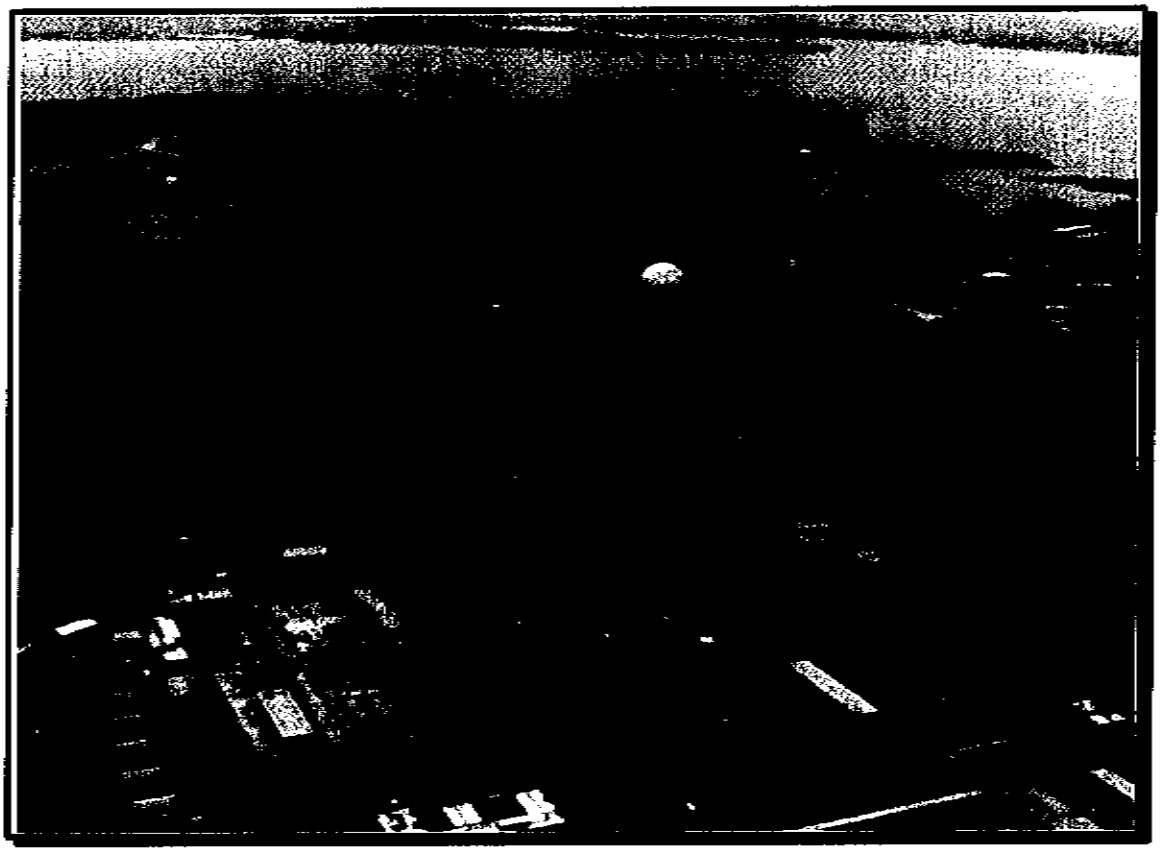
Catalog

APPENDIX A

Soil Survey Report

Aberdeen Proving Ground



Soil Survey Report

October 1998

How to Use This Soil Survey

The **Detailed Soil Maps** can be useful in planning the use and management of small areas. To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet. Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs on Aberdeen Proving Ground. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Various regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various decisions for land use or land treatment. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Soil Survey of Aberdeen Proving Ground, Maryland

Fieldwork by George P. Demas, Robert H. Ranson, Jr., and Mary Ann Levan, Natural Resources Conservation Service

Introduction by United States Army Garrison, Aberdeen Proving Ground

Cover photo provided by Aberdeen Test Center

ABERDEEN PROVING GROUND, the Army's oldest active proving ground, was established on October 20, 1917, six months after the United States entered World War I, to provide the military a facility where design and testing of ordnance materiel could be carried out in close proximity to the Nation's industrial and shipping centers. The post officially opened on December 14, 1917, and the first gun was fired on January 2, 1918.

Aberdeen Proving Ground (APG) occupies more than 72,500 acres in Harford County, Maryland. Its northernmost point is marked by the confluence of the Susquehanna River and Chesapeake Bay. On the south it is bordered by the Gunpowder River.

The installation comprises two principal areas, separated by the Bush River. The northern area is known as the Aberdeen Area, and the southern area, formerly Edgewood Arsenal (established in November 1917 as a facility for the research, development, and testing of chemical weapons), is known as the Edgewood Area. The two areas were administratively combined in 1971. APG property not attached to the main installation includes the Churchill Test Site in Harford County and Carroll Island and Grace's Quarters in Baltimore County.

Aberdeen Proving Ground is home to more than 50 tenants and several satellite activities. Among the major tenants are the U.S. Army Test and Evaluation Command (APG's parent command), U.S. Army Ordnance Center and School, U.S. Army Aberdeen Test Center, U.S. Army Chemical and Biological Defense Command, U.S. Army Environmental Center, U.S. Army Center for Health Promotion and Preventive Medicine, Northeast Region Civilian Personnel Operations Center, U.S. Army Medical Research Institute for the Chemical Defense, Program Manager for Chemical Demilitarization, 203rd Military Intelligence Battalion, and major elements of the Army Research Laboratory.

As a center for Army materiel testing, laboratory research, and military training, the post is a key element in the Nation's defense. All tanks and wheeled vehicles which have served U.S. forces for the past 50 years have been tested for performance and durability at APG.

Army ordnance personnel have been trained at APG since 1918. The Army's ordnance training was consolidated at the proving ground during World War II, and today the U.S. Army Ordnance Center and School (OC&S) provides mechanical maintenance training for more than 20,000 U.S. and foreign personnel each year. OC&S also is regimental headquarters for the Army's Chief of Ordnance.

More than 7,600 civilians work at Aberdeen Proving Ground, and more than 4,500 military personnel are assigned there. In addition, there are nearly 3,000 contractor and private business employees working on the proving ground.

About 2,900 military family members live on the post, and 1,175 live off-post. The post supports more than 8,000 area military retirees and more than 12,500 retiree family members. It is Harford County's largest employer and one of the largest employers in the state of Maryland.

U.S. Army Garrison, Aberdeen Proving Ground, provides general, administrative, and logistical support to the post's tenants and satellite activities and is responsible for the management and operation of the entire installation.

Environmental stewardship is an essential component of all activity at APG. The installation and

its tenants are actively involved in a wide variety of environmental compliance, pollution prevention, conservation, and restoration programs.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas, their location, and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from local and regional farm records and from local and regional field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in accurately locating boundaries.

This survey area was mapped at two levels of detail. At the more detailed level, map units are narrowly defined. Map unit boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Boundaries were plotted and verified at wider intervals. In the legend for the detailed soil maps, narrowly

defined units are indicated by symbols in which the first letter is a capital and the second is lowercase. For broadly defined units, the first and second letters are capitals.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, soil taxonomic differences, variations in the intensity of mapping, variations in the extent of the soils in the survey areas, or the age of adjacent published soil surveys.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 1 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning wet, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fluvaquents (*Fluv*, meaning flood plains, plus *aquent*, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Fluvaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, siliceous, acid, mesic Typic Fluvaquents.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series.

Soil Series and Detailed Soil Map Units

In this section, arranged in alphabetical order, each soil series recognized in the survey area is described. Each description is followed by the detailed soil map units that are associated with the series.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual." Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" and in "Keys to Soil Taxonomy." Unless otherwise indicated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units delineated on the detailed maps represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given under the heading "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. A few included areas may not have been observed, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Beltsville silt loam, 2 to 5 percent slopes, is a phase of the Beltsville series in the survey area.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes, is a complex in the survey area.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Romney and Elkton soils, cratered, is an undifferentiated group in the survey area.

Table 2 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Beltsville Series

The Beltsville series consist of very deep, slowly permeable and very slowly permeable, moderately well drained soils. These soils formed in loamy alluvial and marine sediments. They are on level to gently rolling uplands of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Beltsville soils are similar in drainage to Mattapex and Woodstown soils and are commonly associated with Romney and Fallsington soils. These associated soils do not have a fragipan. The Beltsville soils have more sand and less silt in the solum than the Mattapex series. Romney and Fallsington soils are on the lower or more level landforms and are more poorly drained than the Beltsville soils.

Typical pedon of Beltsville silt loam, 0 to 2 percent slopes; Edgewood Area of Aberdeen Proving Ground, on a low bluff at the edge of "C Field," approximately 150 feet northwest of Wilson Point.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) silt loam; weak medium granular structure; very friable; many roots throughout; very strongly acid; clear smooth boundary.

A2—3 to 7 inches; brown (10YR 5/3) silt loam; weak fine granular structure; very friable; many roots throughout; very strongly acid; clear smooth boundary.

BE—7 to 11 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; very friable; many roots throughout; very strongly acid; clear smooth boundary.

Bt—11 to 19 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; slightly brittle, firm; slightly sticky, slightly plastic; common roots throughout; common fine distinct pale brown (10YR 6/3) and common fine faint yellowish brown (10YR 5/8) masses of iron accumulation; very strongly acid; clear smooth boundary.

Btx1—19 to 29 inches; variegated matrix of approximately 60 percent yellowish brown (10YR 5/6), 30 percent strong brown (7.5YR 4/6), and 10 percent light gray (10YR 7/2) silt loam; moderate medium platy structure parting to strong coarse prismatic; brittle, very firm; slightly sticky, slightly plastic; few roots on vertical faces of peds; common fine distinct light gray (10YR 7/2) iron depletions; very strongly acid; clear smooth boundary.

Btx2—29 to 45 inches; light olive brown (2.5Y 5/4) silt loam; strong very coarse prismatic structure parting to moderate medium platy; very firm; slightly sticky, slightly plastic; common fine distinct reddish yellow (7.5YR 6/8) hard nodules; common fine and very fine roots on faces of peds; thick dark brown (7.5YR 4/4) clay skins on faces of peds; common fine distinct gray (10YR 6/1) iron depletions; very strongly acid; clear smooth boundary.

Cg—45 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; firm; slightly sticky, plastic; many fine prominent strong brown (7.5YR 5/6) and many medium prominent brown (7.5YR 5/4) masses of iron accumulation; very strongly acid.

The thickness of the solum ranges from 40 to 60 inches. A fragipan is at a depth of 12 to 34 inches. In unlimed areas reaction ranges from strongly acid to extremely acid throughout the profile.

The A or Ap horizon has hue of 10YR, value of 2 to 7, and chroma of 1 to 6. Value of 2, 3, or 4 and chroma of 1 or 2 generally occur only in thin, undisturbed surface horizons. The horizon is silt loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 7.5YR to 2.5Y, value of 5 or 6, and chroma of 4 to 8. It is silt loam or silty clay loam.

The Bt horizon has hue of 7.5YR or 2.5Y, value of 5

or 6, and chroma of 4 to 8. It is silt loam or sandy clay loam.

The Btx horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 6. In many pedons it is variegated and has some iron depletions with low chroma. It is silt loam, silty clay loam, or loam and can be clay loam in subhorizons. The structure is strong very coarse prismatic.

The C horizon generally has hue of 10YR or 2.5Y, value of 4 to 7, and chroma of 2 to 4. In some pedons it has variegations of colors. It is stratified with textures ranging from sandy loam to clay loam.

BeA—Beltsville silt loam, 0 to 2 percent slopes

Composition

Beltsville soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

BeB—Beltsville silt loam, 2 to 5 percent slopes

Composition

Beltsville soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

BeC—Beltsville silt loam, 5 to 10 percent slopes

Composition

Beltsville soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

BU—Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes

Composition

Beltsville soil and similar soils: 35 percent
Udorthents and similar soils: 35 percent
Urban land: 20 percent
Inclusions (unnamed soils): 10 percent

Setting

Landform: Upland flats
Slope: 0 to 5 percent

Component Description

Beltsville

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

Udorthents

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

A typical soil description of the Beltsville soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Chicone Series

The Chicone series consists of very deep, moderately permeable, very poorly drained soils. These soils formed in loamy fluvial sediments overlying highly decomposed organic material. They are on wide flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Chicone soils occur on flood plains with Puckum, Lenape, and Indiantown soils. Indiantown soils have a sandy substratum and a thick organic-rich surface layer. They are at the slightly higher elevations. Puckum and Lenape soils are organic. They are in the slightly lower landscape positions.

Typical pedon of Chicone silt loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

A—0 to 3 inches; very dark brown (10YR 2/2) silt loam; weak fine granular structure; friable; slightly sticky; many very fine and fine and common medium roots; common very fine and fine pores; strongly acid; clear wavy boundary.

Cg1—3 to 15 inches; dark brown (7.5YR 3/2) silt loam; massive; friable; slightly sticky; common very fine and fine roots; few very fine and fine pores; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation; strongly acid; gradual wavy boundary.

Cg2—15 to 24 inches; black (N 2/0) silt loam; massive; firm; slightly sticky, slightly plastic; common very fine roots; few very fine pores; strongly acid; clear wavy boundary.

Oa—24 to 65 inches; black (10YR 2/1) sapric material; fiber content is one-tenth of the soil volume after rubbing; 20 percent, by weight, mineral soil material; strongly acid.

The thickness of the mineral surface layer ranges from 16 to 40 inches. The thickness of the organic deposits ranges from 16 to 45 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR or 7.5YR, value of 2 to 4, and chroma of 1 to 3. Where value is less than 3.5, the horizon is less than 10 inches thick. The horizon is mucky silt loam, mucky loam, or silt loam.

The Cg horizon has hue of 10YR or 7.5YR, value of 2 to 5, and chroma of 0 to 4. It is silt loam or mucky silt loam. In some pedons it has thin layers of sandy loam or loam.

The Oa horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 0 or 1. It is sapric or hemic material that is 16 inches to more than 40 inches thick. The fiber content after rubbing ranges from one-tenth to one-half of the soil volume. The content of mineral material, by weight, ranges from 20 to 40 percent. In some pedons the organic material is underlain by stratified sandy or loamy sediments.

Ch—Chicone silt loam

Composition

Chicone soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Mucky silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Silty alluvial sediments over organic deposits
Flooding: Occasional
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Codorus Series

The Codorus series consists of very deep, moderately permeable, moderately well drained and somewhat poorly drained soils. These soils formed in recently deposited alluvial sediments weathered from mostly metamorphic and crystalline rocks. They are on flood plains and very low-lying uplands, which are subject to overwash by wind tides, of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 3 percent.

The Codorus soils are commonly adjacent to Mattapex, Woodstown, Romney, Puckum, and Lenape soils. Mattapex, Woodstown, and Romney soils are on uplands. They have a clay content in the subsoil that increases as depth increases. Mattapex and Romney soils have less sand and more silt in the subsoil than the Codorus soils. Puckum and Lenape soils are in adjacent tidal areas. They are organic soils and have thick, dark organic deposits.

Typical pedon of Codorus loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

Ap—0 to 9 inches; dark brown (10YR 4/3) loam; weak fine granular structure; friable; nonsticky, nonplastic; 5 percent rock fragments; strongly acid; abrupt smooth boundary.

Bw1—9 to 18 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; slightly sticky, nonplastic; 5 percent rock fragments; strongly acid; clear wavy boundary.

Bw2—18 to 30 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; many mica flakes; common fine faint light brownish gray (10YR 6/2) iron depletions and common fine distinct strong brown (7.5YR 5/6) masses of iron accumulation; strongly acid; gradual smooth boundary.

C1—30 to 54 inches; light yellowish brown (10YR 6/4) loam; massive; friable; slightly sticky, slightly plastic; many mica flakes; common medium faint light brownish gray (10YR 6/2) iron depletions and common medium distinct brown (7.5YR 5/4) masses of iron accumulation; strongly acid; clear smooth boundary.

C2—54 to 65 inches; light yellowish brown (10YR 6/4) loam that is stratified with sand and gravel; massive; friable; nonsticky, nonplastic; 40 percent rock fragments in individual strata; common faint brownish gray (10YR 6/2) iron depletions; strongly acid.

The thickness of the solum ranges from 30 to 60 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR, value of 3 to 6, and chroma of 2 or 3. It is loam or silt loam in the fine-earth fraction.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam, silt loam, or silty clay loam in the fine-earth fraction. Iron depletions with chroma of 2 or less are within a depth of 24 inches.

The C horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is loam, silt loam, or silty clay loam in the fine-earth fraction. In some pedons it

has layers of stratified sand and gravel below a depth of 40 inches.

Cd—Codorus loam

Composition

Codorus soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy alluvial sediments
Flooding: Occasional
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Corsica Series

The Corsica series consists of very deep, very poorly drained, moderately permeable soils. These soils formed in loamy alluvial sediments overlying stratified fluvial sediments. They are in upland swales and depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 3 percent.

The Corsica soils are similar to Pone and Kentuck soils and are commonly adjacent to Fallsington, Romney, Mattapex, and Woodstown soils. Kentuck soils have less sand and more silt in the subsoil than the Corsica soils. Pone soils have less clay in the subsoil than the Corsica soils. Fallsington soils do not have a thick organic-rich surface layer. They are in the higher landscape positions. Romney soils are somewhat poorly drained. They have less sand and more silt in the subsoil than the Corsica soils. Woodstown and Mattapex soils are better drained than the Corsica soils and occur on adjacent uplands.

Typical pedon of Corsica loam; on a 1 percent slope in a wooded area. (Colors are for moist soil.)

Oi—0 to 2 inches; undecomposed and partially decomposed leaves and twigs from loblolly pine, sweetgum, and oak.

A—2 to 12 inches; black (10YR 2/1) loam; weak fine granular structure; very friable; slightly sticky, slightly plastic; common fine and medium and few coarse roots throughout; few very fine tubular pores; very strongly acid; clear smooth boundary.

BEg—12 to 18 inches; light brownish gray (2.5Y 6/2) loam; weak fine subangular blocky structure; very friable; slightly sticky, slightly plastic; few fine and medium and very few coarse roots; few very fine tubular pores; few medium distinct light olive brown (2.5Y 5/4) masses of iron accumulation; very strongly acid; clear smooth boundary.

Btg1—18 to 31 inches; light gray (2.5Y 7/2) sandy clay loam; moderate medium subangular blocky structure; friable; slightly sticky, plastic; common fine and very fine roots; few fine and medium tubular pores; common prominent dark gray (10YR 4/1) clay films on faces of peds; common medium distinct light yellowish brown (2.5Y 6/4) and few medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear smooth boundary.

Btg2—31 to 40 inches; light gray (2.5Y 7/2) sandy loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; common fine and very fine roots; few fine and medium tubular pores; common prominent dark gray (10YR 4/1) clay films on faces of peds; common medium distinct light yellowish brown (2.5Y 6/4) and few medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear smooth boundary. (combined thickness of the Btg horizons is 10 to 34 inches)

BCg—40 to 48 inches; gray (10YR 6/1) sandy loam; weak coarse subangular blocky structure; friable; slightly sticky, nonplastic; few fine and very fine roots; common very fine and fine tubular pores; few medium distinct light yellowish brown (10YR 6/4) masses of iron accumulation; very strongly acid; clear wavy boundary.

Cg1—48 to 64 inches; stratified light gray (10YR 7/1) clay loam and strong brown (7.5YR 5/6) loamy sand; massive; friable; slightly sticky, slightly plastic; few fine and very fine roots; common very fine tubular pores; very strongly acid; clear wavy boundary.

Cg2—64 to 72 inches; gray (5Y 6/1) clay loam; massive; friable; slightly sticky, plastic; few fine and very fine tubular pores; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation; strongly acid.

The thickness of the solum ranges from 30 to 55 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR to 5Y or is neutral in hue, has value of 2 or 3, and has chroma of 0 to 2. It is mucky loam or mucky silt loam. It may have redoximorphic features.

The Eg or BEg horizon, if it occurs, has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is loam, silt loam, fine sandy loam, or sandy loam. Masses of iron accumulation have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 or 6.

The Btg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 or 2. It is typically clay loam, sandy clay loam, or loam but can be sandy loam, silt loam, or silty clay loam in part of the argillic horizon. Masses of iron accumulation have hue of 7.5YR to 2.5Y, value of 4 to 7, and chroma of 4 to 8. Iron depletions, if they occur, have hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 or 2.

The BCg horizon, if it occurs, has hue of 7.5YR to 2.5Y, value of 6 or 7, and chroma of 1 or 2. It is typically sandy loam or sandy clay loam but can be loam, clay loam, loamy sand, or the gravelly analogues of these textures. The content of rock fragments ranges from 0 to 30 percent. The horizon has redoximorphic features.

The Cg or C horizon has hue of 10YR to 5Y or is neutral in hue, has value of 5 to 8, and has chroma of 0 to 3. It is commonly stratified and has textures ranging from sand to clay loam and including their gravelly analogues. The content of rock fragments ranges from 0 to 30 percent. The horizon has redoximorphic features.

An Ab horizon occurs in some pedons below a depth of 60 inches.

Co—Corsica loam

Composition

Corsica soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Depressions and swales
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Elkton Series

The Elkton series consist of very deep, slowly permeable, poorly drained soils. These soils formed in silty aeolian sediments and the underlying loamy alluvial and marine sediments. They are on upland and lowland flats and in depressions of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

The Elkton soils are similar to Othello and Fallsington soils and are commonly adjacent to Romney soils. They have more clay in the subsoil than Othello soils and have less sand and more silt in the subsoil than the Fallsington soils. Romney soils are on the somewhat higher landforms. They do not have the gray surface layer that is typical of the Elkton soils. They also have more sand and less silt in the subsurface layers than the Elkton soils.

Typical pedon of Elkton silt loam; Aberdeen Area of Aberdeen Proving Ground, 0.6 mile southeast of the intersection of Phillips Field Road and Phillips Field Loop, 1,000 feet east of Phillips Field Loop in hardwood stand of red maple and sweetgum.

Oi—2 inches to 0; partially decomposed woody organic matter.
A—0 to 4 inches; very dark gray (5Y 3/1) silt loam; weak fine granular structure; very friable; slightly sticky, slightly plastic; very strongly acid; abrupt smooth boundary.
BEg—4 to 14 inches; gray (5Y 6/1) silt loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; common medium

distinct strong brown (7.5YR 4/6) masses of iron accumulation; very strongly acid; clear wavy boundary.
Btg1—14 to 25 inches; gray (5Y 6/1) silty clay loam; strong medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 4/6) masses of iron accumulation; very strongly acid; clear wavy boundary.
Btg2—25 to 40 inches; dark gray (N 4/0) and gray (N 5/0) silt loam; common medium prominent strong brown (7.5YR 4/6) masses of iron accumulation; very strongly acid; clear smooth boundary.
2BCg—40 to 60 inches; gray (5Y 6/1) fine sandy loam; massive; friable; slightly sticky, slightly plastic; very strongly acid.

The thickness of the solum ranges from 40 to more than 60 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 0 to 3. It is silt loam, mucky silt loam, or loam.

The Eg horizon typically occurs only where the soil has not been disturbed. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silt loam or loam.

The Btg horizon has hue of 10YR to 5GY, value of 4 to 7, and chroma of 0 to 2. It is silt loam or silty clay loam.

The 2BCg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 0 or 2. It is fine sandy loam or sandy clay loam.

The 2Cg horizon, if it occurs, is at depths of more than 40 inches. It has colors similar to those of the BCg horizon. It is fine sand or loamy fine sand.

Ek—Elkton silt loam

Composition

Elkton soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Fallsington Series

The Fallsington series consists of very deep, moderately permeable, poorly drained soils. These soils formed in loamy alluvial and marine sediments. They are on upland and lowland flats and in shallow depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 2 percent.

The Fallsington soils are similar to Othello and Elkton soils and are commonly adjacent to Corsica, Pone, Romney, and Woodstown soils. The Fallsington soils have more sand and less silt in the subsoil than Othello and Elkton soils. Corsica and Pone soils have a thick organic-rich surface layer. They occur in the lower landscape positions. Pone soils have less clay in the subsoil than the Fallsington soils. Romney soils are somewhat poorly drained. They have less sand and more silt in the subsoil than the Fallsington soils. Woodstown soils are better drained than the Fallsington soils and occur on adjacent uplands.

Typical pedon of Fallsington sandy loam; in a cultivated area. (Colors are for moist soil.)

Ap—0 to 10 inches; dark gray (10YR 4/1) sandy loam; moderate coarse granular structure; friable; nonsticky, nonplastic; many fine roots; 2 percent gravel; moderately acid; abrupt smooth boundary.
Btg1—10 to 20 inches; gray (10YR 6/1) sandy clay loam; weak very coarse prismatic structure parting to moderate subangular blocky; friable; slightly sticky, slightly plastic; common fine roots; common thin clay films on faces of peds and in pores; common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation; extremely acid; clear smooth boundary.
Btg2—20 to 32 inches; gray (10YR 6/1) sandy clay loam; weak very coarse prismatic structure parting

to moderate medium subangular blocky; friable; sticky, slightly plastic; common fine roots on faces of peds; common thick clay films on faces of peds; common coarse prominent yellowish brown (10YR 5/6) masses of iron accumulation; extremely acid; clear wavy boundary.

BCg—32 to 40 inches; light gray (10YR 7/1) loamy sand; weak very coarse subangular blocky structure; loose; nonsticky, nonplastic; very few thin clay films on faces of peds; common medium distinct yellowish brown (10YR 5/6) masses of iron accumulation and gray (10YR 5/1) iron depletions; very strongly acid; clear wavy boundary.

2Cg—40 to 46 inches; light gray (10YR 7/1) sandy clay loam; weak moderate subangular blocky structure; firm; slightly sticky, slightly plastic; few fine distinct yellowish brown (10YR 5/6) masses of iron accumulation; very strongly acid; clear wavy boundary.

3Cg—46 to 62 inches; light gray (10YR 7/2) sand; single grain; loose; nonsticky, nonplastic; very strongly acid.

The thickness of the solum ranges from 24 to 40 inches. The content of coarse fragments, mostly round to subrounded gravel, ranges from 0 to 10 percent in individual horizons. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR to 5Y, value of 2 to 6, and chroma of 1 to 3. Values of 2 and 3 occur only in thin, upper A horizons. The horizon is loam, sandy loam, or fine sandy loam.

The B horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 0 to 4. Values of 3 and 4 occur only below a depth of 30 inches. The horizon is sandy clay loam, loam, or sandy loam and has an average of 18 to 27 percent clay.

The C horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 0 to 4. It is loamy sand, sand, or sandy loam. It can be stratified.

Fa—Fallsington sandy loam

Composition

Fallsington soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Hambrook Series

The Hambrook series consists of very deep, moderately permeable, well drained soils. These soils formed in loamy alluvial and marine sediments. They are on level to gently rolling uplands of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 60 percent.

The Hambrook soils are similar to Nassawango soils and are commonly adjacent to Mattapex, Woodstown, and Beltsville soils. Nassawango soils have less sand and more silt in the subsoil than the Hambrook soils. The Hambrook soils are better drained than Woodstown, Mattapex, and Beltsville soils. Beltsville soils have a fragipan.

Typical pedon of Hambrook sandy loam, 0 to 2 percent slopes; Spesutie Island Area of Aberdeen Proving Ground, in an open field.

Ap—0 to 7 inches; dark brown (10YR 4/3) sandy loam; moderate medium granular structure; friable; nonsticky, nonplastic; neutral; abrupt smooth boundary.

A—7 to 14 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; friable; nonsticky, nonplastic; neutral; clear wavy boundary.

Bt1—14 to 21 inches; yellowish brown (10YR 5/8) sandy clay loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; strongly acid; gradual wavy boundary.

Bt2—21 to 28 inches; strong brown (7.5YR 5/6) sandy loam; weak medium granular structure; friable; slightly sticky, slightly plastic; strongly acid; gradual wavy boundary.

C1—28 to 43 inches; strong brown (7.5YR 5/6) loamy

sand; massive; very friable; extremely acid; clear smooth boundary.
C2—43 to 60 inches; yellowish brown (10YR 5/6) sand; massive; common medium distinct pale brown (10YR 6/3) iron depletions and few medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; extremely acid.

The thickness of the solum ranges from 21 to 48 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A or Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is sandy loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is sandy loam or loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 5 to 8. It is sandy loam, sandy clay loam, or loam.

The BC horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 6 to 8. It is loamy sand or sandy loam.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 6. It is loamy sand or sandy loam. Iron depletions and masses of iron accumulation commonly occur in most pedons in the lower part of the horizon.

HbA—Hambrook sandy loam, 0 to 2 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HbB—Hambrook sandy loam, 2 to 5 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HbC—Hambrook sandy loam, 5 to 10 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HbE—Hambrook sandy loam, 10 to 60 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Escarpments
Slope: 10 to 60 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HU—Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes

Composition

Hambrook soil and similar soils: 50 percent
Udorthents and similar soils: 25 percent
Urban land: 15 percent
Inclusions (unnamed soils): 10 percent

Setting

Landform: Upland flats
Slope: Hambrook and Udorthents—0 to 10 percent; Urban land—0 to 5 percent

Component Description

Hambrook

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Udorthents

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

A typical soil description of the Hambrook soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Indiantown Series

The Indiantown series consist of very deep, moderately permeable, very poorly drained soils. These soils formed in loamy fluvial sediments overlying sandy alluvial and marine sediments. They are on narrow low-gradient flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Indiantown soils are similar to Longmarsh soils and are on flood plains associated with Longmarsh, Zekiah, Lenape, and Puckum soils. The organic surface material of the Indiantown soils is thicker than that of the Longmarsh soils. The Indiantown soils have a thicker organic-rich surface layer than the associated soils. Zekiah soils can be intermingled with Indiantown soils or can occur at the higher reaches of the flood plain. Longmarsh soils are generally at the lower reaches of the flood plain. Lenape and Puckum soils are organic soils and occur in tidal areas at the lower reaches of the flood plain.

Typical pedon of Indiantown mucky silt loam; on a smooth 1 percent slope on a wooded flood plain.

A1—0 to 13 inches; very dark brown (10YR 2/2) mucky silt loam; weak fine granular structure; friable; slightly sticky, slightly plastic; many very fine and fine roots; very strongly acid; abrupt wavy boundary.

A2—13 to 25 inches; black (10YR 2/1) mucky loam; massive; friable; slightly sticky, slightly plastic; common very fine and fine roots; very strongly acid; abrupt wavy boundary.

Cg1—25 to 41 inches; grayish brown (10YR 5/2) loamy sand; common coarse black (10YR 2/1) organic stains; massive; few very fine roots; extremely acid; abrupt wavy boundary.

Cg2—41 to 51 inches; dark grayish brown (2.5Y 4/2) loamy sand; common medium very dark gray (10YR 3/1) organic stains; massive; very strongly acid; clear wavy boundary.

Cg3—51 to 72 inches; dark grayish brown (2.5Y 4/2) sand; single grain; loose; few medium very dark gray (10YR 3/1) organic stains; few medium prominent dark yellowish brown (10YR 4/4) masses of iron accumulation; extremely acid.

The content of organic matter ranges from 5 to 18 percent in the A horizon. It is variable in the substratum, ranging from 1 to 10 percent. Reaction ranges from extremely acid to strongly acid throughout the profile. Salinities are less than 2 millimhos.

The A horizon has hue of 7.5YR to 2.5Y or is neutral in hue, has value of 2 or 3, and has chroma of 0 to 2. It is mucky silt loam, mucky loam, silt loam, or loam.

The Cg horizon has hue of 10YR to 5B, value of 3 to 7, and chroma of 1 to 3. It is loam, sandy loam, loamy sand, or sand.

A 2Cg horizon that has properties similar to those of the Cg horizon can be identified in places where the deposited material has originated from areas where a silt mantle dominates the surrounding uplands. A discontinuity may occur in these soils.

In—Indiantown mucky silt loam

Composition

Indiantown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 1 percent

Component Description

Surface layer texture: Mucky silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Kentuck Series

The Kentuck series consists of very deep, slowly permeable, very poorly drained soils. These soils formed in woody organic deposits overlying unconsolidated eolian, alluvial, or marine sediments. They are on low-lying uplands, in depressions, and on flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Kentuck soils are similar to Corsica soils and are commonly adjacent to Othello, Elkton, and Romney soils. Corsica soils have more sand and less silt in the subsoil than the Kentuck soils. Othello and

Elkton soils do not have a dark organic-rich surface layer. They are in the slightly higher landscape positions. Romney soils are better drained than the Kentuck soils and occur on low-lying uplands.

Typical pedon of Kentuck silt loam; on a smooth 1 percent slope in an area of woodland. (Colors are for moist soil.)

Oi/Oe—0 to 3 inches; undecomposed and moderately decomposed leaves and twigs; clear smooth boundary.

A—3 to 13 inches; black (10YR 2/1) silt loam; strong fine granular structure; very friable; slightly sticky, slightly plastic; many very fine and fine and common medium and coarse roots; many very fine and fine and common medium irregular pores; 10 percent organic matter; extremely acid; clear wavy boundary.

Eg—13 to 24 inches; light brownish gray (2.5Y 6/2) silt loam; weak medium subangular blocky structure; very friable; slightly sticky, plastic; common very fine and fine and few medium roots; many very fine, common fine, and few medium tubular pores; common medium prominent brownish yellow (10YR 6/6) masses of iron accumulation and common medium distinct white (10YR 8/1) iron depletions; very strongly acid; clear wavy boundary.

Btg1—24 to 37 inches; light brownish gray (10YR 6/2) silt loam; moderate medium subangular blocky structure; friable; sticky, plastic; common very fine and fine and few medium roots; many very fine, common fine, and few medium tubular pores; common faint clay films on faces of peds; common fine prominent strong brown (7.5YR 5/8) masses of iron accumulation and common medium distinct white (10YR 8/1) iron depletions; very strongly acid; gradual wavy boundary.

Btg2—37 to 45 inches; grayish brown (2.5Y 5/2) silty clay loam; moderate medium subangular blocky structure; firm; sticky, plastic; few very fine and fine roots; common very fine and fine tubular pores; common distinct clay films on faces of peds; common fine prominent reddish yellow (7.5YR 6/8) masses of iron accumulation and few medium distinct white (10YR 8/1) iron depletions; very strongly acid; gradual wavy boundary.

2BCg—45 to 56 inches; grayish brown (10YR 5/2) fine sandy loam; massive; very friable; slightly sticky; few very fine and fine roots; many very fine tubular pores; very few fine distinct white (10YR 8/1) iron depletions; strongly acid; gradual wavy boundary.

2Cg—56 to 70 inches; light gray (10YR 7/1) fine sand; single grain; loose; few very fine roots; very strongly acid.

The thickness of the solum ranges from 30 to 56 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is mucky silt loam.

The Eg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silt loam.

The Btg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 or 2. It is silt loam or silty clay loam.

Some pedons have a 2Btg horizon. This horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2. It is very fine sandy loam, loam, or clay loam.

The 2BCg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam or fine sandy loam.

The 2Cg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 to 4. It is sand, fine sand, or loamy sand that has pockets of finer material.

Kn—Kentuck silt loam

Composition

Kentuck soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Lowland flats and shallow depressions
Slope: 0 to 1 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Klej Series

The Klej series consists of very deep, moderately well drained and somewhat poorly drained soils. These soils are rapidly permeable and very rapidly permeable in the solum and moderately permeable to very slowly permeable in the substratum. They formed in sandy unconsolidated sediments. They occur on flood plains and very low-lying uplands, which are subject to overwash by wind tides, of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

The Klej soils are commonly adjacent to Romney, Woodstown, Puckum, and Lenape soils. Romney and Woodstown are on uplands. They have a clay content in the subsoil that increases as depth increases. They have less sand and more silt in the subsoil than the Klej soils. Puckum and Lenape are in adjacent tidal areas. They have very dark, thick organic deposits.

Typical pedon of Klej loamy sand; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

A1—0 to 2 inches; grayish brown (2.5Y 5/2) loamy sand; very weak medium granular structure; very friable; common roots; very strongly acid; clear wavy boundary.

A2—2 to 9 inches; light brownish gray (2.5Y 6/2) loamy sand; very weak medium granular structure; very friable; common roots; very strongly acid; clear wavy boundary.

Bw1—9 to 19 inches; olive yellow (2.5Y 6/6) loamy sand; single grain; loose; many roots; sand grains coated with silt; extremely acid; gradual irregular boundary.

Bw2—19 to 39 inches; olive yellow (2.5Y 6/6) loamy sand; single grain; loose; few roots; some coated sand grains; common medium distinct light brownish gray (2.5Y 6/2) iron depletions; extremely acid; gradual irregular boundary.

Cg1—39 to 47 inches; light brownish gray (2.5Y 6/2) grading to gray (5Y 6/1) sand; single grain; loose; very few roots; common medium prominent brownish yellow (10YR 6/6) masses of iron accumulation; extremely acid; abrupt smooth boundary.

2Cg2—47 to 65 inches; light gray (2.5Y 7/2) sandy loam; massive; friable; sticky, slightly plastic; common coarse prominent light yellowish brown (10YR 6/4) masses of iron accumulation; extremely acid.

The thickness of the solum ranges from 30 to 60 inches. Reaction ranges from extremely acid to strongly acid in unlimed areas.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 4. It is loamy sand, fine sand, or loamy fine sand.

The Bw horizon has hue of 7.5YR to 5Y, value of 5 or 6, and chroma of 4 to 6. The lower part of the horizon has iron depletions. The fine-earth texture is loamy sand or loamy fine sand in the upper part of the horizon and ranges from loamy fine sand to sand in the lower part.

The Cg1 horizon is neutral in hue or has hue of 10YR to 5Y, has value of 5 to 7, and has chroma of 0 to 6. It is loamy sand, sand, or fine sand in the fine-earth fraction.

The 2Cg2 horizon is neutral in hue or has hue of 10YR to 5Y, has value of 5 to 7, and has chroma of 0 to 4. It ranges from sandy loam to clay.

Kj—Klej loamy sand

Composition

Klej soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Dominant parent material: Sandy eolian deposits over fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Low

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Lenape Series

The Lenape series consists of deep, moderately permeable, very poorly drained soils. These soils formed in organic deposits overlying loamy estuarine

or marine deposits having a high *n* value. They formed in closed depressions, on flood plains, and in freshwater, tidally flooded swamps of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Lenape soils are similar to Manahawkin soils and occur adjacent to Manahawkin, Puckum, Indiantown, and Chicone soils. Manahawkin soils are underlain by sand. Puckum soils have an organic layer that is thicker than that of the Lenape soils. Indiantown soils have an organic layer that is thinner than that of the Lenape soils. They typically occur in the higher areas on the flood plain. Chicone soils are mineral soils and do not have a thick organic surface layer. They are in landscape positions similar to those of the Lenape soils.

Typical pedon of Lenape mucky peat; on a smooth 1 percent slope in an estuarine tidal marsh. (Colors are for moist, rubbed soil.)

Oe1—0 to 4 inches; dark brown (7.5YR 3/2) mucky peat (hemic soil material); 60 percent fiber unrubbed, 30 percent fiber rubbed; 10 percent blackened leaves and twigs; few fine and medium roots; 45 percent organic material; very strongly acid; clear wavy boundary.

Oe2—4 to 8 inches; very dark grayish brown (10YR 3/2) mucky peat (hemic soil material); 45 percent fiber unrubbed, 18 percent fiber rubbed; few fine and medium roots; 50 percent organic material; extremely acid; clear smooth boundary.

Oa—8 to 26 inches; very dark brown (10YR 2/2) muck (sapric soil material); 20 percent fiber unrubbed, 5 percent fiber rubbed; few fine roots; 70 percent organic material; extremely acid; gradual wavy boundary.

Cg1—26 to 34 inches; very dark gray (10YR 3/1) loam; massive; friable; slightly sticky, slightly plastic; *n* value greater than 1.0, material flows easily between fingers when squeezed; 5 percent organic soil material; very strongly acid; clear smooth boundary.

Cg2—34 to 60 inches; dark greenish gray (5GY 4/1) silty clay loam; massive; firm; slightly sticky, plastic; *n* value greater than 1.0, material flows easily between fingers when squeezed; strongly acid.

2Cg3—60 to 72 inches; gray (10YR 6/1) and light gray (10YR 7/1) sand; single grain; loose; very strongly acid.

The thickness of the organic deposits ranges from 16 to 51 inches. Conductivity of the saturation extract is less than 4 millimhos per centimeter throughout the profile. Reaction ranges from extremely acid to strongly acid. In the mineral soil horizons, the *n* value is typically greater than 0.7 but ranges to less than 0.7.

The surface tier is neutral in hue or has hue of 7.5YR or 10YR, has value of 2 to 4, and has chroma of 1 to 3. It is hemic and fibric soil material. The fiber content after rubbing is more than one-third of the soil volume. The mineral content, by weight, ranges from 20 to 60 percent.

The subsurface tier is neutral in hue or has hue of 5YR to 10YR, has value of 2 to 4, and has chroma of 1 to 4. It is typically sapric soil material but ranges from hemic to sapric. The fiber content after rubbing ranges from one-tenth to one-third of the soil volume. The mineral content, by weight, ranges from 25 to 75 percent.

The Cg horizon is neutral in hue or has hue of 10YR to 5GY, has value of 2 to 4, and has chroma of 0 to 2. It is loam, silt loam, or silty clay loam. In some pedons thin sandy mineral layers are stratified within the horizon.

The 2Cg horizon has hue of 2.5Y to 5GY, value of 3 to 7, and chroma of 0 to 2. It is loamy sand, sand, or loamy fine sand. In some pedons, the upper boundary of the 2C horizon is below a depth of 72 inches.

Le—Lenape mucky peat

Composition

Lenape soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Swamps, flood plains, and depressions
Slope: 0 to 1 percent

Component Description

Surface layer texture: Mucky peat
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic deposits over loamy fluviomarine sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Longmarsh Series

The Longmarsh series consists of very deep, moderately permeable, very poorly drained soils. These soils formed in loamy fluvial sediments overlying sandy alluvial and marine sediments. They are on narrow low-gradient flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Longmarsh soils are similar to Pone and Indiantown soils and are associated with Indiantown, Zekiah, and Fallsington soils. Pone soils have a subsurface horizon of clay accumulation. They occur on the higher landforms. The Longmarsh soils have a thicker organic-rich surface layer than the associated soils. Zekiah soils can be intermingled with the Longmarsh soils or can occur at the higher reaches of the flood plain. The Longmarsh soils are generally on reaches of the flood plain lower than those of Indiantown soils. Fallsington soils occur on adjacent uplands.

Typical pedon of Longmarsh sandy loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

Oi—0 to 0.5 inch; undecomposed leaves and twigs.

Oe—0.5 to 1 inch; partially decomposed organic materials.

A1—1 to 7 inches; black (10YR 2/1) sandy loam; weak medium subangular blocky structure parting to weak medium granular; very friable; nonsticky, slightly plastic; many very fine to coarse roots throughout; few fine discontinuous tubular pores; very strongly acid; gradual smooth boundary.

A2—7 to 19 inches; very dark gray (7.5YR 3/1) sandy loam; weak coarse subangular blocky structure; very friable; nonsticky, slightly plastic; many very fine to coarse roots throughout; few fine discontinuous tubular pores; moderately acid; clear smooth boundary.

