THIS FORM.** When afield, PASPs must be visibly displayed on your person on your outermost garment.

7. Sportsmen should take care not to misplace or lose their PASP as it will be needed for updating any subsequent authorizations purchased within the calendar year, or for receiving new PASPs the following calendar year. One free replacement PASP may be issued in a calendar year.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

8. Sportsmen who purchase a fishing PASP will also receive a Fishing/Boating Pass (FBP) at the time of purchase. The Hunting/Trapping Pass (HTP) are issued when signing in/out at the Picatinny Police desk. These passes must be displayed in the fisherman's and hunters/trappers' vehicle during active outings and are valid only with the concurrent PASP. Designed for periodic use throughout the year as a security device, these passes are non-transferrable and must be safeguarded at all times. Use of FBP or HTP without concurrent valid PASP or other misappropriation will be considered a security violation. Loss of personally issued FBP or HTP must be reported to Outdoor Recreation or PAPD as soon as possible.

c. General Sportsmen Requirements - Sportsmen MUST:

1. Comply with all installation safety, security, and traffic regulations and carry at least one form of personal photo identification on their person at all times. Additional Safety instructions can be located at the FMWR website www.pica.army.mil/outdoor titled: Safety Guidelines for Hunting, Fishing, Trapping, Boating on Picatinny

2. Present both their PASP and government-issued ID at the inspection gate. Failure to provide government-issued ID, in addition to the PASP, may be grounds to deny access or to confiscate the PASP, until eligibility status is verified by Outdoor Recreation or security personnel.

3. Park at least ten yards away from any building or 40 yards from any explosive building (bearing Hazard Symbols 1, 2, 3, or 4) and in a manner, which will not impede normal use of buildings, roadways, bridges, or boat ramps; nor damage turf areas. Sportsmen vehicles must display either FBP or HTP during active outings.

4. Reveal for inspection, but need not relinquish their PASP to any person requesting to examine it.

5. Relinquish their PASP to identified law enforcement personnel, if requested to do so.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

6. Leave the field/water/ice immediately upon hearing the customary danger/distress signal of any sequence of three identical sounds (siren, horn, or whistle). Head to nearest road/ramp/shore or vehicle and vacate vicinity immediately. Security measures may mandate that sportsmen vacate the installation in an expeditious manner. In such an event, a police officer or authorized personnel will signal repeatedly. Sportsmen should report as promptly as possible to the nearest officer so that they can be identified and accounted for. Sportsmen should NOT return to Bldg 173, unless directed or permitted to do so. Hunters and trappers should surrender their HTPs (if applicable) to the officer in the field, or retain them until the next opportunity to return to post. Leave the installation safely and efficiently or as directed.

7. Display or provide for inspection, any game or fish harvested, if requested to do so by law enforcement or bona fide persons engaged in biological harvest data collection efforts.

8. Notify PAPD at 973-724-6666 immediately of any field accident/incident involving personal injury, endangerment, or property damage.

9. Report to PAPD any KNOWN violations of State or Federal hunting, fishing, or trapping laws or suspected breaches of this policy.

10. Register in and out at the Picatinny Arsenal Police Station, building 173, prior to hunting and/or trapping.

11. MUST NOT pick up, move, or otherwise disturb items of ammunition, ordnance, or debris of an unknown or questionable nature. If in doubt, DO NOT TOUCH, LEAVE IT ALONE! Note and mark the location and notify PAPD at 973-724-6666. DO NOT enter areas, which are flagged or otherwise marked as restricted or potentially hazardous.

12. MUST NOT enter or attempt to travel through any hazardous area where a red flag is displayed, either on a flag pole or road barrier; or where any other restrictive signage or barriers are emplaced.

13. MUST NOT photograph, by any means, any government building or structure on the installation. Violators will have their camera apparatus confiscated.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

d. Special Instructions for Hunting and Trapping

1. Primary and authorized Associate Sportsmen may hunt on Picatinny Arsenal. Guests and children under the age of 17 must be accompanied by their sponsor or legal guardian to/from their hunting area and must remain together in the same hunting area throughout their outing.

2. All hunters and trappers must receive their annual hunting brief through Outdoor Recreation. Hunters and trappers must successfully complete the online or written exam annually prior to procuring the PASP.

3. Hunters (or trappers) must declare upon entering the installation that they are transporting weapons and must present their current weapons registration card authorized by the PAPD. All weapons must be registered with the PAPD prior to hunting and trapping. When not actively hunting all shotguns, muzzleloaders, .22 rifles, Bows and Crossbows must be kept in a closed/fastened case or sock in a safe unloaded condition with ammo stored separately in a vehicle, IAW State Law.

4. Hunting and Trapping Area Sign-In Procedures.

a. Hunters / Trappers will sign-in at the beginning of their event at PAPD front desk, Building 173. Hunters may sign-in up to (2) hours prior to legal hunting commencement.

b. Hunters / Trappers will provide their PASP and government-issued ID at sign-in and will be asked their desired Hunting Area (HA) or Trapping Area (TA).

c. If there is room in the desired HA, the desk officer will grant access to that area and track total numbers of hunters on a white board.

d. Hunters/Trappers may be issued a numbered Hunting /Trapping Pass (HTP) to display in their vehicle for the duration of their event.

e. Hunters/Trappers may switch HAs by calling the PAPD front desk at 973-724-6666, provided there remains room in the desired HA.

f. Keys are available for issue for HAs 1E, 2B, 2W, 3, 4, 10, 14W, and 20B.

g. At the conclusion of the hunt, hunters/trappers must sign-out, surrender their HTP, and any access keys within an hour of departing their HA. All harvest data is to be recorded on the registration log at the PAPD.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

h. All hunters or trappers must follow the foregoing procedures, and be unarmed, whenever scouting game; whether pre-season or in-season. Police and Sportsmen will be especially cognizant of subparagraphs 6d (3) and (5) during the open seasons.

5. Hunters wishing to hunt as a group whose populations are greater than the maximum allowable on the Picatinny Arsenal Sportsman's Map may do so upon approval of the PAPD front desk and as long as the desired HA does not already have other hunters signed-in. A member of the hunting party must be designated as the "Huntermaster" and will be responsible for safe hunting practices of the group. The Huntermaster will annotate his/her role on the sign-in sheet and will advise the PAPD front desk that all members have cleared the HA upon sign-out. The Huntermaster may call in to switch HAs for the group as long the new destination HA is free of other hunters. When calling in, the Huntermaster must advise PAPD of any changes to the group composition (i.e., deletions or additions).

6. All tree stand devices and game cameras left unattended within the installation boundary MUST be marked with the hunter's full name and PASP number. All game cameras must be registered with the PAPD and any camera is subject to screening by PAPD at any time.

7. Still Hunting vs. Drive Hunting.

a. Still Hunting is defined as a slow, deliberate hunt for animals on the ground, through woods, fields, river bottoms and marshes. At Picatinny Arsenal, still hunting includes hunting for game from an elevated position or stand.

b. Drive Hunting is defined one group of hunters walking in line in an attempt to drive game in their path towards another group of hunters.

c. The following hunting areas are considered Still Hunting only: HAs 8E, 8N, 9E, 10, 11E, 11W, 12W, 13E, 13W – no Drive Hunting is authorized in these areas.

d. Drive (or Still) Hunting is authorized in any other hunting area not listed above as designated by the first hunter to sign in to that area. Once designated, the method of hunting will remain in place until vacated.