Cg1—19 to 34 inches; grayish brown (2.5Y 5/2) fine sandy loam; massive; firm; nonsticky, slightly plastic; common very fine and fine roots throughout; common coarse distinct dark grayish brown (10YR 4/2) iron depletions; moderately acid; gradual smooth boundary.

Cg2—34 to 54 inches; light gray (2.5Y 7/2) loamy sand; massive; loose; nonsticky, nonplastic; 2 percent fine mixed gravel; moderately acid; gradual smooth boundary.

Cg3—54 to 66 inches; 60 percent light brownish gray (2.5Y 6/2) and 40 percent grayish brown (2.5Y 5/2) loamy sand; massive; loose; nonsticky, nonplastic; moderately acid.

The content of organic matter ranges from 5 to 18 percent in the A horizon. In the substratum it is variable and ranges from 1 to 10 percent. The content of coarse fragments of mixed rounded gravel ranges from 0 to 20 percent in the A horizon and from 0 to 40 percent in the substratum.

The A horizon has hue of 7.5YR to 5Y or is neutral in hue, has value of 2 to 4, and has chroma of 0 to 2. It is typically mucky sandy loam, mucky loam, sandy loam, or loam but has textures ranging to sand, loamy sand, silt loam, and fine sandy loam.

The Cg horizon has hue of 10YR to 5Y, value of 3 to 8, and chroma of 1 or 2. It is commonly loamy sand or coarse sand but may include sand, loamy coarse sand, sandy loam, fine sandy loam, and their gravelly analogues. Redoximorphic features have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6.

The C horizon, if it occurs, has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 3 to 6. It occurs in a reduced environment despite the high chromas. It is clay loam, loamy sand, or sand. It may have redoximorphic features.

Lo—Longmarsh sandy loam

Composition

Longmarsh soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep
Drainage class: Very poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Low

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Manahawkin Series

The Manahawkin series consists of deep, very poorly drained soils. These soils are moderately slowly permeable to moderately rapidly permeable in the organic horizons and moderately rapidly permeable in the mineral material. They formed in organic deposits over sandy mineral material. They occur in freshwater swamps and back swamps near tidal channels of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Manahawkin soils are similar to Lenape soils and occur adjacent to Lenape, Puckum, and Chicone soils. Lenape soils are underlain by loamy sediments. Chicone soils are in landscape positions similar to those of the Manahawkin soils. They are mineral soils and do not have a thick surface layer of organic material. Puckum soils have an organic layer that is thicker than that of the Manahawkin soils.

Typical pedon of Manahawkin muck; on a nearly level lowland flat in a forested area. (Description is for soil that was wet throughout.)

Oa1—0 to 8 inches; black (5YR 2/1) broken face and rubbed muck; 10 percent fiber unrubbed, less than 2 percent fiber rubbed; moderate medium granular structure; mat of many fine roots; identifiable material is primarily herbaceous with a trace of woody fragments; 85 percent organic matter; extremely acid; clear wavy boundary.

Oa2—8 to 20 inches; black (5YR 2/1) broken face and rubbed muck; 5 percent fiber unrubbed, less than 2 percent fiber rubbed; many fine roots; 95 percent organic matter; 2 percent soft woody fragments which break down when rubbed; very strongly acid; gradual wavy boundary.

Oa3—20 to 30 inches; black (5YR 2/1) broken face and rubbed muck (broken face color was slightly redder and lighter than rubbed color but did not differ a whole unit); 15 percent fiber unrubbed, less than 2 percent fiber rubbed; weak medium granular structure; common fine and medium roots; 95 percent organic matter; 10 percent soft woody fragments as much as 1 inch in diameter which break down when rubbed; very strongly acid; gradual wavy boundary.

Oa4—30 to 39 inches; black (5YR 2/1) broken face and rubbed muck (broken face color is slightly redder and lighter than rubbed color but did not differ a whole unit); 10 percent fiber unrubbed, less than 2 percent fiber rubbed; massive; few roots; 90 percent organic matter; 30 percent woody fragments as much as 2 inches in diameter which break down when rubbed; very strongly acid; abrupt smooth boundary.

2C1—39 to 46 inches; gray (10YR 5/1) sand; single grain; loose; strongly acid; abrupt smooth boundary.

2C2—46 to 60 inches; gray (10YR 6/1) gravelly sand; single grain; loose; 20 percent fine quartzose pebbles; very strongly acid.

The thickness of the organic deposits ranges from 16 to 51 inches. The mineral content of the organic layers ranges from 5 to 80 percent. The organic layers consist of sapric material, but some pedons have subhorizons of hemic material as much as 10 inches thick. The 2C horizon contains as much as 50 percent pebbles. In some pedons the organic horizons have as much as 50 percent woody fragments consisting of twigs, branches, or logs ranging in size from ⅛ inch to 20 inches in diameter. Most woody fragments break down completely when rubbed. Reaction is extremely acid or very strongly acid in the surface tier and very strongly acid or strongly acid in the lower tiers and in the mineral substratum.

The surface tier is neutral in hue or has hue of 10YR to 5Y, has value of 2 or 3, and has chroma of 0 or 1. It is typically sapric soil material but in some pedons is hemic soil material or contains layers of hemic soil material. It has granular structure or is massive.

The organic part of the subsurface and bottom tiers is neutral in hue or has hue of 10YR to 5Y, has value of 2 or 3, and has chroma of 0 to 2. Broken face and rubbed colors are similar but may differ one or two units in value or chroma or in both. These tiers are dominantly sapric soil material but in some pedons contain layers of hemic soil material as much as 10 inches thick. They have granular structure or are massive.

The 2C horizon is neutral in hue or has hue of 7.5YR or 10YR, has value of 2 to 5, and has chroma of 0 or 1. It is sand, fine sand, loamy sand, or the gravelly analogues of these textures.

Ma—Manahawkin muck

Composition

Manahawkin soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Swamps and flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic deposits over loamy fluviomarine sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Mattapex Series

The Mattapex series consists of very deep, moderately well drained soils. These soils are moderately permeable in the subsoil and moderately rapidly permeable and rapidly permeable in the substratum. They formed in silty aeolian sediments and the underlying loamy alluvial and marine sediments. They are on uplands, in shallow depressions, and in swales of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Mattapex soils are similar to Beltsville and Woodstown soils and are commonly adjacent to Nassawango, Hambrook, and Romney soils. Beltsville and Woodstown soils have less silt and more sand in the subsoil than the Mattapex soils. Beltsville soils have a fragipan. Nassawango and Hambrook soils are better drained than the Mattapex soils. The Mattapex soils are better drained than the Romney soils, which occur on adjacent low-lying or somewhat depressional uplands.

Typical pedon of Mattapex silt loam, 0 to 2 percent slopes; Aberdeen Area of Aberdeen Proving Ground, 2,500 feet northwest of the intersection of Route 715 and Aberdeen Road, 100 feet northeast of Aberdeen Road, in an open wooded area.

Ap—0 to 8 inches; brown (10YR 5/3) silt loam; weak medium granular structure; friable; slightly sticky, slightly plastic; neutral; abrupt smooth boundary.

Bt1—8 to 21 inches; light yellowish brown (2.5Y 6/4) silt loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; common medium distinct strong brown (7.5YR 5/8) masses of iron accumulation and few medium distinct light olive gray (5Y 6/2) iron depletions; strongly acid; clear wavy boundary.

Bt2—21 to 40 inches; light yellowish brown (2.5Y 6/4) silt loam; moderate medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 5/8) masses of iron accumulation and few medium distinct light olive gray (5Y 6/2) iron depletions; strongly acid; clear wavy boundary.

2C1—40 to 47 inches; brown (10YR 5/3) fine sandy loam; moderate medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 5/8) masses of iron accumulation and few medium distinct light olive gray (5Y 6/2) iron depletions; extremely acid; gradual irregular boundary.

2C2—47 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; moderate medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 5/6) and common medium faint yellowish brown (10YR 5/4) masses of iron accumulation; extremely acid.

The thickness of the solum ranges from 24 to 42 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It is silt loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is silt loam or loam.

The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 4 to 7. It has few to many, faint to prominent masses of iron accumulation and iron depletions. It is silt loam or silty clay loam.

The 2BC horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 to 6. It has few to many, faint to prominent masses of iron accumulation. It is fine sandy loam or sandy clay loam.

The 2C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 8. It has few to many, faint to prominent masses of iron accumulation. It ranges from sand to fine sandy loam and includes the gravelly analogues of these textures. The content of rock fragments or gravel ranges from 0 to 20 percent.

MpA—Mattapex silt loam, 0 to 2 percent slopes

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MpB—Mattapex silt loam, 2 to 5 percent slopes

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MpC—Mattapex silt loam, 5 to 10 percent slopes

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MU—Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes

Composition

Mattapex soil and similar soils: 50 percent
Udorthents: 25 percent
Urban land: 10 percent
Inclusions (unnamed soils): 10 percent

Setting

Landform: Upland flats and knolls
Slope: Mattapex and Udorthents—0 to 2 percent; Urban land—0 to 5 percent

Component Description

Mattapex

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

Udorthents

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

A typical soil description of the Mattapex soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MwA—Mattapex silt loam, cratered

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Note:
• This map unit consists of areas where ordnance has exploded, resulting in the formation of craters.

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Nassawango Series

The Nassawango series consists of very deep, well drained soils. These soils are moderately permeable in the subsoil and moderately rapidly permeable and rapidly permeable in the substratum. They formed in silty sediments overlying loamy alluvial and marine sediments. They are on level to gently rolling uplands of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Nassawango soils are similar to Hambrook soils and are commonly adjacent to Mattapex, Beltsville, and Woodstown soils. Hambrook and Beltsville soils have less silt and more sand in the subsoil than the Nassawango soils. The Nassawango soils are better drained than Mattapex, Woodstown, and Beltsville soils. Beltsville soils have a fragipan.

Typical pedon of Nassawango silt loam, 0 to 2 percent slopes; Spesutie Island Area of Aberdeen Proving Ground, in an open field.

Ap—0 to 11 inches; yellowish brown (10YR 5/4) loam; weak fine granular structure; friable; slightly sticky, slightly plastic; neutral; abrupt smooth boundary.
E—11 to 24 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; neutral; clear smooth boundary.
Bt1—24 to 36 inches; dark yellowish brown (10YR 4/4)

silt loam; weak medium subangular blocky structure; slightly sticky, slightly plastic; slightly acid; clear smooth boundary.

Bt2—36 to 47 inches; brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; sticky, slightly plastic; common medium distinct strong brown (7.5YR 4/6) soft masses of iron accumulation; slightly acid; clear smooth boundary.

2C—47 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam and sandy clay loam; massive; few medium distinct yellowish red (5YR 4/6) soft masses of iron accumulation and few medium distinct light brownish gray (2.5Y 6/2) iron depletions; moderately acid.

The thickness of the solum ranges from 30 to 50 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A or Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 3 to 5. It is silt loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam.

The BC horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is silt loam.

The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. Iron depletions and soft masses of iron accumulation are common at the base of the horizon in most pedons. The horizon ranges from sand to fine sandy loam and in many pedons is stratified with thin layers of finer or coarser textured sediments. The content of rock fragments or gravel ranges from 0 to 20 percent.

NnA—Nassawango silt loam, 0 to 2 percent slopes

Composition

Nassawango soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Perched
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

NnB—Nassawango silt loam, 2 to 5 percent slopes

Composition

Nassawango soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Perched
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

NnC—Nassawango silt loam, 5 to 10 percent slopes

Composition

Nassawango soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 0 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Perched
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Othello Series

The Othello series consists of very deep, moderately slowly permeable, poorly drained soils. These soils formed in loess (silty) sediments overlying sandy alluvial and marine sediments. They are on broad upland and lowland flats and in shallow depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 2 percent.

The Othello soils are similar to Fallsington and Elkton soils and are commonly adjacent to Pone, Corsica, Romney, and Mattapex soils. Fallsington soils have less silt and more sand in the subsoil than the Othello soils. Elkton soils have more clay in the subsoil than the Othello soils. Corsica and Pone soils have a thick organic-rich surface layer. They occur in the lower landscape positions. Romney and Mattapex soils are better drained than the Othello soils and occur on adjacent uplands.

Typical pedon of Othello silt loam; in a cultivated area. (Colors are for moist soil.)

Ap—0 to 9 inches; dark grayish brown (2.5Y 4/2) silt loam; very weak fine and medium granular structure; friable; slightly sticky, slightly plastic; many roots; moderately acid; abrupt smooth boundary.

Btg1—9 to 18 inches; light olive gray (5Y 6/2) silty clay loam; weak fine and medium blocky and subangular blocky structure; firm; sticky, slightly plastic; common roots; common dark grayish brown (2.5Y 5/2) clay films on faces of peds; few medium faint light gray (5Y 7/1) iron depletions and common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation; very strongly acid; clear to abrupt smooth boundary.

Btg2—18 to 29 inches; gray (5Y 6/1) silty clay loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; few roots; many light olive gray (5Y 5/2) clay films on faces of peds; common coarse prominent yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; very strongly acid; clear to abrupt smooth boundary.

2Cg1—29 to 34 inches; gray (N 5/0) sandy loam; massive; friable; slightly sticky, slightly plastic; common medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; extremely acid; gradual smooth boundary.

2Cg2—34 to 60 inches; light gray (N 7/0) loamy sand; single grain; loose; common coarse yellowish brown (10YR 5/6) streaks and splotches; extremely acid.

The thickness of the solum ranges from 24 to 40 inches. In unlimed areas reaction is strongly acid or very strongly acid in the A horizon and extremely acid to strongly acid in the B and C horizons. The depth to unconforming, coarse textured sediments is less than 40 inches.

The A horizon has hue of 10YR to 5Y, value of 3 to 7, and chroma of 0 to 2. It is silt loam, fine sandy loam, or silty clay loam.

The Btg horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 0 to 2. Redoximorphic features have hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 8. The horizon is silt loam or silty clay loam and has 18 to 35 percent clay in the particle-size control section. The BCg horizon, if it occurs, is sandy clay loam, loam, or sandy loam.

The 2Cg horizon has hue of 10YR to 5Y or is neutral in hue, has value of 5 to 7, and has chroma of 0 to 2. It is loamy sand, sandy loam, or sandy clay loam. It can contain as much as 10 percent fine rounded gravel.

Ot—Othello silt loam

Composition

Othello soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Pone Series

The Pone series consists of very deep, moderately rapidly permeable, very poorly drained soils. These soils formed in loamy alluvial sediments overlying stratified alluvial and marine sediments. They are on flood plains, in upland swales, and in depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 3 percent.

The Pone soils are similar to Corsica and Kentuck soils and are commonly adjacent to Fallsington, Romney, and Woodstown soils. Kentuck soils have less sand and more silt in the subsoil than the Pone soils. Corsica soils have more clay in the subsoil than the Pone soils. Fallsington soils do not have a thick organic-rich surface layer. They occur in the higher landscape positions. Romney soils are somewhat poorly drained. They have less sand and more silt in the subsoil than the Pone soils. Woodstown soils are better drained than the Pone soils and occur on adjacent uplands.

Typical pedon of Pone mucky loam; on a 1 percent slope in an area of woodland. (Colors are for moist soil.)

Oi/Oa—3 inches to 0; undecomposed and highly decomposed leaves, needles, and twigs; clear smooth boundary.

A1—0 to 6 inches; black (10YR 2/1) mucky loam; strong medium granular structure; friable; slightly sticky, slightly plastic; many very fine and fine, common medium, and few coarse roots; many very fine and fine and common medium irregular pores; 10 percent organic matter; extremely acid; gradual smooth boundary.

A2—6 to 14 inches; black (10YR 2/1) mucky loam; weak medium subangular blocky structure parting to weak fine granular; friable; slightly sticky, slightly plastic; many very fine, common fine and medium, and few coarse roots; many very fine and fine and common medium irregular pores; high organic matter content; strongly acid; gradual wavy boundary.

Btg—14 to 26 inches; grayish brown (10YR 5/2) sandy loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; common coarse distinct very dark grayish brown (10YR 3/2) material from A horizon in vertical channels; many very fine, common fine, and few medium roots; many very fine, common fine, and few medium tubular pores; common prominent clay films on faces of peds and lining pores; very common medium distinct light gray (10YR 7/1) iron depletions; strongly acid; clear irregular boundary.

BC—26 to 37 inches; light gray (10YR 7/2) loamy sand; massive; very friable; common very fine and few fine roots; common very fine and fine and few medium tubular pores; 10 percent pockets of dark gray sandy clay loam in vertical channels; common coarse distinct grayish brown (2.5Y 5/2) iron depletions and few medium prominent yellowish brown (10YR 5/8) masses of iron accumulation; very strongly acid; clear irregular boundary.

Cg1—37 to 47 inches; gray (10YR 5/1) sand; massive; very friable; common very fine roots; stratified horizontal lines of light and dark gray sand less than 3 millimeters thick; many coarse prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear broken boundary.

2Cg2—47 to 69 inches; gray (5Y 6/1) silt loam;

massive; friable; slightly sticky, plastic; few very fine roots; many very fine tubular pores; common coarse distinct gray (10YR 5/1) iron depletions and common fine prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid.

The thickness of the solum ranges from 26 to 40 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 5YR to 5Y, value of 2 or 3, and chroma of 0 to 2. It is mucky sandy loam, mucky loam, sandy loam, or loam.

The Btg horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2. It is commonly sandy loam or loam but in some pedons includes thin layers of sandy clay loam.

The BC horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 or 2. It is loamy sand or sandy loam.

The Cg horizon is neutral in hue or has hue of 10YR to 5Y, value of 5 to 8, and chroma of 1 or 2. It is sand or loamy sand.

The 2Cg horizon is neutral in hue or has hue of 10YR to 5Y, has value of 5 to 7, and has chroma of 0 to 3. It ranges from very fine sandy loam to silty clay loam.

The 2C horizon is commonly above a depth of 50 inches but occurs below that depth in some pedons. Some pedons have a buried A horizon below a depth of 60 inches. This horizon has a high content of organic matter.

Po—Pone mucky loam

Composition

Pone soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Low-lying uplands, depressions, and swales
Slope: 0 to 2 percent

Component Description

Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic deposits over fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Puckum Series

The Puckum series consists of very deep, moderately permeable, very poorly drained soils. These soils formed in thick, highly decomposed organic deposits derived from woody materials. They formed in freshwater swamps on flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Puckum soils are associated with Lenape, Manahawkin, and Chicone soils. Lenape soils are underlain by loamy mineral sediments at depths of 16 to 51 inches. Manahawkin soils are underlain by sandy sediments at depths of 16 to 51 inches. Chicone soils are mineral soils and do not have a thick surface layer of organic material. They occur in landscape positions similar to those of the Puckum soils.

Typical pedon of Puckum muck; on a smooth 1 percent slope in a wooded area. (Colors are for moist soil.)

Oa1—0 to 4 inches; very dark brown (10YR 2/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 20 percent, by weight, mineral soil material; strongly acid; abrupt smooth boundary.

Oa2—4 to 20 inches; dark brown (7.5YR 3/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 25 percent, by weight, mineral soil material; strongly acid; gradual wavy boundary.

Oa3—20 to 40 inches; dark brown (7.5YR 3/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 30 percent, by weight, mineral soil material; material has a higher water content than the horizon above; strongly acid; gradual wavy boundary.

Oa4—40 to 57 inches; very dark brown (10YR 2/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 40 percent, by weight, mineral soil material; 20 percent yellow (10YR 8/6) soft woody fragments 0.5 inch to 2 inches in diameter; strongly acid; gradual wavy boundary.

Oa5—57 to 65 inches; dark brown (7.5YR 3/2) muck

(sapric soil material); fiber content is one-tenth of the soil volume after rubbing; 50 percent, by weight, mineral soil material; strongly acid; clear wavy boundary.

Oa6—65 to 80 inches; very dark brown (10YR 3/2) muck (sapric soil material); fiber content is one-tenth of the soil volume after rubbing; 60 percent, by weight, mineral soil material; strongly acid.

The thickness of the organic deposits ranges from 16 to 51 inches. Woody fragments occur in some part of the profile in most pedons, and their content ranges from 0 to 25 percent, by volume. The fragments consist of twigs, branches, logs, or stumps and are ½ inch to 12 inches in diameter. Woody fragments are firm but break under pressure. Conductivity of the saturation extract is less than 4 millimhos per centimeter throughout the profile. Reaction ranges from extremely acid to strongly acid.

The surface tier has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 to 4. It is hemic or sapric soil material. The fiber content after rubbing is less than one-half of the soil volume. The content of mineral material, by weight, ranges from 10 to 55 percent.

The subsurface and bottom tiers have hue of 5YR to 10YR, value of 2 to 4, and chroma of 1 to 4. They are dominantly sapric soil material but include some thin layers of hemic soil material. The fiber content after rubbing generally is less then one-quarter of the soil volume but averages less then one-sixth. The content of mineral material, by weight, ranges from 25 to 70 percent.

Some pedons contain thin strata of loamy or sandy mineral material.

Pk—Puckum muck

Composition

Puckum soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Swamps and flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic woody deposits
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Romney Series

The Romney series consists of very deep, moderately slowly permeable, somewhat poorly drained soils. These soils formed in silty sediments overlying loamy marine and fluvial sediments. They are on low-lying uplands and in shallow depressions of the Mid-Atlantic Coastal Plain. Slopes are nearly level and range from 0 to 2 percent.

The Romney soils are commonly adjacent to Mattapex and Othello soils. Mattapex soils are in the slightly higher landscape positions or on the more convex landforms. They have gray iron depletions that are deeper in the solum than those of the Romney soils. Othello soils are lower on the landscape. They have gray iron depletions that are not as deep as those of the Romney soils.

Typical pedon of Romney silt loam; on a 1 percent slope, Aberdeen Area of Aberdeen Proving Ground, east of Phillips Field, 0.3 mile northeast of the intersection of Michaelsville Road and Aviation Arms Road, northwest side of Michaelsville Road, in an area of woods.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium granular structure; friable; few fine and medium roots; neutral; clear smooth boundary.

E—4 to 8 inches; gray (10YR 5/1) silt loam; moderate medium granular structure; friable; few fine and medium roots; few medium prominent yellowish brown (10YR 5/8) masses of iron accumulation; strongly acid; clear smooth boundary.

Bt—8 to 16 inches; 40 percent light yellowish brown (10YR 6/4), 30 percent yellowish brown (10YR 5/4), and 30 percent yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; friable; few light gray (10YR 7/1) iron depletions and few strong brown (7.5YR 5/6) masses of iron accumulation; positive reaction to alpha,alpha-dipyridyl; strongly acid; clear smooth boundary.

Btg—16 to 48 inches; 40 percent gray (10YR 6/1), 40

percent light gray (10YR 7/1), and 20 percent gray (10YR 5/1) silt loam; weak medium subangular blocky structure; friable; common prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) and few distinct yellowish red (5YR 4/6) masses of iron accumulation; strongly acid; clear smooth boundary.

BCg—48 to 60 inches; mixed light gray (10YR 7/1, 2.5Y 7/2, and N 7/0) silt loam; weak medium subangular blocky structure; friable; common prominent light olive brown (2.5Y 5/4) and few prominent strong brown (7.5Y 5/8) masses of iron accumulation; strongly acid; clear smooth boundary.

2Cg—60 to 70 inches; light gray (10YR 7/1) sandy loam; massive; friable; common prominent light olive brown (2.5Y 5/4) and few prominent strong brown (7.5Y 5/8) masses of iron accumulation; strongly acid.

The thickness of the solum ranges from 30 to 50 inches. In unlimed areas reaction ranges from extremely acid to strongly acid throughout the profile.

The Ap or A horizon has hue of 10YR to 2.5Y, value of 3 to 6, and chroma of 2 to 6. It is silt loam or loam.

The A, E, or BEg horizon, if it occurs, has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 or 2. The AE, EB, or BE horizon, if it occurs, has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 6. Masses of iron accumulation in shades of brown, yellow, and red are few or common. These horizons are silt loam or loam.

The Bt horizon has hue of 10YR to 2.5Y, value of 4 to 7, and chroma of 3 to 8. It has few or common brown to red masses of iron accumulation and iron depletions. It is silt loam or silty clay loam.

The Btg horizon has hue of 10YR to 5GY or is neutral in hue, has value of 4 to 7, and has chroma of 0 to 2. In most pedons it has reddish brown masses of iron accumulation and gray iron depletions. It is silt loam or silty clay loam.

The BCg horizon, if it occurs, has colors similar to those in the lower part of the Btg horizon. It is silt loam or loam.

The 2Cg horizon, if it occurs, has hue of 10YR to 5Y or is neutral in hue, has value of 4 to 7, and has chroma of 0 to 2. It commonly ranges from stratified sand to loam but in some pedons contains thin strata of clay.

RE—Romney and Elkton soils, cratered

Composition

Romney soil and similar soils: 55 percent
Elkton soil and similar soils: 30 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent
Note:
• This map unit consists of areas where ordnance has exploded, resulting in the formation of craters.

Component Description

Romney

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Elkton

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description for each soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

RoA—Romney silt loam

Composition

Romney soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Ud—Udorthents, loamy, 0 to 10 percent slopes

Composition

Udorthents and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and side slopes
Slope: 0 to 10 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Dominant parent material: Sandy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Ur—Urban land-Udorthents complex, 0 to 10 percent slopes

Composition

Urban land: 55 percent
Udorthents and similar soils: 30 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and side slopes
Slope: 0 to 10 percent

Component Description

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

Udorthents

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Dominant parent material: Sandy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Woodstown Series

The Woodstown series consists of very deep, moderately permeable, moderately well drained soils. These soils formed in loamy marine and alluvial sediments. They are on uplands, in shallow depressions, and in swales of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Woodstown soils are similar to Beltsville and Mattapex soils and are commonly adjacent to Hambrook, Nassawango, and Fallsington soils. Mattapex and Nassawango soils have less sand and more silt in the subsoil than the Woodstown soils.

Beltsville soils have a fragipan. Nassawango and Hambrook soils are better drained than the Woodstown soils. Fallsington soils are poorly drained.

Typical pedon of Woodstown sandy loam, 2 to 5 percent slopes.

A—0 to 3 inches; dark grayish brown (2.5Y 4/2) sandy loam; weak medium granular structure; friable; many roots; strongly acid; clear wavy boundary.

E—3 to 11 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak medium granular structure; friable; many roots; strongly acid; clear wavy boundary.

Bt1—11 to 19 inches; light olive brown (2.5Y 5/6) sandy clay loam; weak medium blocky and subangular blocky structure; friable; slightly sticky, slightly plastic; common roots; thin clay films; very strongly acid; clear wavy boundary.

Bt2—19 to 29 inches; light olive brown (2.5Y 5/6) sandy clay loam; moderate medium subangular blocky structure; firm; sticky, slightly plastic; few roots; thin yellowish brown (10YR 5/6) and thick olive yellow (2.5Y 6/6) clay films; common medium distinct light gray (2.5Y 7/2) iron depletions and common medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear wavy boundary.

Cg1—29 to 45 inches; light brownish gray (2.5Y 6/2) sandy loam; massive; friable; very few roots; common fine to coarse distinct yellowish brown (10YR 5/4 and 5/6) masses of iron accumulation; very strongly acid; clear wavy boundary.

Cg2—45 to 60 inches; light gray (5Y 7/2) loamy sand; common thick grayish brown (2.5Y 5/2) horizontal streaks; single grain; loose; 10 percent rounded gravel; extremely acid.

The thickness of the solum ranges from 24 to 45 inches. The content of coarse fragments consisting of round to subrounded resistant gravel ranges from 0 to 20 percent in individual horizons of the solum and in the C horizon. In unlimed areas reaction ranges from strongly acid to extremely acid.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is sandy loam, loam, or fine sandy loam.

The Bt horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 4 to 8. Iron depletions with chroma of 2 or less occur in the upper 24 inches of the argillic horizon. The Bt horizon is sandy clay loam, loam, sandy loam, or fine sandy loam that has 18 to 27 percent clay and 20 to 35 percent silt in the control section.

The C horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 0 to 4. It ranges from sandy loam to sand and can contain thin strata of fine sandy clay loam or sandy clay loam.

WdA—Woodstown sandy loam, 0 to 2 percent slopes

Composition

Woodstown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, depressions, and swales
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

WdB—Woodstown sandy loam, 2 to 5 percent slopes

Composition

Woodstown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, depressions, and swales
Slope: 2 to 5 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

WdC—Woodstown sandy loam, 5 to 10 percent slopes

Composition

Woodstown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Zekiah Series

The Zekiah series consists of very deep, moderately permeable, poorly drained soils. These soils formed in loamy fluvial sediments overlying alluvial and marine sediments. They are on flood plains of the Mid-Atlantic Coastal Plain and are subject to scouring and uneven distribution of deposited sediment. Slopes are smooth and nearly level and are 0 to 1 percent.

The Zekiah soils are associated with Indiantown, Manahawkin, Chicone, and Fallsington soils. In some areas Indiantown soils are intermingled with the Zekiah soils. Indiantown soils have a thick organic-rich surface layer. Manahawkin and Chicone soils occur in the slightly lower landscape positions of the flood plain. Manahawkin soils are organic soils. Chicone soils formed in finer sediments than the Zekiah soils. Fallsington soils occur on the adjacent low-lying uplands.

Typical pedon of Zekiah loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

A—0 to 3 inches; dark brown (7.5YR 3/2) loam; weak fine granular structure; friable; slightly sticky, slightly plastic; many very fine and fine roots; few very fine vesicular pores; very strongly acid; abrupt wavy boundary.

Cg—3 to 20 inches; dark grayish brown (10YR 4/2) silt loam; common medium prominent dark reddish brown (5YR 3/3) soft masses of iron accumulation; massive; friable; slightly sticky, slightly plastic; common very fine and fine roots; few very fine vesicular pores; very strongly acid; abrupt wavy boundary.

2Ab—20 to 27 inches; very dark gray (10YR 3/1) sandy loam; common medium prominent dark brown (7.5YR 3/4) masses of iron accumulation; massive; friable; slightly sticky; few very fine roots; very strongly acid; abrupt wavy boundary.

2Cg1—27 to 37 inches; dark grayish brown (2.5Y 4/2) sandy loam; massive; friable; slightly sticky; few medium gray (10YR 5/1) sand lenses; few medium prominent dark brownish yellow (10YR 4/6) soft masses of iron accumulation; common coarse very dark grayish brown (10YR 3/2) organic stains; extremely acid; clear wavy boundary.

2Cg2—37 to 50 inches; bluish gray (5B 5/1) loam; massive; friable; slightly sticky; few elongated strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear wavy boundary.

2Cg3—50 to 72 inches; stratified grayish brown (2.5Y 5/2) loamy sand and sand; single grain; loose; common medium dark grayish brown (10YR 4/2) organic stains; extremely acid.

These soils are flooded for brief periods during

storm events. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 2.5Y to 7.5YR, value of 2 to 4, and chroma of 1 to 3. It is silt loam, mucky silt loam, or loam.

The Cg horizon has hue of 2.5Y or 10YR, value of 4 to 7, and chroma of 0 to 2. It is silt loam or loam.

The 2Ab horizon, if it occurs, has hue of 2.5Y or 10YR, value of 1 to 3, and chroma of 0 to 2. It is mucky loam, loam, or sandy loam. Some pedons may have a series consisting of as many as four buried surface layers.

The 2Cg horizon has hue of 10YR to 5B, value of 3 to 7, and chroma of 1 to 3. It is loam, sandy loam, loamy sand, or sand.

Ze—Zekiah loam

Composition

Zekiah soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: Frequent
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; for woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction or crop failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others will also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The estimated yields of the main crops and pasture plants are listed for each soil, the system of land capability classification used by the Natural Resources Conservation Service is explained, and prime farmland is described.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Soil Series and Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Federal and State regulations require that any area designated as wetlands cannot be altered without prior approval. Contact the local office of the Natural Resources Conservation Service for identification of hydric soils and potential wetlands.

Cropland Limitations and Hazards

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in table 3. The limitations and hazards listed in this table apply only to the crops shown in table 4. Some of the limitations and hazards shown in the table, especially flooding and ponding, cannot be easily overcome. The major concerns in managing nonirrigated cropland are conserving moisture, controlling soil blowing and water erosion, and maintaining soil fertility.

Conserving moisture consists primarily of reducing the evaporation and runoff rates and increasing the water intake rate. Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, and leaving crop residue on the surface conserve moisture.

Generally, a combination of several practices is needed to control soil blowing and water erosion. Conservation tillage, stripcropping, field windbreaks, tall grass barriers, contour farming, conservation cropping systems, crop residue management, diversions, and grassed waterways help to prevent excessive soil loss.

Measures that are effective in maintaining soil fertility include applying fertilizer, both organic and inorganic; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Controlling erosion helps to prevent the loss of organic

matter and plant nutrients and thus helps to maintain productivity, although the fertility level can be reduced even in areas where erosion is controlled. All soils used for nonirrigated crops respond well to applications of fertilizer.

Additional management concerns include excessive permeability, restricted permeability, and slope. Excessive permeability results in deep leaching of nutrients and pesticides. The capacity of the soil to retain moisture for plant use is poor. Restricted permeability can be overcome by incorporating manure or crop residue into the soil, applying a system of conservation tillage, and using conservation cropping systems. Slope is a concern where it is more than 8 percent because water erosion and soil blowing may be accelerated unless conservation farming practices are applied.

On irrigated soils the main management concerns are efficient water use, nutrient management, control of erosion, pest and weed control, and timely planting and harvesting for a successful crop. An irrigation system that provides optimum control and distribution of water at minimum cost is needed. Overirrigation wastes water, leaches plant nutrients, and causes erosion. It also can create drainage problems and raise the water table.

The criteria used to determine the limitations or hazards for the soils listed in table 3 are explained in the following paragraphs.

Erosion by water.—The surface K factor multiplied by the upper slope limit is more than 2 (same as prime farmland criteria).

Excessive permeability.—The upper limit of the permeability range is at a depth of 6 inches or more.

Flooding.—The component of the map unit is occasionally flooded or frequently flooded.

Ponding.—Ponding duration is assigned to the component of the map unit.

Restricted permeability.—Permeability is 0.06 inch per hour or less within the soil profile.

Slope.—The upper slope range of the component of the map unit is more than 8 percent.

Soil blowing.—The wind erodibility index multiplied by the selected high C factor for the survey area and then divided by the T factor is more than 8 for the component of the map unit.

High water table.—The component of the map unit has a high water table within a depth of 60 inches.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 4. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of local farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials, computer modeling, and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and cover crops; and harvesting that ensures the smallest possible loss.

A high level of management includes maintaining proper soil reaction and fertility levels as indicated by standard soil tests. The application rate of nitrogen for corn on soils that have a yield potential of 125 to 150 bushels per acre should be 140 to 160 pounds per acre. If the yield potential for corn is 100 bushels per acre or less, a rate of 100 to 120 pounds of nitrogen per acre should be used. The application of nitrogen in excess of that required for potential yields generally is not recommended. The excess nitrogen fertilizer that is not utilized by the crop is an unnecessary expense and causes a hazard of water pollution. If corn or cotton is grown after the harvest of soybeans or peanuts, nitrogen rates can be reduced by about 20 to 30 pounds per acre. Because nitrogen can be readily leached from sandy soils, applications may be needed on these soils more than once during the growing season.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed and applied. The relative productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 4 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide

information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that usually preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a letter, *E, W, or S* to the class numeral, for example, 2E. The letter *E* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *W* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *S* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *W* or *S* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the yields table.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

A recent trend in land use in some parts of the survey area has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This

list does not constitute a recommendation for a particular land use. On some soils included in the list, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures. The extent of each listed map unit is shown in table 2. The location is shown on the detailed soil maps. The soil qualities that affect use and management are described under the heading "Soil Series and Detailed Soil Map Units."

Highly Erodible Land

The basis for identifying highly erodible land is the erodibility index of a soil map unit. The erodibility index of a soil is determined by dividing the potential erodibility for each soil by the soil loss tolerance (T) value established for the soil. The T value represents the maximum annual rate of soil erosion that could take place without causing a decline in long-term productivity. A soil map unit that has an erodibility index of 8 or more is a highly erodible soil map unit.

Water Erosion

Potential erodibility for sheet and rill erosion is estimated by multiplying the following factors of the Universal Soil Loss Equation (USLE): (1) rainfall and runoff factor (R), (2) susceptibility of the soil to water erosion (K), and (3) combined effects of slope length and steepness (LS).

The erodibility index for sheet and rill erosion is represented by the formula RKLS/T. A soil map unit is highly erodible if the LS factor for the shortest length and minimum percent of slope is used and the RKLS/T value equals or exceeds 8C. All highly erodible soil map units are assigned a value of *1* in table 6.

A soil map unit is potentially highly erodible if: (1) the RKLS/T value using the minimum LS factor is less than 8 and (2) the RKLS/T value using the maximum LS factor is equal to or greater than 8. All potentially highly erodible soil map units are assigned a value of *2* in table 6.

All other soil map units, that do not fall in either of the above two classes, are assigned a value of *3*, which stands for "not highly erodible."

Wind Erosion

Potential erodibility from wind erosion is estimated by multiplying the following factors of the Wind Erosion Equation (WEQ): (1) climatic characterization of windspeed and surface soil moisture (C) and (2) the susceptibility of the soil to wind erosion (*I*).

The erodibility index for wind erosion is represented by the formula CI/T. A soil map unit is highly erodible if the CI/T value equals or exceeds 8.

Woodland Management and Productivity

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce in a pure stand under natural conditions. The number 1 indicates low potential productivity; 2 or 3, moderate; 4 or 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 7, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the

surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class* represents the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Recreation

The soils of the survey area are rated in table 8 according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that

limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the period of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat. The ratings in table 9 are intended to be used as a guide and are not site specific. Onsite investigation is needed for individual management plans.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining the specified element of habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, millet, wheat, oats, soybeans, sunflowers, sorghum, buckwheat, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are lovegrass, lespedeza, bromegrass, orchardgrass, timothy, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, pokeweed, goldenrod, butterflyweed, switchgrass, bluegrass, redtop, gama grass, and panic grass.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, slope, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, locust, dogwood, and hickory.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are loblolly pine, scrub pine, white pine, Virginia pine, spruce, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, arrow-arum, saltgrass, spatterdock, cordgrass, rushes, sedges, ferns, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, forbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, deer, cottontail rabbit, morning dove, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants (or both) and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, gray squirrels, gray fox, fox squirrels, raccoon, deer, and various species of small mammals, reptiles, and songbirds.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns, landscaping, and golf fairways. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm, dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns, landscaping, and golf fairways require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or

maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as

final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less

than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Drainage may be a major management consideration in some areas. Management of drainage in conformance with regulations concerning wetlands may require special permits and extra planning. The local office of the Natural Resources Conservation Service should be contacted for identification of hydric soils and potential wetlands.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of

terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, a low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Detailed Soil Map Units."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system and the system adopted by the American Association of State Highway and Transportation Officials.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The

sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time. It is the difference between the amount of soil water at field moisture capacity and the amount at wilting point.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in

soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.
4L. Calcareous loams, silt loams, clay loams, and silty clay loams.
4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various water features, and table 17 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious

material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 16 are the depth to the high water table; the kind of water table—that is, *perched* or *apparent*; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil.

In table 17, *depth to bedrock* is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion

of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Hydric Soil Interpretations

Hydric soils developed under conditions sufficiently wet to support the growth and regeneration of hydrophytic vegetation. Table 18 lists map units that may or may not have been drained. Some soil series that are designated as hydric have phases that are not hydric because of water table, flooding, or ponding characteristics.

Table 18 has several agricultural and nonagricultural applications. It can be used in land-use planning, conservation planning, and assessment of potential wildlife habitat. An area that meets the hydric soil criteria must also meet the hydrophytic vegetation and wetland hydrology criteria in order for it to be classified as a jurisdictional wetland.

Definition of Hydric Soil

A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. The following criteria reflect those soils that meet this definition.

Criteria for Hydric Soils

1. All Histosols except Folists, or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:
   A) Somewhat poorly drained with a water table equal to 0.0 feet from the surface during the growing season, or
   B) Poorly drained or very poorly drained and have either:
      (1) water table equal to 0.0 feet during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
      (2) water table at less than or equal to 0.5 foot from the surface during the growing season if permeability is equal to or greater than 6.0 inches per hour in all layers within a depth of 20 inches, or
      (3) water table at less than or equal to 1.0 foot from the surface during the growing season if permeability is less than 6.0 inches per hour in any layer within a depth of 20 inches, or
3. Soils that are frequently ponded for long duration or very long duration during the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpha,alpha-dipridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Argillite. Weakly metamorphosed mudstone or shale.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Board foot. A unit of measure of the wood in lumber, logs, or trees. The amount of wood in a board 1 foot wide, 1 foot long, and 1 inch thick before finishing.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Brackish water. Water commonly in the tidal reaches of a river where sea water and fresh water mix. The content of salt in brackish water is greater than that in fresh water but less than that in sea water.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. Some common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channeled. Refers to a streambed in which meandering, repeated branching, and convergence of streams, either active or abandoned, have created deeply incised cuts in alluvial material.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth. This practice is commonly called chisel plowing or ripping.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clayey soil. Silty clay, sandy clay, or clay.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Clearcutting. A method of forest harvesting that removes the entire stand of trees in one cutting. The stand is reproduced artificially or by natural seeding from adjacent stands.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Closed depression. A low area completely surrounded by higher ground and having no natural outlet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Codominant trees. Trees whose crowns form the general level of the forest canopy and that receive full light from above but comparatively little from the sides.

Commercial forest. Forest land capable of producing 20 cubic feet or more of wood per acre per year at the culmination of mean annual increment.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a

plane that typically takes the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Congeliturbate. Soil material disturbed by frost action.

Conglomerate. A coarse-grained, clastic rock composed of rounded to subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of cover crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Consolidated sandstone. Sandstone that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry, are not easily crushed, and cannot be textured by the usual field method.

Consolidated shale. Shale that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry and are not easily crushed.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine-grained soil material stabilized around shrubs or small trees.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deep soil. A soil that is 40 to 60 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Dominant trees. Trees whose crowns form the general level of the forest canopy and that receive full light from above and from the sides.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainageway. A land area that is lower in elevation than surrounding areas and in which water collects and is drained to a closed depression or lake or to a drainageway at a lower elevation. A drainageway may have distinctly incised channels at its upper reaches or throughout its course.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune. A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Exposed material is hard or soft bedrock. Synonym: scarp.

Estuarine. Term relating to marsh soils that may contain mineral material with a high *n* value that was deposited by tidally influenced streams in a quiescent environment.

Even-aged. Refers to a stand of trees in which only small differences in age occur between individual trees. A range of 20 years is allowed.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Fluviomarine. Of or pertaining to material deposited by oceans and reworked and deposited by streams after exposure.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water. Water filling all the unblocked pores of material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsum. A mineral consisting of hydrous calcium sulfate.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head; especially referring to small grain crops.

Heavy metals. Inorganic substances that are solid at ordinary temperatures and are not soluble in water. They form oxides and hydroxides that are basic. Examples are copper, iron, cadmium, zinc, manganese, lead, and arsenic.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the

surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Hummock. A small, irregularly shaped knob or mound consisting of mineral or organic material covered by vegetation.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or

tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loamy soil. Coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, silt, clay loam, sandy clay loam, or silty clay loam.

Loess. Fine-grained material, dominantly of silt-sized particles, deposited by the wind.