8. Hunting dogs are authorized for waterfowl hunting and upland game birds only and may be unleashed when hunting or retrieving. Training or practicing retrieval with hunting dogs is not authorized anywhere on the installation, with the exception of the Dog Park located on Parker Road near the main gate, or during hunting demonstrations sanctioned by Outdoor Recreation.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

9. Hunters WILL NOT direct any shot towards any structure bearing Hazard Symbols 1, 2, 3, or 4 (these are ammo/energetic storage bunkers); or any installation boundary line, unless the following safe distances are met: 1200 feet for muzzleloader or shotgun with slug; 600 feet for shotgun with buckshot or birdshot; 450 feet for bow and arrow.

10. Resident Goose Population Control – Special Hunting Group. Special instructions can be located at the FMWR website at www.pica.army.mil/outdoor

11. Trappers must identify every trap set with their name and address or state trapper identification number borne upon a metal tag.

12. Traps must be tended at least once in every 24-hour period, and removed at the end of the trapping season.

13. Trapping is authorized in designated areas. Trappers may coordinate with the NRM for trapping furbearers in other areas.

14. Dispatch trapped animals IAW state law, using a rifle with not more than 3 each .22 caliber short, rimfire cartridges.

15. Other than as allowed and reiterated in Paragraph 6n above (for trappers only); hunting for any small game species with rimfire or center fire rifles is prohibited on PICA.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

16. Night hunting one half hour after sunset to one half hour before sunrise for any game species is also prohibited on Picatinny Arsenal.

e. Special Instructions for Fishing

1. Primary or Associate Sportsmen, age 17 and older, may fish alone. Dependents under the age of 17 must be accompanied by their sponsor or legal guardian to/from the intended body of water and fish on the same body of water.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

2. Children or juveniles under age 16 may legally fish designated installation waters without a PASP. Although these children are not required to be licensed, they are still bound by New Jersey fishing laws, as well as this policy. Sponsors or supervisors of these children are responsible for compliance.

3. Guests must be accompanied by their sponsor to/from the intended body of water, and fish on the same body of water.

4. Check Open/Closed status of upper 2/3rds Fishing Area (FA) 'K' Picatinny Lake or Lower 1/2 Fishing Area 'L', also known as Lynn's Pond via signage or Police. Mission operations within certain buildings may necessitate closure of these areas.

5. Check on ice fishing conditions by calling Outdoor Recreation on weekdays, PAPD at 973-724-6666 on weekends or during non-duty hours, or check the Outdoor Recreation website: www.pica.army.mil/outdoor.

6. Coordinate all fishing tournaments on post with Outdoor Recreation.

7. Bank fishing is authorized in all designated areas, except western shores of Lakes Denmark and Picatinny.

8. Portable liquid-fueled cooking stoves are authorized beyond 20 yards from the western shore of Lake Denmark, and the entire shore of Picatinny Lake while ice-fishing.

9. Trapping to catch baitfish is not authorized. This restriction is subject to annual review.

10. Creel limits established by NJDFW are reviewed and published annually in a separate addendum for Picatinny Arsenal. Guest harvests count towards the Primary Sportsman's limit – this provision is subject to annual review through the Natural Resources Manager.

11. Fish consumption advisories are tailored to two groups - the General Population; and High Risk Individuals defined as pregnant women, women planning pregnancy within one year, nursing mothers, and children under age 5.

a. High Risk Individuals are cautioned not to eat Largemouth Bass from FAs B, G, K, or L; Chain Pickerel from FAs K or L; and Carp from FA I. These individuals should also limit consumption of Largemouth Bass, Channel Catfish, and all non-stocked fish species from all other FAs to one 8oz serving per month.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

b. General Population individuals are cautioned to limit consumption of Largemouth Bass, Channel Catfish, and all non-stocked fish species from all FAs to one 8oz serving per month.

c. The New Jersey DEP encourages fishermen to consult the Fish-Smart – Eat Smart Fish Advisory Guide or www.FishSmartEatSmartNJ.org when making decisions about eating recreationally caught fish and crabs.

f. Operational Areas (OAs). Due to explosive hazards there are special restricted access areas on the installation. Three such OAs (also known as enclosures) which sportsmen should be aware of are: Robinson Hunting Areas (HAs) 5B, 11E, 11W, 12W, 13E, 13W, 14E, 19, as well as Fishing Areas (FAs) J and Ku; Mt. Hope - South (HA2); Mt. Hope - North (HA3 and HA4), and G2 Range (HA8E). The following rules apply to all sportsmen entering these OAs:

1. The availability of hunting, fishing, or trapping areas within OAs is subject to the daily mission activities in those areas.

2. All sportsmen entering an OA must register with the police officer on duty and clearly state the purpose of the outing: hunting or trapping. Similarly, sportsmen must check out upon departure. Although most OA gates are typically unmanned, especially before and after duty hours and on weekends/holidays, a police officer must be contacted to open those where keys cannot be issued.

3. The use of matches or lighters is strictly forbidden. Smoking is also prohibited. The only exception for sportsmen is while on open water or ice beyond 20 yards from the shore.

4. Robinson Enclosure. This sizeable OA includes range complexes and storage areas. Entry into the OA is at the gate and checkpoint on 9th Ave. The following procedures apply specifically to this enclosure:

a. Parking is prohibited for all sportsmen near Bldgs 825; 922 and 923, including Babbit Rd. (between former Bldg 975 and Bldg 923). Parking is also prohibited along Rose Rd. (between Bldgs 931 and 939).

b. Hunters accessing HA13E and ice fishermen accessing the western shore of Picatinny Lake are advised not to park in such a manner as to block any roadway in the 800 and 900 areas. Hunters or fishermen accessing HA5B may park on any roads (north of Willis St) within or adjacent to HA5B.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

c. Picatinny Lake. This lake has some of its shoreline abutting interior portions of the Robinson Enclosure even though the surface waters may be accessed by boat without registering at the OA gate. That portion of the southern shoreline from Bldg 337 to Bldg 506 and the portion of the eastern shoreline from Bldg 506 to the OA fence line (just beyond the outfall of Basin Brook into a small cove) are hereafter referred to as “unrestricted access shoreline.”

1. Sportsmen launching boats from the ramp or dock near Bldg 337 may not disembark to Hunt, Trap, or Fish ashore. Boaters may only come ashore for bona fide emergencies.

2. Ice access is for ice fishing only. Fishermen must exit ice surface from their same point of entry. Fishermen must not access shore points other than their point of entry. Ice fishermen may access safe ice along the unrestricted access shoreline from former Bldg 527A to the OA fence line.

g. Robinson Enclosure Access Procedures. The following procedure applies to access of the Robinson Enclosure (HAs 5B, 8E, 11E, 11W, 12W, 13E, 13W, 14E, 19, FA J, and FA Ku) any time for all hunting and fishing seasons.

1. Sportsmen desiring access to the Robinson Enclosure or the G2 Range (HA8E) any time must contact ARDEC Range Control a minimum of 24 and a maximum of 72 hours in advance via e-mail at [USARMY Picatinny Arsenal ARDEC List 600RangeControl](mailto:USARMY.Picatinny.Arsenal.ARDEC.List.600RangeControl) and provide the following information:

- a. Requested date of entry.
- b. Requested time of entry.
- c. Time of exiting.
- d. Requested area to be visited by zone IAW Sportsman Map.
- e. Any intention to pass through Area 1222 (Gorge).
- f. Mobile phone number.

2. ARDEC Range Control will provide an e-mail to the requesting sportsman with cc: to the PAPD granting Confirmation of Approval as soon as possible based on current mission schedule but no later than by COB the prior day.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

3. In the unlikely event of any unanticipated mission required action the morning of the requested access the Sportsman will be contacted via phone number provided in addition to an e-mail with cc: to PAPD cancelling prior approval.

4. Sportsmen will sign in at PAPD the day of their outing using normal sign-in procedures.

5. PAPD will assure that a Confirmation of Approval e-mail has been received prior to granting access to the sportsman.

6. Upon accessing the Robinson Enclosure, the sportsman will proceed to B806 or B611 as applicable and sign in with a mobile phone number. A sign in sheet will be available in the box located near the front doors of B611 and B806 to be utilized only if sportsman should arrive prior to staffing of Range Control or storage areas.

7. The sportsman may then proceed to their intended hunting or fishing area.

8. If the sportsman desires to change hunting/fishing areas, they **MUST** contact both PAPD 973-724-6666 and ARDEC Range Control 973-724-4788 **BEFORE** moving to the new area.

9. Sportsmen departing the Robinson Enclosure shall:

a. Sign out at the same location which they signed in.

b. Those wishing to transit through Area 1222 (Gorge) **MUST** contact ARDEC Range Control at (973.724.4788) **BEFORE** crossing the Gorge boundary and be granted approval.

h. Boating

1. All boating must be conducted under the provision of New Jersey State Police Safe Boating Manual, including all navigational rules. Boats used on Picatinny Arsenal waters must be equipped with personal floatation devices (PFD). Non-swimmers and persons under age 14 must wear their PFDs when underway.

2. There is a no wake policy in effect for Lakes Denmark and Picatinny. No wake implies no visible white water or cresting waveform in the “V” shaped wake astern the boat.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

3. Any personally owned boats used on this installation must be registered annually by the owner, with Outdoor Recreation. The decal provided must be affixed to the boat within two feet abaft amidships on both sides.

4. Recreationists may use non-motorized or electric powered boats in all designated lakes and ponds and may use gasoline-powered boats only on Lakes Picatinny and Denmark. Iceboats, jet skis, sailboats, and fan boats or any other motorized personal watercraft is prohibited and may not be used on installation lakes, ponds, or installation streams.

i. Camping- Camping is not authorized on Picatinny Arsenal.

j. Swimming- Swimming or sail-boarding is prohibited in all natural waters on Picatinny Arsenal.

k. Paintball, Biking, and Hiking. These activities are restricted to designated and approved trails and fields on the Picatinny Arsenal Sportsmen Map, 29 February 2012 and Picatinny Arsenal Recreational Trails Map.

l. Roles and Responsibilities. Multiple organizations are stakeholders and diverse land users where hunting, fishing, or trapping may occur. Law enforcement, security controls, and safety compliance are key elements of any policy involving such sportsman activities.

1. Outdoor Recreation. Designated lead on all outdoor programs including hunting, fishing and trapping.

2. Natural Resource Manager (NRM). Advisory role to Garrison Commander. Ensures programmatic compliance of outdoor programs with applicable State and Federal Regulations. Primary liaison to New Jersey Department of Environmental Protection, NJ Division of Fish and Wildlife and US Fish and Wildlife Service. Supports PAPD with State and Federal hunting, fishing, and trapping laws as directed by the Garrison Commander.

3. Picatinny Arsenal Police Department. Enforcement of all Installation, State and Federal regulations. Management of hunt log and hunting area sign in/out. Issue of weapons permits. Primary liaison to New Jersey Division of Fish and Wildlife for law enforcement matters.

4. Installation Safety Office. Completes annual Certificate of Risk Assessment for the installation hunting program prior to the beginning of the calendar year.

IMPI-ZA

SUBJECT: Policy No IMPI-MWR-006 Recreational Hunting, Fishing, Trapping, Boating, and Other Outdoor Activities

5. ARDEC Range Control. Establishes procedures for and facilitates access to Robinson Enclosure and G2 Range to ensure maximum availability without adversely impacting mission requirements. Approves and controls access to Robinson Enclosure hunting/fishing areas during duty hours.

5. PROPONENT: US Army Garrison, FMWR Business & Recreation Chief, Mr. Christopher Kunkel, can be reached at 973-724-2045 or Christopher.m.kunkel.naf@mail.mil.

INGRID A. PARKER
LTC, MI
Commanding

APPENDIX J

16 U.S.C. 670 a-f & Sikes Act Reauthorization Act – 2013

Current through Pub. L. 113-31.

14 pages

16 USC § 670 - Definitions

In this subchapter:

(1) **Military installation**

The term “military installation”—

(A) means any land or interest in land owned by the United States and administered by the Secretary of Defense or the Secretary of a military department, except land under the jurisdiction of the Assistant Secretary of the Army having responsibility for civil works;

(B) includes all public lands withdrawn from all forms of appropriation under public land laws and reserved for use by the Secretary of Defense or the Secretary of a military department; and

(C) does not include any land described in subparagraph (A) or (B) that is subject to an approved recommendation for closure under the Defense Base Closure and Realignment Act of 1990 (part A of title XXIX of Public Law 101–510; 10 U.S.C. 2687 note).

(2) **State**

The term “State” means any of the several States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, the Commonwealth of the Northern Mariana Islands, American Samoa, and the Virgin Islands.

(3) **State-owned National Guard installation**

The term “State-owned National Guard installation” means land owned and operated by a State when such land is used for training the National Guard pursuant to chapter 5 of title 32, with funds provided by the Secretary of Defense or the Secretary of a military department, even though such land is not under the jurisdiction of the Department of Defense.

(4) **State fish and wildlife agency**

The term “State fish and wildlife agency” means the one or more agencies of State government that are responsible under State law for managing fish or wildlife resources.

(5) **United States**

The term “United States” means the States, the District of Columbia, and the territories and possessions of the United States.

(6) **Indian tribe**

The term “Indian tribe” means any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601 et seq.), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

16 USC § 670a - Cooperative plan for conservation and rehabilitation

(a) **Authority of Secretary of Defense**

(1) **Program**

(A) **In general**

The Secretary of Defense shall carry out a program to provide for the conservation and rehabilitation of natural resources on military installations.

(B) Integrated natural resources management plan

(i) To facilitate the program, the Secretary of each military department shall prepare and implement an integrated natural resources management plan for each military installation in the United States under the jurisdiction of the Secretary, unless the Secretary determines that the absence of significant natural resources on a particular installation makes preparation of such a plan inappropriate.