Lowland. A general term for low-lying land or an extensive region of low land, at elevations near tide level.

Lowland flats. A general term for a level or nearly level surface or large area of land that is characterized by little or no relief.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mean annual increment. The average annual volume of a tree from the year of origin to the age under consideration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Merchantable trees. Trees that are of sufficient size to be economically processed into wood products.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no soil development and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately deep soil. A soil that is 20 to 40 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mud flat. A level area along a shore that consists of fine-grained material alternately covered and uncovered by the tide or covered by shallow water and that is barren of vegetation during winter.

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neck. A narrow strip of land that is connected to a larger body of land but is bounded on both sides by water.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Overstory. The trees in a forest that form the upper crown cover.

Oxbow. The horseshoe-shaped channel of a former meander, remaining after the stream formed a cutoff across a narrow meander neck.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Panne. A small pond located on a tidal marsh, commonly having a higher content of salt than the surrounding areas of marsh.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.00 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse-grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content

of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Quartzite, metamorphic. Rock consisting mainly of quartz that formed through recrystallization of quartz-rich sandstone or chert.

Quartzite, sedimentary. Very hard but unmetamorphosed sandstone consisting chiefly of quartz grains.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation. Descriptive terms for concentrations and depletions are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regeneration. The new growth of a natural plant community, developing from seed.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relict stream terrace. One of a series of platforms in or adjacent to a stream valley that formed prior to the current stream system.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Riser. The relatively short, steeply sloping area below a terrace tread that grades to a lower terrace tread or base level.

Riverwash. Unstable areas of sandy, silty, clayey, or gravelly sediments. These areas are flooded, washed, and reworked by rivers so frequently that they support little or no vegetation.

Road cut. A sloping surface produced by mechanical

means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop. An area of exposed bedrock in a map unit that has less than 0.1 percent exposed bedrock.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

Salinity. The electrical conductivity of a saline soil. It is expressed, in millimhos per centimeter, as follows:

Nonsaline	0 to 4
Slightly saline	4 to 8
Moderately saline	8 to 16
Strongly saline	more than 16

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sandy soil. Sand or loamy sand.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Sawlogs. Logs of suitable size and quality for the production of lumber.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Scarp. An escarpment, cliff, or steep slope of considerable extent along the margin of a terrace.

Scribner's log rule. A method of estimating the number of board feet that can be cut from a log of a given diameter and length.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary plain. An extensive, nearly level to gently rolling or moderately sloping area that is underlain by sedimentary bedrock and that has a slope of 0 to 8 percent.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Semiconsolidated sedimentary beds. Soft geologic sediments that disperse when fragments are placed in water. The fragments are hard or very hard when dry. Determining the texture by the usual field method is difficult.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shallow soil. A soil that is 10 to 20 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. The uppermost inclined surface at the top of a hillside. It is the transition zone from the back slope to the summit of a hill or mountain. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building

foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. One crystalline mineral form is quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Skid trails. Pathways along which logs are dragged to a common site for loading onto a logging truck.

Slash. The branches, bark, treetops, reject logs, and broken or uprooted trees left on the ground after logging.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Species. A single, distinct kind of plant or animal having certain distinguishing characteristics.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stream channel. The hollow bed where a natural stream of surface water flows or may flow; the deepest or central part of the bed, formed by the main current and covered more or less continuously by water.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel. It originally formed near the level of the stream and is the dissected remnants of an abandoned flood plain, streambed, or valley floor that was produced during a former stage of erosion or deposition.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular),

and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any subsurface soil horizon (E, BE, or EB) below the surface layer.

Summit. A general term for the top, or highest level, of an upland feature, such as a hill or mountain. It commonly refers to a higher area that has a gentle slope and is flanked by steeper slopes.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, AE, and AB horizons, considered collectively. It includes all subdivisions of these horizons.

Swamp. A saturated, very poorly drained area that is intermittently or permanently covered by water. Swamps are dominantly covered by shrubs or trees.

Tailwater. The water directly downstream of a structure.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Trafficability. The degree to which a soil is capable of supporting vehicular traffic across a wide range in soil moisture conditions.

Tread. The relatively flat terrace surface that was cut or built by stream or wave action.

Understory. The trees and other woody species growing under a more or less continuous cover of branches and foliage formed collectively by the upper portions of adjacent trees and other woody growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley. An elongated depressional area primarily developed by stream action.

Very deep soil. A soil that is more than 60 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Very shallow soil. A soil that is less than 10 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of

coarse-grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

Table 1.--Classification of the Soils

Soil name	Family or higher taxonomic class
Beltsville	Fine-loamy, mixed, semiactive, mesic Typic Fragiudults
Chicone	Coarse-silty, mixed, active, acid, mesic Thapto-Histic Fluvaquents
Codorus	Fine-loamy, mixed, semiactive, mesic Fluvaquentic Dystrochrepts
Corsica	Fine-loamy, mixed, active, mesic Typic Umbraquults
Elkton	Fine-silty, mixed, active, mesic Typic Endoaquults
Fallsington	Fine-loamy, mixed, active, mesic Typic Endoaquults
Hambrook	Fine-loamy, siliceous, semiactive, mesic Typic Hapludults
Indiantown	Coarse-loamy, siliceous, active, acid, mesic Cumulic Humaquepts
Kentuck	Fine-silty, mixed, active, mesic Typic Umbraquults
Klej	Mesic, coated Aquic Quartzipsamments
Lenape	Loamy, mixed, dysic, mesic Terric Haplosaprists
Longmarsh	Coarse-loamy, siliceous, active, acid, mesic Fluvaquentic Humaquepts
Manahawkin	Sandy or sandy-skeletal, siliceous, dysic, mesic Terric Haplosaprists
Mattapex	Fine-silty, mixed, active, mesic Aquic Hapludults
Nassawango	Fine-silty, mixed, semiactive, mesic Typic Hapludults
Othello	Fine-silty, mixed, active, mesic Typic Endoaquults
Pone	Coarse-loamy, siliceous, active, mesic Typic Umbraquults
Puckum	Dysic, mesic Typic Haplosaprists
Romney	Fine-silty, mixed, active, mesic Aeric Endoaquults
Udorthents	Udorthents
Woodstown	Fine-loamy, mixed, active, mesic Aquic Hapludults
Zekiah	Coarse-loamy, siliceous, semiactive, acid, mesic Typic Fluvaquents

Table 2.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil map unit name	Acres	Percent
BeA	Beltsville silt loam, 0 to 2 percent slopes	199	0.5
BeB	Beltsville silt loam, 2 to 5 percent slopes	1,874	5.0
BeC	Beltsville silt loam, 5 to 10 percent slopes	99	0.3
BU	Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes	244	0.7
Ch	Chicone silt loam	18	*
Cd	Codorus loam	732	2.0
Co	Corsica loam	522	1.4
Ek	Elkton silt loam	1,284	3.4
Fa	Fallsington sandy loam	1,232	3.3
HbA	Hambrook sandy loam, 0 to 2 percent slopes	624	1.7
HbB	Hambrook sandy loam, 2 to 5 percent slopes	651	1.7
HbC	Hambrook sandy loam, 5 to 10 percent slopes	146	0.4
HbE	Hambrook sandy loam, 10 to 60 percent slopes	90	0.2
HU	Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes	117	0.3
In	Indiantown mucky silt loam	622	1.7
Kn	Kentuck silt loam	175	0.5
Kj	Klej loamy sand	20	*
Le	Lenape mucky peat	2,331	6.2
Lo	Longmarsh sandy loam	343	0.9
Ma	Manahawkin muck	93	0.3
MpA	Mattapex silt loam, 0 to 2 percent slopes	4,516	12.1
MpB	Mattapex silt loam, 2 to 5 percent slopes	1,382	3.7
MpC	Mattapex silt loam, 5 to 10 percent slopes	90	0.2
MU	Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes	836	2.2
MwA	Mattapex silt loam, cratered	292	0.8
NnA	Nassawango silt loam, 0 to 2 percent slopes	705	1.9
NnB	Nassawango silt loam, 2 to 5 percent slopes	274	0.7
NnC	Nassawango silt loam, 5 to 10 percent slopes	43	*
Ot	Othello silt loam	63	0.2
Po	Pone mucky loam	375	1.0
Pk	Puckum muck	3,030	8.1
RE	Romney and Elkton soils, cratered	311	0.8
RoA	Romney silt loam	6,661	17.8
Ud	Udorthents, loamy, 0 to 10 percent slopes	3,228	8.6
Ur	Urban land-Udorthents complex, 0 to 10 percent slopes	1,300	3.5
WdA	Woodstown sandy loam, 0 to 2 percent slopes	2,733	7.3
WdB	Woodstown sandy loam, 2 to 5 percent slopes	752	2.0
WdC	Woodstown sandy loam, 5 to 10 percent slopes	58	0.2
Ze	Zekiah loam	523	1.4
	Water	187	0.5
	Total	38,775	100.0

* Less than 0.1 percent

Table 3.--Main Cropland Limitations and Hazards

(See text for a description of the limitations and hazards listed in this table)

Soil name and map symbol	Limitation or hazard
BeA:	
Beltsville	Acidity (additions of lime needed), restricted permeability, high water table.
BeB:	
Beltsville	Acidity (additions of lime needed), erosion by water, restricted permeability, high water table.
BeC:	
Beltsville	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
BU:	
Beltsville	Acidity (additions of lime needed), erosion by water, restricted permeability, soil blowing, high water table.
Udorthents	Acidity (additions of lime needed), restricted permeability, high water table.
Urban land	Nonsoil material.
Ch:	
Chicone	Acidity (additions of lime needed), excessive permeability, flooding, ponding, high water table.
Cd:	
Codorus	Acidity (additions of lime needed), flooding, high water table.
Co:	
Corsica	Acidity (additions of lime needed), ponding, high water table.
Ek:	
Elkton	Acidity (additions of lime needed), restricted permeability, high water table.
Fa:	
Fallsington	Acidity (additions of lime needed), high water table.

Table 3.--Main Cropland Limitations and Hazards--Continued

Soil name and map symbol	Limitation or hazard
HbA:	
Hambrook	Acidity (additions of lime needed), restricted permeability, high water table.
HbB:	
Hambrook	Acidity (additions of lime needed), restricted permeability, high water table.
HbC:	
Hambrook	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
HbE:	
Hambrook	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
HU:	
Hambrook	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
Udorthents	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
Urban land	Nonsoil material.
In:	
Indiantown	Acidity (additions of lime needed), excessive permeability, flooding, ponding, high water table.
Kn:	
Kentuck	Acidity (additions of lime needed), excessive permeability, ponding, restricted permeability, high water table.
Kj:	
Klej	Acidity (additions of lime needed), excessive permeability, restricted permeability, high water table.
Le:	
Lenape	Acidity (additions of lime needed), flooding, ponding, high water table.

Table 3.--Main Cropland Limitations and Hazards--Continued

Soil name and map symbol	Limitation or hazard
Lo:	
Longmarsh	Acidity (additions of lime needed), excessive permeability, flooding, ponding, soil blowing.
Ma:	
Manahawkin	Acidity (additions of lime needed), excessive permeability, flooding, ponding, high water table.
MpA:	
Mattapex	Acidity (additions of lime needed), excessive permeability, high water table.
MpB:	
Mattapex	Acidity (additions of lime needed), erosion by water, excessive permeability, high water table.
MpC:	
Mattapex	Acidity (additions of lime needed), erosion by water, excessive permeability, slope, high water table.
MU:	
Mattapex	Acidity (additions of lime needed), excessive permeability, high water table.
Udorthents	Nonsoil material.
Urban land	Nonsoil material.
MwA:	
Mattapex	Acidity (additions of lime needed), excessive permeability, high water table.
NnA:	
Nassawango	Acidity (additions of lime needed), excessive permeability, high water table.
NnB:	
Nassawango	Acidity (additions of lime needed), erosion by water, excessive permeability, high water table.
NnC:	
Nassawango	Acidity (additions of lime needed), erosion by water, excessive permeability, slope, high water table.

Table 3.--Main Cropland Limitations and Hazards--Continued

Soil name and map symbol	Limitation or hazard
Ot:	
Othello	Acidity (additions of lime needed), excessive permeability, ponding, high water table.
Po:	
Pone	Acidity (additions of lime needed), ponding, restricted permeability, high water table.
Pk:	
Puckum	Acidity (additions of lime needed), flooding, ponding, high water table.
RE:	
Romney	Acidity (additions of lime needed), excessive permeability, high water table.
Elkton	Acidity (additions of lime needed), restricted permeability, high water table.
RoA:	
Romney	Acidity (additions of lime needed), excessive permeability, high water table.
Ud:	
Udorthents	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
Ur:	
Urban land	Nonsoil material.
Udorthents	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
WdA:	
Woodstown	Acidity (additions of lime needed), high water table.
WdB:	
Woodstown	Acidity (additions of lime needed), high water table.
WdC:	
Woodstown	Acidity (additions of lime needed), erosion by water, slope, high water table.
Ze:	
Zekiah	Acidity (additions of lime needed), flooding, high water table.

Table 4.--Land Capability and Yields Per Acre of Crops and Pasture

(Yields in the N columns are for nonirrigated soils, and those in the I columns are for irrigated soils)

Map symbol	Soil name	Land capability		Corn		Wheat		Soybeans		Pasture	
		N	I	N	I	N	I	N	I	N	I
				Bu		Bu		Bu		AUM*	
BeA	Beltsville	2W	---	95	---	45	---	35	---	5.5	---
BeB	Beltsville	2E	---	95	---	45	---	35	---	5.5	---
BeC	Beltsville	2E	---	95	---	45	---	35	---	5.5	---
BU**	Beltsville-Udorthents-Urban land.										
Ch**	Chicone	5W	---	---	---	---	---	---	---	---	---
Cd	Codorus	2W	---	130	---	45	---	---	---	8.1	---
Co**	Corsica	4W	---	---	---	---	---	---	---	---	---
Ek**	Elkton	4W	---	---	---	---	---	---	---	---	---
Fa	Fallsington	4W	---	70	---	35	---	30	---	5.0	---
HbA	Hambrook	1	---	110	165	50	55	45	55	---	---
HbB	Hambrook	2E	---	110	165	50	55	40	55	---	---
HbC	Hambrook	3E	---	100	155	---	---	---	---	---	---
HbE**	Hambrook	7E	---	---	---	---	---	---	---	---	---
HU**	Hambrook-Udorthents-Urban land.										
In**	Indiantown	5W	---	---	---	---	---	---	---	---	---
Kn**	Kentuck	5W	---	---	---	---	---	---	---	---	---
Kj**	Klej	4W	---	---	---	---	---	---	---	---	---
Le**	Lenape	8W	---	---	---	---	---	---	---	---	---
Lo**	Longmarsh	5W	---	---	---	---	---	---	---	---	---
Ma	Manahawkin	7W	---	---	---	---	---	---	---	---	---
MpA	Mattapex	2W	---	135	165	65	---	40	55	8.0	---
MpB	Mattapex	2E	---	135	165	60	---	40	55	8.0	---
MpC	Mattapex	3E	---	130	140	---	---	35	---	7.5	---
MU**	Mattapex-Udorthents-Urban land.										

See footnotes at end of table.

Table 4.--Land Capability and Yields Per Acre of Crops and Pasture--Continued

Map symbol	Soil name	Land capability		Corn		Wheat		Soybeans		Pasture	
		N	I	N	I	N	I	N	I	N	I
				Bu		Bu		Bu		AUM*	
MwA	Mattapex	2W	---	135	165	65	---	40	55	8.0	---
NnA	Nassawango	1	---	140	---	60	---	45	---	---	---
NnB	Nassawango	2E	---	140	---	60	---	45	---	---	---
NnC	Nassawango	3E	---	135	---	55	---	40	---	---	---
Ot**	Othello	5W	---	---	---	---	---	---	---	---	---
Po**	Pone	4W	---	---	---	---	---	---	---	---	---
Pk**	Puckum	8W	---	---	---	---	---	---	---	---	---
RE	Romney	3W	---	100	---	45	---	40	---	10.0	---
	Elkton	4W	---	---	---	---	---	---	---	---	---
RoA	Romney	3W	---	100	---	45	---	40	---	10.0	---
Ud**	Udorthents.										
Ur**	Urban land-Udorthents.										
WdA	Woodstown	2W	---	130	170	45	50	40	50	8.0	---
WdB	Woodstown	2W	---	130	170	45	50	40	50	8.0	---
WdC	Woodstown	3E	---	120	155	40	45	35	45	8.0	---
Ze	Zekiah	5W	---	---	---	---	---	---	---	---	---

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

Table 5.--Prime Farmland

Map symbol	Prime farmland code*	Soil map unit name
Cd	1	Codorus loam
Fa	2	Fallsington sandy loam
HbA	1	Hambrook sandy loam, 0 to 2 percent slopes
HbB	1	Hambrook sandy loam, 2 to 5 percent slopes
MpA	1	Mattapex silt loam, 0 to 2 percent slopes
MpB	1	Mattapex silt loam, 2 to 5 percent slopes
NnA	1	Nassawango silt loam, 0 to 2 percent slopes
NnB	1	Nassawango silt loam, 2 to 5 percent slopes
Ot	2	Othello silt loam
WdA	1	Woodstown sandy loam, 0 to 2 percent slopes
WdB	1	Woodstown sandy loam, 2 to 5 percent slopes

* Code 1 indicates that all areas are prime farmland; code 2 indicates that only drained areas are prime farmland.

Table 6.--Highly Erodible Land

(See text for definitions of classifications)

Map symbol	Soil map unit name	HEL classification
BeA	Beltsville silt loam, 0 to 2 percent slopes	3
BeB	Beltsville silt loam, 2 to 5 percent slopes	2
BeC	Beltsville silt loam, 5 to 10 percent slopes	1
BU	Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes	2
Ch	Chicone silt loam	3
Cd	Codorus loam	3
Co	Corsica loam	3
Ek	Elkton silt loam	3
Fa	Fallsington sandy loam	3
HbA	Hambrook sandy loam, 0 to 2 percent slopes	3
HbB	Hambrook sandy loam, 2 to 5 percent slopes	2
HbC	Hambrook sandy loam, 5 to 10 percent slopes	1
HbE	Hambrook sandy loam, 10 to 60 percent slopes	1
HU	Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes	2
In	Indiantown mucky silt loam	3
Kn	Kentuck silt loam	3
Kj	Klej loamy sand	3
Le	Lenape mucky peat	3
Lo	Longmarsh sandy loam	3
Ma	Manahawkin muck	3
MpA	Mattapex silt loam, 0 to 2 percent slopes	3
MpB	Mattapex silt loam, 2 to 5 percent slopes	2
MpC	Mattapex silt loam, 5 to 10 percent slopes	1

Table 6.--Highly Erodible Land--Continued

Map symbol	Soil map unit name	HEL classification
MU	Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes	3
MwA	Mattapex silt loam, cratered	3
NnA	Nassawango silt loam, 0 to 2 percent slopes	3
NnB	Nassawango silt loam, 2 to 5 percent slopes	2
NnC	Nassawango silt loam, 5 to 10 percent slopes	1
Ot	Othello silt loam	3
Po	Pone mucky loam	3
Pk	Puckum muck	3
RE	Romney and Elkton soils, cratered	3
RoA	Romney silt loam	3
Ud	Udorthents, loamy, 0 to 10 percent slopes	2
Ur	Urban land-Udorthents complex, 0 to 10 percent slopes	2
WdA	Woodstown sandy loam, 0 to 2 percent slopes	3
WdB	Woodstown sandy loam, 2 to 5 percent slopes	2
WdC	Woodstown sandy loam, 5 to 10 percent slopes	1
Ze	Zekiah loam	3

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
			Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class	
BeA	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine,
								Sweetgum	---	---	Virginia pine.
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
BeB	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine,
								Sweetgum	---	---	Virginia pine.
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
BeC	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine,
								Sweetgum	---	---	Virginia pine.
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
BU	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine,
								Sweetgum	---	---	Virginia pine.
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
	Udorthents.										
	Urban land.										
Ch	Chicone	2W	Slight	Severe	Severe	Severe	Severe	Red maple	50	2	Atlantic
								Sweetgum	50	4	white-cedar,
								Water oak	50	2	baldcypress.
								Pin oak	50	2	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
			Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class	
Cd	Codorus	5W	Slight	Moderate	Slight	Slight	Slight	Northern red oak	90	5	Sugar maple, white ash, black walnut, yellow-poplar, eastern white pine, European larch, Norway spruce.
								Sugar maple	90	4	
								White ash	90	5	
								Black walnut	100	---	
								Yellow-poplar	100	8	
								Eastern white pine	100	10	
Co	Corsica	3W	Slight	Severe	Severe	Severe	Moderate	Red maple	65	3	Swamp chestnut oak, willow oak, loblolly pine, swamp white oak, southern red oak.
								Sweetgum	65	4	
								Swamp chestnut oak	60	4	
								Willow oak	65	4	
Ek	Elkton	8W	Slight	Severe	Slight	Slight	Slight	Red maple	---	---	Loblolly pine.
								Sweetgum	80	6	
								Blackgum	---	---	
								Southern red oak	---	---	
								Willow oak	---	---	
								Loblolly pine	78	8	
Fa	Fallsington	9W	Slight	Moderate	Moderate	Moderate	Severe	White oak	---	---	Sweetgum, loblolly pine, yellow-poplar, eastern white pine.
								Willow oak	---	---	
								Sweetgum	80	6	
								Loblolly pine	90	9	
HbA	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	
HbB	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	
HbC	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
			Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class	
HbE	Hambrook	8A	Severe	Severe	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	
HU	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	
	Udorthents.										
	Urban land.										
In	Indiantown	3W	Slight	Severe	Severe	Severe	Severe	Red maple	60	3	Baldcypress, Atlantic white-cedar.
								Blackgum	60	3	
								Water oak	70	4	
								Baldcypress	100	6	
Kn	Kentuck	3W	Slight	Severe	Severe	Severe	Severe	Red maple	70	3	Loblolly pine.
								Sweetgum	70	4	
								Swamp chestnut oak	60	4	
								Water oak	70	4	
								Willow oak	70	4	
								Loblolly pine	70	6	
Kj	Klej	8S	Slight	Moderate	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, Virginia pine, eastern white pine.
								White oak	70	4	
								Loblolly pine	80	8	
								Virginia pine	70	8	
Le	Lenape	3W	Slight	Severe	Severe	Severe	Severe	Red maple	50	2	Atlantic white-cedar, baldcypress.
								Blackgum	60	6	
								Water oak	60	3	
								Baldcypress	70	3	
								Northern whitecedar	60	6	
Lo	Longmarsh	3W	Slight	Severe	Severe	Severe	Severe	Red maple	60	3	Atlantic white-cedar, green ash, baldcypress.
								Blackgum	60	6	
								Water oak	70	4	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
			Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class	
Ma	Manahawkin	3W	Slight	Severe	Severe	Severe	Severe	Red maple	75	3	Atlantic white-cedar, baldcypress.
								Atlantic white-cedar	50	---	
								Sweetgum	75	5	
								Blackgum	60	3	
MpA	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
MpB	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
MpC	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
MU	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
	Udorthents.										
	Urban land.										
MwA	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
NnA	Nassawango	8A	Slight	Slight	Slight	Slight	Slight	Yellow-poplar	90	6	Loblolly pine.
								White oak	75	4	
								Loblolly pine	85	8	
NnB	Nassawango	8A	Slight	Slight	Slight	Slight	Slight	Yellow-poplar	90	6	Loblolly pine.
								White oak	75	4	
								Loblolly pine	85	8	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
			Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class	
NnC	Nassawango	8A	Slight	Slight	Slight	Slight	Slight	Yellow-poplar	90	6	Loblolly pine.
								White oak	75	4	
								Loblolly pine	85	8	
Ot	Othello	3W	Slight	Severe	Moderate	Severe	Severe	Red maple	70	3	Loblolly pine, baldcypress.
								Sweetgum	70	4	
								Swamp chestnut oak	60	4	
								Water oak	70	4	
								Willow oak	70	4	
								Loblolly pine	70	6	
Po	Pone	3W	Slight	Severe	Severe	Severe	Severe	Red maple	65	3	Loblolly pine, yellow-poplar, baldcypress.
								Sweetgum	65	4	
								Swamp chestnut oak	60	4	
								Water oak	65	4	
								Willow oak	65	4	
								Loblolly pine	60	5	
Pk	Puckum	2W	Slight	Severe	Severe	Severe	Severe	Red maple	50	2	Atlantic white-cedar, baldcypress.
								Sweetgum	60	4	
								Blackgum	60	6	
								Swamp chestnut oak	60	---	
								Water oak	60	3	
								Northern whitecedar	60	6	
RE	Romney	9W	Slight	Moderate	Slight	Slight	Severe	Red maple	---	---	Sweetgum, loblolly pine.
								Yellow-poplar	---	---	
								Blackgum	---	---	
								White oak	---	---	
								Southern red oak	---	---	
								Swamp chestnut oak	---	---	
								Water oak	---	---	
								Sweetgum	---	---	
								Loblolly pine	87	9	
	Elkton	8W	Slight	Severe	Slight	Slight	Slight	Red maple	---	---	Loblolly pine.
								Sweetgum	80	6	
								Blackgum	---	---	
								Southern red oak	---	---	
								Willow oak	---	---	
								Loblolly pine	78	8	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
			Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class	
RoA	Romney	9W	Slight	Moderate	Slight	Slight	Severe	Red maple	---	---	Sweetgum, loblolly pine.
								Yellow-poplar	---	---	
								Blackgum	---	---	
								White oak	---	---	
								Southern red oak	---	---	
								Swamp chestnut oak	---	---	
								Water oak	---	---	
								Sweetgum	---	---	
								Loblolly pine	87	9	
WdA	Woodstown	4A	Slight	Slight	Slight	Slight	Moderate	Sweetgum	90	7	Yellow-poplar, loblolly pine, eastern white pine.
								White oak	80	4	
								Northern red oak	---	---	
								Yellow-poplar	90	6	
								Loblolly pine	85	8	
WdB	Woodstown	4A	Slight	Slight	Slight	Slight	Moderate	Sweetgum	90	7	Yellow-poplar, loblolly pine, eastern white pine.
								White oak	80	4	
								Northern red oak	---	---	
								Yellow-poplar	90	6	
								Loblolly pine	85	8	
WdC	Woodstown	4A	Slight	Slight	Slight	Slight	Moderate	Sweetgum	90	7	Yellow-poplar, loblolly pine, eastern white pine.
								White oak	80	4	
								Northern red oak	---	---	
								Yellow-poplar	90	6	
								Loblolly pine	85	8	
Ze	Zekiah	3W	Slight	Severe	Severe	Moderate	Severe	Red maple	60	3	Eastern white pine, American sycamore.
								Sweetgum	80	6	
								Water oak	70	4	

Table 8.--Recreational Development

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
BeA	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.
BeB	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.
BeC	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.
BU	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
	Urban land.				
Ch	Chicone	Severe: flooding, ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding.
Cd	Codorus	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Co	Corsica	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding.
Ek	Elkton	Severe: wetness, percs slowly, too acid.	Severe: wetness, too acid, percs slowly.	Severe: wetness, percs slowly, too acid.	Severe: wetness.
Fa	Fallsington	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
HbA	Hambrook	Slight	Slight	Moderate: small stones.	Slight.
HbB	Hambrook	Slight	Slight	Moderate: slope, small stones.	Slight.
HbC	Hambrook	Slight	Slight	Severe: slope.	Slight.
HbE	Hambrook	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

Table 8.--Recreational Development--Continued

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
HU	Hambrook	Slight	Slight	Moderate: slope, small stones.	Slight.
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
	Urban land.				
In	Indiantown	Severe: flooding, ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, flooding, too acid.	Severe: ponding.
Kn	Kentuck	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding.
Kj	Klej	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.
Le	Lenape	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
Lo	Longmarsh	Severe: flooding, ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, flooding, too acid.	Severe: ponding.
Ma	Manahawkin	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
MpA	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.
MpB	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.
MpC	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.
MU	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: small stones, percs slowly.	Slight.
	Urban land.				

Table 8.--Recreational Development--Continued

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
MwA	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.
NnA	Nassawango	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones.	Slight.
NnB	Nassawango	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones.	Slight.
NnC	Nassawango	Moderate: slope, small stones, percs slowly.	Moderate: slope, small stones, percs slowly.	Severe: slope, small stones.	Slight.
Ot	Othello	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Po	Pone	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pk	Puckum	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
RE	Romney	Severe: wetness, too acid.	Severe: too acid.	Severe: wetness, too acid.	Moderate: wetness.
	Elkton	Severe: wetness, percs slowly, too acid.	Severe: wetness, too acid, percs slowly.	Severe: wetness, percs slowly, too acid.	Severe: wetness.
RoA	Romney	Severe: wetness, too acid.	Severe: too acid.	Severe: wetness, too acid.	Moderate: wetness.
Ud	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
Ur	Urban land.				
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
WdA	Woodstown	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: small stones, wetness.	Moderate: wetness.
WdB	Woodstown	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones, wetness.	Moderate: wetness.

Table 8.--Recreational Development--Continued

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
WdC	Woodstown	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Moderate: wetness.
Ze	Zekiah	Severe: flooding, wetness, too acid.	Severe: wetness, too acid.	Severe: wetness, flooding, too acid.	Severe: wetness.

Table 9.--Wildlife Habitat

Map symbol	Soil name	Potential for habitat elements							Potential as habitat for--		
		Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
BeA	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
BeB	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
BeC	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
BU	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
	Udorthents.										
	Urban land.										
Ch	Chicone	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Cd	Codorus	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Co	Corsica	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Ek	Elkton	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Fa	Fallsington	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
HbA	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HbB	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HbC	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HbE	Hambrook	Very poor.	Poor	Good	Good	Poor	Very poor.	Very poor.	Poor	Good	Very poor.
HU	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
	Udorthents.										
	Urban land.										
In	Indiantown	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Kn	Kentuck	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Kj	Klej	Fair	Fair	Good	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
Le	Lenape	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
Lo	Longmarsh	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Ma	Manahawkin	Very poor.	Poor	Poor	Poor	Poor	Good	Poor	Poor	Poor	Fair.

Table 9.--Wildlife Habitat--Continued

Map symbol	Soil name	Potential for habitat elements							Potential as habitat for--		
		Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
MpA	Mattapex	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MpB	Mattapex	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MpC	Mattapex	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MU	Mattapex Udorthents. Urban land.	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MwA	Mattapex	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
NnA	Nassawango	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
NnB	Nassawango	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
NnC	Nassawango	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
Ot	Othello	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Po	Pone	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Pk	Puckum	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
RE	Romney	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
	Elkton	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
RoA	Romney	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
WdA	Woodstown	Fair	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
WdB	Woodstown	Fair	Good	Good	Good	Poor	Poor	Very poor.	Good	Good	Very poor.
WdC	Woodstown	Fair	Good	Good	Good	Poor	Poor	Very poor.	Good	Good	Very poor.
Ze	Zekiah	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.

Table 10.--Building Site Development

Map symbol	Soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns, landscaping, and golf fairways
BeA	Beltsville	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
BeB	Beltsville	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
BeC	Beltsville	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Moderate: wetness, slope.	Severe: frost action.	Moderate: wetness, slope.
BU	Beltsville	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
	Urban land.						
Ch	Chicone	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding.	Severe: too acid, ponding.
Cd	Codorus	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: flooding, wetness.
Co	Corsica	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: too acid, ponding.
Ek	Elkton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: too acid, wetness.
Fa	Fallsington	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
HbA	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Slight---------	Moderate: frost action.	Slight.
HbB	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Slight---------	Moderate: frost action.	Slight.
HbC	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Moderate: slope.	Moderate: frost action.	Slight.
HbE	Hambrook	Severe: cutbanks cave. slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
HU	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Moderate: slope.	Moderate: frost action.	Slight.
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
	Urban land.						

Table 10.--Building Site Development--Continued

Map symbol	Soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns, landscaping, and golf fairways
In	Indiantown	Severe: cutbanks cave, excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding.	Severe: too acid, ponding, flooding.
Kn	Kentuck	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: too acid, ponding.
Kj	Klej	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Le	Lenape	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.
Lo	Longmarsh	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: too acid, ponding, flooding.
Ma	Manahawkin	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: too acid, ponding, flooding.
MpA	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
MpB	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
MpC	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Severe: low strength.	Moderate: wetness.
MU	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.
	Urban land.						
MwA	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
NnA	Nassawango	Severe: cutbanks cave.	Slight----------	Moderate: wetness.	Slight----------	Severe: low strength.	Moderate: small stones.
NnB	Nassawango	Severe: cutbanks cave.	Slight----------	Moderate: wetness.	Slight----------	Severe: low strength.	Moderate: small stones.
NnC	Nassawango	Severe: cutbanks cave.	Moderate: slope.	Moderate: wetness, slope.	Severe: slope.	Severe: low strength.	Moderate: small stones, slope.

Table 10.--Building Site Development--Continued

Map symbol	Soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns, landscaping, and golf fairways
Ot	Othello	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Po	Pone	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pk	Puckum	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: too acid, ponding, flooding.
RE	Romney	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Severe: too acid.
	Elkton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: too acid, wetness.
RoA	Romney	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Severe: too acid.
Ud	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
Ur	Urban land.						
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
WdA	Woodstown	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
WdB	Woodstown	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
WdC	Woodstown	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Ze	Zekiah	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: too acid, wetness, flooding.

Table 11.--Sanitary Facilities

Map symbol	Soil name	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BeA	Beltsville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, wetness.
BeB	Beltsville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, wetness.
BeC	Beltsville	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, slope, wetness.
BU	Beltsville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, wetness.
	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight-----	Good.
	Urban land.					
Ch	Chicone	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, too acid.
Cd	Codorus	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
Co	Corsica	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding, too acid.	Severe: seepage, ponding.	Poor: ponding, too acid.
Ek	Elkton	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
Fa	Fallsington	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
HbA	Hambrook	Severe: poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
HbB	Hambrook	Severe: poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
HbC	Hambrook	Severe: poor filter.	Severe: seepage, slope.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
HbE	Hambrook	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: wetness, too sandy, slope.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

Table 11.--Sanitary Facilities--Continued

Map symbol	Soil name	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HU	Hambrook	Severe: poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight-----	Good.
	Urban land.					
In	Indiantown	Severe: flooding, ponding.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.
Kn	Kentuck	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding, too acid.	Severe: ponding.	Poor: ponding, too acid.
Kj	Klej	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: seepage, wetness.
Le	Lenape	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, thin layer.
Lo	Longmarsh	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, small stones.
Ma	Manahawkin	Severe: flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, too acid.
MpA	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
MpB	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
MpC	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, slope, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
MU	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
	Udorthents	Severe: percs slowly.	Slight--------	Severe: wetness.	Slight-----	Good.
	Urban land.					
MwA	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.

Table 11.--Sanitary Facilities--Continued

Map symbol	Soil name	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
NnA	Nassawango	Severe: wetness, percs slowly.	Severe: seepage.	Severe: too acid.	Slight	Poor: too acid.
NnB	Nassawango	Severe: wetness, percs slowly.	Severe: seepage.	Severe: too acid.	Slight	Poor: too acid.
NnC	Nassawango	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: too acid.	Moderate: slope.	Poor: too acid.
Ot	Othello	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: ponding.
Po	Pone	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Pk	Puckum	Severe: flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, too acid.
RE	Romney	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
	Elkton	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
RoA	Romney	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
Ud	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight	Good.
Ur	Urban land.					
	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight	Good.
WdA	Woodstown	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
WdB	Woodstown	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
WdC	Woodstown	Severe: wetness, percs slowly.	Severe: seepage, slope, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ze	Zekiah	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, too acid.

Table 12.--Construction Materials

Map symbol	Soil name	Roadfill	Sand	Gravel	Topsoil
BeA	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
BeB	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
BeC	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
BU	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
	Urban land.				
Ch	Chicone	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness, too acid.
Cd	Codorus	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Co	Corsica	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness, too acid.
Ek	Elkton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness, too acid.
Fa	Fallsington	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
HbA	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
HbB	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
HbC	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
HbE	Hambrook	Poor: slope.	Probable -	Improbable: too sandy.	Poor: slope.

Table 12.--Construction Materials--Continued

Map symbol	Soil name	Roadfill	Sand	Gravel	Topsoil
HU	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
	Urban land.				
In	Indiantown	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness, too acid.
Kn	Kentuck	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness, too acid.
Kj	Klej	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, small stones, thin layer.
Le	Lenape	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
Lo	Longmarsh	Poor: wetness.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim, wetness.
Ma	Manahawkin	Poor: wetness.	Probable	Probable	Poor: excess humus, area reclaim, wetness.
MpA	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
MpB	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
MpC	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
MU	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
	Urban land.				
MwA	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
NnA	Nassawango	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too acid.
NnB	Nassawango	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too acid.

Table 12.--Construction Materials--Continued

Map symbol	Soil name	Roadfill	Sand	Gravel	Topsoil
NnC	Nassawango	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too acid.
Ot	Othello	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Po	Pone	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Pk	Puckum	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
RE	Rowney	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too acid.
	Elkton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness, too acid.
RoA	Romney	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too acid.
Ud	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Ur	Urban land.				
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
WdA	Woodstown	Fair: wetness.	Probable	Improbable: too sandy.	Poor: small stones.
WdB	Woodstown	Fair: wetness.	Probable	Improbable: too sandy.	Poor: small stones.
WdC	Woodstown	Fair: wetness.	Probable	Improbable: too sandy.	Poor: small stones.
Ze	Zekiah	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness, too acid.

Table 13.--Water Management

Map symbol	Soil name	Limitations for--			Features affecting--			
		Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
BeA	Beltsville	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, rooting depth.
BeB	Beltsville	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, rooting depth.
BeC	Beltsville	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.
BU	Beltsville	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, rooting depth.
	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
	Urban land.							
Ch	Chicone	Severe: seepage.	Severe: excess humus, ponding.	Severe: cutbanks cave.	Ponding, flooding, too acid.	Ponding, flooding, too acid.	Erodes easily, ponding.	Wetness, erodes easily.
Cd	Codorus	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness--------	Flooding, wetness.
Co	Corsica	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, too acid.	Ponding, too acid.	Ponding--------	Wetness.
Ek	Elkton	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, too acid.	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
Fa	Fallsington	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, soil blowing.	Wetness, too sandy.	Wetness, rooting depth.
HbA	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Favorable------	Erodes easily, too sandy.	Erodes easily.
HbB	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope----------	Erodes easily, too sandy.	Erodes easily.

Table 13.--Water Management--Continued

Map symbol	Soil name	Limitations for--			Features affecting--			
		Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
HbC	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope	Erodes easily, too sandy.	Erodes easily.
HbE	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope	Erodes easily, too sandy.	Slope, erodes easily.
HU	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope	Erodes easily, too sandy.	Erodes easily.
	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
	Urban land.							
In	Indiantown	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding flooding, cutbanks cave.	Ponding, flooding.	Ponding, too sandy.	Wetness.
Kn	Kentuck	Severe: seepage.	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, too acid.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Kj	Klej	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.
La	Lenape	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, flooding, subsides.	Ponding, flooding.	Ponding	Wetness.
Lo	Longmarsh	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, flooding, frost action.	Ponding, droughty, flooding.	Ponding, too sandy.	Wetness, droughty.
Ma	Manahawkin	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, flooding, frost action.	Ponding, soil blowing, flooding.	Ponding, soil blowing.	Wetness.
MpA	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness	Erodes easily, wetness.	Erodes easily.

Table 13.--Water Management--Continued

Map symbol	Soil name	Limitations for--			Features affecting--			
		Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
MpB	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
MpC	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
MU	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
	Udorthents	Slight-----	Severe: piping.	Severe: no water.	Deep to water	Soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
	Urban land.							
MwA	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness--------	Erodes easily, wetness.	Erodes easily.
NnA	Nassawango	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Erodes easily, too acid.	Erodes easily	Erodes easily.
NnB	Nassawango	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, erodes easily, too acid.	Erodes easily	Erodes easily.
NnC	Nassawango	Severe: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Erodes easily, too acid.	Slope, erodes easily.	Slope, erodes easily.
Ot	Othello	Severe: seepage.	Severe: thin layer, ponding.	Severe: slow refill, cutbanks cave.	Ponding--------	Ponding--------	Erodes easily, ponding.	Wetness, erodes easily.
Po	Pone	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding--------	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, rooting depth.
Pk	Puckum	Severe: seepage.	Severe: excess humus, ponding.	Slight---------	Ponding, flooding, subsides.	Ponding, flooding, too acid.	Ponding--------	Wetness.

Table 13.--Water Management--Continued

Map symbol	Soil name	Limitations for--			Features affecting--			
		Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
RE	Romney	Slight-----	Severe: piping, wetness.	Severe: slow refill.	Too acid-------	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
	Elkton	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, too acid.	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
RoA	Romney	Slight-----	Severe: piping, wetness.	Severe: slow refill.	Too acid-------	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
Ud	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
Ur	Urban land.							
	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
WdA	Woodstown	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Droughty.
WdB	Woodstown	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty.
WdC	Woodstown	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty.
Ze	Zekiah	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, too acid.	Wetness, droughty, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, droughty.