(ii) The Secretary of a military department may, subject to the availability of appropriations, develop and implement an integrated natural resources management plan for a State-owned National Guard installation. Such a plan shall be developed and implemented in coordination with the chief executive officer of the State in which the State-owned National Guard installation is located. Such a plan is deemed, for purposes of any other provision of law, to be for lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use.

(2) Cooperative preparation

The Secretary of a military department shall prepare each integrated natural resources management plan for which the Secretary is responsible in cooperation with the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, and the head of each appropriate State fish and wildlife agency for the State in which the military installation or State-owned National Guard installation concerned is located. Consistent with paragraph (4), the resulting plan for the military installation or State-owned National Guard installation shall reflect the mutual agreement of the parties concerning conservation, protection, and management of fish and wildlife resources.

(3) Purposes of program

(A) Consistent with the use of military installations and State-owned National Guard installations to ensure the preparedness of the Armed Forces, the Secretaries of the military departments shall carry out the program required by this subsection to provide for—

- (i) the conservation and rehabilitation of natural resources on such installations;
- (ii) the sustainable multipurpose use of the resources on such installations, which shall include hunting, fishing, trapping, and non-consumptive uses; and
- (iii) subject to safety requirements and military security, public access to military installations to facilitate the use.

(B) In the case of a State-owned National Guard installation, such program shall be carried out in coordination with the chief executive officer of the State in which the installation is located.

(4) Effect on other law

Nothing in this subchapter—

- (A)
 - (i) affects any provision of a Federal law governing the conservation or protection of fish and wildlife resources; or
 - (ii) enlarges or diminishes the responsibility and authority of any State for the protection and management of fish and resident wildlife; or

(B) except as specifically provided in the other provisions of this section and in section 670b of this title, authorizes the Secretary of a military department to require a Federal license or permit to hunt, fish, or trap on a military installation.

(b) Required elements of plans

Consistent with the use of military installations and State-owned National Guard installations to ensure the preparedness of the Armed Forces, each integrated natural resources management plan prepared under subsection (a) of this section—

(1) shall, to the extent appropriate and applicable, provide for—

(A) fish and wildlife management, land management, forest management, and fish- and wildlife-oriented recreation;

(B) fish and wildlife habitat enhancement or modifications;

(C) wetland protection, enhancement, and restoration, where necessary for support of fish, wildlife, or plants;

(D) integration of, and consistency among, the various activities conducted under the plan;

(E) establishment of specific natural resource management goals and objectives and time frames for proposed action;

(F) sustainable use by the public of natural resources to the extent that the use is not inconsistent with the needs of fish and wildlife resources;

(G) public access to the installation that is necessary or appropriate for the use described in subparagraph (F), subject to requirements necessary to ensure safety and military security;

(H) enforcement of applicable natural resource laws (including regulations);

(I) no net loss in the capability of installation lands to support the military mission of the installation; and

(J) such other activities as the Secretary of the military department determines appropriate;

(2) must be reviewed as to operation and effect by the parties thereto on a regular basis, but not less often than every 5 years; and

(3) may, in the case of a military installation, stipulate the issuance of special State hunting and fishing permits to individuals and require payment of nominal fees therefor, which fees shall be utilized for the protection, conservation, and management of fish and wildlife, including habitat improvement and related activities in accordance with the integrated natural resources management plan; except that—

(A) the Commanding Officer of the installation or persons designated by that Officer are authorized to enforce such special hunting and fishing permits and to collect, spend, administer, and account for fees for the permits, acting as agent or agents for the State if the integrated natural resources management plan so provides, and

(B) the fees collected under this paragraph may not be expended with respect to other than the military installation on which collected, unless the military installation is subsequently closed, in which case the fees may be transferred to another military installation to be used for the same purposes.

(c) Prohibitions on sale and lease of lands unless effects compatible with plan

After an integrated natural resources management plan is agreed to under subsection (a) of this section—

(1) no sale of land, or forest products from land, that is within a military installation covered by that plan may be made under section 2665 (a) or (b) of title 10; and

(2) no leasing of land that is within the installation may be made under section 2667 of such title 10;

unless the effects of that sale or leasing are compatible with the purposes of the plan.

(d) Implementation and enforcement of integrated natural resources management plans

With regard to the implementation and enforcement of integrated natural resources management plans agreed to under subsection (a) of this section—

(1) neither Office of Management and Budget Circular A-76 nor any successor circular thereto applies to the procurement of services that are necessary for that implementation and enforcement; and

(2) priority shall be given to the entering into of contracts for the procurement of such implementation and enforcement services with Federal and State agencies having responsibility for the conservation or management of fish or wildlife.

(e) Applicability of other laws

Integrated natural resources management plans agreed to under the authority of this section and section 670b of this title shall not be deemed to be, nor treated as, cooperative agreements to which chapter 63 of title 31 applies.

(f) Reviews and reports

(1) Secretary of Defense

Not later than March 1 of each year, the Secretary of Defense shall review the extent to which integrated natural resources management plans were prepared or were in effect and implemented in accordance with this subchapter in the preceding year, and submit a report on the findings of the review to the committees. Each report shall include—

(A) the number of integrated natural resources management plans in effect in the year covered by the report, including the date on which each plan was issued in final form or most recently revised;

(B) the amounts expended on conservation activities conducted pursuant to the plans in the year covered by the report; and

(C) an assessment of the extent to which the plans comply with this subchapter.

(2) Secretary of the Interior

Not later than March 1 of each year and in consultation with the heads of State fish and wildlife agencies, the Secretary of the Interior shall submit a report to the committees on the amounts expended by the Department of the Interior and the State fish and wildlife agencies in the year covered by the report on conservation activities conducted pursuant to integrated natural resources management plans.

(3) “Committees” defined

In this subsection, the term “committees” means—

(A) the Committee on Resources and the Committee on Armed Services of the House of Representatives; and

(B) the Committee on Armed Services and the Committee on Environment and Public Works of the Senate.

(g) Pilot program for invasive species management for military installations in Guam

(1) Inclusion of invasive species management

During fiscal years 2009 through 2014, the Secretary of Defense shall, to the extent practicable and conducive to military readiness, incorporate in integrated natural resources management plans for military installations in Guam the management, control, and eradication of invasive species—

(A) that are not native to the ecosystem of the military installation; and

(B) the introduction of which cause or may cause harm to military readiness, the environment, or human health and safety.

(2) Consultation

The Secretary of Defense shall carry out this subsection in consultation with the Secretary of the Interior.

16 USC § 670b - Migratory game birds; hunting permits

(a) Integrated natural resources management plan

The Secretary of Defense in cooperation with the Secretary of the Interior and the appropriate State agency is authorized to carry out a program for the conservation, restoration and management of migratory game birds on military installations, including the issuance of special hunting permits and the collection of fees therefor, in accordance with an integrated natural resources management plan mutually agreed upon by the Secretary of Defense, the Secretary of the Interior and the appropriate State agency.

(b) Applicability of other laws

Possession of a special permit for hunting migratory game birds issued pursuant to this subchapter shall not relieve the permittee of the requirements of the Migratory Bird Hunting Stamp Act as amended [16 U.S.C. 718 et seq.] nor of the requirements pertaining to State law set forth in Public Law 85-337.