Table 14.--Engineering Index Properties

Map symbol	Soil name	Depth (In)	USDA texture	Classification		Fragments >3 in. (Pct)	Percent passing sieve number--				Liquid limit (Pct)	Plasticity index
				Unified	AASHTO		4	10	40	200		
BeA	Beltsville	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
BeB	Beltsville	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
BeC	Beltsville	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
BU	Beltsville	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
	Urban land.											
Ch	Chicone	0-3	MK-SIL	OL, ML, CL-ML	A-4, A-8	0	100-100	100-100	80-95	70-90	15-25	0-10
		3-15	SIL	ML, CL-ML, CL	A-4	0	100-100	100-100	80-95	70-90	15-25	0-10
		15-24	SIL	ML, CL-ML, CL	A-4	0	100-100	100-100	80-95	70-85	18-30	0-10
		24-65	Muck MPT	PT	A-8	0	---	---	---	---	0-14	0-0
		65-72	S LS	SM, SP-SM	A-2, A-1	0	80-100	70-100	20-70	5-30	0-20	0-5
Cd	Codorus	0-18	L	ML, CL, CL-ML	A-4, A-6	0	80-100	70-100	65-100	55-95	22-35	2-12
		18-54	SIL L SICL	ML, CL, CL-ML	A-4, A-6	0	80-100	75-100	65-100	55-85	22-35	2-12
		54-60	SR S SI	SM, GM, ML	A-1, A-2, A-4	0	25-100	20-100	20-85	15-65	0-35	0-7
Co	Corsica	0-12	L	OL, CL-ML, ML	A-4	0	95-100	95-100	70-90	45-90	10-20	0-5
		12-18	L SIL	SC-SM, SC, CL-ML	A-4, A-2-4	0	95-100	95-100	40-90	30-90	10-20	5-10
		18-40	CL SCL L	SC, CL-ML, CL	A-4, A-6	0	95-100	95-100	75-95	35-75	20-30	5-15
		40-48	SL SCL GR-L	SC, CL, CL-ML	A-2, A-4	0	55-100	45-100	40-95	20-75	0-30	0-10
		48-72	SR GR-S CL	SM, SP-SM, SC-SM	A-1, A-3, A-6, A-4	0	45-100	45-100	20-90	5-85	0-40	0-15

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification		Frag-ments >3 in. (Pct)	Percent passing sieve number--				Liquid limit (Pct)	Plas-ticity index
				Unified	AASHTO		4	10	40	200		
Ek	Elkton	0-10	SIL	CL-ML	A-4, A-6	0	100-100	100-100	90-100	50-95	20-45	5-20
		10-24	SICL	CL	A-6	0	100-100	100-100	90-100	85-95	25-40	10-20
		24-40	SICL SIC	CL, CH	A-6, A-7	0	100-100	100-100	95-100	85-95	30-55	10-35
		40-65	VFSL FSL	SC, ML, CL	A-4	0	100-100	95-100	85-95	45-75	20-30	0-10
Fa	Fallsington	0-10	SL	SM, CL-ML ML, SC-SM	A-2, A-4	0	95-100	90-100	65-90	30-60	0-19	0-5
		10-32	SL L SCL	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	65-85	30-55	0-30	0-15
		32-72	SR S SCL	SM, SP-SM, CL, CL-ML	A-2, A-3, A-4	0	95-100	90-100	50-85	5-55	0-30	0-15
HbA	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
HbB	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
HbC	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
HbE	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification		Frag-ments >3 in. (Pct)	Percent passing sieve number--				Liquid limit (Pct)	Plas-ticity index
				Unified	AASHTO		4	10	40	200		
HU	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
	Urban land.											
In	Indiantown	0-25	MK-SIL	OL, ML	A-4, A-8	0	100-100	100-100	90-100	75-90	25-35	0-10
		25-41	L SL LS	SM, SC-SM	A-4, A-2-4	0	100-100	100-100	40-80	25-50	5-15	0-5
		41-72	LS S	SM, SP-SM	A-3, A-2-4	0	100-100	100-100	20-70	5-30	---	0-0
Kn	Kentuck	0-13	SIL	CL, CL-ML	A-4, A-8	0	100-100	100-100	90-100	75-90	25-40	5-15
		13-24	SIL	CL, CL-ML	A-4, A-6	0	100-100	100-100	90-100	75-90	25-40	5-15
		24-45	SIL SICL	CL	A-6, A-7	0	100-100	100-100	90-100	75-95	35-45	15-20
		45-56	SL FSL	SC-SM, SC	A-4, A-2	0	100-100	100-100	60-85	30-50	15-25	5-10
		56-70	FS LS S	SM, SP-SM	A-2, A-1, A-3	0	100-100	100-100	40-80	5-35	0-20	0-5
Kj	Klej	0-9	S	SM, SP-SM	A-2	0	100-100	95-100	50-95	10-25	0-20	0-0
		9-39	LS LFS	SM, SP-SM	A-2	0	100-100	95-100	50-95	10-25	0-20	0-0
		39-47	S FS	SP-SM, SM	A-1, A-2, A-3	0	90-100	75-100	40-80	5-20	0-20	0-0
		47-60	SL SCL	SM, SC, ML, CL	A-2, A-4, A-6	0	90-100	75-100	45-95	20-60	10-30	0-15
Le	Lenape	0-8	PT	PT	A-8	---	---	---	---	---	0-14	---
		8-26	SP	PT	A-8	---	---	---	---	---	0-14	---
		26-60	L SICL SIL	CL, CL-ML	A-4, A-6	0	100-100	100-100	80-95	70-90	15-30	5-15
		60-72	S LS LFS	SC, SM, SP-SM	A-2, A-1	0	100-100	95-100	40-75	10-30	0-15	0-5
Lo	Longmarsh	0-19	SL	CL-ML, SM, ML	A-2-4, A-4	0	85-100	75-100	40-90	15-70	15-20	0-5
		19-34	SL LS FSL	SM, SP-SM	A-4, A-2-4, A-1	0	75-100	45-100	25-90	10-45	8-20	0-6
		34-66	SR GR-LS COS	SM, SP-SM, SP	A-3, A-2-4, A-1	0	75-100	45-100	10-75	0-30	0	0-0
Ma	Manahawkin	0-39	Muck	PT	A-8	---	---	---	---	---	0-14	---
		39-60	S GR-S	SW, GP-GM, SP-SM, GW	A-1	0	40-100	35-100	20-50	4-10	15-20	0-3

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification		Frag-ments >3 in. (Pct)	Percent passing sieve number--				Liquid limit (Pct)	Plas-ticity index
				Unified	AASHTO		4	10	40	200		
MpA	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
MpB	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
MpC	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
MU	Mattapex	0-15	FSL	SM, SC-SM, ML	A-4, A-2	0	95-100	90-100	80-100	30-65	15-30	0-10
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
	Urban land.											
MwA	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
NnA	Nassawango	0-10	SIL	CL-ML, SC-SM	A-4	0	85-100	70-100	70-90	40-85	20-33	3-9
		10-16	SIL	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		16-36	SICL SIL	CL	A-7, A-6	0	100-100	100-100	80-100	80-100	27-45	10-22
		36-44	SIL L	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		44-60	LS S	SP-SM	A-2, A-3, A-4	0	95-100	90-100	55-70	5-40	0-15	0-0
		60-72	FSL SL SIL	SM, ML, CL-ML	A-4	0	85-100	70-95	50-90	40-85	15-30	2-9

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification		Frag-ments >3 in. (Pct)	Percent passing sieve number--				Liquid limit (Pct)	Plas-ticity index
				Unified	AASHTO		4	10	40	200		
NnB	Nassawango	0-10	SIL	CL-ML, SC-SM	A-4	0	85-100	70-100	70-90	40-85	20-33	3-9
		10-16	SIL	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		16-36	SICL SIL	CL	A-7, A-6	0	100-100	100-100	80-100	80-100	27-45	10-22
		36-44	SIL L	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		44-60	LS S	SP-SM	A-2, A-3, A-4	0	95-100	90-100	55-70	5-40	0-15	0-0
		60-72	FSL SL SIL	SM, ML, CL-ML	A-4	0	85-100	70-95	50-90	40-85	15-30	2-9
NnC	Nassawango	0-10	SIL	CL-ML, SC-SM	A-4	0	85-100	70-100	70-90	40-85	20-33	3-9
		10-16	SIL	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		16-36	SICL SIL	CL	A-7, A-6	0	100-100	100-100	80-100	80-100	27-45	10-22
		36-44	SIL L	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		44-60	LS S	SP-SM	A-2, A-3, A-4	0	95-100	90-100	55-70	5-40	0-15	0-0
		60-72	FSL SL SIL	SM, ML, CL-ML	A-4	0	85-100	70-95	50-90	40-85	15-30	2-9
Ot	Othello	0-6	SIL	CL, OL	A-4, A-6	0	100-100	100-100	90-100	75-90	30-40	5-15
		6-12	SIL	CL, CL-ML, ML	A-4, A-6	0	100-100	100-100	80-100	50-90	15-35	0-15
		12-40	SIL SICL	CL	A-6	0	100-100	100-100	80-100	50-90	20-30	10-15
		40-48	SCL SL FSL	SC-SM, CL, ML, SM	A-2, A-4	0	90-100	85-100	50-95	25-60	15-25	0-10
		48-72	LS S	SM, SP-SM	A-1, A-2, A-3	0	90-100	85-100	30-85	5-35	0-20	0-5
Po	Pone	0-14	MK-L	SC, OL, CL-ML	A-2, A-4, A-8	0	100-100	90-100	40-90	15-55	20-30	0-10
		14-26	SL L	SC-SM, CL-ML	A-2, A-4	0	90-100	85-95	40-90	20-60	10-25	0-10
		26-37	LS SL	SM, SC, SP-SM	A-1, A-2	0	90-100	85-95	30-70	10-40	0-20	0-10
		37-47	S LS	SM, SP-SM	A-1, A-2	0	80-100	75-100	20-70	5-30	0-20	0-5
		47-69	VFSL SIL SICL	CL-ML, CL	A-4, A-6	0	90-100	85-95	70-90	60-90	10-30	5-15
Pk	Puckum	0-4	Muck	PT	A-8	0	---	---	---	---	---	---
		4-80	Muck MPT	PT	A-8	0	---	---	---	---	---	---
RE	Romney	0-8	SIL	ML, CL, CL-ML	A-4	0	100-100	100-100	85-98	60-85	20-35	3-10
		8-75	L SIL	CL, CL-ML	A-6, A-7, A-4	0	100-100	100-100	85-99	60-95	22-49	6-30
	Elkton	0-10	SIL	CL-ML	A-4, A-6	0	100-100	100-100	90-100	50-95	20-45	5-20
		10-24	SICL	CL	A-6	0	100-100	100-100	90-100	85-95	25-40	10-20
		24-40	SICL SIC	CL, CH	A-6, A-7	0	100-100	100-100	95-100	85-95	30-55	10-35
		40-65	VFSL FSL	SC, ML, CL	A-4	0	100-100	95-100	85-95	45-75	20-30	0-10
RoA	Romney	0-8	SIL	ML, CL, CL-ML	A-4	0	100-100	100-100	85-98	60-85	20-35	3-10
		8-75	L SIL	CL, CL-ML	A-6, A-7, A-4	0	100-100	100-100	85-99	60-95	22-49	6-30
Ud	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification		Frag-ments >3 in. (Pct)	Percent passing sieve number--				Liquid limit (Pct)	Plas-ticity index
				Unified	AASHTO		4	10	40	200		
Ur	Urban land.											
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
WdA	Woodstown	0-11	SL	SM, CL-ML, SC-SM	A-2, A-4	0	90-100	80-100	60-95	30-75	0-28	0-7
		11-29	SCL L SL	SM, CL-ML, CL, SC-SM	A-2, A-4, A-6	0	90-100	70-100	45-90	25-60	0-32	0-20
		29-70	SR GR-S SL	SM, SP-SM, SC-SM	A-1, A-2, A-3, A-2-4	0	80-100	70-95	35-55	5-25	0-26	0-6
WdB	Woodstown	0-11	SL	SM, CL-ML, SC-SM	A-2, A-4	0	90-100	80-100	60-95	30-75	0-28	0-7
		11-29	SCL L SL	SM, CL-ML, CL, SC-SM	A-2, A-4, A-6	0	90-100	70-100	45-90	25-60	0-32	0-20
		29-70	SR GR-S SL	SM, SP-SM, SC-SM	A-1, A-2, A-3, A-2-4	0	80-100	70-95	35-55	5-25	0-26	0-6
WdC	Woodstown	0-11	SL	SM, CL-ML, SC-SM	A-2, A-4	0	90-100	80-100	60-95	30-75	0-28	0-7
		11-29	SCL L SL	SM, CL-ML, CL, SC-SM	A-2, A-4, A-6	0	90-100	70-100	45-90	25-60	0-32	0-20
		29-70	SR GR-S SL	SM, SP-SM, SC-SM	A-1, A-2, A-3, A-2-4	0	80-100	70-95	35-55	5-25	0-26	0-6
Ze	Zekiah	0-3	L	ML, CL-ML	A-4	0	100-100	100-100	70-100	45-100	15-25	0-10
		3-20	SIL L	ML, CL-ML	A-4	0	100-100	100-100	70-100	45-100	15-25	0-10
		20-27	MK-L L SL	ML, SM	A-4, A-2-4	0	90-100	75-100	50-95	25-75	15-26	0-10
		27-37	MK-SL SL LS	SM	A-2-4	0	90-100	75-100	50-70	25-45	15-26	0-10
		37-50	L SL SIL	SM	A-4, A-2-4	0	90-100	75-100	35-70	25-50	15-25	0-10
		50-72	S LS COS	SM, SP-SM	A-3, A-2-4, A-1	0	90-100	75-100	35-70	5-25	---	0-5

Table 15.--Physical and Chemical Properties of the Soils

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
BeA	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
BeB	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
BeC	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
BU	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
	Urban land.												
Ch	Chicone	0-3	8-15	1.30-1.50	0.6-2.0	0.15-0.30	3.5-5.5	0	Low	.28	5	8	10.0-20.0
		3-15	8-15	1.50-1.70	0.6-6.0	0.10-0.18	3.5-5.5	0	Low	.37			0.5-3.0
		15-24	8-18	1.55-1.70	0.6-6.0	0.10-0.18	3.5-5.5	0	Low	.37			0.5-3.0
		24-65	0	0.10-0.50	6.0-20	0.35-0.45	3.5-5.5	0	Low	.05			60.0-80.0
		65-72	3-8	1.40-1.70	2.0-20	0.05-0.10	3.5-5.5	0	Low	.15			0.5-1.0
Cd	Codorus	0-18	15-25	1.20-1.40	0.6-2.0	0.14-0.20	4.5-6.0	0	Low	.37	5	5	2.0-4.0
		18-54	18-35	1.20-1.50	0.6-2.0	0.14-0.18	5.1-6.5	0	Low	.37			0.0-0.5
		54-60	5-12	1.20-1.50	2.0-20	0.04-0.08	5.1-6.5	0	Low	.24			0.0-0.5
Co	Corsica	0-12	6-15	1.10-1.50	0.6-6.0	0.15-0.30	3.5-5.5	0	Low	.24	5	5	3.0-15.0
		12-18	10-15	1.20-1.70	0.6-2.0	0.12-0.20	3.5-5.5	0	Low	.32			0.5-1.0
		18-40	18-30	1.30-1.70	0.2-6.0	0.10-0.24	3.5-5.5	0	Low	.32			0.0-0.5
		40-48	5-25	1.30-1.70	0.2-2.0	0.10-0.20	3.5-5.5	0	Low	.24			0.0-0.5
		48-72	0-35	1.50-1.80	0.2-20	0.05-0.20	3.5-5.5	0	Low	.10			0.0-0.5
Ek	Elkton	0-10	11-25	1.20-1.50	0.6-2.0	0.18-0.24	3.5-5.5	0	Low	.43	5	5	1.0-4.0
		10-24	27-35	1.35-1.55	0.06-0.2	0.14-0.20	3.5-5.5	0	Moderate	.37			0.0-0.5
		24-40	27-45	1.35-1.55	0.00-0.2	0.12-0.19	3.5-5.5	0	Moderate	.32			0.0-0.5
		40-65	10-20	1.45-1.65	0.2-20	0.10-0.15	3.5-5.5	0	Low	.32			0.0-0.5
Fa	Fallsington	0-10	5-18	1.00-1.45	0.6-6.0	0.15-0.20	3.6-5.5	0	Low	.24	5	3	0.5-2.0
		10-32	18-30	1.50-1.80	0.2-2.0	0.15-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		32-72	2-30	1.50-1.85	0.6-20	0.06-0.20	3.6-5.5	0	Low	.20			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
HbA	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HbB	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HbC	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HbE	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HU	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
	Urban land.												
In	Indiantown	0-25	8-15	1.30-1.50	0.6-2.0	0.18-0.30	3.5-5.5	0-2	Low	.28	4	5	5.0-18.0
		25-41	5-15	1.40-1.65	2.0-6.0	0.02-0.08	3.5-5.5	0-2	Low	.32			1.0-10.0
		41-72	3-8	1.40-1.70	6.0-20	0.04-0.09	3.5-5.5	0-2	Low	.17			0.0-1.0
Kn	Kentuck	0-13	14-20	1.20-1.70	0.6-2.0	0.20-0.21	3.5-5.5	0	Low	.43	4	5	0.5-1.0
		13-24	14-20	1.40-1.70	0.6-2.0	0.15-0.21	3.5-5.5	0	Low	.43			0.5-1.0
		24-45	24-34	1.40-1.70	0.06-0.6	0.15-0.21	3.5-5.5	0	Low	.43			0.0-0.5
		45-56	10-15	1.65-1.80	2.0-6.0	0.11-0.15	3.5-5.5	0	Low	.24			0.0-0.5
		56-70	3-8	1.65-1.80	6.0-20	0.05-0.11	3.5-5.5	0	Low	.15			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
Kj	Klej	0-9	2-10	1.30-1.60	6.0-20	0.06-0.11	3.6-5.5	0	Low	.17	5	2	1.0-3.0
		9-39	2-10	1.30-1.60	6.0-20	0.06-0.10	3.6-5.5	0	Low	.17			0.0-0.5
		39-47	2-10	1.50-1.75	6.0-20	0.06-0.08	3.6-5.5	0	Low	.17			0.0-0.5
		47-60	10-27	1.40-1.55	0.0-2.0	0.11-0.17	3.6-5.5	0	Low	.24			0.0-0.5
Le	Lenape	0-8	0	0.10-0.80	2.0-6.0	0.35-0.45	3.6-5.5	0-2	Low	.02	2	8	30.0-90.0
		8-26	0	0.10-0.80	2.0-6.0	0.35-0.45	3.6-5.5	0-2					30.0-80.0
		26-60	15-35	1.20-1.70	0.2-0.6	0.10-0.20	3.6-5.5	0-2					1.0-5.0
		60-72	2-8	1.20-1.60	2.0-20	0.05-0.10	3.6-5.5	0-2					0.0-2.0
Lo	Longmarsh	0-19	8-15	1.40-1.70	0.6-2.0	0.15-0.21	3.5-5.5	0-2	Low	.17	4	5	0.0-5.0
		19-34	5-15	1.40-1.65	2.0-6.0	0.02-0.08	3.5-5.5	0-2	Low	.10			1.0-8.0
		34-66	0-8	1.40-1.70	6.0-20	0.04-0.09	3.5-5.5	0-2	Low	.10	5	5	0.0-1.0
Ma	Manahawkin	0-39	0	0.30-0.65	6.0-20	0.30-0.40	3.5-5.5	0-2		.05	2	2	20.0-95.0
		39-60	0-10	1.10-1.70	2.0-20	0.04-0.08	4.5-5.0	0	Low	.17			0.5-1.0
MpA	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
MpB	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
MpC	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
MU	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.13-0.20	3.6-5.5	0	Low	.37	5	3	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
	Urban land.												
MwA	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
NnA	Nassawango	0-10	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.43	4	5	1.0-2.0
		10-16	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.49			0.0-0.5
		16-36	18-30	1.40-1.65	0.2-0.6	0.18-0.25	3.5-5.5	0	Low	.49			0.0-0.5
		36-44	10-20	1.40-1.65	0.6-2.0	0.18-0.25	3.5-5.5	0	Low	.28			0.0-0.5
		44-60	2-10	1.65-1.85	6.0-20	0.08-0.15	3.5-5.5	0	Low	.15			0.0-0.5
		60-72	8-20	1.40-1.70	0.2-2.0	0.15-0.24	3.5-5.5	0	Low	.28			0.0-0.5
NnB	Nassawango	0-10	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.43	4	5	1.0-2.0
		10-16	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.49			0.0-0.5
		16-36	18-30	1.40-1.65	0.2-0.6	0.18-0.25	3.5-5.5	0	Low	.49			0.0-0.5
		36-44	10-20	1.40-1.65	0.6-2.0	0.18-0.25	3.5-5.5	0	Low	.28			0.0-0.5
		44-60	2-10	1.65-1.85	6.0-20	0.08-0.15	3.5-5.5	0	Low	.15			0.0-0.5
		60-72	8-20	1.40-1.70	0.2-2.0	0.15-0.24	3.5-5.5	0	Low	.28			0.0-0.5
NnC	Nassawango	0-10	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.43	4	5	1.0-2.0
		10-16	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.49			0.0-0.5
		16-36	18-30	1.40-1.65	0.2-0.6	0.18-0.25	3.5-5.5	0	Low	.49			0.0-0.5
		36-44	10-20	1.40-1.65	0.6-2.0	0.18-0.25	3.5-5.5	0	Low	.28			0.0-0.5
		44-60	2-10	1.65-1.85	6.0-20	0.08-0.15	3.5-5.5	0	Low	.15			0.0-0.5
		60-72	8-20	1.40-1.70	0.2-2.0	0.15-0.24	3.5-5.5	0	Low	.28			0.0-0.5
Ot	Othello	0-6	14-22	1.20-1.50	0.6-2.0	0.20-0.25	3.6-5.5	0	Low	.24	4	5	3.0-10.0
		6-12	12-20	1.30-1.50	0.6-2.0	0.16-0.24	3.6-5.5	0	Low	.49			0.0-1.0
		12-40	18-30	1.40-1.70	0.2-0.6	0.18-0.24	3.6-5.5	0	Low	.49			0.0-0.5
		40-48	15-24	1.65-1.80	2.0-6.0	0.12-0.20	3.6-5.5	0	Low	.28			0.0-0.5
		48-72	3-10	1.65-1.80	6.0-20	0.05-0.10	3.6-5.5	0	Low	.15			0.0-0.5
Po	Pone	0-14	10-18	1.20-1.40	0.6-6.0	0.15-0.24	3.6-5.5	0	Low	.15	5	5	3.0-15.0
		14-26	8-18	1.55-1.75	2.0-6.0	0.10-0.16	3.6-5.5	0	Low	.24			0.0-0.5
		26-37	3-15	1.40-1.70	2.0-6.0	0.05-0.10	3.6-5.5	0	Low	.20			0.0-0.5
		37-47	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	0	Low	.15			0.0-0.5
		47-69	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	0	Low	.55			0.0-0.5
Pk	Puckum	0-4	0	0.10-0.50	2.0-6.0	0.35-0.45	3.5-5.5	0-4	Low	.02	3	8	45.0-90.0
		4-80	0	0.10-0.50	2.0-6.0	0.35-0.45	3.5-5.5	0-4	Low	.02			30.0-75.0
RE	Romney	0-8	6-20	1.30-1.50	0.6-2.0	0.14-0.18	3.5-5.5	0	Low	.37	5	5	2.0-4.0
		8-75	18-35	1.30-1.50	0.2-0.6	0.15-0.22	3.5-6.5	0	Low	.43			0.0-0.5
	Elkton	0-10	11-25	1.20-1.50	0.6-2.0	0.18-0.24	3.5-5.5	0	Low	.43	5	5	1.0-4.0
		10-24	27-35	1.35-1.55	0.06-0.2	0.14-0.20	3.5-5.5	0	Moderate	.37			0.0-0.5
		24-40	27-45	1.35-1.55	0.00-0.2	0.12-0.19	3.5-5.5	0	Moderate	.32			0.0-0.5
		40-65	10-20	1.45-1.65	0.2-20	0.10-0.15	3.5-5.5	0	Low	.32			0.0-0.5
RoA	Romney	0-8	6-20	1.30-1.50	0.6-2.0	0.14-0.18	3.5-5.5	0	Low	.37	5	5	2.0-4.0
		8-75	18-35	1.30-1.50	0.2-0.6	0.15-0.22	3.5-6.5	0	Low	.43			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
Ud	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
Ur	Urban land.												
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
WdA	Woodstown	0-11	5-18	1.00-1.40	0.6-6.0	0.08-0.16	3.6-5.5	0	Low	.24	5	3	1.0-2.0
		11-29	18-30	1.35-1.70	0.2-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
		29-70	5-20	1.35-1.65	0.6-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
WdB	Woodstown	0-11	5-18	1.00-1.40	0.6-6.0	0.08-0.16	3.6-5.5	0	Low	.24	5	3	1.0-2.0
		11-29	18-30	1.35-1.70	0.2-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
		29-70	5-20	1.35-1.65	0.6-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
WdC	Woodstown	0-11	5-18	1.00-1.40	0.6-6.0	0.08-0.16	3.6-5.5	0	Low	.24	5	3	1.0-2.0
		11-29	18-30	1.35-1.70	0.2-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
		29-70	5-20	1.35-1.65	0.6-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
Ze	Zekiah	0-3	8-15	1.20-1.50	0.6-2.0	0.12-0.22	3.5-5.5	0-2	Low	.43	5	8	5.0-18.0
		3-20	8-18	1.20-1.50	0.6-2.0	0.10-0.20	3.5-5.5	0-2	Low	.43			1.0-5.0
		20-27	5-15	1.30-1.50	2.0-6.0	0.10-0.20	3.5-5.5	0-2	Low	.28			2.0-18.0
		27-37	5-15	1.30-1.60	2.0-6.0	0.08-0.15	3.5-5.5	0-2	Low	.24			1.0-18.0
		37-50	5-18	1.30-1.60	2.0-6.0	0.10-0.20	3.5-5.5	0-2	Low	.15			1.0-5.0
		50-72	2-8	1.50-1.70	2.0-20	0.05-0.10	3.5-5.5	0-2	Low	.15			1.0-5.0

Table 16.--Water Features

Map symbol	Soil name	Hydrologic group	Flooding			High water table		
			Frequency	Duration	Months	Depth	Kind	Months
						Ft		
BeA	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
BeB	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
BeC	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
BU	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
	Urban land.							
Ch	Chicone	D	Occasional	Brief	Jan-Dec	+1.0-0.5	Apparent	Nov-Jun
Cd	Codorus	C	Occasional	Very brief	Dec-Apr	1.0-2.0	Apparent	Nov-Apr
Co	Corsica	C/D	None		---	+1.0-0.5	Apparent	Dec-Jun
Ek	Elkton	C/D	None		---	0-1.0	Apparent	Nov-May
Fa	Fallsington	B/D	None		---	0-1.0	Apparent	Dec-May
HbA	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HbB	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HbC	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HbE	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HU	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
	Urban land.							
In	Indiantown	D	Frequent	Brief	Jan-Dec	+0.5-0.5	Apparent	Sep-Jun
Kn	Kentuck	B/D	None		---	+1.0-0.5	Apparent	Dec-Jun
Kj	Klej	B/D	None		---	1.0-2.0	Apparent	Dec-Apr
Le	Lenape	D	Frequent	Very brief	Jan-Dec	+1.0-0.5	Apparent	Jan-Dec
Lo	Longmarsh	D	Frequent	Brief	Jan-Dec	+0.5-1.5	Apparent	Sep-Jun
Ma	Manahawkin	D	Frequent	Long	Jan-Mar	+1.0-0	Apparent	Oct-Jul
MpA	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
MpB	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
MpC	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
MU	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
	Urban land.							
MwA	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr

Table 16.--Water Features--Continued

Map symbol	Soil name	Hydrologic group	Flooding			High water table		
			Frequency	Duration	Months	Depth	Kind	Months
						Ft		
NnA	Nassawango	B	None		---	3.5-6.0	Perched	Dec-Apr
NnB	Nassawango	B	None		---	3.5-6.0	Perched	Dec-Apr
NnC	Nassawango	B	None		---	3.5-6.0	Perched	Dec-Apr
Ot	Othello	D	None		---	+1.0-0.5	Apparent	Jan-Jun
Po	Pone	B/D	None		---	+1.0-0.5	Apparent	Dec-Jun
Pk	Puckum	D	Frequent	Brief	Jan-Dec	+1.0-0	Apparent	Jan-Dec
RE	Romney	C	None		---	1.0-2.5	Apparent	Dec-May
	Elkton	C/D	None		---	0-1.0	Apparent	Nov-May
RoA	Romney	C	None		---	1.0-2.5	Apparent	Dec-May
Ud	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
Ur	Urban land.							
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
WdA	Woodstown	C	None		---	1.5-3.5	Apparent	Jan-Apr
WdB	Woodstown	C	None		---	1.5-3.5	Apparent	Jan-Apr
WdC	Woodstown	C	None		---	1.5-3.5	Apparent	Jan-Apr
Ze	Zekiah	D	Frequent	Brief	Jan-Dec	0-1.0	Apparent	Sep-Jun

Table 17.--Soil Features

Map symbol	Soil name	Depth to bedrock	Subsidence		Potential frost action	Risk of corrosion	
			Initial	Total		Uncoated steel	Concrete
		In	In	In			
BeA	Beltsville	>60	0	---	High	High	High
BeB	Beltsville	>60	0	---	High	High	High
BeC	Beltsville	>60	0	---	High	High	High
BU	Beltsville	>60	0	---	High	High	High
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
	Urban land.						
Ch	Chicone	>60	0	---	Moderate	High	High
Cd	Codorus	>60	0	---	High	High	Moderate
Co	Corsica	>99	0	---	Moderate	High	High
Ek	Elkton	>60	0	---	Moderate	High	High
Fa	Fallsington	>60	0	---	Moderate	High	High
HbA	Hambrook	>60	0	---	Moderate	Moderate	High
HbB	Hambrook	>60	0	---	Moderate	Moderate	High
HbC	Hambrook	>60	0	---	Moderate	Moderate	High
HbE	Hambrook	>60	0	---	Moderate	Moderate	High
HU	Hambrook	>60	0	---	Moderate	Moderate	High
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
	Urban land.						
In	Indiantown	>60	0	---	Moderate	High	High
Kn	Kentuck	>60	0	---	Moderate	High	High
Kj	Klej	>60	0	---	Moderate	Low	High
Le	Lenape	>60	10-20	20-40	Low	High	High
Lo	Longmarsh	>99	0	---	High	High	High
Ma	Manahawkin	>60	6-12	18-32	High	High	High
MpA	Mattapex	>60	0	---	Moderate	High	High
MpB	Mattapex	>60	0	---	Moderate	High	High
MpC	Mattapex	>60	0	---	Moderate	High	High
MU	Mattapex	>60	0	---	Moderate	High	High
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
	Urban land.						
MwA	Mattapex	>60	0	---	Moderate	High	High

Table 17.--Soil Features--Continued

Map symbol	Soil name	Depth to bedrock	Subsidence		Potential frost action	Risk of corrosion	
			Initial	Total		Uncoated steel	Concrete
		In	In	In			
NnA	Nassawango	>60	0	---	Moderate	Moderate	High
NnB	Nassawango	>60	0	---	Moderate	Moderate	High
NnC	Nassawango	>60	0	---	Moderate	Moderate	High
Ot	Othello	>60	0	---	Low	High	High
Po	Pone	>60	0	---	Moderate	High	High
Pk	Puckum	>60	10-20	20-40	Low	High	High
RE	Romney	>60	0	---	None	High	High
	Elkton	>60	0	---	Moderate	High	High
RoA	Romney	>60	0	---	None	High	High
Ud	Udorthents	>60	0	---	Moderate	Moderate	Moderate
Ur	Urban land.						
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
WdA	Woodstown	>60	0	---	Moderate	Moderate	High
WdB	Woodstown	>60	0	---	Moderate	Moderate	High
WdC	Woodstown	>60	0	---	Moderate	Moderate	High
Ze	Zekiah	>60	0	---	Moderate	High	High

Table 18.--Comprehensive Hydric Soils List

[All map units are displayed regardless of hydric status and are listed in alphanumeric order by map unit symbol. The 'Hydric soils criteria' columns indicate the conditions that caused the map unit component to be classified as hydric or non-hydric. These criteria are defined in "Hydric Soils of the United States" (USDA Miscellaneous Publication No. 1491, June, 1991, as revised in the Federal Register, Vol. 60, No. 37, February 24, 1995)]

Map symbol and map unit name	Component (C) / Inclusion (I)*	Hydric	Local landform	Hydric soils criteria: Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
BeA:							
Beltsville silt loam, 0 to 2 percent slopes							
	Beltsville (C)	No					
	Unnamed soils (I)	No					
BeB:							
Beltsville silt loam, 2 to 5 percent slopes							
	Beltsville (C)	No					
	Unnamed soils (I)	No					
BeC:							
Beltsville silt loam, 5 to 10 percent slopes							
	Beltsville (C)	No					
	Unnamed soils (I)	No					
BU:							
Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes							
	Beltsville (C)	No					
	Udorthents (C)	No					
	Urban land (C)	Unranked					
	Unnamed soils (I)	No					
Ch:							
Chicone silt loam							
	Chicone (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Cd:							
Codorus loam							
	Codorus (C)	No					
	Unnamed soils (I)	No					
Co:							
Corsica loam							
	Corsica (C)	Yes	Carolina Bay	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Carolina Bay	2B3	Yes	No	No

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component(C)/ Inclusion(I)*	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
Ek:							
Elkton silt loam------							
	Elkton (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Fa:							
Fallsington sandy loam							
	Fallsington (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
HbA:							
Hambrook sandy loam, 0 to 2 percent slopes							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HbB:							
Hambrook sandy loam, 2 to 5 percent slopes							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HbC:							
Hambrook sandy loam, 5 to 10 percent slopes							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HbE:							
Hambrook sandy loam, 10 to 60 percent slopes----------							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HU:							
Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes							
	Hambrook (C)	No					
	Udorthents (C)	No					
	Urban land (C)	Unranked					
	Unnamed soils (I)	No					
In:							
Indiantown mucky silt loam----------							
	Indiantown (C)	Yes	Flood Plain	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flood Plain	2B3	Yes	No	No

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component(C)/ Inclusion(I)*	Hydric	Local landform	Hydric soils criteria: Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
Kn:							
Kentuck silt loam-----							
	Kentuck (C)	Yes	Carolina Bay	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Carolina Bay	2B3	Yes	No	No
Kj:							
Klej loamy sand-------							
	Klej (C)	No					
	Unnamed soils (I)	No					
Le:							
Lenape mucky peat-----							
	Lenape (C)	Yes	Salt Marsh	1	Yes	No	No
	Unnamed soils (I)	Yes	Salt Marsh	1	Yes	No	No
Lo:							
Longmarsh sandy loam--							
	Longmarsh (C)	Yes	Flood Plain	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flood Plain	2B3	Yes	No	No
Ma:							
Manahawkin muck-------							
	Manahawkin (C)	Yes	Marsh	1,4	Yes	Yes	No
	Unnamed soils (I)	Yes	Flood Plain	1,4	Yes	Yes	No
MpA:							
Mattapex silt loam, 0 to 2 percent slopes							
	Mattapex (C)	No					
	Unnamed soils (I)	No					
MpB:							
Mattapex silt loam, 2 to 5 percent slopes							
	Mattapex (C)	No					
	Unnamed soils (I)	No					
MpC:							
Mattapex silt loam, 5 to 10 percent slopes							
	Mattapex (C)	No					
	Unnamed soils (I)	No					
MU:							
Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes							
	Mattapex (C)	No					
	Udorthents (C)	No					
	Urban land (C)	Unranked					
	Unnamed soils (I)	No					

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component (C)/ Inclusion (I)*	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
MwA: Mattapex silt loam, cratered	Mattapex (C)	No					
	Unnamed soils (I)	No					
NnA: Nassawango silt loam, 0 to 2 percent slopes	Nassawango (C)	No					
	Unnamed soils (I)	No					
NnB: Nassawango silt loam, 2 to 5 percent slopes	Nassawango (C)	No					
	Unnamed soils (I)	No					
NnC: Nassawango silt loam, 5 to 10 percent slopes	Nassawango (C)	No					
	Unnamed soils (I)	No					
Ot: Othello silt loam	Othello (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Po: Pone mucky loam	Pone (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Pk: Puckum muck	Puckum (C)	Yes	Swamp	1	Yes	No	No
	Unnamed soils (I)	Yes	Swamp	1	Yes	No	No
RE: Romney and Elkton soils, cratered	Romney (C)	No					
	Elkton (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	No					
RoA: Romney silt loam	Romney (C)	No					
	Unnamed soils (I)	No					

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component(C)/ Inclusion(I)*		Hydric	Local landform	Hydric soils criteria			
					Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
Ud:								
Udorthents, loamy, 0 to 10 percent slopes								
	Udorthents	(C)	No					
	Unnamed soils	(I)	No					
Ur:								
Urban land-Udorthents complex, 0 to 10 percent slopes								
	Urban land	(C)	Unranked					
	Udorthents	(C)	No					
	Unnamed soils	(I)	No					
WdA:								
Woodstown sandy loam, 0 to 2 percent slopes								
	Woodstown	(C)	No					
	Unnamed soils	(I)	No					
WdB:								
Woodstown sandy loam, 2 to 5 percent slopes								
	Woodstown	(C)	No					
	Unnamed soils	(I)	No					
WdC:								
Woodstown sandy loam, 5 to 10 percent slopes								
	Woodstown	(C)	No					
	Unnamed soils	(I)	No					
Ze:								
Zekiah loam								
	Zekiah	(C)	Yes	Flood Plain	2B3	Yes	No	No
	Unnamed soils	(I)	Yes	Flood Plain	2B3	Yes	No	No

* There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are defined in the maps and the USDA-NRCS Technical Guide, Part II.

** See text for explanation of hydric criteria code.

APPENDIX B

List of Flora Species Known to Occur on APG

List of Flora Species Known to Occur on APG

Scientific Name	Common Name	Occurrence	Origin
Trees			
Acer palmatum	Japanese maple	Uncommon	Introduced
Acer platanoides	Norway maple	Common	Introduced
Acer negundo	Box elder	Scarce	Native
Acer rubrum	Red maple	Common	Native
Acer saccahrum	Sugar maple	Scarce	Native
Acer saccharinum	Silver maple	Common	Native
Aesculus octandra	Sweet buckeye	Scarce	Native
Ailanthus altissima	Tree of heaven	Uncommon	Introduced
Amelanchier arborea	Common shadbush	Uncommon	Native
Betula nigra	River birch	Uncommon	Native
Betula populifolia	Gray birch	Uncommon	Native
Carpinus caroliniana	Ironwood	Uncommon	Native
Carya cordiformis	Bitternut hickory	Common	Native
Carya glabra	Pignut hickory	Common	Native
Carya ovata	Shagbark hickory	Common	Native
Carya tomentosa	Mockernut hickory	Common	Native
Castanea dentata	American chestnut	Common	Native
Catalpa speciosa	Northern catalpa	Uncommon	Native
Cedrus atlantica	Altlantic cedar	Uncommon	Introduced
Celtis occidentalis	American hackberry	Uncommon	Native
Cercis canadensis	Eastern redbud	Uncommon	Native
Chamaecyperis thyoides	Atlantic white cedar	Uncommon	Native
Cornus florida	Flowering dogwood	Common	Native
Diospyros virginiana	Persimmon	Common	Native
Fagus grandifolia	American beech	Common	Native
Fagus sylvatica	Weeping beech	Uncommon	Introduced
Fraxinus americana	White ash	Uncommon	Native
Fraxinus pennsylvanica	Green ash	Common	Native
Ginkgo biloba	Maidenhair tree	Scarce	Introduced
Gleditsia triacanthos	Honey locust	Uncommon	Native
Gymnocladus dioicus	Kentucky coffeetree	Scarce	Native
Ilex aquifolium	English holly	Uncommon	Introduced
Ilex opaca	American holly	Common	Native
Juglans cinerea	Butternut	Uncommon	Native
Juglans nigra	Black walnut	Common	Native
Juniperus virginiana	Red cedar	Common	Native
Koelreuteria paniculata	Goldenrain tree	Uncommon	Introduced
Liquidambar styraciflua	Sweetgum	Common	Introduced
Liriodendron tulipifera	Tulip tree	Common	Native
Maclura pomifera	Osage orange	Common	Native
Magnolia acuminata	Cucumber tree	Scarce	Native
Magnolia tripetala	Umbrella tree	Scarce	Native
Malus sp.	Crabapple	Scarce	Native
Metasequoia glyptostroboides	Dawn redwood	Scarce	Introduced
Morus alba	White mulberry	Uncommon	Introduced

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Nyssa sylvatica	Black gum	Common	Native
Paulownia tomentosa	Princesstree	Common	Introduced
Picea abies	Norway spruce	Scarce	Introduced
Picea pungens	Blue spruce	Uncommon	Native
Pinus nigra	Austrian pine	Uncommon	Introduced
Pinus rigida	Pitch pine	Uncommon	Native
Pinus strobus	Eastern white pine	Common	Native
Pinus taeda	Loblolly pine	Uncommon	Native
Pinus virginiana	Virginia pine	Common	Native
Platanus occidentalis	American sycamore	Common	Native
Populus sp.	Cottonwood	Common	Native
Prunus avium	Sweet cherry	Uncommon	Introduced
Prunus cerasifera	Cherry plum	Uncommon	Introduced
Prunus serotina	Black cherry	Common	Native
Prunus serrulata	Japanese flowering cherry	Uncommon	Introduced
Pseudotsuga menziesii	Douglas fir	Uncommon	Native
Pyrus calleryana	Callery pear	Uncommon	Introduced
Pyrus communis	Common pear	Scarce	Introduced
Pyrus malus	Apple	Scarce	Introduced
Quercus alba	White oak	Common	Native
Quercus bicolor	Swamp white oak	Common	Native
Quercus cerris	European turkey oak	Uncommon	Introduced
Quercus coccinea	Scarlet oak	Common	Native
Quercus falcata	Southern red oak	Common	Native
Quercus michauxii	Swamp chestnut oak	Common	Native
Quercus palustris	Pin oak	Common	Native
Quercus phellos	Willow oak	Common	Native
Quercus prinus	Chestnut oak	Common	Native
Quercus rubra	Northern red oak	Common	Native
Quercus stellate	Post oak	Uncommon	Native
Quercus velutina	Black oak	Common	Native
Robinia pseudoacacia	Black locust	Common	Native
Salix x sepulcralis	Weeping willow	Uncommon	Native
Salix nigra	Black willow	Common	Native
Sassafras albidum	Sassafras	Common	Native
Styphnolobium japonicum	Japanese pagoda tree	Scarce	Introduced
Taxodium distichum	Bald cypress	Infrequent	Native
Thuja occidentalis	Arborvitae	Locally common	Native
Tilia europaea	European linden	Scarce	Introduced
Tsuga canadensis	Eastern hemlock	Infrequent	Native
Ulmus americana	American elm	Uncommon	Native
Vibernum prunifolium	Black haw	Uncommon	Native
Zanthoxylum clava-herculis	Hercules club	Scarce	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Shrubs and Woody Vines			
Amelanchier canadensis	Canadian serviceberry	Common	Native
Amorpha fruticosa	False indigo	Locally common	Native
Asimina triloba	Pawpaw	Uncommon	Native
Baccharis halimifolia	Groundsel tree	Locally common	Native
Berberis thunbergii	Japanese barberry	Common	Introduced
Callicarpa dichotoma	Purple beautyberry	Uncommon	Native
Campsis radicans	Trumpet creeper	Uncommon	Native
Clethra alnifolia	Sweet pepperbush	Common	Native
Cornus amomum	Silky dogwood	Uncommon	Native
Crataegus sp.	Hawthorn	Scarce	Native
Elaeagnus umbellate	Autumn olive	Common	Introduced
Gaylussacia baccata	Black huckleberry	Common	Native
Gaylussacia frondosa	Blue huckleberry	Common	Native
Hedera helix	English ivy	Uncommon	Introduced
Hypericum hypericoides	St. Andrew's cross	Uncommon	Native
Ilex verticullata	Common winterberry	Uncommon	Native
Kalmia latifolia	Mountain laurel	Uncommon	Native
Leucothoe racemosa	Fetterbush	Uncommon	Native
Ligustrum sp.	Privet	Common	Introduced
Lindera benzoin	Spicebush	Common	Native
Lonicera japonica	Japanese honeysuckle	Common	Introduced
Lonicera sp.	Honeysuckle	Common	Introduced
Lyonia ligustrina	Maleberry	Uncommon	Native
Magnolia virginiana	Sweetbay	Common	Native
Morella cerifera	Wax myrtle	Uncommon	Native
Morella sp.	Bayberry	Common	Native
Parthenocissus quinquefolia	Virginia creeper	Common	Native
Rhododendron sp.	Rhododendron	Scarce	Native
Rosa multiflora	Multiflora rose	Common	Introduced
Rosa palustris	Swamp rose	Uncommon	Native
Rubus flagellaris	Dewberry	Common	Native
Rubus phoenicolasius	Wineberry	Common	Introduced
Sambucus sp.	Elderberry	Common	Native
Smilax sp.	Greenbrier	Common	Native
Spiraea alba var. latifolia	White meadowsweet	Uncommon	Native
Spiraea tomentosa	Steeplebush	Uncommon	Native
Symphoricarpos orbiculatus	Coralberry	Uncommon	Native
Toxicodendron radicans	Eastern poison ivy	Common	Native
Vaccinium angustifolium	Early low blueberry	Common	Native
Vaccinium corymbosum	Highbush blueberry	Common	Native
Vaccinium stamineum	Deerberry	Common	Native
Viburnum acerifolium	Mapleleaf viburnum	Common	Native
Viburnum dentatum	Southern arrowood	Common	Native
Vitis sp.	Grape	Common	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Ferns and Fern Allies			
Athyrium filix-femina	Lady fern	Uncommon	Native
Dennstaedtia punctilobula	Eastern hayscented fern	Unknown	Native
Dryopteris marginalis	Mariginal woodfern	Unknown	Native
Onoclea sensibilis	Sensitive fern	Common	Native
Osmunda cinnamomea	Cinnamon fern	Common	Native
Osmunda claytoniana	Interrupted fern	Infrequent	Native
Osmunda regalis	Royal fern	Abundant	Native
Polystichum acrostichoides	Christmas fern	Unknown	Native
Selaginella apoda	Meadow spikemoss	Scarce	Native
Thelypteris noveboracensis	New York fern	Common	Native
Thelypteris palustris	Marsh fern	Unknown	Native
Woodsia obtusa	Blunt-lobed woodsia	Unknown	Native
Woodwardia areolata	Netted chain fern	Scarce	Native
Woodwardia virginica	Virginia chain fern	Unknown	Native
Herbs			
Abutilon theophrasti	Velvet leaf	Scarce	Introduced
Acalypha rhomboidea	Three-sided mercury	Unknown	Native
Acalypha virginica	Three-seeded mercury	Uncommon	Native
Achillea millefolium	Yarrow	Common	Native
Acnida cannabina	Water hemp	Common	Native
Agastache scrophulariifolia	Purple giant hyssop	Unknown	Native
Agrimonia sp.	Agrimony	Common	Native
Alisma sp.	Water plaintain	Scarce	Native
Allium vineale	Field garlic	Common	Introduced
Amaranthus retroflexus	Pigweed	Uncommon	Native
Ambrosia artemesiifolia	Common ragweed	Common	Native
Anagallis arvensis	Scarlet pimpernel	Common	Introduced
Antennaria plantaginifolia	Pussy toes	Uncommon	Native
Apios americana	Groundnut	Unknown	Native
Apocynum cannabinum	Indian hemp	Uncommon	Native
Arctium minus	Common burdock	Common	Native
Arisaema triphyllum	Jack-in-the-pulpit	Uncommon	Native
Ascelpias syriaca	Common milkweed	Common	Native
Ascelpias tuberosa	Butterfly weed	Common	Native
Ascelpias viridiflora	Green milkweed	Common	Native
Asparagus officinalis	Asparagus	Uncommon	Introduced
Aster novi-belgi	New York aster	Common	Native
Barbarea vulgaris	Garden yellowrocket	Common	Introduced
Belamcanda chinensis	Blackberry lilly	Common	Introduced
Bidens aristosa	Beggar Ticks	Common	Native
Bidens bidentoides	Delmarva beggarticks	Common	Native
Bidens coronate	Crowned beggarticks	Common	Native
Bidens discoidea	Small beggarticks	Common	Native
Bidens laevis	Larger bur marigold	Common	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Boehmeria cylindrical	False nettle	Common	Native
Botrychium virginianum	Rattlesnake fern	Unknown	Native
Calibrachoa parviflora	Seaside petunia	Unknown	Native
Callitriche sp.	Water starwort	Uncommon	Introduced
Capsella bursa-pastoris	Shepherds purse	Uncommon	Introduced
Cardamine bulbosa	Bulbous bittercress	Unknown	Native
Cardamine parviflora	Small-flowered bittercress	Unknown	Native
Carduus acanthoides	Thistle	Scarce	Native
Cassia nictitans	Wild sensitive plant	Common	Native
Centaurea biebersteinii	Spotted knapweed	Unknown	Introduced
Cerastium vulgatum	Mouse-ear chickweed	Common	Introduced
Ceratophyllum echinatum	Spineless hornwort	Unknown	Native
Chelone glabra	Turtlehead	Unknown	Native
Chenopodium sp.	Goosefoot	Uncommon	Introduced
Chimaphila maculate	Spotted wintergreen	Scarce	Native
Chrysanthemum leucanthemum	Ox-eye daisy	Common	Native
Cimicifuga racemosa	Black snakeroot	Common	Native
Cichorium intybus	Chicory	Common	Native
Circaea quadrisulcata	Enchanter's nightshade	Common	Native
Cirsium arvense	Canada thistle	Uncommon	Introduced
Cirsium discolor	Field thistle	Uncommon	Native
Cirsium horridulum	Yellow thistle	Uncommon	Native
Cirsium muticum	Swamp thistle	Uncommon	Native
Cirsium vulgare	Bull thistle	Uncommon	Introduced
Collinsonia canadensis	Horsebalm	Uncommon	Native
Commelina communis	Asiatic dayflower	Infrequent	Introduced
Conyza canadensis	Horseweed	Common	Native
Daucus carota	Queen Anne's lace	Abundant	Introduced
Decodon verticillatus	Water willow	Unknown	Native
Desmodium ciliare	Hairy small-leaf tick trefoil	Uncommon	Native
Desmodium cuspidatum	Large-bracted tick trefoil	Uncommon	Native
Desmodium paniculatum	Panicled tick trefoil	Uncommon	Native
Desmodium sessifolium	Sessile-leaf tick trefoil	Uncommon	Native
Desmodium sessilifolium	Sessile-leaf tick trefoil	Uncommon	Native
Dianthus armeria	Deptford Pink	Uncommon	Introduced
Diodia virginiana	Virginia buttonweed	Unknown	Native
Dioscorea villosa	Wild yam	Uncommon	Introduced
Duchesnea indica	Indian strawberry	Uncommon	Introduced
Epifagus virginiana	Beech-drops	Uncommon	Native
Epilobium coloratum	Willow herb	Uncommon	Native
Erechtites hieracifolia	Pilewort	Common	Native
Erigeron annuus	Daisy fleabane	Common	Native
Erigeron strigosus	Lesser daisy fleabane	Common	Native
Euphorbia sp.	Spurge	Common	Native
Eupatorium dubium	Joe-pye weed	Common	Native
Eupatorium hyssopifolium	Hyssop-leaved boneset	Unknown	Natve
Eupatorium rotundifolium	Round-leaved boneset	Unknown	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Eupatorium sp.	Boneset	Common	Native
Fragaria sp.	Strawberry	Uncommon	Native
Galearis spectabilis	Showy orchid	Unknown	Native
Galium aparine	Cleavers	Unknown	Native
Galium circaezans	Wild licorice	Unknown	Native
Galium mollugo	Wild madder	Common	Introduced
Galium palustre	Marsh bedstraw	Unknown	Native
Geranium macuatum	Wild geranium	Unknown	Native
Geranium robertianum	Herb robert	Unknown	Introduced
Gerardia purpurea	Gerardia	Uncommon	Native
Geum canadense	White avens	Uncommon	Native
Glecoma hederaces	Ground ivy	Common	Introduced
Gnaphilum purpurea	Purple Cudweed	Uncommon	Native
Goodyera pubescens	Downy rattlesnake plaintain	Unknown	Native
Hedeoma pulegiodes	Pennyroyal	Uncommon	Native
Hemerocallis fulva	Day lily	Common	Introduced
Heteranthera dubia	Water stargrass	Common	Native
Heteranthera reniformis	Mud plantain	Infrequent	Native
Hibiscus palustris	Swamp rose mallow	Uncommon	Native
Hieracium aurantiacum	Orange hawkweed	Uncommon	Introduced
Hieracium pratense	Field hawkweed	Uncommon	Introduced
Hieracium venosum	Rattlesnake weed	Uncommon	Native
Hottonia inflata	American featherfoil	Unknown	Native
Hydrilla verticillata	Hydrilla	Common	Introduced
Hydrocotyle ranunculoides	Floating marshpennywort	Scarce	Native
Hydrophyllum virginianum	Virginia waterleaf	Unknown	Native
Hypericum gentianoides	Orangegrass	Unknown	Native
Hypericum punctatum	St. John's-wort	Uncommon	Native
Hypoxis hirsute	Yellow stargrass	Unknown	Native
Impatiens capensis	Jewelweed	Common	Native
Ipomoea purpurea	Morning glory	Uncommon	Introduced
Iris prismatica	Slender blue iris	Unknown	Native
Iris pseudacorus	Yellow iris	Unknown	Introduced
Iris versicolor	Harlequin blueflag	Unknown	Native
Krigia sp.	Dwarf dandelion	Uncommon	Native
Lactuca sp.	Lettuce	Abundant	Native
Lamium purpureum	Red dead nettle	Uncommon	Introduced
Lemna minor	Common duckweed	Common	Native
Lemna triscula	Star duckweed	Unknown	Native
Lepidium campestre	Field peppergrass	Unknown	Introduced
Lepidium virgincum	Common peppergrass	Common	Native
Lespedeza capitata	Round-head bush clover	Common	Native
Lespedeza procumbens	Trailing bush clover	Common	Native
Lespedeza repens	Creeping bush clover	Common	Native
Lespedeza violacea	Violet bush clover	Common	Native
Lespedeza virginica	Slender bush clover	Common	Native
Lilaeopsis chinensis	Eastern grasswort	Unknown	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Linaria canadensis	Blue toadflax	Unknown	Native
Linaria vulgaris	Butter-and-eggs	Uncommon	Introduced
Linum virginianum	Wild yellow flax	Uncommon	Native
Listera australis	Southern twayblade	Unknown	Native
Lobelia cardinalis	Cardinal flower	Unknown	Native
Lobelia inflate	Indian tobacco	Scarce	Native
Lobelia puberula	Downy lobelia	Unknown	Native
Ludwigia palustris	False loosestrife	Locally common	Native
Lycopus americanus	Water horehound	Unknown	Native
Lycopus uniflorus	Northern bugleweed	Unknown	Native
Lysimachia hybrid	Lowland yellow loosestrife	Unknown	Native
Lysimachia nummularia	Creeping jenny	Unknown	Introduced
Lysmachia terrestris	Swamp candles	Unknown	Native
Medeola virginiana	Indian cucumber root	Unknown	Native
Medicago lupulina	Black medick	Common	Introduced
Melampyrum lineare	Cowwheat	Unknown	Native
Melilotus alba	White sweet clover	Common	Introduced
Mentha piperita	Peppermint	Unknown	Introduced
Mentha spicata	Spearmint	Uncommon	Introduced
Mikania scandens	Climbing hempweed	Scarce	Native
Mimulus ringens	Ringeon monkeyflower	Unknown	Native
Mitchella repens	Partridgeberry	Uncommon	Introduced
Mollugo verticillata	Carpet weed	Uncommon	Introduced
Monotropa uniflora	Indian pipe	Scarce	Native
Muriophyllum exalbescens	Water milfoil	Common	Native
Myriophyllum spicatum	Eurasian watermilfoil	Common	Introduced
Nuphar luteum	Yellow water lily	Uncommon	Native
Oenothera biennis	Evening primrose	Uncommon	Native
Oenothera fruticosa	Sundrops	Uncommon	Native
Ophioglossum vulgatum	Southern adderstongue	Unknown	Native
Ornithogalum umbellatum	Star-of-Bethlehem	Unknown	Introduced
Orontium aquaticum	Golden club	Unknown	Native
Osmorhiza claytonii	Clayton’s sweetroot	Unknown	Native
Oxalis stricta	Yellow wood sorrel	Common	Native
Oxalis violacea	Violet wood sorrel	Common	Native
Passiflora lutea	Passion flower	Scarce	Native
Pedicularis lanceolata	Swamp lousewort	Unknown	Native
Peltandra virginica	Arrow arum	Common	Native
Penstemon digitalis	White beardtongue	Unknown	Native
Penthorum sedoides	Ditch stonecrop	Unknown	Native
Perilla frutesceus	Beefsteak plant	Common	Introduced
Petunia parviflora	Ground cherry	Scarce	Native
Phytolacca americana	Pokeberry	Common	Native
Pilea pumila	Clearweed	Common	Native
Plantago aristata	Bracted plaintain	Unknown	Native
Plantago lanceolata	English plaintain	Common	Introduced
Plantago major	Common plaintain	Common	Introduced

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Plantathera lacera	Green fringed orchid	Scarce	Native
Podophyllum peltatum	Mayapple	Common	Native
Polygala sp.	Milkwort	Common	Native
Polygonum cuspidatum	Japanese knotweed	Common	Introduced
Polygonum hydropiper	Common smartweed	Common	Introduced
Polygonum hydropiperoides	Mild water pepper	Unknown	Native
Polygonum pennsylvanicum	Pink knotweed	Unknown	Native
Polygonum perfoliatum	Asiatic tearthumb	Common	Introduced
Polygonum persicaria	Lady's thumb	Common	Introduced
Polygonum sagittatum	Arrow-leaved tearthumb	Common	Native
Pontederia cordata	Pickerelweed	Unknown	Native
Portulaca oleracea	Purslane	Uncommon	Native
Potamogeton foliosus	Leafy pondweed	Common	Native
Potamogeton perfoliatus	Claspingleaf pondweed	Common	Native
Potamogeton pusillus	Small pondweed	Common	Native
Potentilla canadensis	Dwarf cinquefoil	Unknown	Native
Potentilla norvegica	Rough cinquefoil	Unknown	Native
Potentilla simplex	Common cinquefoil	Common	Native
Proserpinaca palustris	Mermaid weed	Unknown	Native
Prunella vulgaris	Heal-all	Uncommon	Native
Pycnanthemum tenuifolium	Narrowleaf mountain mint	Uncommon	Native
Pycnanthemum virginianum	Virginia mountain mint	Uncommon	Native
Ranunculus abortivus	Small-flowered crowfeet	Unknown	Native
Ranunculus trichophyllus	White water buttercup	Unknown	Native
Rhexia mariana	Maryland meadow beauty	Unknown	Native
Rudbeckia hirta	Black-eyed susan	Common	Native
Rumex acetosella	Field sorrel	Common	Introduced
Rumex crispus	Curled dock	Common	Introduced
Sabatia angularis	Rose pink	Uncommon	Native
Sabatia stellaris	Marsh pink	Uncommon	Native
Sagittaria calycina	Hooded arrowhead	Common	Native
Sagittaria latifolia	Common arrowhead	Common	Native
Salvia lyrata	Lyreleaf sage	Unknown	Native
Samolus parviflorus	Water pimpernel	Unknown	Native
Saururus cernuus	Lizard tail	Uncommon	Native
Saxifraga virginiensis	Early saxifrage	Unknown	Native
Scrophularia marilandica	Carpenter's square	Scarce	Native
Scutellaria galericulata	Marsh skullcap	Unknown	Native
Scutellaria lateriflora	Mad-dog skullcap	Unknown	Native
Senecio aureus	Golden ragwort	Unknown	Native
Silene antirrlina	Sleepy catchfly	Uncommon	Native
Sium suave	Water parsnip	Unknown	Native
Smilacina racemosa	False solomous seal	Uncommon	Native
Solanum americanum	Black nightshade	Uncommon	Native
Solanum carolinense	Horsenettle	Common	Native
Solanum dulcamara	Climbing nightshade	Common	Native
Solidago altissima	Tall goldenrod	Common	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Solidago graminifolia	Lance-leaved goldenrod	Common	Native
Solidago odora	Sweet goldenrod	Common	Native
Solidago rugosa	Rough-stem goldenrod	Common	Native
Solidago sempervirens	Seaside goldenrod	Common	Native
Spiranthes lacera var. gracilis	Northern slender lady tresses	Unknown	Native
Stellaria media	Common chickweed	Common	Introduced
Strophostyles helvola	Wild bean	Uncommon	Native
Stylosanthes biflora	Pencil flower	Scarce	Native
Symplocarpus foetidus	Skunk cabbage	Infrequent	Native
Taraxacum officinale	Common dandelion	Common	Introduced
Teucrium canadense	American germander	Uncommon	Native
Tipularia discolor	Crippled cranefly	Unknown	Native
Toyara virginiana	Jump seed	Common	Native
Triadenum virginicum	Marsh St. Johnswort	Unknown	Native
Trichostema dichotomum	Blue curls	Unknown	Native
Trifolium dubium	Least hop clover	Common	Introduced
Trifolium repens	White clover	Common	Introduced
Typha angustifolia	Narrow-leaved cattail	Abundant	Native
Typha latifolia	Common cattail	Abundant	Native
Urtica gracilenta	Stinging nettle	Unknown	Native
Utricularia gibba	Humped bladderwort	Unknown	Native
Uvularia sessilifolia	Bellwort	Uncommon	Native
Vallisneria americana	Wild celery	Common	Native
Verbascum sp.	Mullein	Uncommon	Native
Verbena hastate	Blue vervain	Uncommon	Native
Verbesina sp.	Crownbeard	Uncommon	Native
Vernonia noveboracensis	New York Ironweed	Common	Native
Veronica arvensis	Corn speedwell	Common	Introduced
Veronica officinalis	Common gypsyweed	Common	Introduced
Veronica persica	Persian speedwell	Common	Introduced
Veronicastrum virginicum	Culver's root	Unknown	Native
Vicia americana	American vetch	Scarce	Native
Vicia angustifolia	Narrowleaf vetch	Scarce	Introduced
Vicia cracca	Cow vetch	Scarce	Introduced
Viola affinis	Le Conte's violet	Unknown	Native
Viola cucullata	Marsh blue violet	Unknown	Native
Viola papilionacea	Common violet	Common	Native
Wolffia papulifera	Brazilian watermeal	Scarce	Native
Xanthium sp.	Cocklebur	Uncommon	Native
Zannichellia palustris	Horned pondweed	Unknown	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Grasses			
Agropyron repens	Quack grass	Uncommon	Introduced
Agrostis alba	Red top	Common	Native
Agrostis hyemalis	Ticklegrass	Unknown	Native
Agrostis perennans	Upland bentgrass	Unknown	Native
Ammophila breviligulata	Beach grass	Uncommon	Native
Andropogon scoparius	Broom	Uncommon	Native
Andropogon virginicus	Broom Sedge	Common	Native
Anthoxanthum odoratum	Sweet vernal grass	Common	Introduced
Arthraxon hispidus	Makino	Abundant	Introduced
Bromus ciliatus	Brome grass	Unknown	Native
Bromus inermis	Smooth brome	Unknown	Natve
Bromus japonicus	Japanese brome	Common	Introduced
Cinna arundinacea	Sweet woodreed	Abundant	Native
Cynodon dactylon	Bermuda grass	Infrequent	Introduced
Dactylis glomerata	Orchard grass	Unknown	Introduced
Danthonia spicata	Poverty grass	Common	Native
Digitaria villosa	Crab grass	Common	Introduced
Distichlis spicata	Inland saltgrass	Unknown	Native
Echinochloa crusqualli	Barnyard grass	Common	Introduced
Eleusine indica	Goose grass	Infrequent	Introduced
Elymus villosus	Hairy wild rye	Common	Native
Eragrostis spectabilis	Purple love grass	Uncommon	Native
Festuca rubra	Red fescue	Common	Introduced
Glyceria septentrionalis	Eastern manna grass	Infrequent	Native
Glyceria striata	Fowl meadow grass	Unknown	Native
Holcus lanatus	Velvet grass	Common	Introduced
Leersia oryzoides	Rice cut grass	Unknown	Native
Leersia virginica	White cut grass	Common	Native
Lolium perenne	Perennial rye grass	Uncommon	Introduced
Microstegium vimineum	Japanese stilt grass	Common	Introduced
Muhlenbergia sp.	Muhly	Infrequent	Native
Panicum sp.	Panic grass	Common	Native
Panicum agrostoides	Redtop panicum	Unknown	Native
Panicum dichotomiflorum	Fall panicgrass	Unknown	Native
Panicum virgatum	Switchgrass	Unknown	Native
Paspalum leave	Smooth pasdalum	Common	Native
Phleum pratense	Timothy	Uncommon	Introduced
Phragmites australis	Common reed	Abundant	Native
Poa annua	Low speargrass	Infrequent	Introduced
Poa compressa	Canada bluegrass	Infrequent	Introduced
Poa pratensis	Kentucky bluegrass	Common	Native
Setaria viridis	Green foxtail	Common	Introduced
Sertaria geniculate	Knotroot bristlegrass	Infrequent	Introduced
Spartina cynosuroides	Big cordgrass	Common	Native
Spartina patens	Salt-meadow cord grass	Uncommon	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Sporobolus vaginiflorus	Poverty grass	Unknown	Native
Triodia flava	Purple top	Uncommon	Native
Tripsacum dactyloides	Eastern gamagrass	Common	Native
Uniola laxa	Spike grass	Uncommon	Native
Sedges			
Carex crinita	Fringed sedge	Abundant	Native
Carex lanuginose	Wooly sedge	Unknown	Native
Carex laxiflora	Looseflower sedge	Unknown	Native
Carex lurida	Sallow sedge	Abundant	Native
Carex radiate	Eastern star sedge	Unknown	Native
Carex scoparia	Broom sedge	Unknown	Native
Carex stricta	Uptight sedge	Unknown	Native
Carex vulpinoidea	Foxtail sedge	Common	Native
Cyperus ovularis	Sedge	Common	Native
Cyperus strigosus	Straw-colored flat sedge	Common	Native
Eleocharis acicularis	Spike rush	Common	Native
Eleocharis obtusa	Spike rush	Common	Native
Eleocharis rostellata	Beaked spikerush	Unknown	Native
Eleocharis tenuis	Doghair	Infrequent	Native
Scirpus americanus	Three-square	Common	Native
Scirpus cyperinus	Wool grass	Unknown	Native
Scirpus olneyi	Olney bulrush	Uncommon	Native
Scirpus validus	Great bulrush	Common	Native
Rushes			
Juncus bufonius	Toad rush	Unknown	Native
Juncus canadensis	Canadian rush	Unknown	Native
Juncus effusus	Soft rush	Infrequent	Native
Juncus tenuis	Path rush	Common	Native
Juncus torreyi	Torrey’s rush	Unknown	Native

Survey for Rare, Threatened and Endangered Vascular Plants of the Aberdeen Proving Grounds

Harford and Baltimore Counties, Maryland

Field Seasons 1998 & 1999

Submitted by

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to

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The Aberdeen Proving Grounds
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TABLE OF CONTENTS

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SITE ORIENTATION AND LOGISTICS
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Mike McCarter, Engineering Technician

ANNOTATION OF BOTANICAL SPECIMENS AT THE BEBB HERBARIUM
Forrest Johnson, Assistant Curator, Bebb Herbarium

ACCESSING MARYLAND HERITAGE DATABASE FILES
Lynn Davidson, Database Manager, Maryland Department of Natural Resources

CONFIRMATION OF BOTANICAL SPECIMENS
Mark Strong (US)
Bidens coronata
Carex typhina
Eleocharis tenuis var. *pseudoptera*
Hedyotis uniflora
Juncus torreyi
Lathyrus palustris
Lycopodiella caroliniana
Lysimachia hybrida
Pycnanthemum virginianum
Rhynchospora globularis var. *recognita*
Scirpus pendulus

Anton Reznicek (MICH)
Carex lupulina
Carex straminea
Eleocharis rostellata

Larry Davenport (Samford University)
Lemna perpusilla
Spirodela punctata
Wolffia papulifera

Robert Haynes (UNA)
Sagittaria spatulata
Sagittaria subulata

Charles Sheviak (NYS)
Spiranthes cernua

INTRODUCTION

THE STUDY SITE

The Aberdeen Proving Grounds (APG) occupy 79,284 acres (31,714 hectares) in northeastern Maryland along the shore of the Chesapeake Bay in Harford and Baltimore Counties. The Harford County portion of APG is divided by the Bush River into the Edgewood area to the south and the larger Aberdeen area to the north. Baltimore County contains only a small portion of APG, comprised of Carroll Island and Graces Quarters peninsula extending out to Battery Point. Since much of APG lie below 7.5 m elevation, numerous wetlands occur throughout the property. Upland areas are comprised of mowed lawns, young deciduous woodlands and some large areas of meadow that are anthropogenically managed to various degrees.

SOILS

Hunt (1974) places APG within the embayed section of the Low-lying Atlantic Coastal Plain Physiographic Province. The soils of Harford County are from Upper Teriary formation (Hunt 1974) and are dominated by silt loam, sandy loam, and mucky peat of alluvial, eolian, and fluvio-marine parent material (Ranson and Levan 1998). For more information concerning the soils of APG refer to the discussion of soil types associated with rare plant populations on page 121.

CLIMATE

The APG fall within the Temperate Continental climate zone delineated by Trewartha and Horn (1980). Between 1961 and 1990, Aberdeen recorded a mean annual temperature of 55.2 °F (12 °C), with and average annual high temperature of 65.1 °F (18 °C) and an average annual low temperature of 45.3 °F (7 °C). The month of July produces the warmest monthly average temperature of 82.6 °F (28 °C) with an average of 11 days reaching 90 °F (32 °C). Along the shores of the Chesapake Bay, 15 to 25 days per year will reach 90 °F. The month of January produces the lowest average temperature of 23.9 °F (-4 °C) and the highest average number of days falling below freezing. An average of at least 98 days per year fall below freezing. The city of Baltimore located 16 km south of APG recorded an extreme high temperature between 1951 and 1980 of 105 °F (40.5 °C) in August and a record low temperature of -7 °F (-21.5 °C) in January (Ruffner 1985, www.weatherpost.com/longterm/historical/data/aberdeen_md.htm 1999).

Aberdeen receives an average of 43.42 inches (110.2 cm) of precipitation per year. The wettest month is August which receives an average of 4.43 inches (11.2 cm) of precipitation. February is the driest month with an average of 2.70 inches (6.8 cm) of precipitation. The maximum monthly precipitation recorded between 1951 and 1980 in

Baltimore was 18.35 inches (46.6 cm) in August. The relative humidity averages about 60% from February - April and 75% from August - October. The month of October is the only month which recorded no precipitation between 1951 and 1980. Average annual snowfall is 10 to 25 inches (25.4 to 63.5 cm) occurring over 10 to 20 days per year. (Ruffner 1985, Rumney 1968, www.weatherpost.com/longterm/historical/data/aberdeen_md.htm 1999).

The average annual wind speed is from the west at 9.3 mph (15 kph). The windiest month is March which averages 11.0 mph (17.7 kph). The sunniest month is July which receives 65% of the possible sunshine. The least amount of sunshine is received in December. There is an average of 109 clear days, 106 partly cloudy days and 150 cloudy days per year. Thunderstorms occur an average of 28 days per year and heavy fog an average of 27 days. The average frost penetration is approximately 10 inches (25.4 cm) along the coast of Maryland. (Ruffner 1985, Rumney 1968, www.weatherpost.com/longterm/historical/data/aberdeen_md.htm 1999).

METHODS and RESULTS

Site surveys were conducted an average of twice monthly from April through October, 1998 and 1999 to locate occurrences of state or federal endangered or threatened vascular plant taxa. A voucher specimen was collected for each rare species located and the specimens were deposited at the Smithsonian Institution's United States National Herbarium (US) and some duplicates were distributed to MICH, BBG and UNA. The location of each rare plant population that was discovered was marked on a copy of the topographic quadrangles for the APG.

These searches resulted in the discovery of 61 vascular plant species from 44 genera in 32 families that are listed as rare, threatened or endangered by the Maryland Natural Heritage Program (1994) and the first Maryland record of *Spirodela punctata* (dotted duckweed). No plant taxa with federal status were found, although two taxa (*Bidens bidentoides* and *Juglans cinerea*) are under review for federal listing (Maryland Natural Heritage Program 1994). Twelve species were discovered with state endangered or extirpated status and two species with state threatened status, as established in Maryland's Nongame and Endangered Species Conservation Act and the Threatened and Endangered Species Regulations of the Maryland Department of Natural Resources (Code of Maryland Regulations 08.03.08). Additionally, 12 species ranked as highly state rare or state rare were found. The additional 38 species are watch listed in the State of Maryland (Maryland Natural Heritage Program 1994). Fourty-one taxa that are not listed as state rare but were previously unrecorded from the APG were also vouchered. All nomenclature in this report follows Gleason and Cronquist (1991) except for *Eleocharis engelmannii* Steud which follows Kartesz and Kartesz (1980) and the Maryland Natural Heritage Program 1994. Herbarium acronyms follow Holmgren et al. (1990).

Of the 62 rare species collected, 42 were associated with wetland habitats and 20 were found on dry to mesic soils. Carroll Island in Baltimore County and Spesutie Island in Harford County collectively contained populations of 32.3% of the rare species reported. Carroll Island supports 11 rare plant species while Spesutie Island is known to harbor populations of 9 rare species. One taxon (*Scutellaria galericulata*) listed as highly state rare was located on both islands. The Harford County portion of APG contained populations of 47 rare species, the Baltimore County portion possessed 7 rare species and 8 rare species were found in both counties.

MARYLAND NATURAL HERITAGE RANK AND STATUS CATEGORIES

[Maryland Natural Heritage Program (1994)]

EXPLANATION OF GLOBAL ELEMENT RANKS

G3 Rare and local throughout its global range or locally abundant throughout a restricted range or vulnerable to extinction by other intrinsic factors.

G4 Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, though it may be rare in parts of its range, especially at the periphery.

EXPLANTION OF STATE ELEMENT RANKS

SH Historically known from Maryland, but not verified in the past 20 years, yet suspected to still be extant.

S1 Critically imperiled in Maryland because of extreme rarity (generally 5 or fewer extant populations known in the State). Equivalent to being ranked as Highly State Rare.

S2 Imperiled in Maryland because of rarity (generally 6 to 20 estimated occurrences in the State). Equivalent to being ranked as State Rare.

S3 Rare or uncommon in Maryland (generally 21 - 100 estimated occurrences in the State). Equivalent to being ranked as Watch List.

S3.1 A Watch List taxa that is actively tracked by the Natural Heritage Program because of the global significance of Maryland occurrences.

S4 Apparently secure in Maryland, although it may be restricted to only a portion of the State, with typically more than 100 occurrences statewide.

RANK QUALIFIERS

A range of ranks, e.g. S2S3 or G4G5, is assigned to a taxon if available information is insufficient to assign a single numerical rank.

FEDERAL LEGAL STATUS

The status of a taxon as determined by the U.S. Fish and Wildlife Service's Office of Endangered Species, in accordance with the Endangered Species Act, (modified from 50 CRF 17).

C2 Candidate taxa selected by the U.S. Fish and Wildlife Service as possibly appropriate for listing as endangered or threatened, but for which conclusive data on biological vulnerability and threats are not currently available to support proposed rules.

STATE LEGAL STATUS

The legal statuses and definitions established in Maryland's Nongame and Endangered Species Conservation Act and the Threatened and Endangered Species Regulations (COMAR 08.03.08).

X Endangered Extirpated; a species that was once a viable component of the flora, but for which no naturally occurring populations are known to exist in the State.

E Endangered; a species whose continued existence as a viable component of the State's flora is determined to be in jeopardy.

T Threatened; a species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.

N The species has no state status.

Rare, Threatened and Endangered Vascular Plants of the Aberdeen Proving Grounds
Harford and Baltimore Counties, Maryland (listed by family)
(TABLE I)

Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
981002.1 HA	S2	N	G5	Alismataceae	Sagittaria	spatulata	(J. G. Smith) Buchenau			Tidal Sagittaria
990710.2 HA	S3	N	G4	Alismataceae	Sagittaria	subulata	(L.) Buchenau			Hudson Sagittaria
980529.4 HA	S3	N	G5	Apiaceae	Hydrocotyle	ranunculoides	L. f.			Buttercup-pennywort
980724.2 BA	S3	N	G5	Apiaceae	Hydrocotyle	verticillata	Thunb.			Whorled Pennywort
990612.2 HA	SH	X	G?	Apocynaceae	Apocynum	sibiricum	Jacq.			Clasping Dogbane
980807.1 HA	S3	N	G5	Asclepiadaceae	Ampelamus	albidus	(Nutt.) Britton			Sandvine
980612.1 HA	S3	N	G4G5	Asclepiadaceae	Asclepias	purpurascens	L.			Purple Milkweed
980904.1 HA	S3.1	N	G3/C2	Asteraceae	Bidens	bidentoides	(Nutt.) Britton			Southern Estuarine Beggar-ticks
980918.2 BA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
990911.5 HA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
980904.2 HA	S2S3	N	G5	Asteraceae	Bidens	discoidea	(T. & G.) Britton			Few-bracted Beggar-ticks
990612.1 BA	S3	N	G5	Asteraceae	Cirsium	horridulum	Michx.			Yellow Thistle
980821.2 HA	S3	N	G5	Asteraceae	Cirsium	muticum	Michx.			Swamp-Thistle
980724.9 HA	S3	N	G5	Asteraceae	Helenium	flexuosum	Raf.			Southern Sneezeweed
980529.1 HA	S3	N	G5	Asteraceae	Senecio	anonymus	A. Wood			Appalachian Groundsel
990626.3 HA	S1	T	G5	Boraginaceae	Myosotis	macrosperma	Engelm.			Big-seed Forget-me-not
990508.2 HA	S3	N	G5	Boraginaceae	Myosotis	verna	Nutt.			Spring Forget-me-not
980720.4 HA	S1	N	G5	Caesalpiniaceae	Gymnocladus	dioica	(L.) K. Koch			Kentucky Coffee-tree
980515.7 HA	S1	E	G4G5	Ceratophyllaceae	Ceratophyllum	echinatum	A. Gray			Hornwort
980720.1 HA	S3	N	G5	Cuscutaceae	Cuscuta	pentagona	Engelm.			Field-dodder
990612.4 HA	S3	N	G5	Cyperaceae	Carex	atlantica	L. Bailey	capillaceae	(L. Bailey) Cronq.	Eastern Sedge
980515.1 HA	S3	N	G5	Cyperaceae	Carex	canescens	L.			Canescent Sedge
980529.8 HA	S3	N	G5	Cyperaceae	Carex	complanata	Torr. & Hook			Flattened Sedge
980612.2 HA	S3	N	G4	Cyperaceae	Carex	grayi	Carey			Gray's Sedge
980529.5 HA	S1	E	G4	Cyperaceae	Carex	radiata	(Wahlenb.) Small			Radiate Sedge
980417.1 HA	S3	N	G4	Cyperaceae	Carex	seorsa	Howe.			Separated Sedge
980515.4 HA	S3	N	G5	Cyperaceae	Carex	straminea	Willd.			Straw-colored Sedge
990626.1 HA	S1	N	G5	Cyperaceae	Carex	typhina	Michx.			Cat-tail Sedge
980724.2 BA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
990724.5 HA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
980720.3 HA	S3	N	G5	Cyperaceae	Cyperus	lancastriensis	Porter			Lancaster's Sedge
990626.5 HA	?	?	?	Cyperaceae	Eleocharis	tenuis	(Willd.) Schultes	pseudoptera	(Weath.) Svenson	A Spikerush
980720.2 HA	S3	N	G5	Cyperaceae	Eleocharis	engelmannii	Steud.			Engelmann's Spikerush
980724.19 BA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
990807.6 HA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
980724.18 BA	S1	T	G5	Cyperaceae	Eleocharis	rostellata	(Torr.) Torr.			Small-beaked Spikerush
990724.4 HA	S1	E	G5	Cyperaceae	Rhynchospora	globularis	(Chapman) Small	recognita	Gale	Globular Beak-rush
980720.7 BA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush

Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
990724.3 HA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush
980807.8 HA	S3	N	G5	Eriocaulaceae	Commelina	virginica	L.			Virginia Dayflower
980807.2 HA	S1	X	G5	Fabaceae	Lathyrus	palustris	L.			Marsh Wild Pea
990522.1 HA	S2S3	N	G4	Fagaceae	Castanea	dentata	(Marshall) Borkh.			American Chestnut
980724.15 BA	S3	N	G5	Gentianaceae	Sabatia	dodecandra	(L.) BSP.			Perennial Sea-pink
990807.4 HA	S3	N	G5	Gentianaceae	Sabatia	dodecandra	(L.) BSP.			Perennial Sea-pink
990807.2 HA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag
980724.13 BA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag
980515.2 HA	S3	N	G4	Isoetaceae	Isoetes	riparia	Engelm.			Riverbank-quillwort
980821.4 HA	S2S3	N	G3/C2	Juglandaceae	Juglans	cinerea	L.			Butternut
980724.1 BA	S1	E	G5	Juncaceae	Juncus	torreyi	Cov.			Torrey's Rush
980807.4 HA	S2	N	G5	Lamiaceae	Pycnanthemum	virginianum	(L.) Durand & B.D. Jackson			Virginia Mountain Mint
980807.7 HA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980724.21 BA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980529.7 HA	S3	N	G5	Lemnaceae	Lemna	perpusilla	Torr.			Duckweed
990626.4 HA	S?	SR	G?	Lemnaceae	Spirodela	punctata	(G. Meyer) C. Thompson			Lesser Spirodela
980529.6 HA	S2	N	G4	Lemnaceae	Wolffia	papulifera	C. Thompson			Water-meal
980724.5 HA	S3	N	G5	Lentibulariaceae	Utricularia	gibba	L.			Creeping Bladderwort
990911.7 HA	SH	X	G5	Lycopodiaceae	Lycopodium	carolinianum	L.			Slender Clubmoss
980724.1 HA	S3S4	N	G5	Lythraceae	Rotala	ramosior	(L.) Koehne			Tooth-cup
980722.2 BA	S3	N	G5	Najadaceae	Najas	guadelupensis	(Sprengel) Magnus			Southern Water-nymph
990925.1 HA	S3	N	G5	Passifloraceae	Passiflora	lutea	L.			Yellow Passion-flower
980515.6 HA	S3	N	G5	Poaceae	Glyceria	septentrionalis	A. Hitchc.			Eastern Mannagrass
980724.4 HA	S1	E	G5	Potamogetonaceae	Potamogeton	foliosus	Raf.			Leafy Pondweed
980722.1 BA	S2	N	G5	Potamogetonaceae	Potamogeton	perfoliatus	L.			Redhead-grass
980722.3 BA	S1	N	G5	Potamogetonaceae	Potamogeton	pusillus	L.			Slender Pondweed
980529.2 HA	S1	E	G3G4	Primulaceae	Hottonia	inflata	Elliott			Featherfoil
980724.6 HA	S1	E	G5	Primulaceae	Lysimachia	hybrida	Michx.			Mississippi-valley Loosestrife
980408.1 BA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
980529.3 HA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
990911.1 HA	S2	N	G5	Rubiaceae	Hedyotis	uniflora	(L.) Lam.			Clustered Bluets
980904.3 HA	S1	E	G5	Scrophulariaceae	Pedicularis	lanceolata	Michx.			Swamp-lousewort
990911.2 HA	S2	N	G5	Xyridaceae	Xyris	difformis	Chapman			Variable Yellow-eyed Grass

HA = Harford County
BA = Baltimore County

Rare, Threatened and Endangered Vascular Plants of the Aberdeen Proving Grounds
Harford and Baltimore Counties, Maryland (listed by genus and species)
(TABLE II)

Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
980807.1 HA	S3	N	G5	Asclepiadaceae	Ampelamus	albidus	(Nutt.) Britton			Sandvine
990612.2 HA	SH	X	G?	Apocynaceae	Apocynum	sibiricum	Jacq.			Clasping Dogbane
980612.1 HA	S3	N	G4G5	Asclepiadaceae	Asclepias	purpurascens	L.			Purple Milkweed
980904.1 HA	S3.1	N	G3/C2	Asteraceae	Bidens	bidentoides	(Nutt.) Britton			Southern Estuarine Beggar-ticks
980918.2 BA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
990911.5 HA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
980904.2 HA	S2S3	N	G5	Asteraceae	Bidens	discoidea	(T. & G.) Britton			Few-bracted Beggar-ticks
990612.4 HA	S3	N	G5	Cyperaceae	Carex	atlantica	L. Bailey	capillaceae	(L. Bailey) Cronq.	Eastern Sedge
980515.1 HA	S3	N	G5	Cyperaceae	Carex	canescens	L.			Canescent Sedge
980529.8 HA	S3	N	G5	Cyperaceae	Carex	complanata	Torr. & Hook			Flattened Sedge
980612.2 HA	S3	N	G4	Cyperaceae	Carex	grayi	Carey			Gray's Sedge
980529.5 HA	S1	E	G4	Cyperaceae	Carex	radiata	(Wahlenb.) Small			Radiate Sedge
980417.1 HA	S3	N	G4	Cyperaceae	Carex	seorsa	Howe.			Separated Sedge
980515.4 HA	S3	N	G5	Cyperaceae	Carex	straminea	Willd.			Straw-colored Sedge
990626.1 HA	S1	N	G5	Cyperaceae	Carex	typhina	Michx.			Cat-tail Sedge
990522.1 HA	S2S3	N	G4	Fagaceae	Castanea	dentata	(Marshall) Borkh.			American Chestnut
980515.7 HA	S1	E	G4G5	Ceratophyllaceae	Ceratophyllum	echinatum	A. Gray			Hornwort
990612.1 BA	S3	N	G5	Asteraceae	Cirsium	horridulum	Michx.			Yellow Thistle
980821.2 HA	S3	N	G5	Asteraceae	Cirsium	muticum	Michx.			Swamp-Thistle
980724.2 BA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
990724.5 HA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
980807.8 HA	S3	N	G5	Eriocaulaceae	Commelina	virginica	L.			Virginia Dayflower
980720.1 HA	S3	N	G5	Cuscutaceae	Cuscuta	pentagona	Engelm.			Field-dodder
980720.3 HA	S3	N	G5	Cyperaceae	Cyperus	lancastriensis	Porter			Lancaster's Sedge
980720.2 HA	S3	N	G5	Cyperaceae	Eleocharis	engelmannii	Steud.			Engelmann's Spikerush
980724.19 BA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
990807.6 HA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
980724.18 BA	S1	T	G5	Cyperaceae	Eleocharis	rostellata	(Torr.) Torr.			Small-beaked Spikerush
990626.5 HA	?	?	?	Cyperaceae	Eleocharis	tenuis	(Willd.) Schultes	pseudoptera	(Weath.) Svenson	A Spikerush
980515.6 HA	S3	N	G5	Poaceae	Glyceria	septentrionalis	A. Hitchc.			Eastern Mannagrass
980720.4 HA	S1	N	G5	Caesalpiniaceae	Gymnocladus	dioica	(L.) K. Koch			Kentucky Coffee-tree
990911.1 HA	S2	N	G5	Rubiaceae	Hedyotis	uniflora	(L.) Lam.			Clustered Bluets
980724.9 HA	S3	N	G5	Asteraceae	Helenium	flexuosum	Raf.			Southern Sneezeweed
980529.2 HA	S1	E	G3G4	Primulaceae	Hottonia	inflata	Elliott			Featherfoil
980529.4 HA	S3	N	G5	Apiaceae	Hydrocotyle	ranunculoides	L. f.			Buttercup-pennywort
980724.2 BA	S3	N	G5	Apiaceae	Hydrocotyle	verticillata	Thunb.			Whorled Pennywort
990807.2 HA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag
980724.13 BA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag

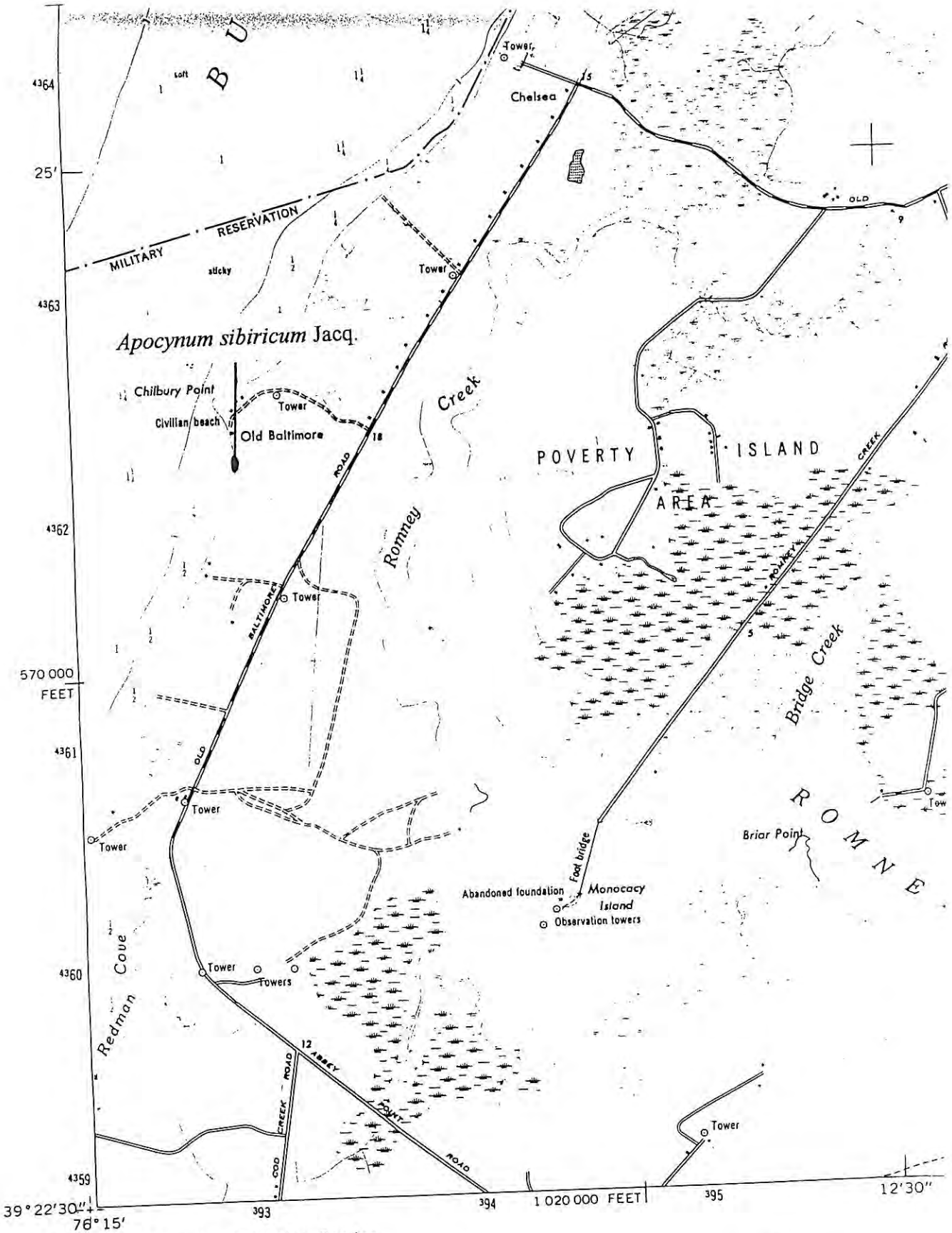
Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
980515.2 HA	S3	N	G4	Isoetaceae	Isoetes	riparia	Engelm.			Riverbank-quillwort
980821.4 HA	S2S3	N	G3/C2	Juglandaceae	Juglans	cinerea	L.			Butternut
980724.1 BA	S1	E	G5	Juncaceae	Juncus	torreyi	Cov.			Torrey's Rush
980807.2 HA	S1	X	G5	Fabaceae	Lathyrus	palustris	L.			Marsh Wild Pea
980529.7 HA	S3	N	G5	Lemnaceae	Lemna	perpusilla	Torr.			Duckweed
990911.7 HA	SH	X	G5	Lycopodiaceae	Lycopodium	carolinianum	L.			Slender Clubmoss
980724.6 HA	S1	E	G5	Primulaceae	Lysimachia	hybrida	Michx.			Mississippi-valley Loosestrife
990626.3 HA	S1	T	G5	Boraginaceae	Myosotis	macrosperma	Engelm.			Big-seed Forget-me-not
990508.2 HA	S3	N	G5	Boraginaceae	Myosotis	verna	Nutt.			Spring Forget-me-not
980722.2 BA	S3	N	G5	Najadaceae	Najas	guadelupensis	(Sprengel) Magnus			Southern Water-nymph
990925.1 HA	S3	N	G5	Passifloraceae	Passiflora	lutea	L.			Yellow Passion-flower
980904.3 HA	S1	E	G5	Scrophulariaceae	Pedicularis	lanceolata	Michx.			Swamp-lousewort
980724.4 HA	S1	E	G5	Potamogetonaceae	Potamogeton	foliosus	Raf.			Leafy Pondweed
980722.1 BA	S2	N	G5	Potamogetonaceae	Potamogeton	perfoliatus	L.			Redhead-grass
980722.3 BA	S1	N	G5	Potamogetonaceae	Potamogeton	pusillus	L.			Slender Pondweed
980807.4 HA	S2	N	G5	Lamiaceae	Pycnanthemum	virginianum	(L.) Durand & B.D. Jackson			Virginia Mountain Mint
980408.1 BA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
980529.3 HA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
990724.4 HA	S1	E	G5	Cyperaceae	Rhynchospora	globularis	(Chapman) Small	recognita	Gale	Globular Beak-rush
980724.1 HA	S3S4	N	G5	Lythraceae	Rotala	ramosior	(L.) Koehne			Tooth-cup
980724.15 BA	S3	N	G5	Gentianaceae	Sabatia	dodecandra	(L.) BSP.			Perennial Sea-pink
990807.4 HA	S3	N	G5	Gentianaceae	Sabatia	dodecandra	(L.) BSP.			Perennial Sea-pink
981002.1 HA	S2	N	G5	Alismataceae	Sagittaria	spatulata	(J. G. Smith) Buchenau			Tidal Sagittaria
990710.2 HA	S3	N	G4	Alismataceae	Sagittaria	subulata	(L.) Buchenau			Hudson Sagittaria
980720.7 BA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush
990724.3 HA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush
980807.7 HA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980724.21 BA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980529.1 HA	S3	N	G5	Asteraceae	Senecio	anonymus	A. Wood			Appalachian Groundsel
990626.4 HA	S?	SR	G?	Lemnaceae	Spirodela	punctata	(G. Meyer) C. Thompson			Lesser Spirodela
980724.5 HA	S3	N	G5	Lentibulariaceae	Utricularia	gibba	L.			Creeping Bladderwort
980529.6 HA	S2	N	G4	Lemnaceae	Wolffia	papulifera	C. Thompson			Water-meal
990911.2 HA	S2	N	G5	Xyridaceae	Xyris	difformis	Chapman			Variable Yellow-eyed Grass

HA = Harford County
BA = Baltimore County

SYNONYMOUS NOMENCLATURE

Four specimens were confirmed using nomenclature differing from that used by Gleason and Cronquist (1991). These taxa and their synonyms are listed below.

Gleason & Cronquist Nomenclature	Synonymous Nomenclature
Lycopodium carolinianum L.	*Pseudolycopodiella* (*Lycopodiella*) *caroliniana* (L.) Pichi Sermolli
Rhynchospora globularis (Chapman) Small var. *recognita* Gale	*Rhynchospora recognita* (Gale) Kral
Sagittaria spatulata (J. G. Smith) Buchenau	*Sagittaria montevidensis* Chamisso & Schlechtendal subsp. *spongiosa* (G. Engelmann)
Wolffia papulifera C. Thompson	*Wolffia brasiliensis* Weddell



(GUNPOWDER NECK) 5762 IV SE

Mapped by the Army Map Service
Published for civil use by the Geological Survey

Control by NOS/NOAA

Planimetry by photogrammetric methods from aerial photographs taken 1943. Topography by planetable surveys 1944. Culture revised from aerial photographs taken 1947. Field checked 1948

Selected hydrographic data compiled fr hart 572 (1947)
This information is not intended for nav urposes

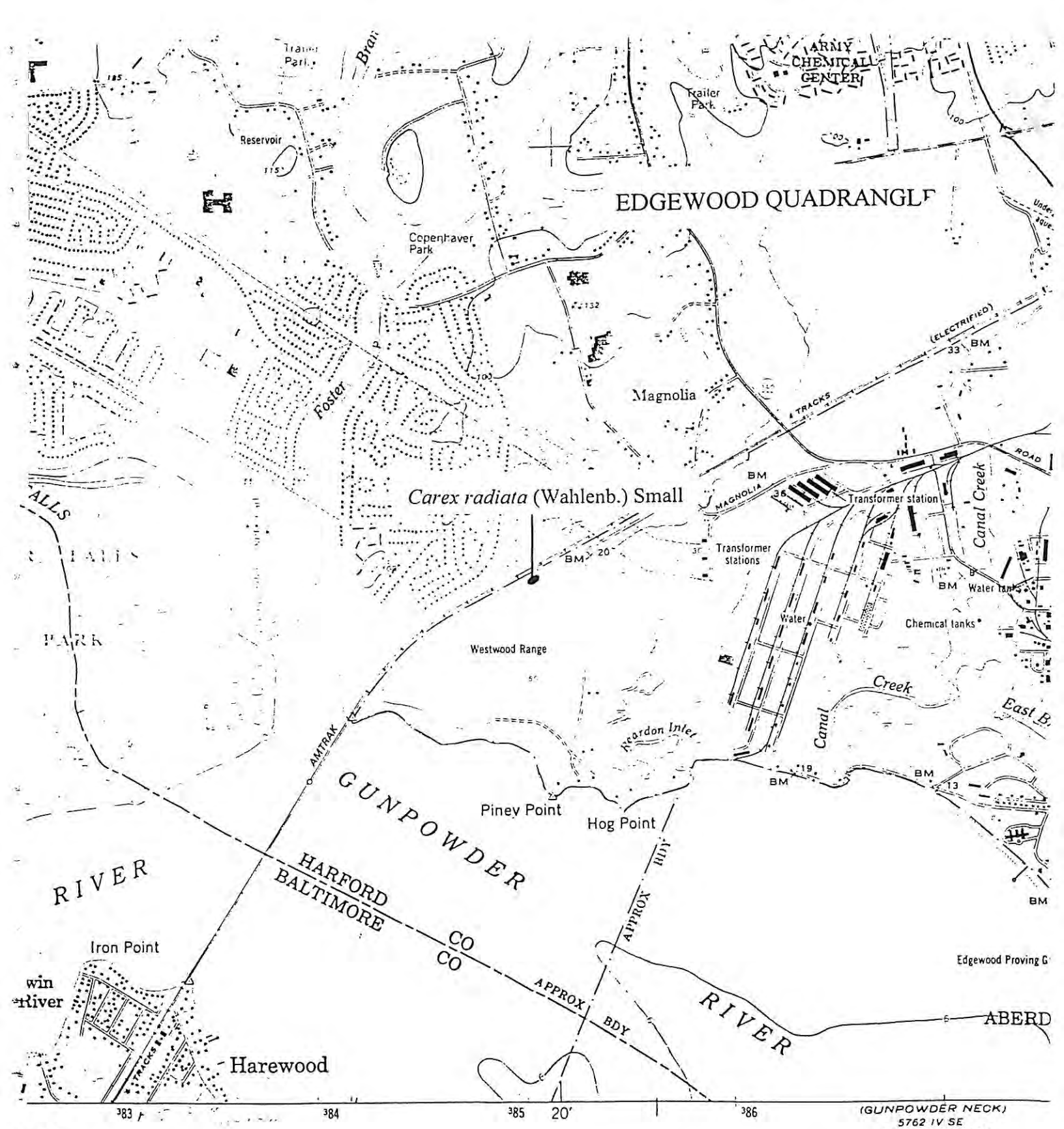
13 a

Polyconic projection. 10,000-foot gri ed on
Maryland coordinate system
1000-meter Universal Transverse Mercator grid ticks, zone 18, shown in blue
1927 North American Datum
To place on the predicted North American Datum 1983

MN GN
10½° 187 MILS
0°45' 13 MILS

UTM GRID AND 1984 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Revisions shown in purple and woodland compiled



Carex radiata (Wahlenb.) Small

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Mercator grid ticks,
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MN
GN
10½°
187 MILS
0°50'
15 MILS

UTM GRID AND 1985 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF
DEPTH CURVES IN FEET DATUM IS MEAN LO
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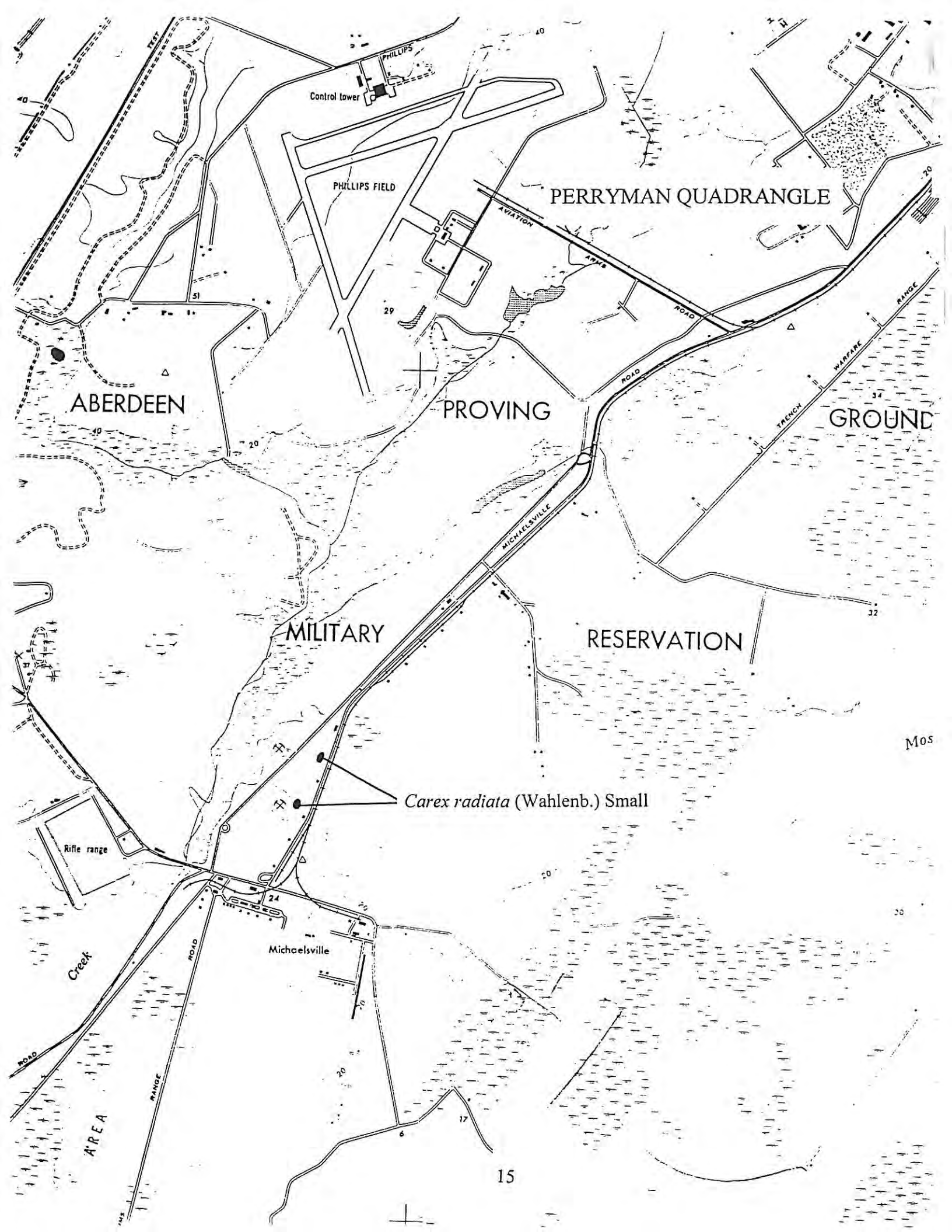
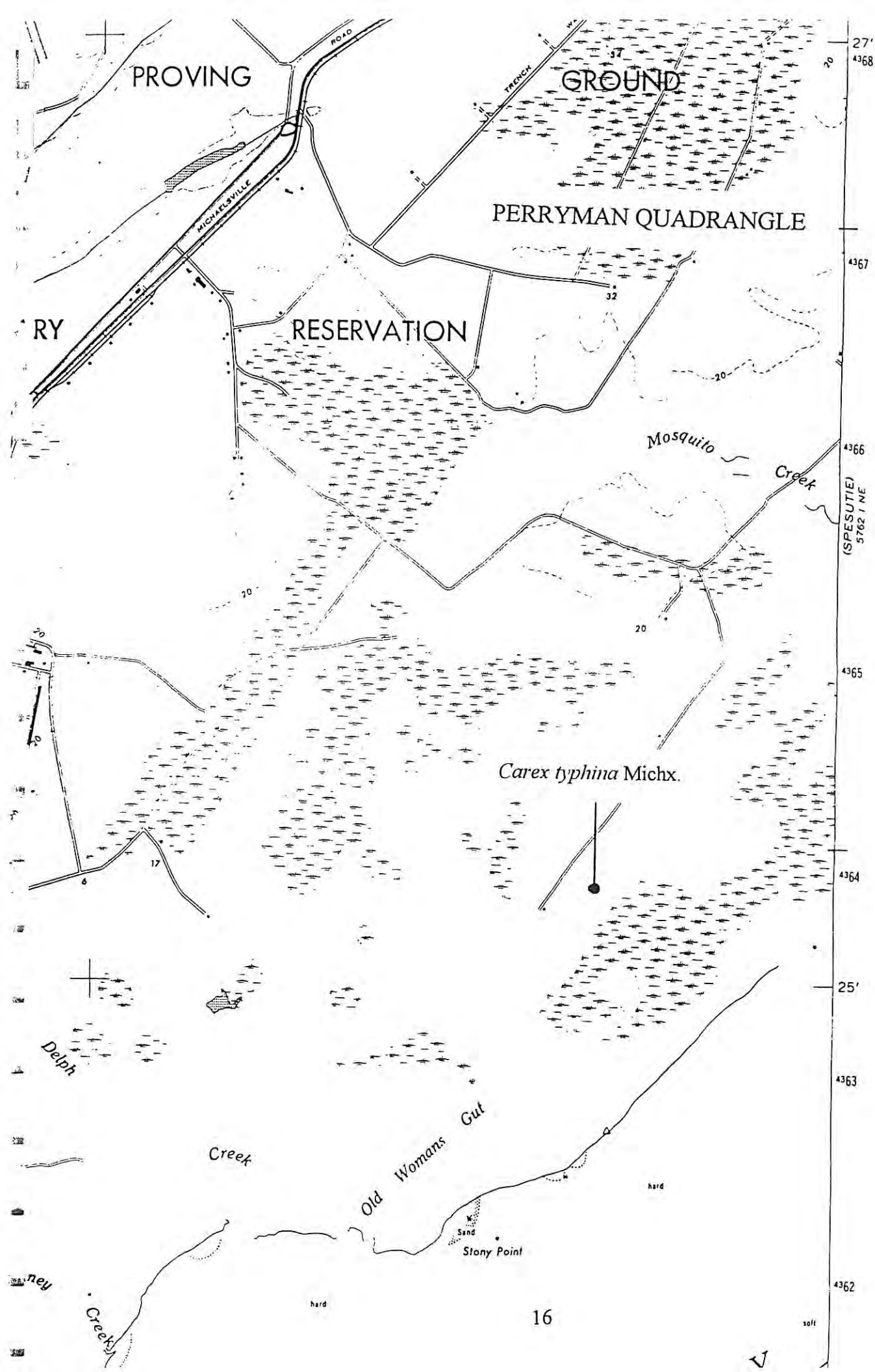
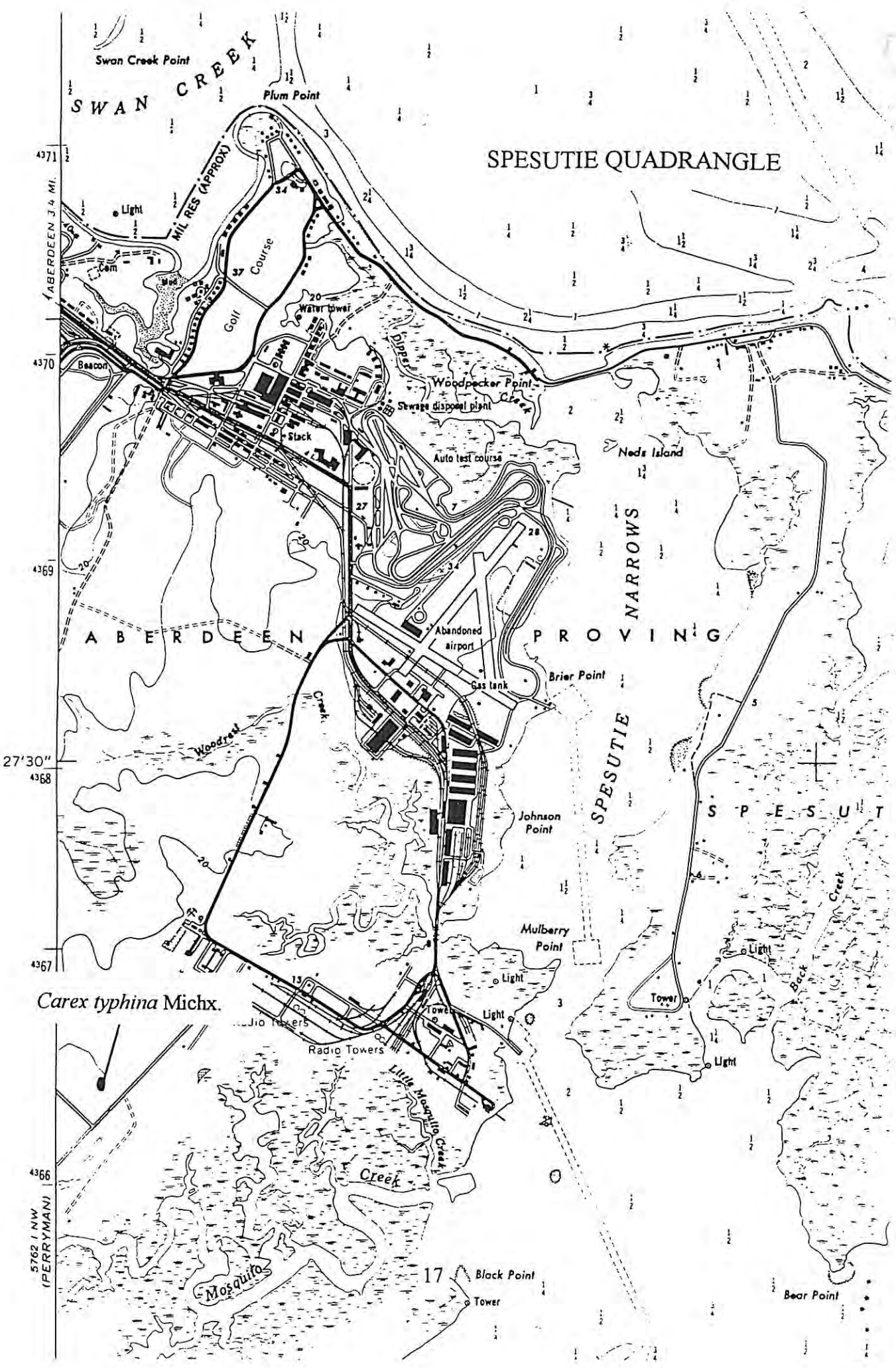
THE AVERAGE RANGE OF TIDE IS APPROXIMATELY

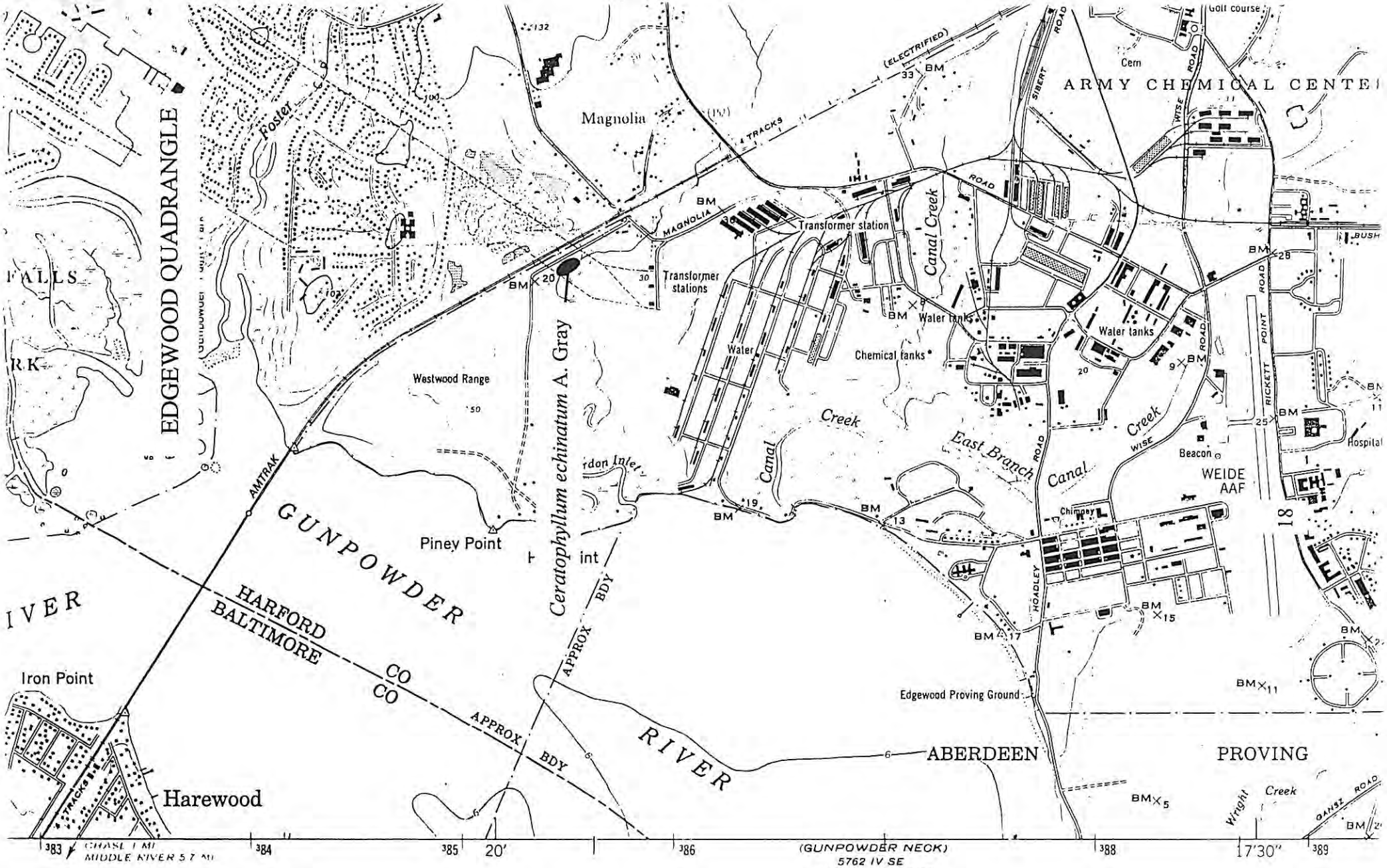
Revisions shown in purple and woodland compiled by the


PERRYMAN QUADRANGLE
ABERDEEN
PROVING
GROUND
MILITARY
RESERVATION
Control tower
PHILLIPS
PHILLIPS FIELD
AVIATION
ROAD
MICHAELSVILLE
TRENCH
WARFARE
RANGE
Rifle range
Michaelsville
Creek
ROAD
RANGE
AREA
Carex radiata (Wahlenb.) Small


PROVING
GROUND
PERRYMAN QUADRANGLE
RESERVATION
RY
MICHAELSVILLE
ROAD
TRENCH
27'30"
4368
4367
4366
4365
4364
25'
4363
4362
Mosquito
Creek
(SPESUTIE)
5762 I NE
Carex typhina Michx.
Delph
Creek
Old Womans Gut
Stony Point
Sand
hard
soft



Carex typhina Michx.



gical Survey

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949
IOS Surveys
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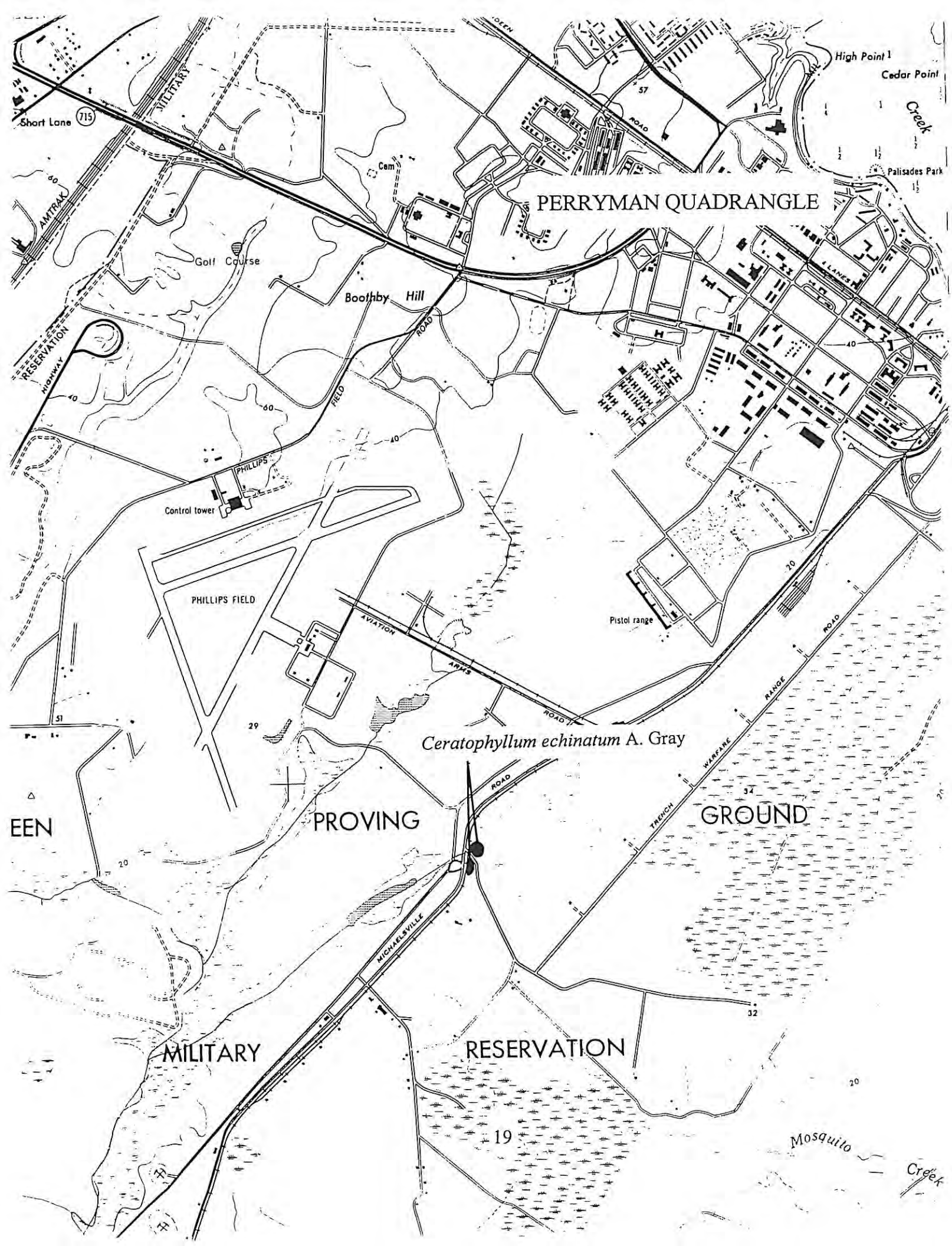
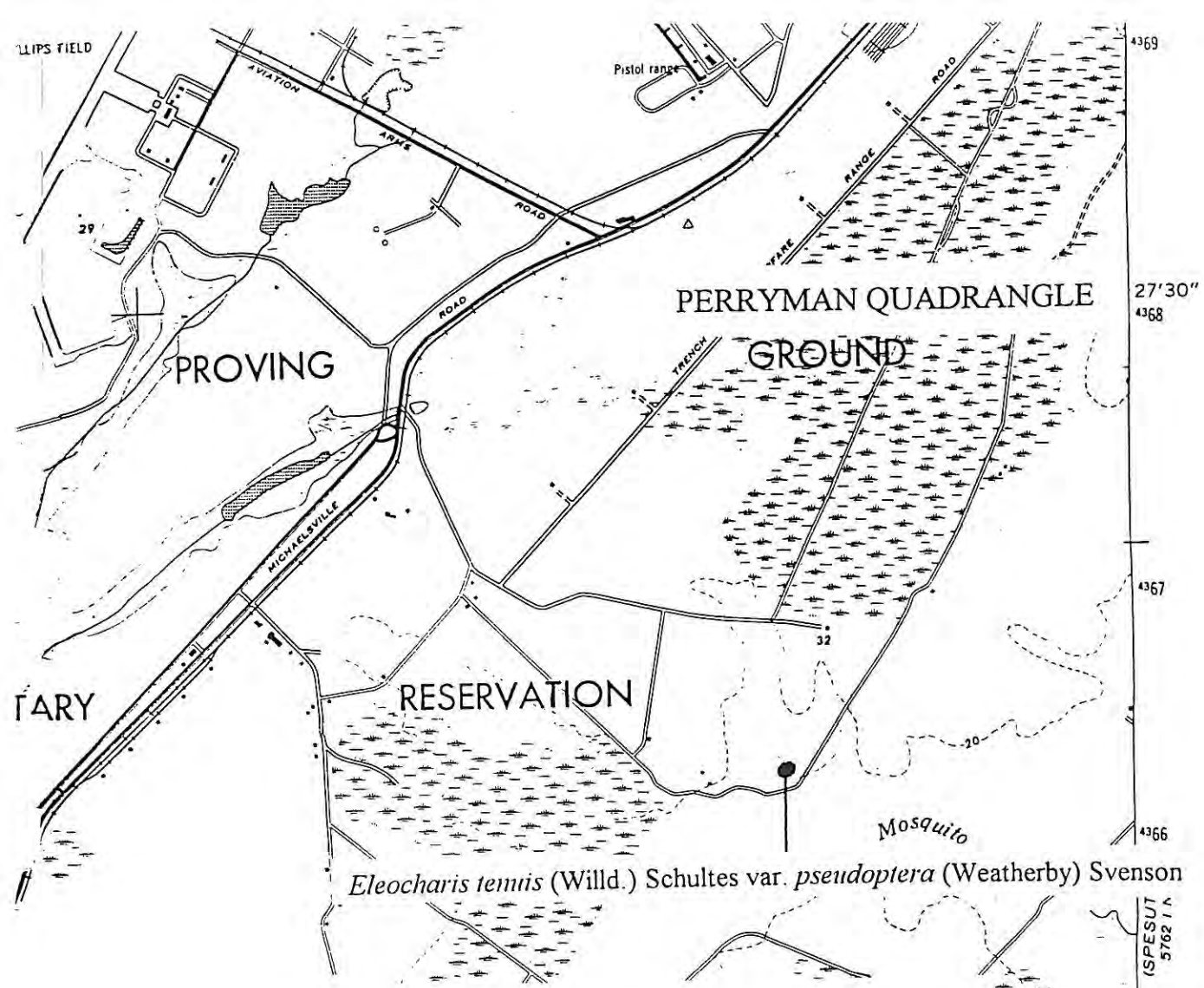
is based on
grid ticks

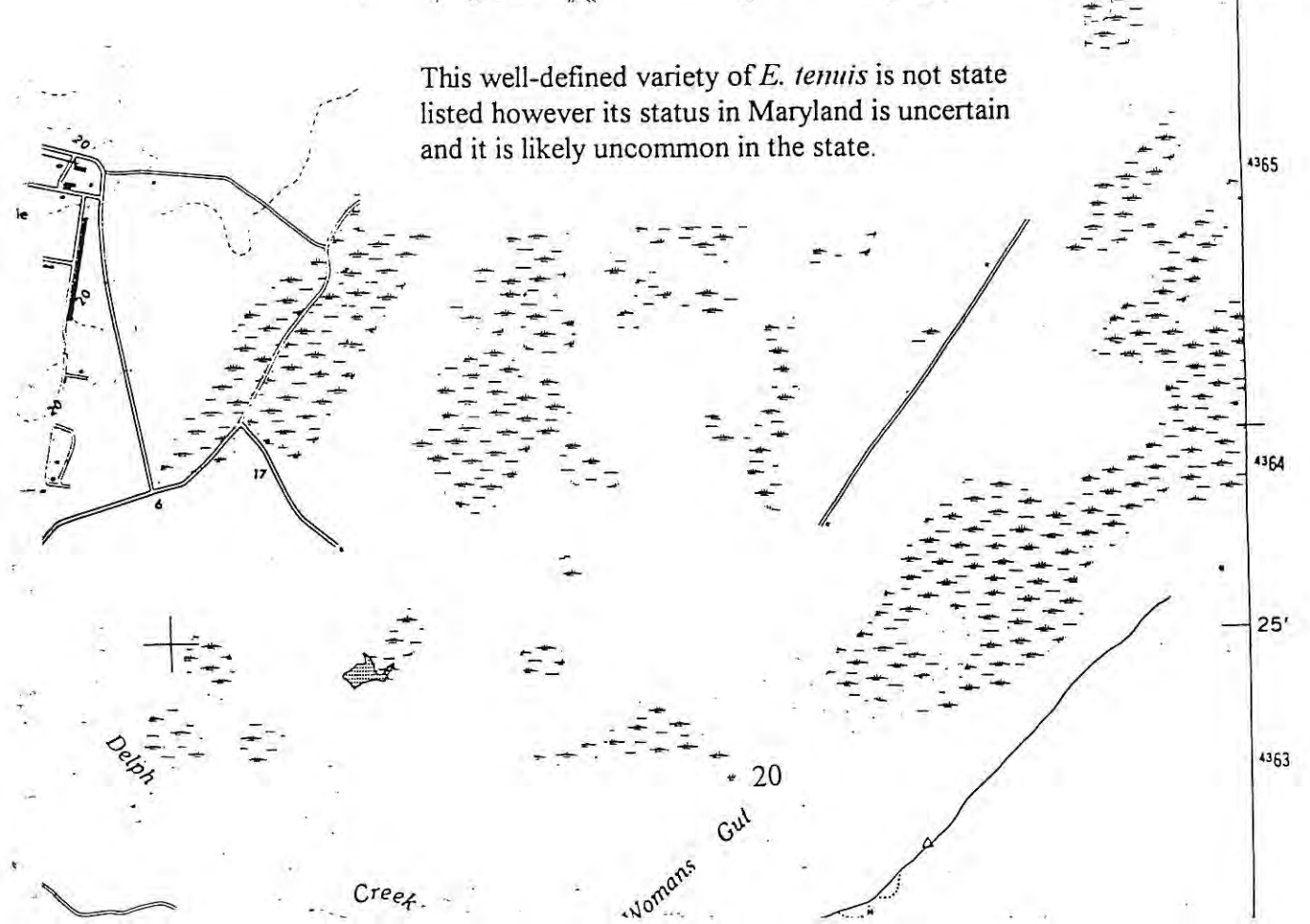
MAP

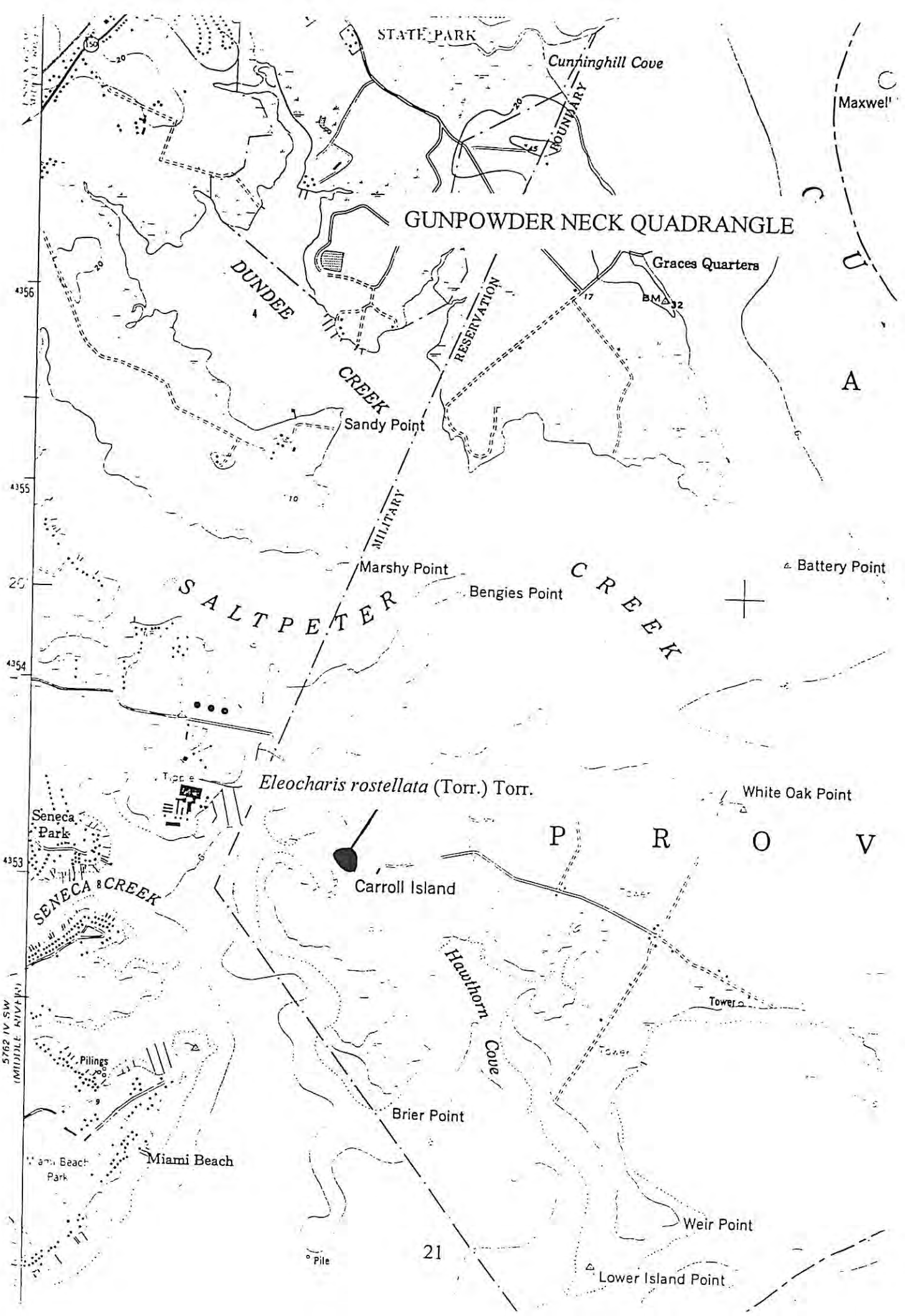

PERRYMAN QUADRANGLE
Short Lane
715
MILITARY
ROAD
Cem
High Point
Cedar Point
Creek
Palisades Park
AMTRAK
Golf Course
Boothby Hill
ROAD
RESERVATION
HIGHWAY
FIELD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ARMS
ROAD
Pistol range
RANGE
ROAD
WARFARE
TRENCH
ROAD
PROVING
GROUND
MICHAELSVILLE
MILITARY
RESERVATION
Mosquito
Creek
Ceratophyllum echinatum A. Gray