16 USC § 670c - Program for public outdoor recreation

(a) Program authorized

The Secretary of Defense is also authorized to carry out a program for the development, enhancement, operation, and maintenance of public outdoor recreation resources at military installations in accordance with an integrated natural resources management plan mutually agreed upon by the Secretary of Defense and the Secretary of the Interior, in consultation with the appropriate State agency designated by the State in which the installations are located.

(b) Access for disabled veterans, military dependents with disabilities, and other persons with disabilities

(1) In developing facilities and conducting programs for public outdoor recreation at military installations, consistent with the primary military mission of the installations, the Secretary of Defense shall ensure, to the extent reasonably practicable, that outdoor recreation opportunities (including fishing, hunting, trapping, wildlife viewing, boating, and camping) made available to the public also provide access for persons described in paragraph (2) when topographic, vegetative, and water resources allow access for such persons without substantial modification to the natural environment.

(2) Persons referred to in paragraph (1) are the following:

(A) Disabled veterans.

(B) Military dependents with disabilities.

(C) Other persons with disabilities, when access to a military installation for such persons and other civilians is not otherwise restricted.

(3) The Secretary of Defense shall carry out this subsection in consultation with the Secretary of Veterans Affairs, national service, military, and veterans organizations, and sporting organizations in the private sector that participate in outdoor recreation projects for persons described in paragraph (2).

(c) Acceptance of donations

In connection with the facilities and programs for public outdoor recreation at military installations, in particular the requirement under subsection (b) of this section to provide access for persons described in paragraph (2) of such subsection, the Secretary of Defense may accept—

- (1) the voluntary services of individuals and organizations; and
- (2) donations of property, whether real or personal.

(d) Treatment of volunteers

A volunteer under subsection (c) of this section shall not be considered to be a Federal employee and shall not be subject to the provisions of law relating to Federal employment, including those relating to hours of work, rates of compensation, leave, unemployment compensation, and Federal employee benefits, except that—

- (1) for the purposes of the tort claims provisions of chapter 171 of title 28, the volunteer shall be considered to be a Federal employee; and
- (2) for the purposes of subchapter I of chapter 81 of title 5, relating to compensation to Federal employees for work injuries, the volunteer shall be considered to be an employee, as defined in section 8101 (1)(B) of title 5, and the provisions of such subchapter shall apply.

16 USC § 670c–1 - Cooperative and interagency agreements for land management on installations

There is 1 Update Pending. Select the tab below to view.

(a) Authority of Secretary of military department

The Secretary of a military department may enter into cooperative agreements with States, local governments, Indian tribes, nongovernmental organizations, and individuals, and into interagency agreements with the heads of other Federal departments and agencies, to provide for the following:

- (1) The maintenance and improvement of natural resources on, or to benefit natural and historic research on, military installations and State-owned National Guard installations.
- (2) The maintenance and improvement of natural resources located off of a military installation or State-owned National Guard installation if the purpose of the cooperative agreement or interagency agreement is to relieve or eliminate current or anticipated challenges that could restrict, impede, or otherwise interfere with, whether directly or indirectly, current or anticipated military activities.

(b) Multiyear agreements

Funds appropriated to the Department of Defense for a fiscal year may be obligated to cover the cost of goods and services provided under a cooperative agreement or interagency agreement entered into under subsection (a) of this section or through an agency agreement

under section 1535 of title 31 during any 18-month period beginning in that fiscal year, without regard to whether the agreement crosses fiscal years.

(c) Availability of funds; agreements under other laws

Cooperative agreements and interagency agreements entered into under this section shall be subject to the availability of funds and shall not be considered, nor be treated as, cooperative agreements to which chapter 63 of title 31 applies.

16 USC § 670d - Liability for funds; accounting to Comptroller General

The Department of Defense is held free from any liability to pay into the Treasury of the United States upon the operation of the program or programs authorized by this subchapter any funds which may have been or may hereafter be collected, received or expended pursuant to, and for the purposes of, this subchapter, and which collections, receipts and expenditures have been properly accounted for to the Comptroller General of the United States.

16 USC § 670e - Applicability to other laws; national forest lands

Nothing herein contained shall be construed to modify, amend or repeal any provision of Public Law 85-337, nor as applying to national forest lands administered pursuant to the provisions of section 9 of the Act of June 7, 1924 (43 Stat. 655), nor section 315m of title 43.

16 USC § 670e-1 - Federal enforcement of other laws

All Federal laws relating to the management of natural resources on Federal land may be enforced by the Secretary of Defense with respect to violations of the laws that occur on military installations within the United States.

16 USC § 670e-2 - Natural resources management services

To the extent practicable using available resources, the Secretary of each military department shall ensure that sufficient numbers of professionally trained natural resources management personnel and natural resources law enforcement personnel are available and assigned responsibility to perform tasks necessary to carry out this subchapter, including the preparation and implementation of integrated natural resources management plans.

16 USC § 670f - Appropriations and expenditures

(a) Expenditures of collected funds under integrated natural resources management plans

The Secretary of Defense shall expend such funds as may be collected in accordance with the integrated natural resources management plans agreed to under sections 670a and 670b of this title and cooperative agreements agreed to under section 670c-1 of this title and for no other purpose. All funds that are so collected shall remain available until expended.

(b) Authorization of appropriations to Secretary of Defense

Of the amounts authorized to be appropriated to the Department of Defense, there are authorized to be appropriated to the Secretary of Defense not to exceed \$1,500,000 for each of the fiscal years 2009 through 2014, to carry out this subchapter, including the enhancement of fish and wildlife habitat and the development of public recreation and other facilities, and to carry out such functions and responsibilities as the Secretary may have under cooperative agreements entered into under section 670c-1 of this title. The Secretary of Defense shall, to the greatest extent practicable, enter into agreements to utilize the services, personnel, equipment, and facilities, with or without reimbursement, of the Secretary of the Interior in carrying out the provisions of this section.

(c) Authorization of appropriations to Secretary of the Interior

Of the amounts authorized to be appropriated to the Department of the Interior, there are authorized to be appropriated to the Secretary of the Interior not to exceed \$3,000,000 for each of the fiscal years 2009 through 2014, to carry out such functions and responsibilities as the Secretary may have under integrated natural resources management plans to which such Secretary is a party under this section, including those for the enhancement of fish and wildlife habitat and the development of public recreation and other facilities.

(d) Use of other conservation or rehabilitation authorities

The Secretary of Defense and the Secretary of the Interior may each use any authority available to him under other laws relating to fish, wildlife, or plant conservation or rehabilitation for purposes of carrying out the provisions of this subchapter.

N.B. Subchapters 670g-o relate only to Departments of Interior and Agriculture or their bureaucratic subdivisions, and not to DOD or military reservations.

29-006

113TH CONGRESS REPT. 113-119

1st Session " HOUSE OF REPRESENTATIVES ! Part 1

SIKES ACT REAUTHORIZATION ACT OF 2013

JUNE 24, 2013.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed
Mr. HASTINGS of Washington, from the Committee on Natural Resources, submitted the following

R E P O R T

[To accompany H.R. 910]

[Including cost estimate of the Congressional Budget Office]

The Committee on Natural Resources, to whom was referred the bill (H.R. 910) to reauthorize the Sikes Act, having considered the same, report favorably thereon without amendment and recommend that the bill do pass.