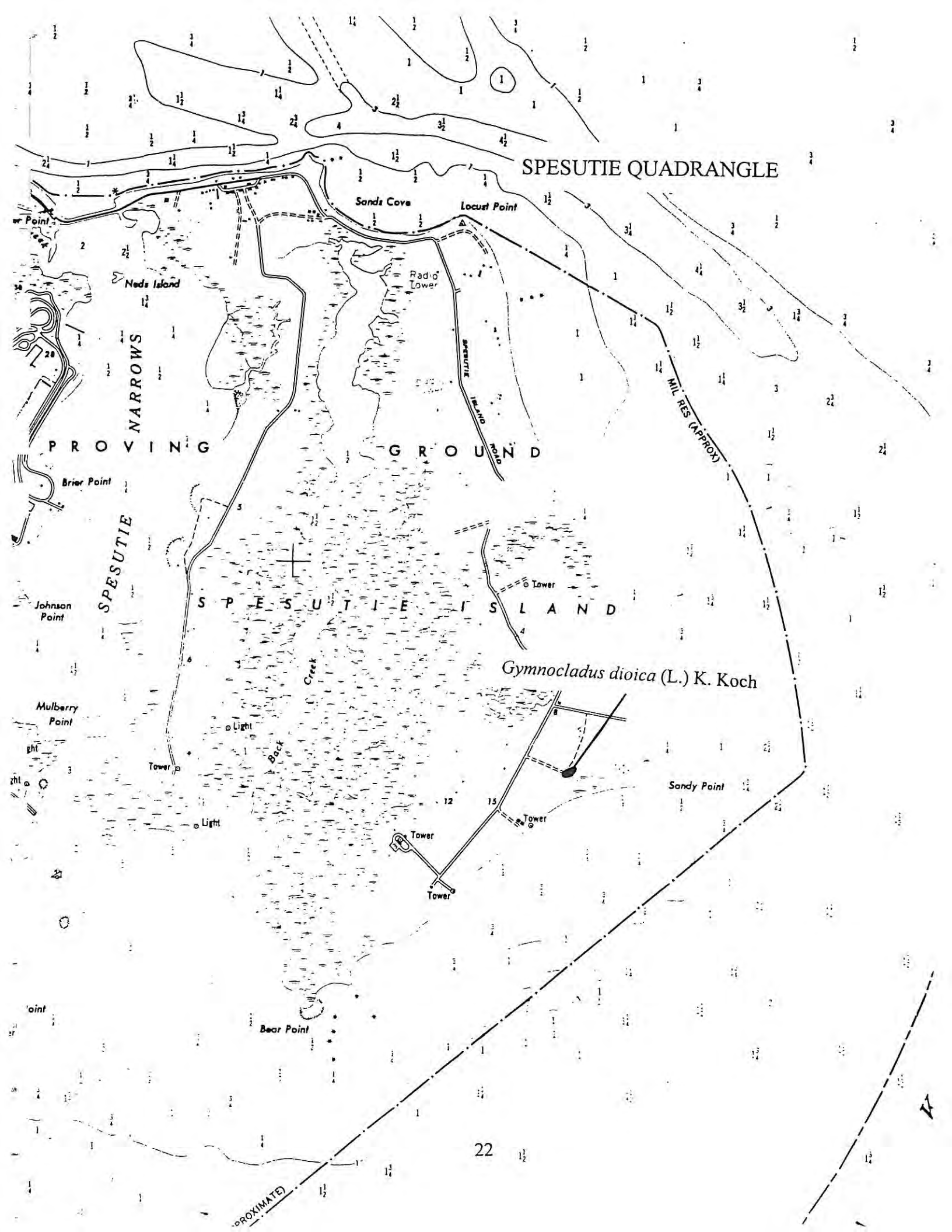


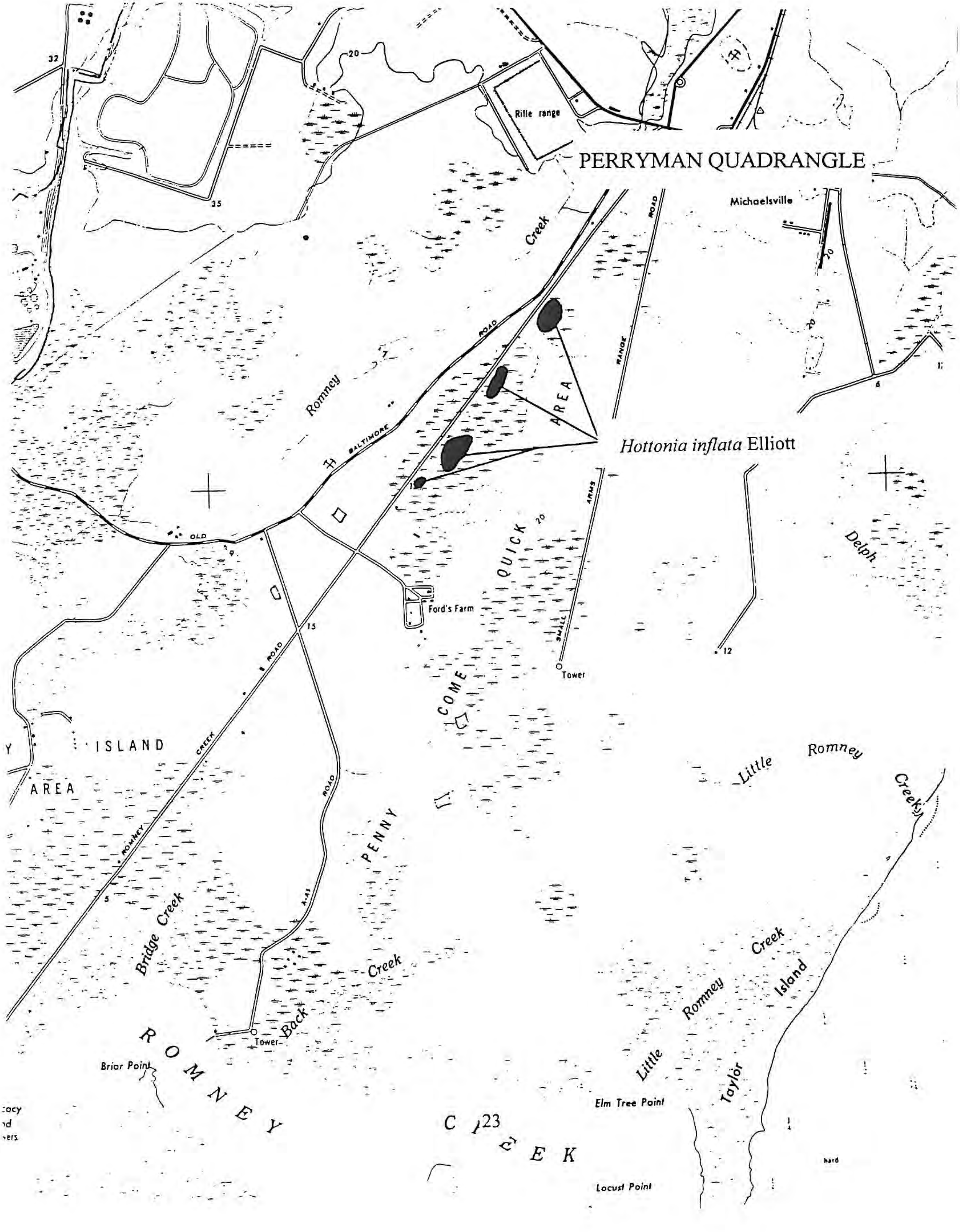
Eleocharis tenuis (Willd.) Schultes var. *pseudoptera* (Weatherby) Svenson

This well-defined variety of *E. tenuis* is not state listed however its status in Maryland is uncertain and it is likely uncommon in the state.

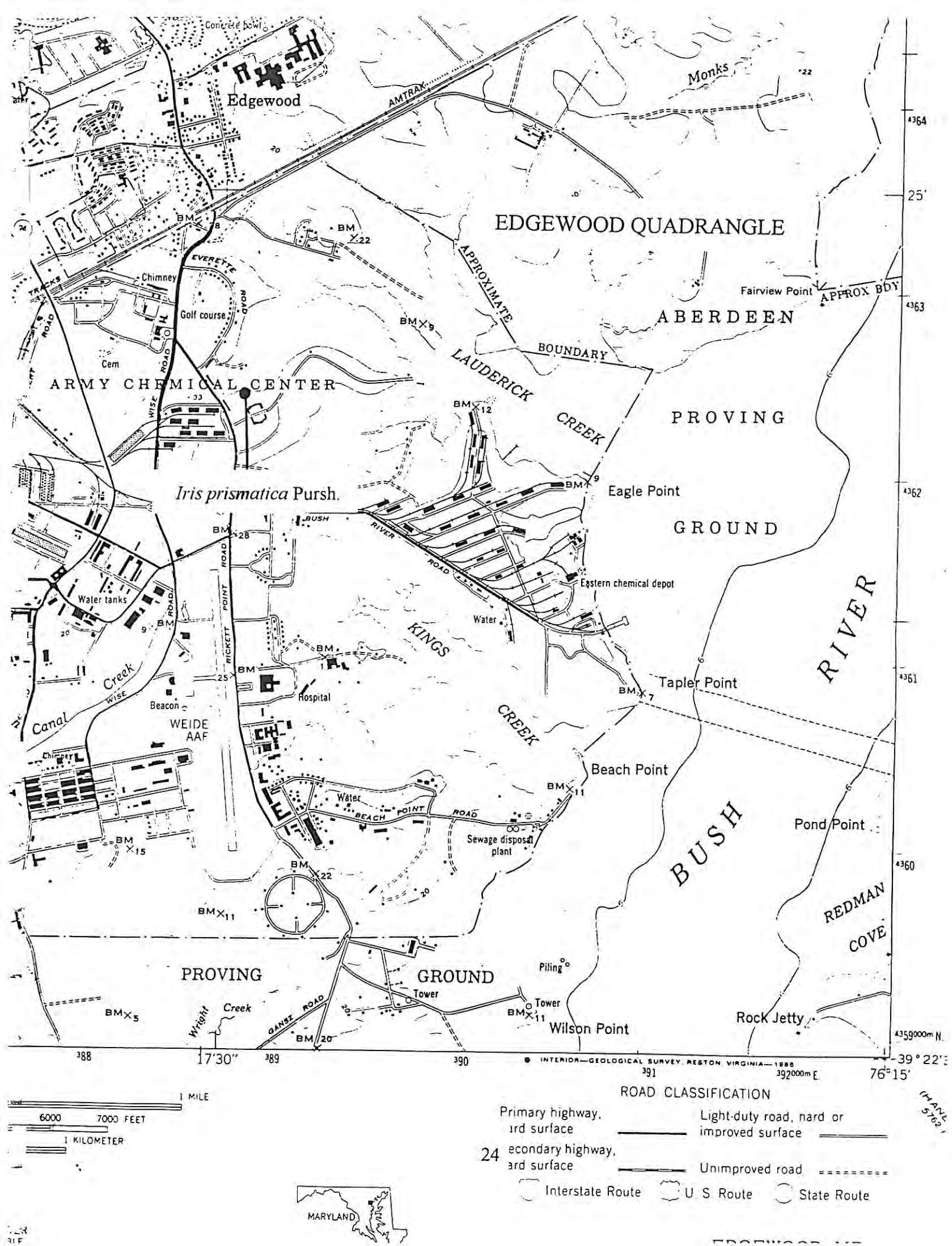


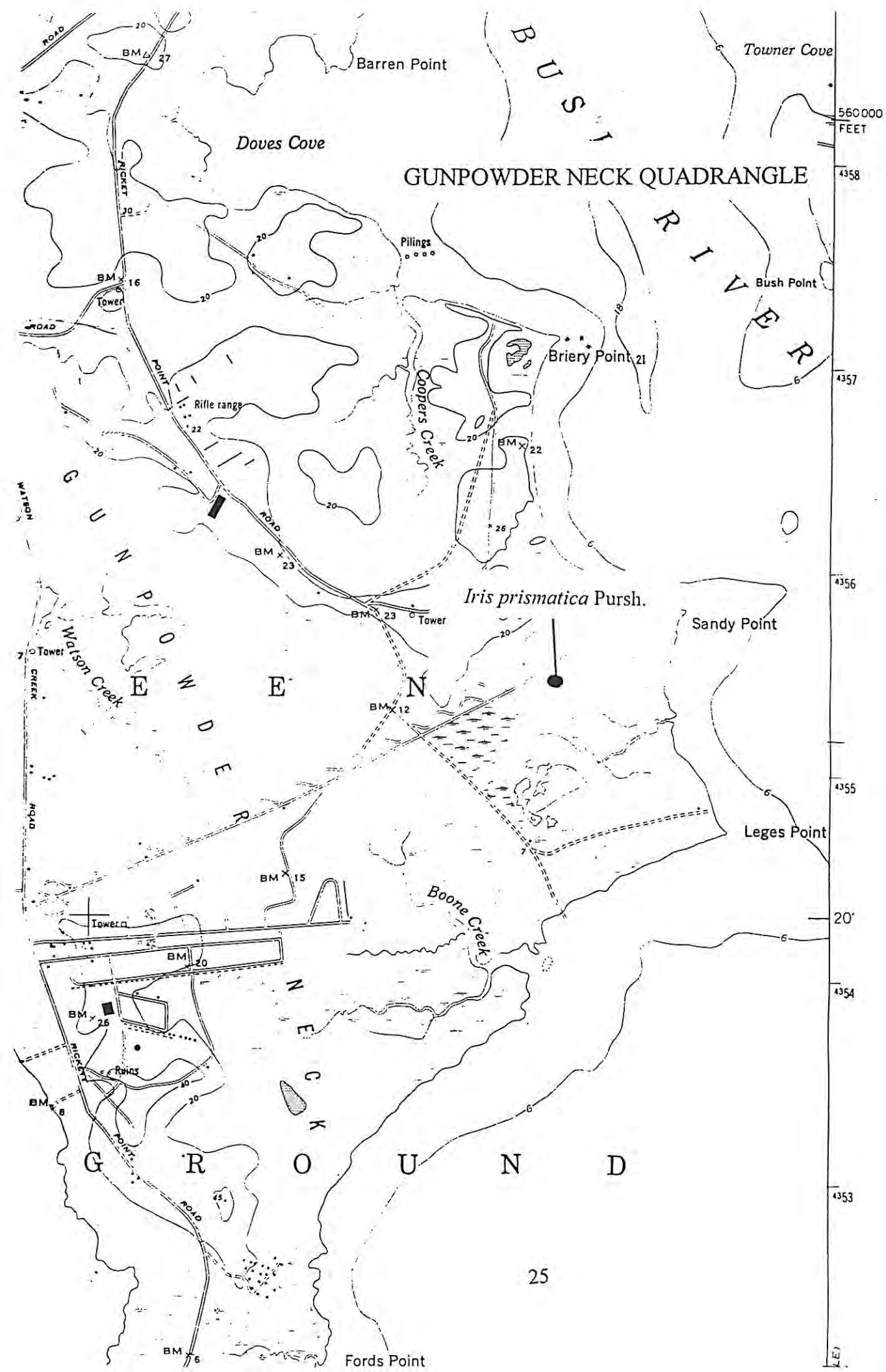

STATE PARK
Cunninghill Cove
BOUNDARY
Maxwel
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER CREEK
Eleocharis rostellata (Torr.) Torr.
White Oak Point
Seneca Park
SENECA CREEK
Carroll Island
Hawthorn Cove
Brier Point
Pilings
Miami Beach
Weir Point
Lower Island Point
4356
4355
4354
4353

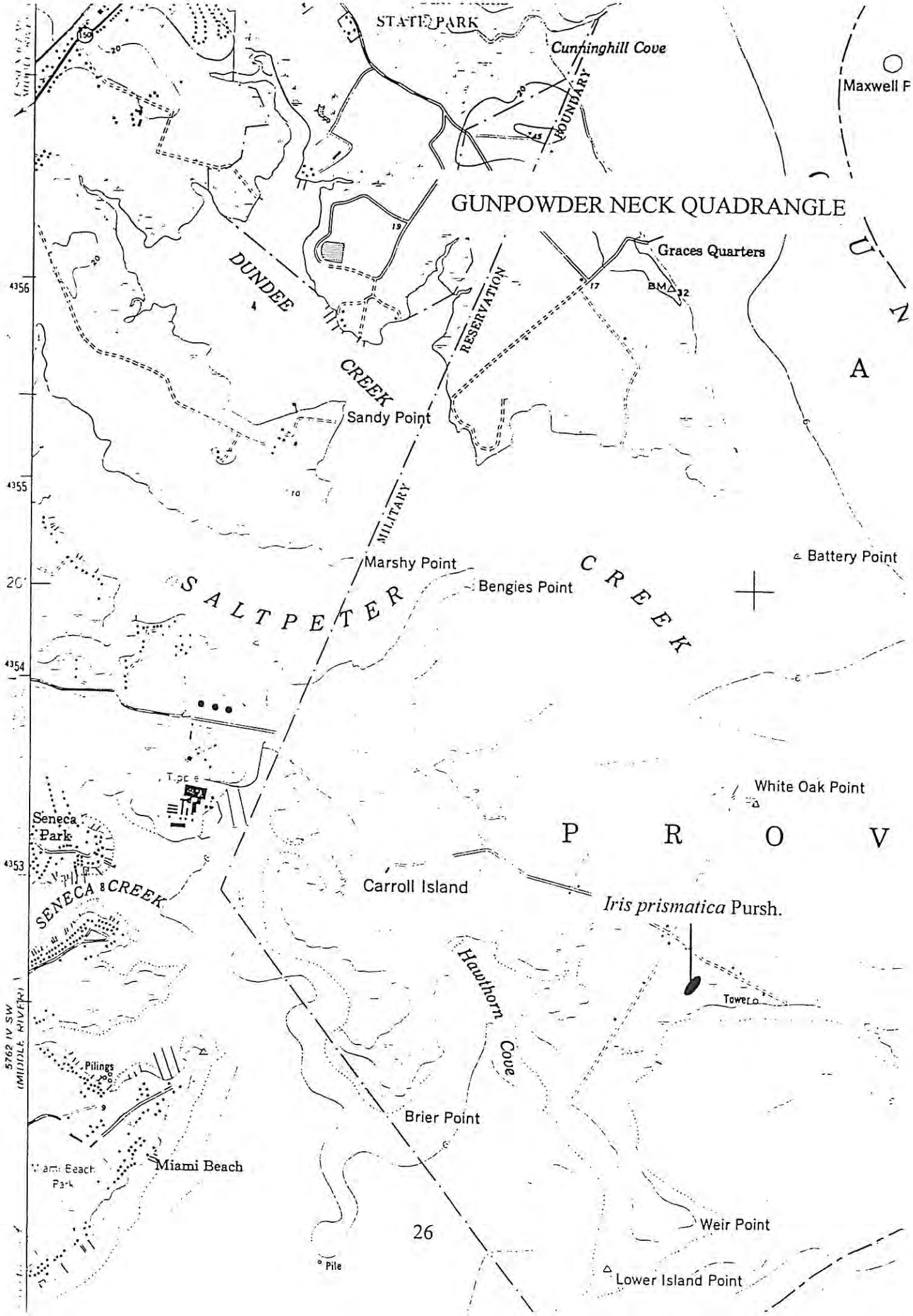

SPESUTIE QUADRANGLE
Sands Cove
Locust Point
Radio Tower
Neds Island
NARROWS
PROVING GROUND
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
Brier Point
SPESUTIE
Johnson Point
SPESUTIE ISLAND
Tower
Creek
Back
Mulberry Point
Light
Tower
Light
Sandy Point
Tower
Tower
Tower
Bear Point
Gymnocladus dioica (L.) K. Koch



PERRYMAN QUADRANGLE
Hottonia inflata Elliott
Rifle range
Michaelsville
Romney
Creek
BALTIMORE
ROAD
OLD
AREA
RANGE
ROAD
SMALL
ARMS
QUICK
COME
Ford's Farm
Tower
Delph
ISLAND
AREA
ROMNEY
CREEK
ROAD
PENNY
A-AS
ROAD
Little
Romney
Creek
Bridge Creek
Back
Creek
Tower
Briar Point
ROMNEY
CREEK
Little
Romney
Creek
Island
Taylor
Elm Tree Point
Locust Point

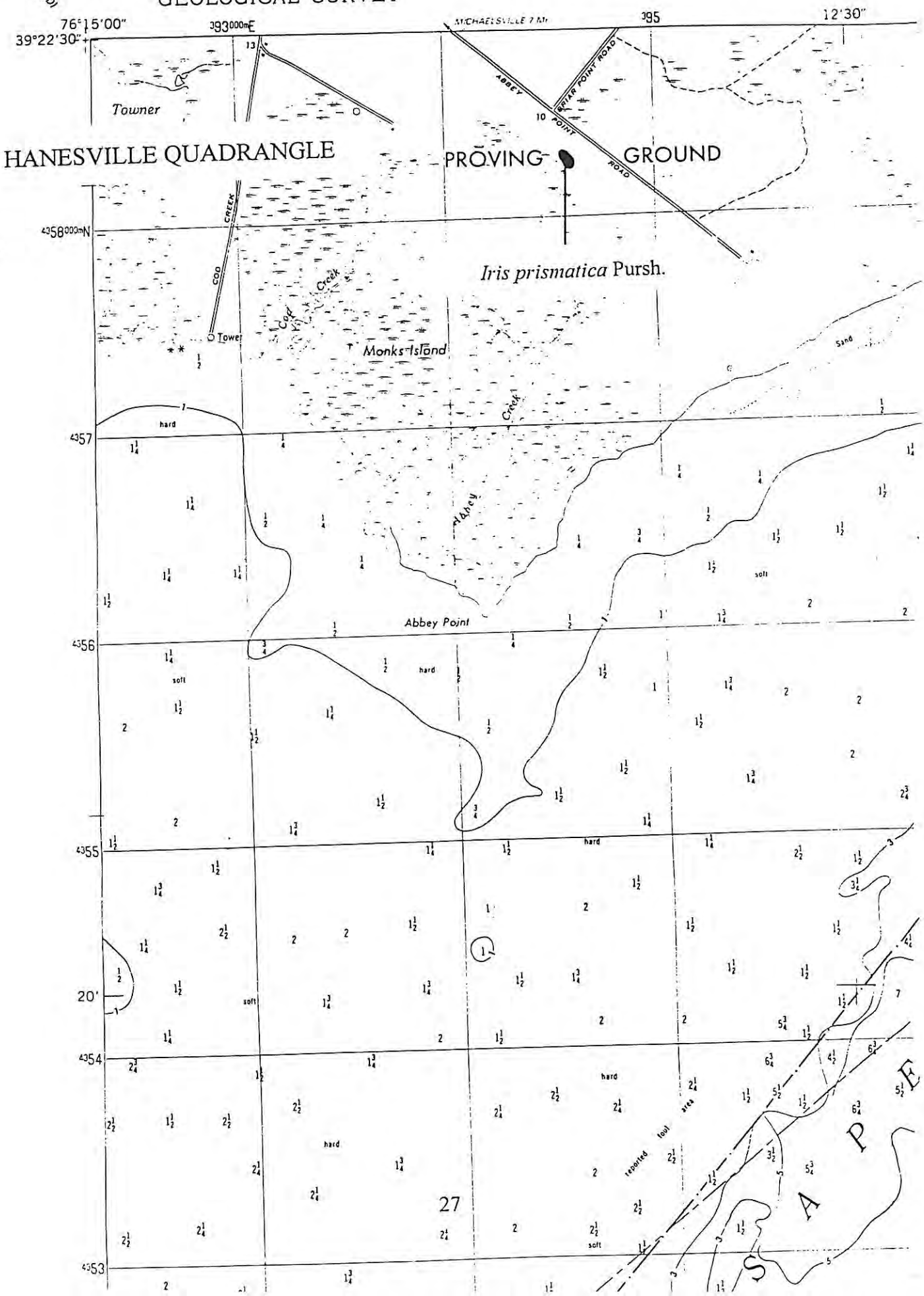

EDGEWOOD QUADRANGLE
Edgewood
AMTRAK
Monks
Concrete bowl
Chimney
Golf course
EVERETTE ROAD
TRACKS
WISE ROAD
Cem
ARMY CHEMICAL CENTER
APPROXIMATE
BOUNDARY
ABERDEEN
PROVING
GROUND
Fairview Point
APPROX BDY
LAUDERICK CREEK
Iris prismatica Pursh.
Eagle Point
Eastern chemical depot
Water tanks
Water
BUSH RIVER ROAD
RICKETT POINT ROAD
KINGS CREEK
Tapler Point
RIVER
Beacon
Hospital
WEIDE AAF
Canal
Creek
Beach Point
BEACH POINT ROAD
Sewage disposal plant
Pond Point
BUSH
REDMAN COVE
Piling
Tower
Wright Creek
GANSE ROAD
Wilson Point
Rock Jetty
4364
4363
4362
4361
4360
4359000m N.
388
17'30"
389
390
391
392000m E
39°22'30"
76°15'
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1988
1 MILE
6000 7000 FEET
1 KILOMETER
ROAD CLASSIFICATION
Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U S Route
State Route
MARYLAND
PLANE 5762


GUNPOWDER NECK QUADRANGLE
Barren Point
Towner Cove
Doves Cove
560000 FEET
4358
Pilings
Bush Point
Briery Point
4357
Coopers Creek
Rifle range
Iris prismatica Pursh.
Sandy Point
4356
Watson Creek
Leges Point
4355
Boone Creek
20'
4354
Ruins
4353
Fords Point
BUSH RIVER
GUNPOWDER NECK GROUND


STATE PARK
Cunninghill Cove
Maxwell F
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE CREEK
RESERVATION
BOUNDARY
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER CREEK
White Oak Point
Seneca Park
SENECA CREEK
Carroll Island
Iris prismatica Pursh.
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Pile
Lower Island Point
4356
4355
4354
4353
20'
5762 IV SW
(MIDDLE RIVER)

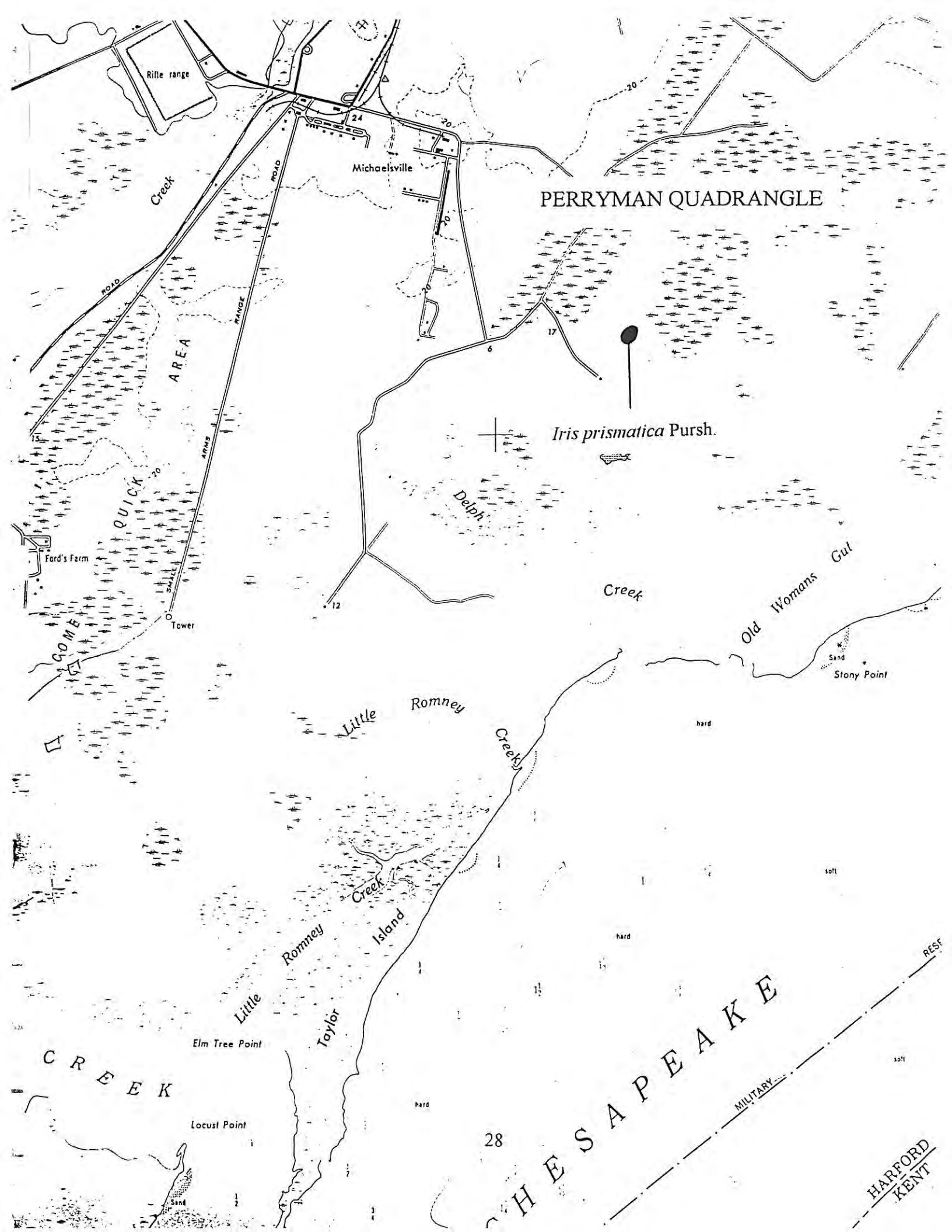
5762 IV NE
(EDGEWOOD)

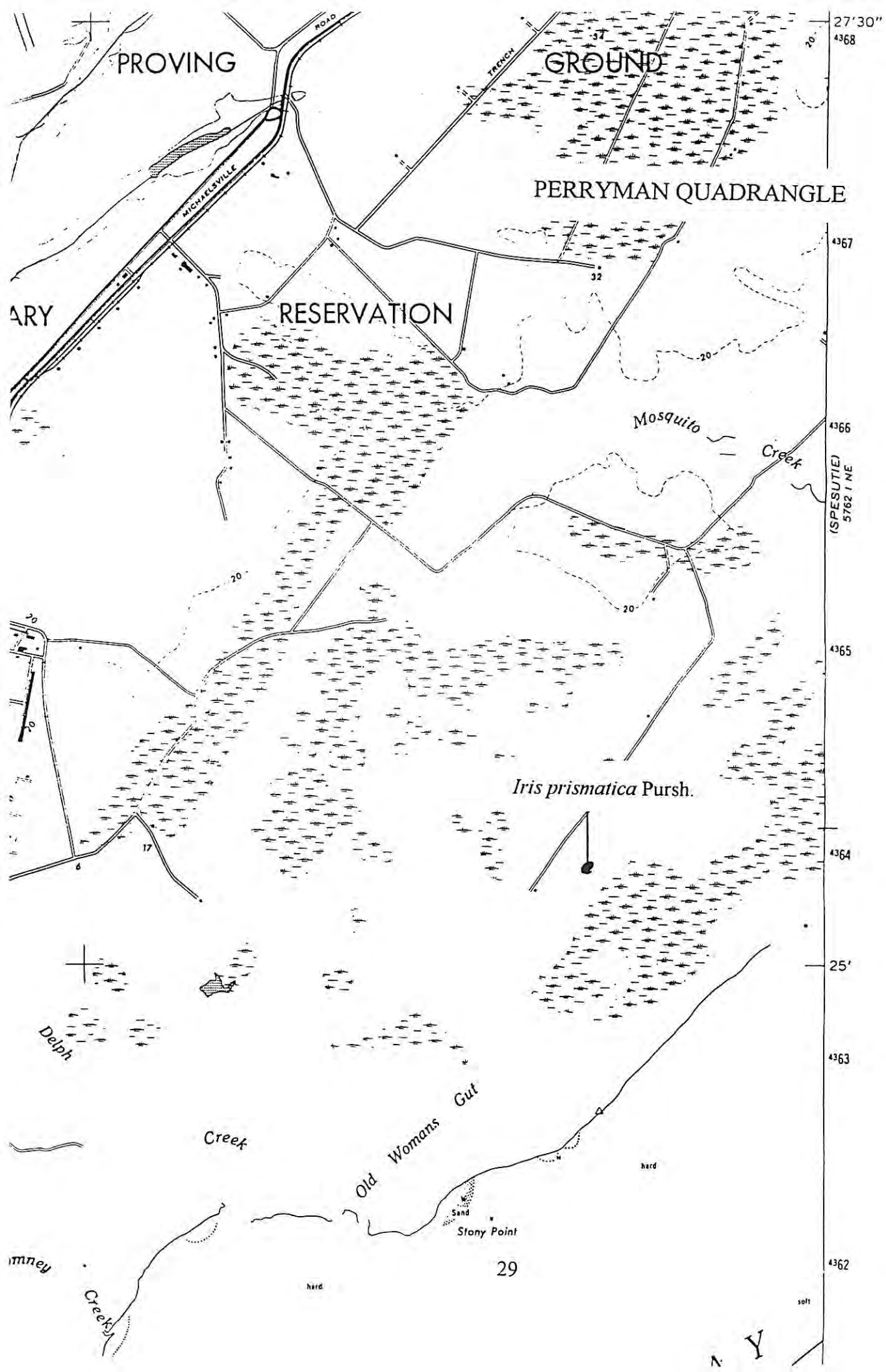
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

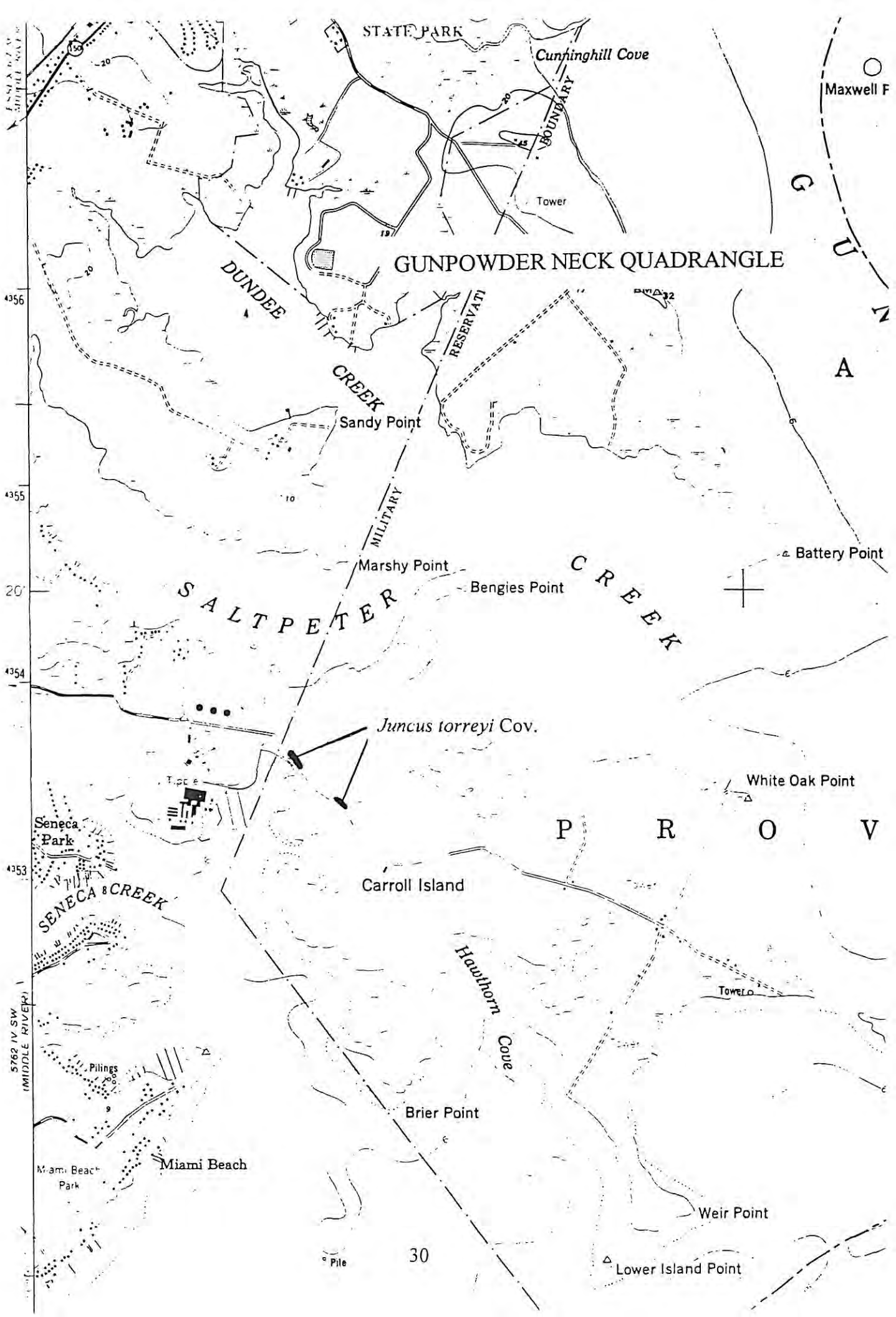


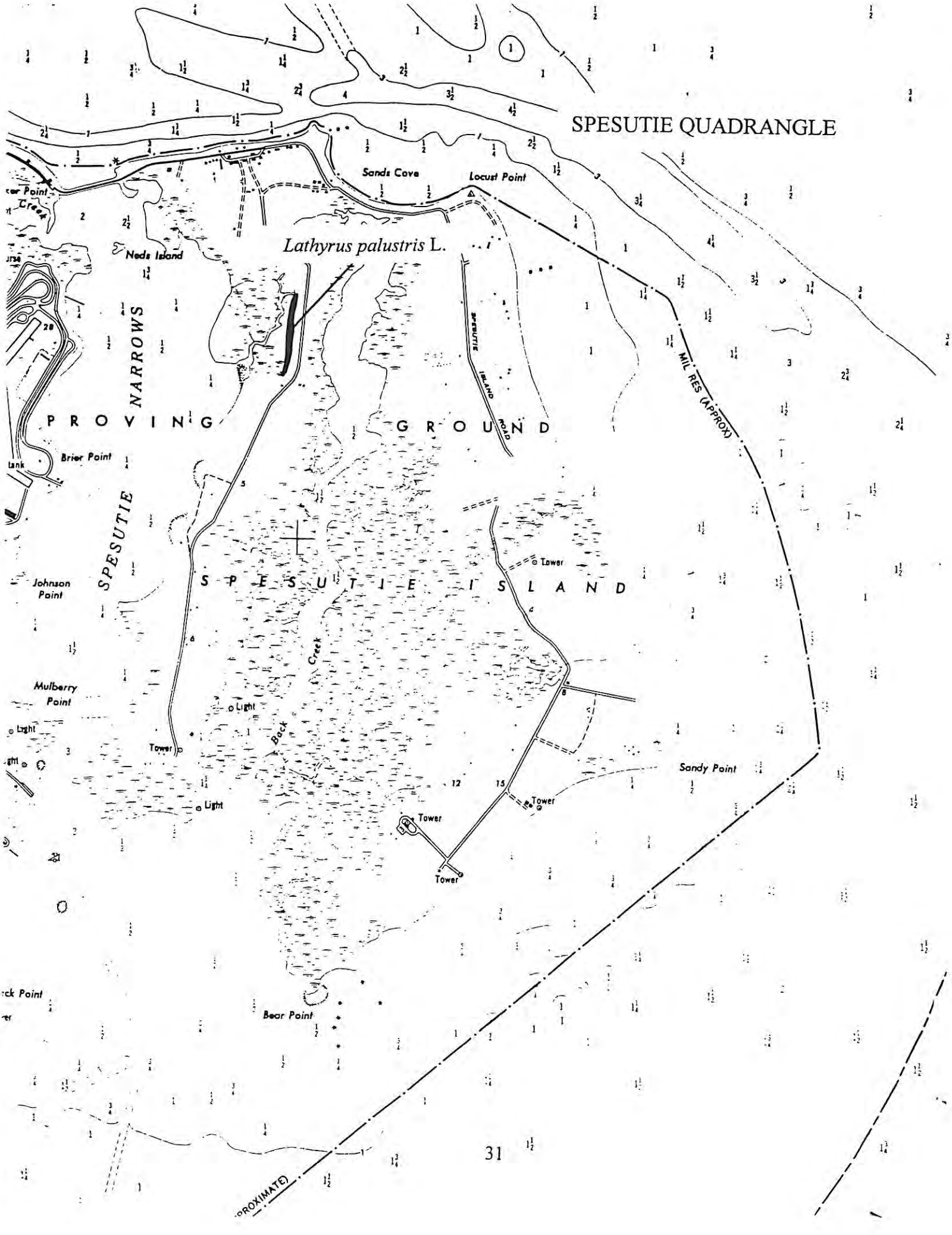
HANESVILLE QUADRANGLE

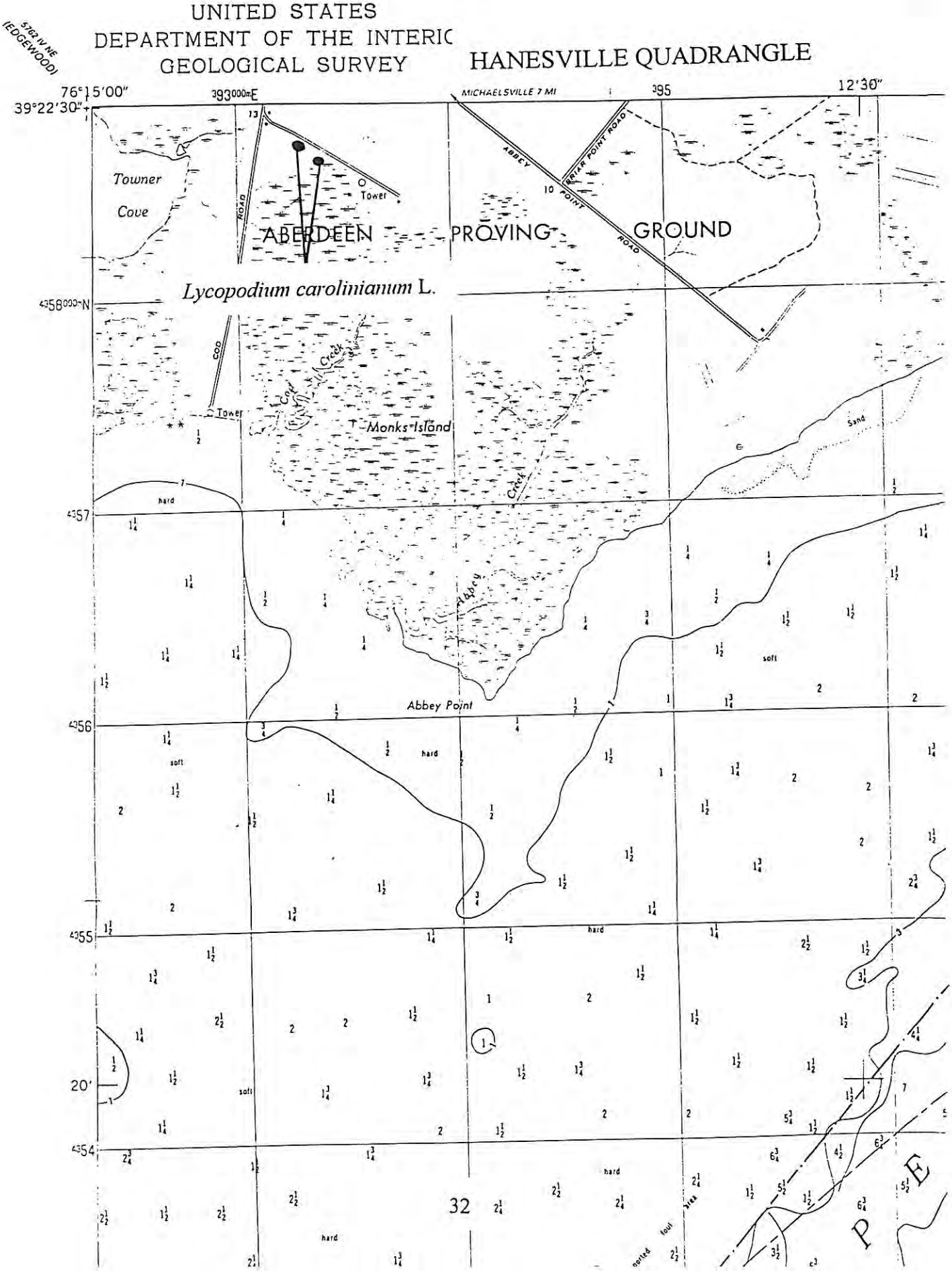
Iris prismatica Pursh.