PURPOSE OF THE BILL

The purpose of H.R. 910 is to reauthorize the Sikes Act.

BACKGROUND AND NEED FOR LEGISLATION

The Department of Defense (DOD) controls over 28 million acres of valuable fish and wildlife habitat at 511 military installations nationwide. These lands contain a wealth of plant and animal life, wetlands for migratory birds and 420 endangered and threatened species. Enacted in 1960, the Sikes Act (16 U.S.C. 670a-670o) has been extended a number of times, with the most recent effort in the National Defense Authorization Act for Fiscal Year 2010. Under Public Law 111-84, Title I of the Sikes Act was extended until September 30, 2014, and the existing annual funding levels of \$1.5 million for DOD and \$3 million for the Department of the Interior through the Fish and Wildlife Service (FWS) were retained. However, neither DOD nor FWS receives a direct appropriation for this program. Instead, the nearly \$60 million that has been spent during the past ten fiscal years in support of Sikes Act activities has been consistently funded through general administrative funds. Prior to the Sikes Act Implementation Act of 1997 (P.L. 105-85), DOD was able to enter into voluntary “cooperative plans” with Secretary of the Interior and the appropriate state fish and wildlife agency to carry out a program to plan, develop, maintain and coordinate fish and wildlife conservation efforts on military lands. In addition, the cooperative plans could allow for the issuance of special hunting and fishing permits with the proceeds used for such things as habitat improvement. These plans were neither uniform nor comprehensive in their requirements and DOD was not required to implement them.

Under current law, DOD is required to complete a comprehensive Integrated Natural Resource Management Plan (INRMP) for each of its installations. These plans must be updated annually by the base commanders and FWS and the affected State must re-confirm these documents no less than every five years. The only exception involves those bases that do not have any significant fish, wildlife or natural resources. DOD believes 341 military installations are required to complete INRMPs. The Department also has noted that it defines an INRMP as “an integrated plan based, to the maximum extent practicable, on ecosystem management that shows the interrelationships of individual components of natural resources management to mission requirements and other land use activities affecting an installation’s natural resources.” These plans include the following components: fish and wildlife management and wildlife- oriented recreation; fish and wildlife habitat enhancement; wetland protection; establishment of specific management goals; public use of natural resources; enforcement of all natural resource laws; and how a “no net loss” of military lands would be ensured. The law allows for a public comment period for each INRMP, requires that each plan be completed within two years, stipulates that a sufficient number of professional trained natural resource management personnel complete these plans, and requires an annual report to Congress. The fundamental goals of INRMPs are to assist installation commanders in their efforts to conserve and rehabilitate natural resources and to balance the use of air, land and water resources for military training and testing with the need to conserve wildlife resources for future generations. They are a comprehensive approach to ecosystem management in a holistic, proactive way that protects endangered species and their habitats. In fiscal year 2011, 92 INRMPs were reviewed at a cost of \$3.9 million, or approximately \$42,800 per plan.

On November 24, 2003, the National Defense Authorization Act (P.L. 108-136) was signed into law and it modified a number of Sikes Act provisions. Among the changes was one to the Endangered Species Act which precluded the designation of critical habitat on DOD lands subject to an INRMP under the Sikes Act. This was an important modification because an increasing amount of military lands were being designated as “critical habitat” which restricted an increasing number of military training activities. To date, 51 military installations have been exempted from critical habitat designation without any significant impact on the listed species residing on those bases. This measure also extended the Sikes Act until September 30, 2008. During the 112th Congress,

the Sikes Act was further revised by a provision stipulating that 47 State-owned National Army Guard facilities would come under the jurisdiction of the DoD for developing and implementing an INRMP.

The fundamental goal of H.R. 910 is to extend the authorization of appropriations for Title 1 of this highly successful conservation law until September 30, 2019.

However, the DOD needs to do a better job of implementing the provisions of the Disabled Sportsmen's Access Act of 1998. While base commanders have a difficult job, efforts should be made to provide improved access and adaptive equipment to those brave Americans who have been severely injured in the service of this country. It is understood that 174 military installations provide "at least some degree of access to disabled persons for hunting, fishing and/or other outdoor recreational opportunities." However, the key is not access but accessibility. Based on this criteria, it is unacceptable that only 55 installations out of 511 military bases have such adaptive equipment. This is especially concerning based on the likelihood that this equipment is many times provided to base commanders at no cost to the federal government.

COMMITTEE ACTION

H.R. 910 was introduced on February 28, 2013, by Congressman John Fleming (R-LA). The bill was referred primarily to the Committee on Natural Resources, and within the Committee to the Subcommittee on Fisheries, Wildlife, Oceans and Insular Affairs. The bill was also referred to the Committee on Armed Services. On March 21, 2013, the Subcommittee held a hearing on the bill. On May 15, 2013, the Full Natural Resources Committee met to consider the bill. The Subcommittee on Fisheries, Wildlife, Oceans and Insular Affairs was discharged by unanimous consent. No amendments were offered, and the bill was then adopted and ordered favorably reported to the House of Representatives by unanimous consent.

COMMITTEE OVERSIGHT FINDINGS AND RECOMMENDATIONS

Regarding clause 2(b)(1) of rule X and clause 3(c)(1) of rule XIII of the Rules of the House of Representatives, the Committee on Natural Resources' oversight findings and recommendations are reflected in the body of this report.

COMPLIANCE WITH HOUSE RULE XIII

1. Cost of Legislation. Clause 3(d)(1) of rule XIII of the Rules of the House of Representatives requires an estimate and a comparison by the Committee of the costs which would be incurred in carrying out this bill. However, clause 3(d)(2)(B) of that rule provides that this requirement does not apply when the Committee has included in its report a timely submitted cost estimate of the bill prepared by the Director of the Congressional Budget Office under section 402 of the Congressional Budget Act of 1974. Under clause 3(c)(3) of rule XIII of the Rules of the House of Representatives and section 403 of the Congressional Budget Act of 1974, the Committee has received the following cost estimate for this bill from the Director of the Congressional Budget Office:

H.R. 910—Sikes Act Reauthorization Act of 2013

H.R. 910 would reauthorize the Sikes Act through 2019. That act requires the Department of Defense and the U.S. Fish and Wildlife Service to develop and implement plans to manage natural resources on certain military lands. For those activities, the bill would authorize the appropriation of up to \$4.5 million a year for 2015 through 2019. Under current law, that amount is authorized to be appropriated through 2014.

Assuming appropriation of the authorized amounts, CBO estimates that implementing H.R. 910 would cost \$18 million over the 2015–2018 period and \$4.5 million after 2018. Enacting the legislation would not affect direct spending or revenues; therefore, pay as-you-go procedures do not apply.

H.R. 910 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act and would not affect the budgets of state, local, or tribal governments.

The CBO staff contact for this estimate is Jeff LaFave. The estimate was approved by Theresa Gullo, Deputy Assistant Director for Budget Analysis.

2. Section 308(a) of Congressional Budget Act. As required by clause 3(c)(2) of rule XIII of the Rules of the House of Representatives and section 308(a) of the Congressional Budget Act of 1974, this bill does not contain any new credit authority or an increase or decrease in revenues or tax expenditures. Assuming appropriation of the authorized amounts, CBO estimates that implementing H.R. 910 would cost \$18 million over the 2015–2018 period and \$4.5 million after 2018.

3. General Performance Goals and Objectives. As required by clause 3(c)(4) of rule XIII, the general performance goal or objective of this bill is to reauthorize the Sikes Act.

EARMARK STATEMENT

This bill does not contain any Congressional earmarks, limited tax benefits, or limited tariff benefits as defined under clause 9(e), 9(f), and 9(g) of rule XXI of the Rules of the House of Representatives.

COMPLIANCE WITH PUBLIC LAW 104-4

This bill contains no unfunded mandates.

COMPLIANCE WITH H. RES. 5

Directed Rule Making. The Chairman does not believe that this bill directs any executive branch official to conduct any specific rule-making proceedings.

Duplication of Existing Programs. This bill does reauthorize a program of the federal government known to be duplicative of another federal program. Such program was identified in the most recent Catalog of Federal Domestic Assistance published pursuant to the Federal Program Information Act (Public Law 95-220, as amended by Public Law 98-169) as relating to other programs. More specifically under the general category of Fish and Wildlife Management Assistance by the U.S. Fish and Wildlife Service, the Sikes Act was grouped with seven other federal laws that provide funding for this activity, including the Fish and Wildlife Act of 1956, the Fish and Wildlife Coordination Act of 1958, the Alaska National Interest Lands Conservation Act, the Marine Mammal Protection Act of 1972, the Fish and Wildlife Conservation Act of 1980, the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, and the Lacey Act. Related programs were identified as Sport Fish Restoration Program and the Partners for Fish and Wildlife. In addition, under the category of Recovery Act Fund—Habitat Enhancement, Restoration and Improvement by the U.S. Fish and Wildlife Service, the Sikes Act was grouped with nine other statutes. In addition to many of the laws listed for Fish and Wildlife Management Assistance, this list also included the American Recovery and Reinvestment Act of 2009, the Great Lakes Fish and Wildlife Restoration Act, the Partners for Fish and Wildlife Act, and the Endangered Species Act. Related programs for this activity were identified as Sport Fish Restoration program, Fish and Wildlife Management Assistance, Coastal Program, Partners for Fish and Wildlife and Pollution Prevention Grants Program. However, as explained in the background and need portion of this report, Congress does not provide specific appropriations to implement the Sikes Act, but rather the Fish and Wildlife Service takes general funds for these activities, from other statutes and programs described in this section, and uses to meet the goals of the Sikes Act.

PREEMPTION OF STATE, LOCAL OR TRIBAL LAW

This bill is not intended to preempt any State, local or tribal law.

CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED

In compliance with clause 3(e) of rule XIII of the Rules of the House of Representatives, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in italic, existing law in which no change is proposed is shown in roman):

SIKES ACT

* * * * *

**TITLE I—CONSERVATION PROGRAMS ON MILITARY
INSTALLATIONS**

* * * * *

SEC. 108. APPROPRIATIONS AND EXPENDITURES.

(a) EXPENDITURES OF COLLECTED FUNDS UNDER INTEGRATED NATURAL RESOURCES MANAGEMENT PLANS.—The Secretary of Defense shall expend such funds as may be collected in accordance with the integrated natural resources management plans agreed to under sections 101 and 102 and cooperative agreements agreed to under section 103a of this title, and for no other purpose. All funds that are so collected shall remain available until expended.

(b) AUTHORIZATION OF APPROPRIATIONS TO SECRETARY OF DEFENSE.—
Of the amounts authorized to be appropriated to the Department of Defense, there are authorized to be appropriated to the Secretary of Defense not to exceed \$1,500,000 for each of the [fiscal years 2009 through 2014] *fiscal years 2015 through 2019*, to carry out this title, including the enhancement of fish and wildlife habitat and the development of public recreation and other facilities, and to carry out such functions and responsibilities as the Secretary may have under cooperative agreements entered into under section 103a. The Secretary of Defense shall, to the greatest extent practicable, enter into agreements to utilize the services, personnel, equipment, and facilities, with or without reimbursement, of the Secretary of the Interior in carrying out the provisions of this section.

(c) AUTHORIZATION OF APPROPRIATIONS TO SECRETARY OF THE INTERIOR.—
Of the amounts authorized to be appropriated to the Department of the Interior, there are authorized to be appropriated to the Secretary of the Interior not to exceed \$3,000,000 for each of the [fiscal years 2009 through 2014] *fiscal years 2015 through 2019*, to carry out such functions and responsibilities as the Secretary may have under integrated natural resources management plans to which such Secretary is a party under this section, including those for the enhancement of fish and wildlife habitat and the development of public recreation and other facilities.

(d) USE OF OTHER CONSERVATION OR REHABILITATION AUTHORITIES.—
The Secretary of Defense and the Secretary of the Interior may each use any authority available to him under other laws relating to fish, wildlife, or plant conservation or rehabilitation for purposes of carrying out the provisions of this title.

* * * * *

DOC HASTINGS WA
TODD HOLOWAY
BOB YOUNG AK
LUISE SCHMERT TX
BOB BISHOP UT
DARLE LAMSON CO
ROBERT J. WITTMAN VA
PAUL C. BROUN GA
JIMM FLANNERY LA
TOM MACINTOSH CA
GLENN THOMPSON PA
CHRIS-BA LUMM WY
DAN BENNETT MI
JEFF DUNCAN SC
SCOTT R. TIPPON CO
PAUL A. GOSAR AZ
RAUL R. LABRADOR ID
STEVE SOUTHERLAND N. H.
BRIJ FLORES TX
MIFFY HARRIS ND
JON RUVYAN NJ
MARK AMODEI NV
MARKWAYNE SULLIVAN OH
CHRIS STENRAIT UT
STEVE DARRIS MT
KEVIN CRAWLER ND
DODD CANNALTA CA

EXCHANGE OF LETTERS
U.S. House of Representatives
Committee on Natural Resources
Washington, DC 20515

CONRAD E. MARIKEY MA
BARBARA GONZALES ARIZONA
PETER A. DUSZKO OR
TIM F. FALGOUTA AL
FRANK PALLONE JR. NJ
DUNCAN F. FORTNEY CA
RUSH HOLT NJ
RAGH M. GRIFFIN AZ
MADEIRA J. BORDALINO HI
JIM COSTA CA
OSWALDO VILLI CARRASCO SANTIAGO OH
ANN TSONGAS MA
PEDRO B. PITILUIS PR
COLLEEN W. HANABUSA IN
TIMY CARDENAS CA
STEVEN HURSFORD NV
JARED HURTMAN IA
BRIJ FLORES CA
DARLE SUEA PORTER NH
ALAN LOWENTHAL CA
JOE BARCA FL
MATTHEW CARTWRIGHT PA

June 19, 2013

JEFFREY DUNCAN
DEMOCRATIC STAFF DIRECTOR

TODD HOLOWAY
CHIEF OF STAFF

The Honorable Howard "Buck" McKeon
Chairman, Committee on Armed Services
House of Representatives
2120 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman:

On May 15, 2013, the Committee on Natural Resources ordered reported a slate of bills that were ultimately included as part of H.R. 1960, the National Defense Authorization Act for Fiscal Year 2014. These bills were referred primarily to the Committee on Natural Resources, with an additional referral to the Committee on Armed Services.

Specifically, these bills are H.R. 910, Sikes Act Reauthorization Act of 2013; H.R. 1299, White Sands Missile Range Security Enhancement Act; H.R. 1672, Limestone Hills Training Area Withdrawal Act; H.R. 1673, To provide for the transfer of certain public land currently administered by the Bureau of Land Management to the administrative jurisdiction of the Secretary of the Navy for inclusion in Naval Air Weapons Station China Lake, California; H.R. 1676, Johnson Valley National Off-Highway Vehicle Recreation Area Establishment Act; and H.R. 1691, Chocolate Mountain Aerial Gunnery Range Transfer Act of 2013.

I ask that you allow the Armed Services Committee to be discharged from further consideration of the bills in order for bill reports to be filed. These discharges in no way affect your jurisdiction over the subject matter of the bills, and it will not serve as precedent for future referrals. In addition, should a conference on any of the bills be necessary, I would support your request to have the Committee on Armed Services represented on the conference committee. Finally, I would be pleased to include this letter and any response in the bill reports filed by the Committee on Natural Resources to memorialize our understanding.

Thank you for your consideration of my request.

Sincerely,

Doc Hastings
Chairman

<http://naturalresources.house.gov>

HOWARD P. "BUCK" MCKEON, ARIZONA, CHAIRMAN
 NANCY DINGEMAN, TEXAS
 WALTER B. JONES, NORTH CAROLINA
 T. ROBERT FORD, VIRGINIA
 JEFF MILLER, FLORIDA
 JOE WALSH, SOUTH CAROLINA
 FRANK A. LOBRENDO, NEW JERSEY
 BOB RIBICH, UTAH
 SUDAN, R. CURRAN, OHIO
 JOHN F. JOYNER, MISSISSIPPI
 MIKE BOGGS, ALABAMA
 TRENHAWK, ARIZONA
 BILL SHUSTER, PENNSYLVANIA
 F. MICHAEL CONWAY, TEXAS
 DON LAMAR, CALIFORNIA
 ROBERT J. WITTMAN, VIRGINIA
 GILCHRIST, CALIFORNIA
 JOHN C. FLEMING, M.D., OKLAHOMA
 MIKE COFFMAN, COLORADO
 T. SCOTT GALL, VIRGINIA
 CHRISTOPHER GIBSON, NEW YORK
 VECK HARTZLER, MISSOURI
 JOSEPH J. ROY, NEVADA
 JON RUBYAN, NEW JERSEY
 AUSTIN SCOTT, GEORGIA
 STEVEN PALAZZO, MISSISSIPPI
 MARTIN ROBY, ALABAMA
 MATHIAS, ALABAMA
 RICHARD B. BURDET, FLORIDA
 KRISTI HAZEN, SOUTH CAROLINA
 PAUL COOK, CALIFORNIA
 JAMES HENSLEY, OKLAHOMA
 BRAD R. WENSTRUP, OHIO
 JACQUE WALKER, TEXAS

COMMITTEE ON ARMED SERVICES
U.S. House of Representatives
 Washington, DC 20515-6035
 ONE HUNDRED THIRTEENTH CONGRESS

DEAN BAILEY, WASHINGTON, BARRING BONDEN
 LORITA SANCHEZ, CALIFORNIA
 MIKE MATHIJE, NORTH CAROLINA
 ROBERT B. ISHAY, PENNSYLVANIA
 ROBERT E. AHLGREN, NEW JERSEY
 JUDAH A. DEAN, CALIFORNIA
 JAMES B. LANGRISH, RHODE ISLAND
 WILK LARSEN, WASHINGTON
 JIM COOPER, TENNESSEE
 MARLENE E. BOHALLER, IOWA
 JACQUELINE SCHIMMELT
 DAVE LOEBACK, IOWA
 NIKI TOSCANI, MASSACHUSETTS
 JOHN B. GARAMENDI, CALIFORNIA
 HENRY C. "BOB" JOHNSON, JR., GEORGIA
 EUSTIN HANSEN, HAWAII
 JAKE SPEER, CALIFORNIA
 RON HARPER, ARIZONA
 ANDREW CARROLL, INDIANA
 CAROL SHEA-PORTER, NEW HAMPSHIRE
 DANIEL H. MAPPEL, NEW YORK
 DICK KLARER, WASHINGTON
 JUAN CARLOS CASTRO, TEXAS
 TAMMY BUCHANAN, ILLINOIS
 SCOTT H. PETERS, CALIFORNIA
 WILLIAM L. BRYANT, KENTUCKY
 PETER F. GALLEGOS, TEXAS
 MARCA YEASEY, TEXAS

June 19, 2013

ROBERT L. DARMOND, ILIAD, DIRECTOR

Chairman Doc Hastings
 House Committee on Natural Resources
 1324 Longworth House Office Building
 Washington, D.C. 20515

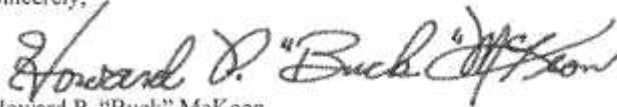
Dear Chairman Hastings:

Thank you for your letter regarding six bills that were referred primarily to the Committee on Natural Resources, with an additional referral to the Committee on Armed Services, and included as part of H.R. 1960, the National Defense Authorization Act for Fiscal Year 2014. This includes H.R. 910, Sikes Act Reauthorization Act of 2013; H.R. 1299, White Sands Missile Range Security Enhancement Act; H.R. 1672, Limestone Hills Training Area Withdrawal Act; H.R. 1673, To provide for the transfer of certain public land currently administered by the Bureau of Land Management to the administrative jurisdiction of the Secretary of the Navy for inclusion in Naval Air Weapons Station China Lake, California; H.R. 1676, Johnson Valley National Off-Highway Vehicle Recreation Area Establishment Act; and H.R. 1691, Chocolate Mountain Aerial Gunnery Range Transfer Act of 2013.

Our committee recognizes the importance of these bills, and the need for the legislation to move expeditiously. Therefore, while we have a valid claim to jurisdiction over these pieces of legislation, I do not intend to request sequential referrals. By waiving consideration of the bills, the Committee on Armed Services does not waive any future jurisdictional claim over the subject matters contained in the bills which fall within its Rule X jurisdiction. Further, should a conference on any of the aforementioned bills be necessary, I request that the Committee on Armed Services be represented during any conference negotiations.

Thank you for your attention to these matters.

Sincerely,



Howard P. "Buck" McKeon
 Chairman

cc: The Honorable John A. Boehner
 The Honorable Adam Smith
 The Honorable Edward J. Markey
 The Honorable Thomas J. Wickham, Jr.