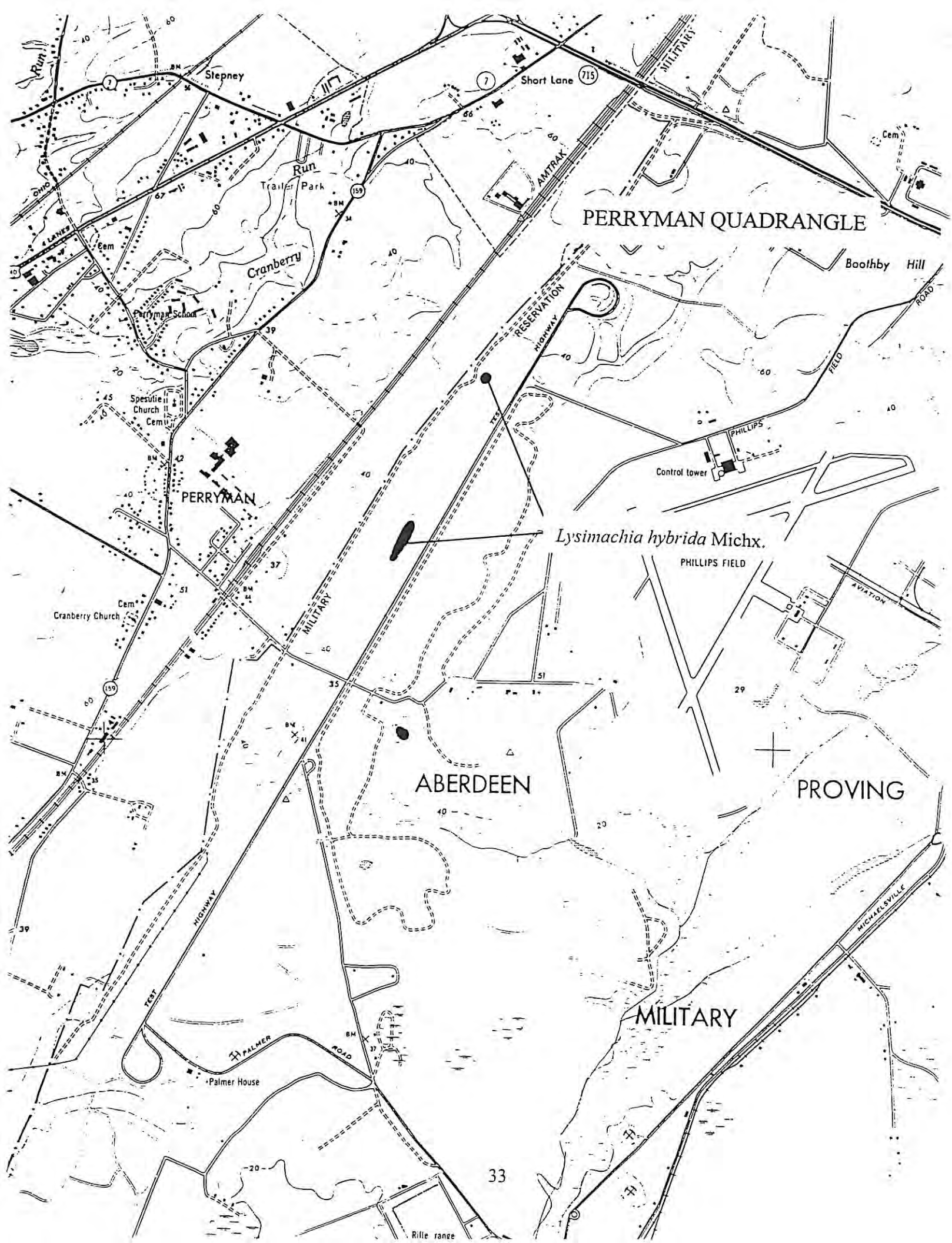

PERRYMAN QUADRANGLE
Iris prismatica Pursh.
Rifle range
Michaelsville
Creek
ROAD
RANGE
AREA
ARMS
SMALL
QUICK
Ford's Farm
Tower
Delph
Creek
Old Womans Gut
Sand
Stony Point
Little Romney Creek
Island
Creek
Little Romney
Taylor
Elm Tree Point
CREEK
Locust Point
Sand
CHESAPEAKE
MILITARY
RESE
HARFORD
KENT
hard
soft
28

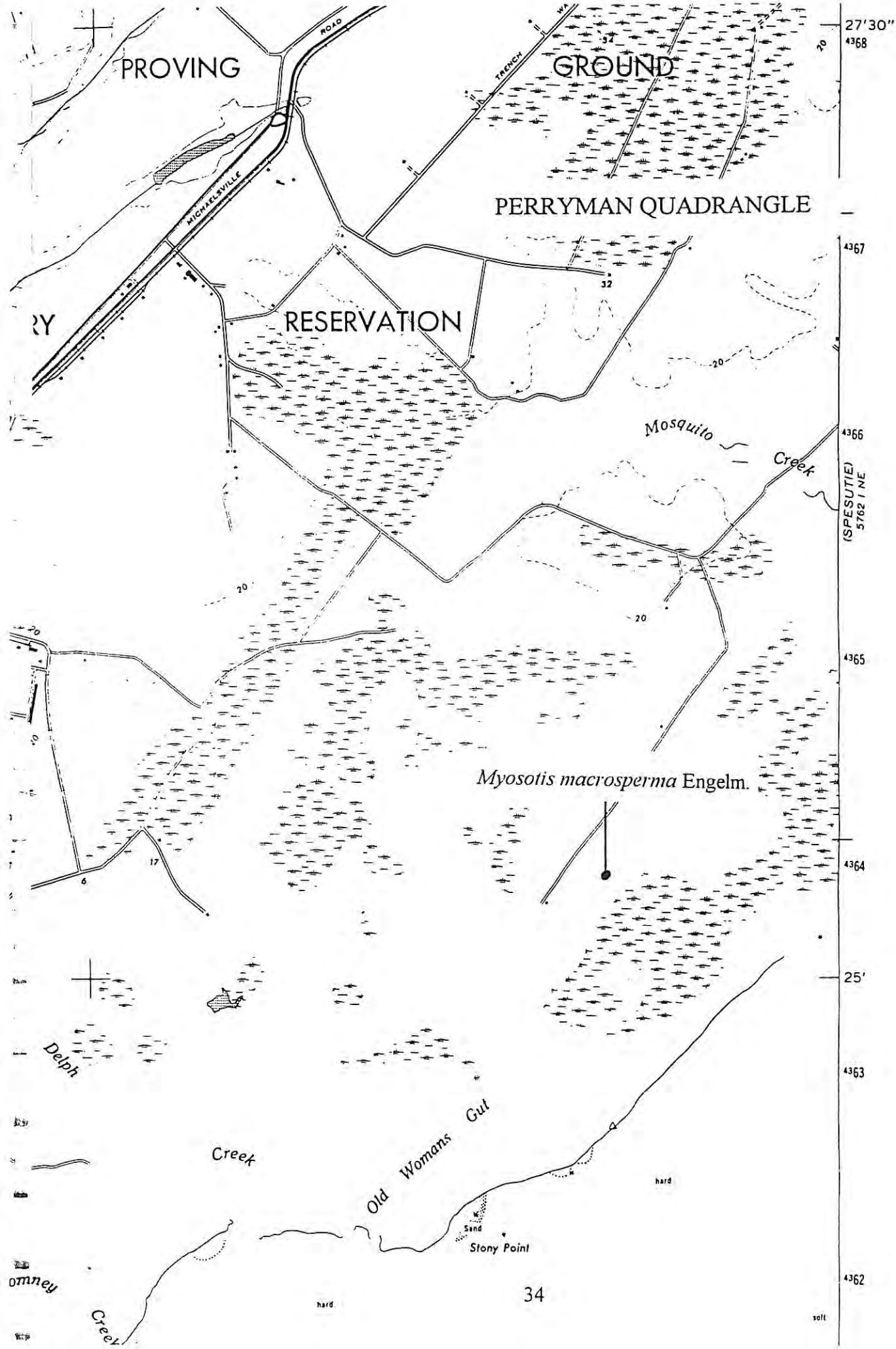

PROVING
GROUND
TRENCH
ROAD
MICHAELSVILLE
27'30"
4368
PERRYMAN QUADRANGLE
4367
RESERVATION
Mosquito
Creek
(SPESUTIE)
5762 I NE
4366
4365
4364
4363
4362
25'
Iris prismatica Pursh.
Delph
Creek
Old Womans Gut
Sand
Stony Point
hard
soft

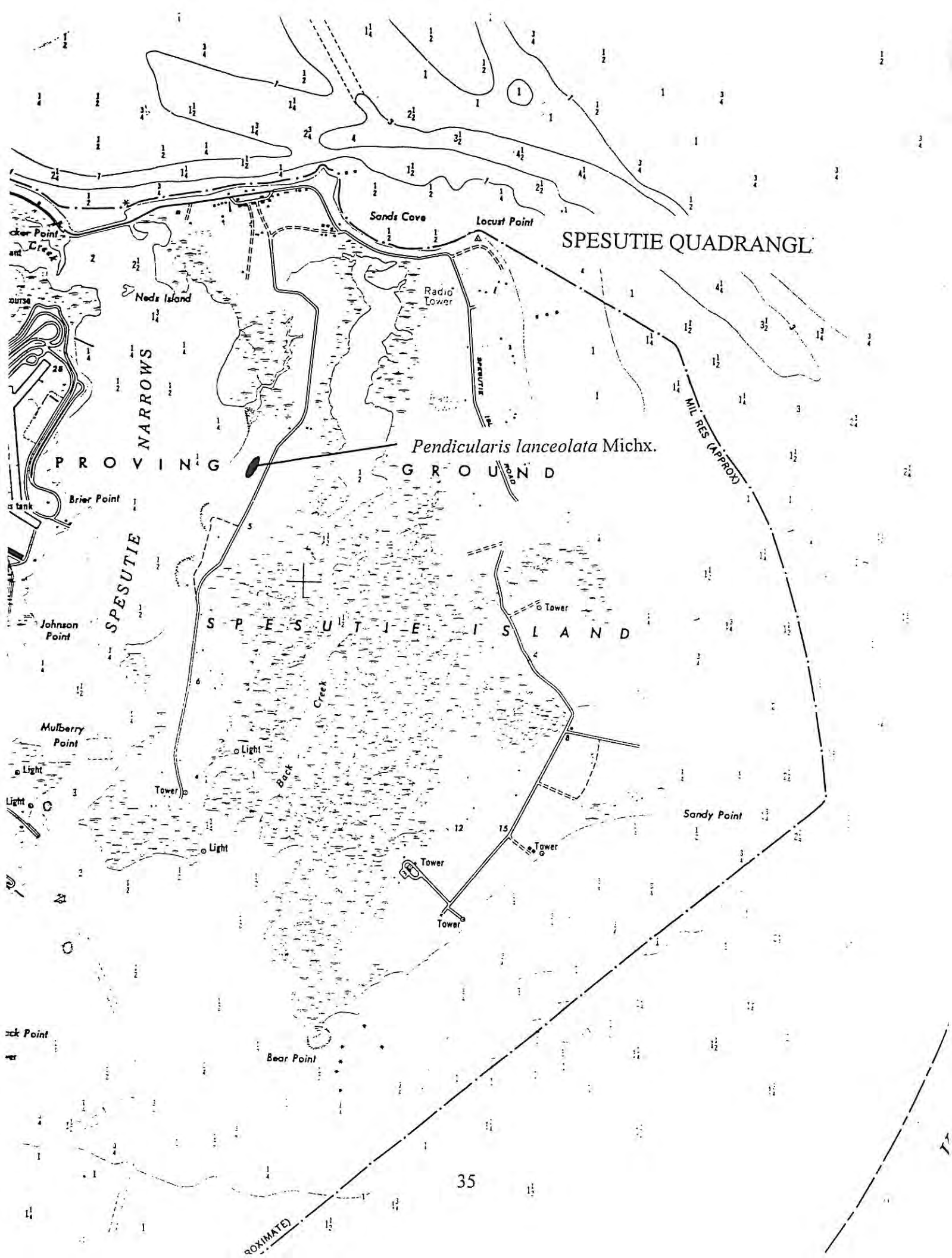

STATE PARK
Cunninghill Cove
Maxwell P
BOUNDARY
Tower
GUNPOWDER NECK QUADRANGLE
DUNDEE
CREEK
RESERVATI
Sandy Point
MILITARY
Marshy Point
Bengies Point
Battery Point
SALTPETER
CREEK
Juncus torreyi Cov.
White Oak Point
Seneca Park
Carroll Island
SENECA CREEK
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Miami Beach Park
Weir Point
Pile
Lower Island Point
4356
4355
4354
4353
20
5762 IV SW
(MIDDLE RIVER)


SPESUTIE QUADRANGLE
Lathyrus palustris L.
Sands Cove
Locust Point
Neds Island
PROVING GROUND
SPESUTIE ISLAND
SPESUTIE NARROWS
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
Brier Point
Johnson Point
Mulberry Point
Back Creek
Sandy Point
Bear Point
Tower
Light
(APPROXIMATE)

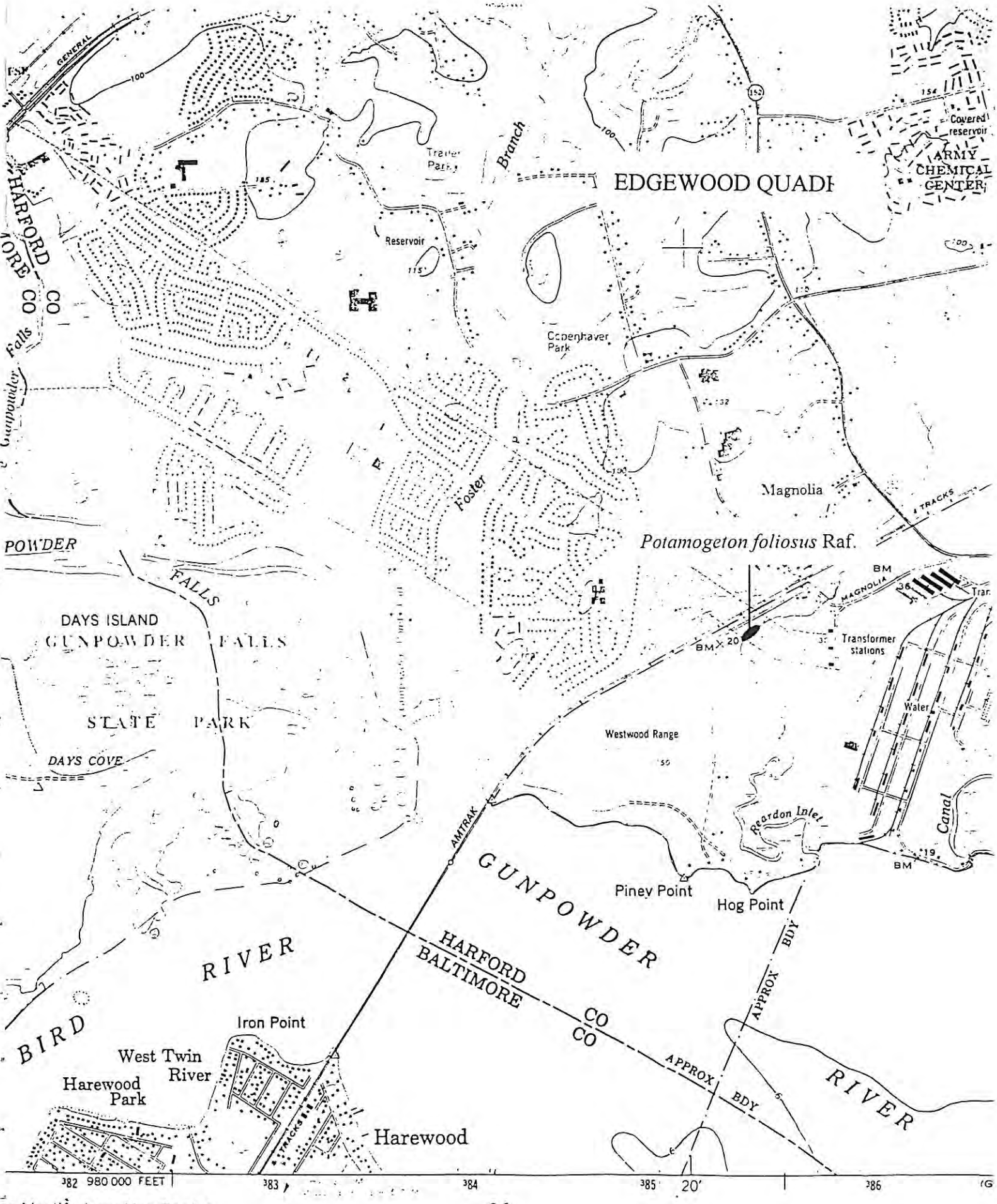

UNITED STATES
DEPARTMENT OF THE INTERIC
GEOLOGICAL SURVEY
HANESVILLE QUADRANGLE
5762 V NE
(EDGEWOOD)
76°15'00"
39°22'30"
393000mE
MICHAELSVILLE 7 MI
395
12'30"
Towner
Cove
ROAD
Tower
ABBEY
POINT
ROAD
BRIAR POINT ROAD
ABERDEEN PROVING GROUND
Lycopodium carolinianum L.
4358000mN
COD
Creek
Tower
Monks Island
Sand
hard
4357
Abbey
Creek
soft
Abbey Point
4356
hard
soft
4355
hard
20'
4354
hard
32
hard
soft
foul
sorted
P
E


PERRYMAN QUADRANGLE
Stepney
Short Lane
Run
Trailer Park
AMTRAK
MILITARY
Cem
Cranberry
Perryman School
Spesutie Church Cem
PERRYMAN
Cranberry Church
Boothby Hill
RESERVATION
HIGHWAY
ROAD
FIELD
PHILLIPS
Control tower
Lysimachia hybrida Michx.
PHILLIPS FIELD
AVIATION
MILITARY
ABERDEEN
PROVING
MICHAELSVILLE
TEST
HIGHWAY
PALMER
ROAD
Palmer House
MILITARY
Rifle range


PROVING
GROUND
ROAD
TRENCH
MICHAELSVILLE
PERRYMAN QUADRANGLE
RESERVATION
Mosquito
Creek
(SPESUTIE)
5762 I NE
27'30"
4368
4367
4366
4365
4364
25'
4363
4362
Myosotis macrosperma Engelm.
Delph
Creek
Old Womans Gut
Stony Point
Sand
hard
soft



Pendicularis lanceolata Michx.



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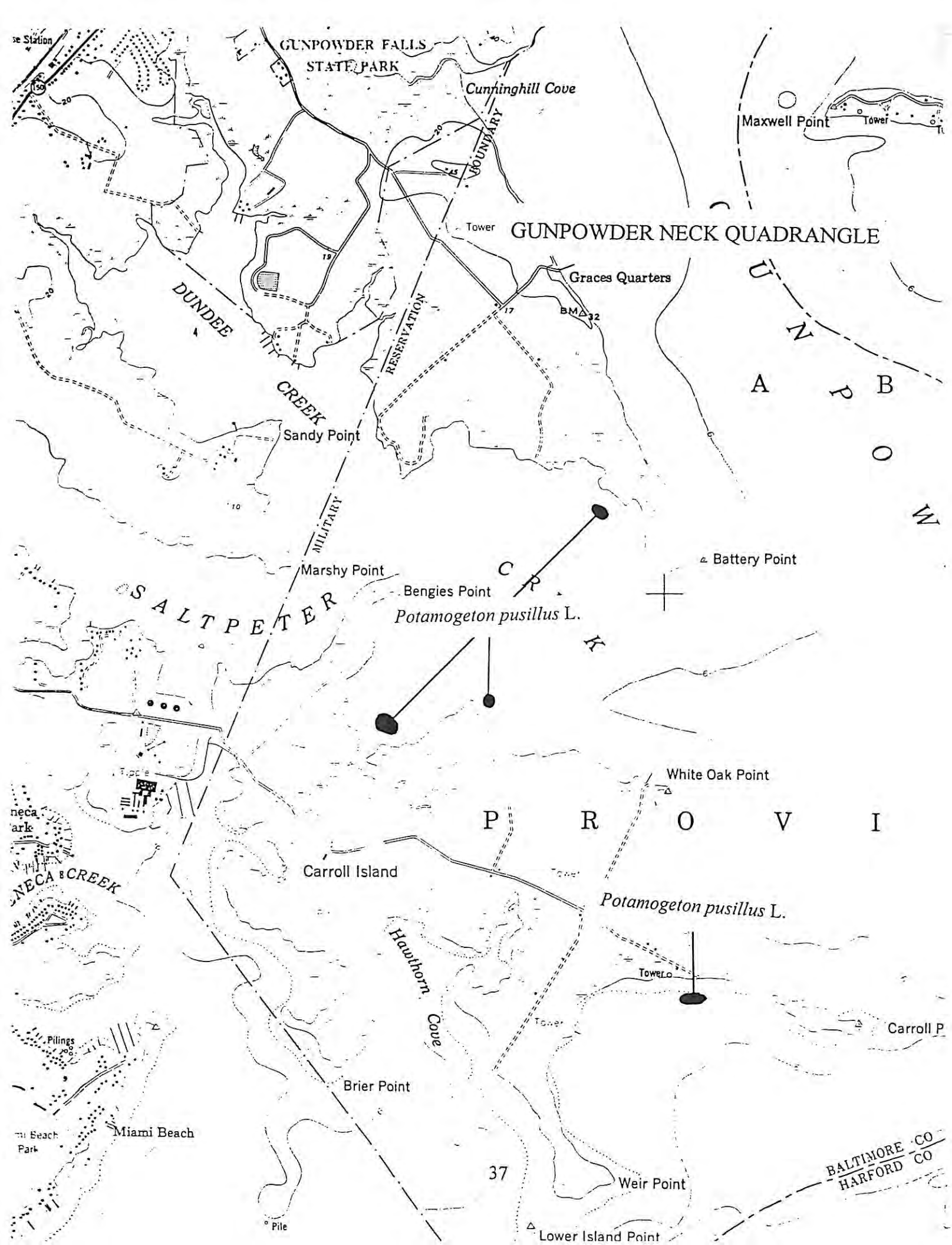
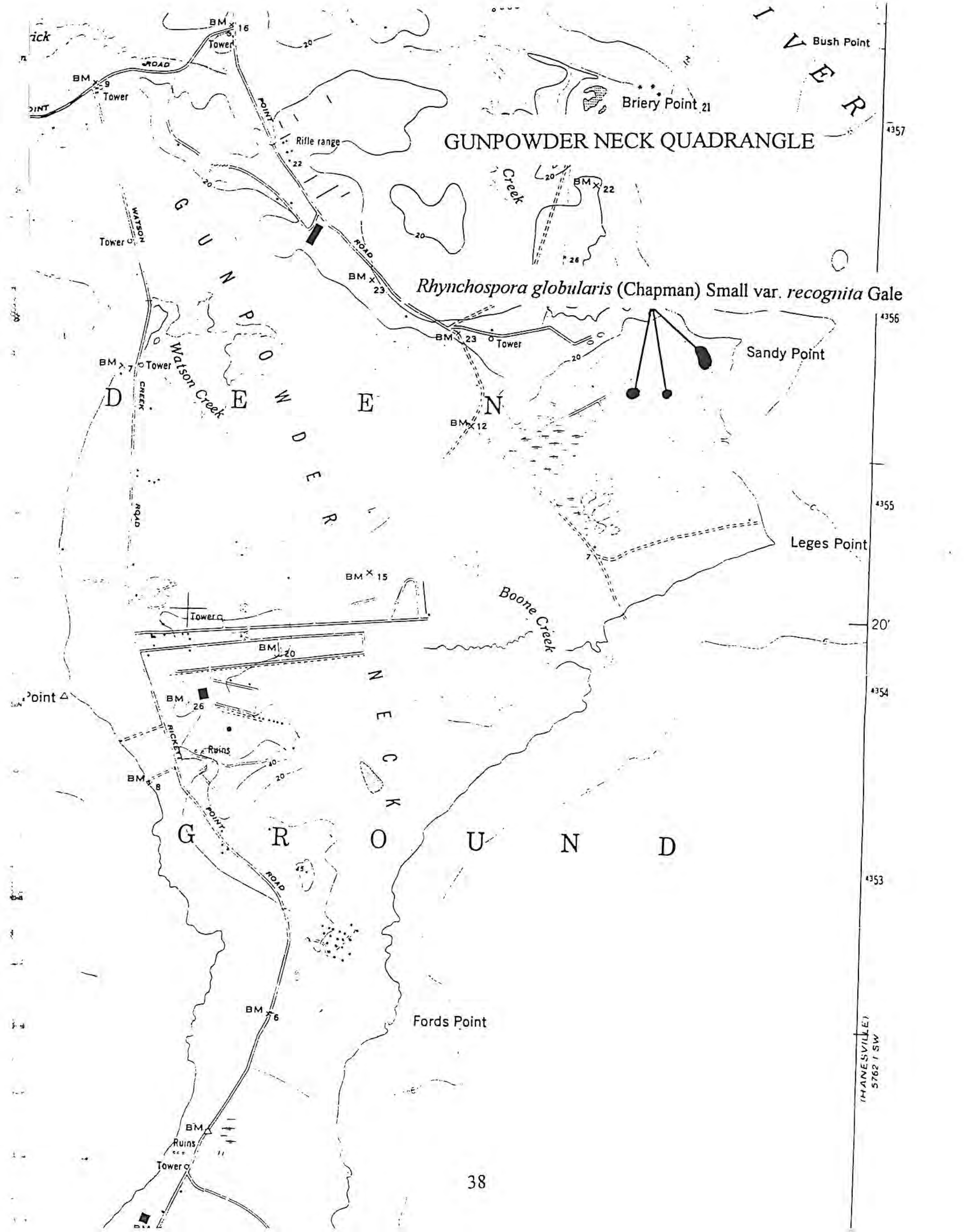
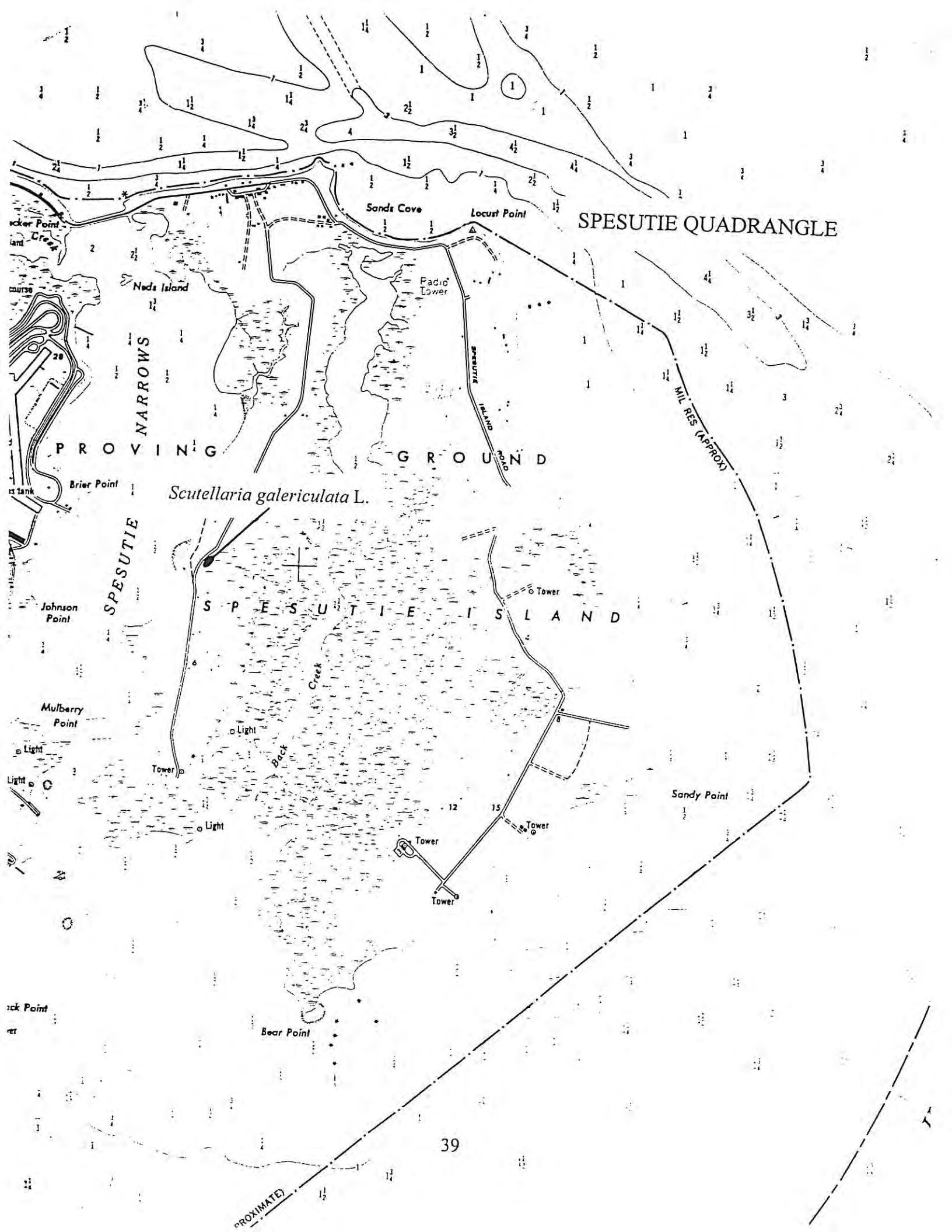
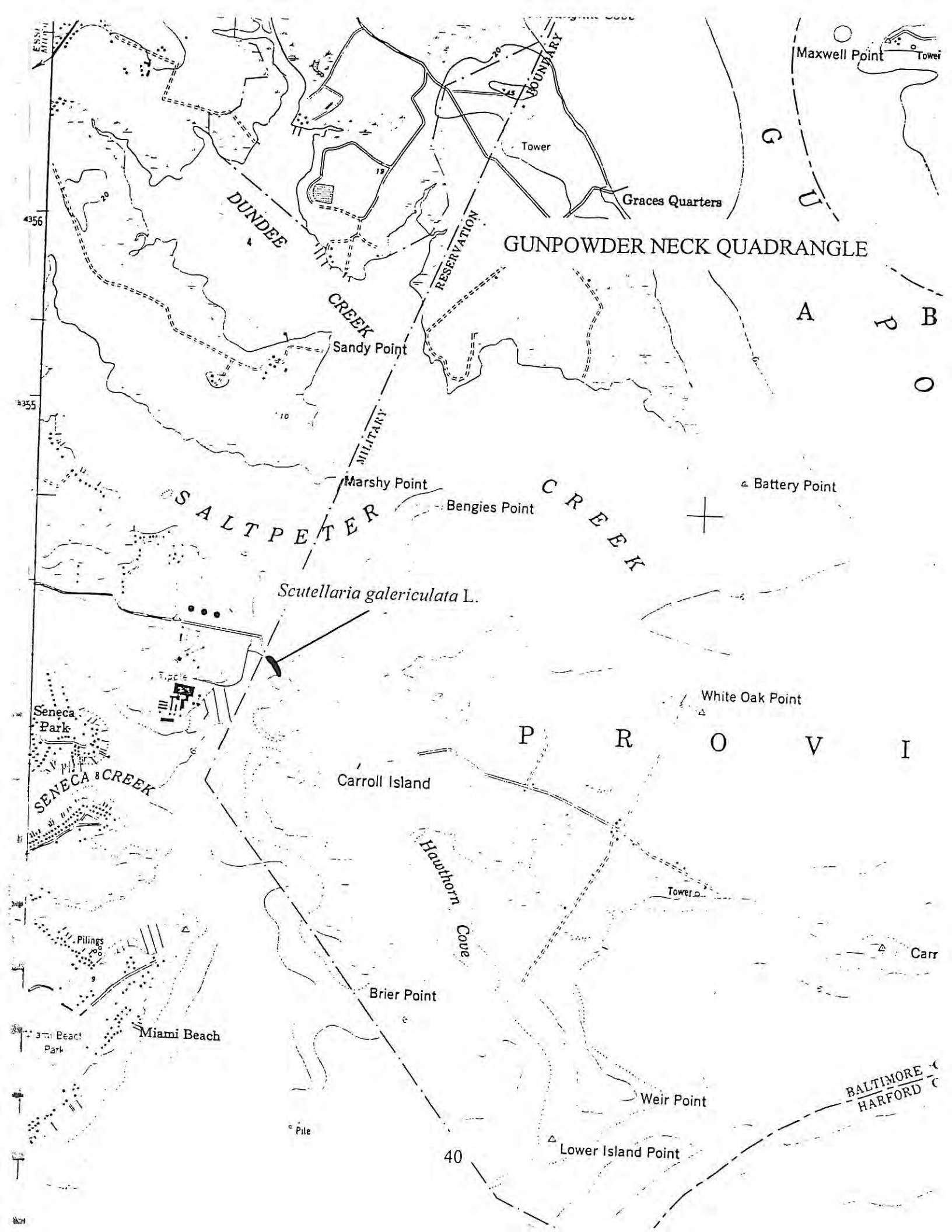
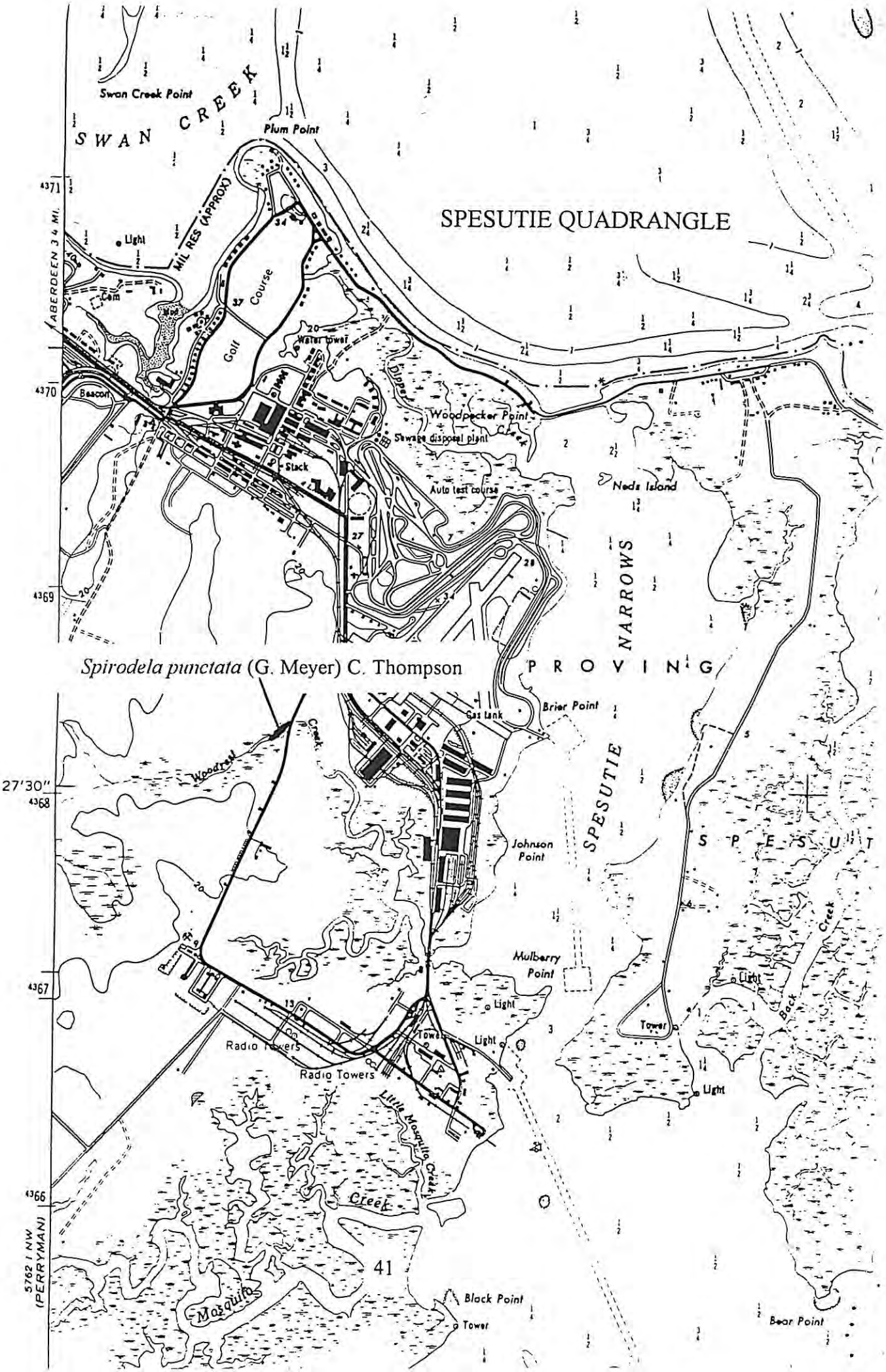
d and published by the Geological Survey
l by NOS/NOAA, USCE, and USGS
aphy by photogrammetric methods from aerial


GUNPOWDER FALLS
STATE PARK
Cunninghill Cove
Maxwell Point
Tower
BOUNDARY
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE
CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER
CREEK
Potamogeton pusillus L.
White Oak Point
Carroll Island
Potamogeton pusillus L.
Hawthorn Cove
Carroll P
Pilings
Brier Point
Miami Beach
Weir Point
Pile
Lower Island Point
37
BALTIMORE CO
HARFORD CO

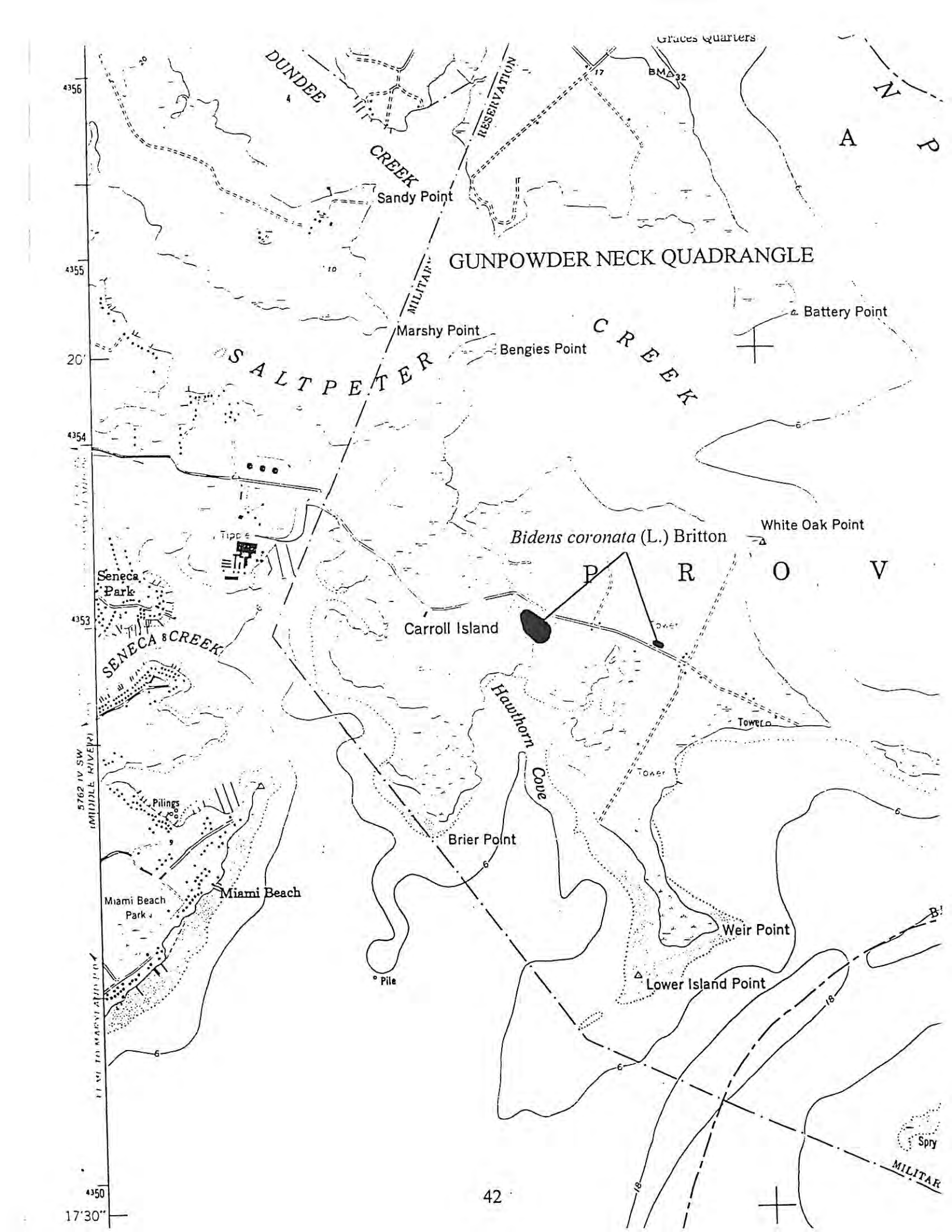

GUNPOWDER NECK QUADRANGLE
Rhynchospora globularis (Chapman) Small var. recognita Gale
Bush Point
Briery Point 21
Rifle range
Creek
Tower
ROAD
POINT
WATSON
Watson Creek
CREEK
Sandy Point
G U N P O W D E R
D E E N
N E C K
G R O U N D
Leges Point
Boone Creek
Ruins
RICKETT
Fords Point
HANESVILLE
5762 I SW
20′

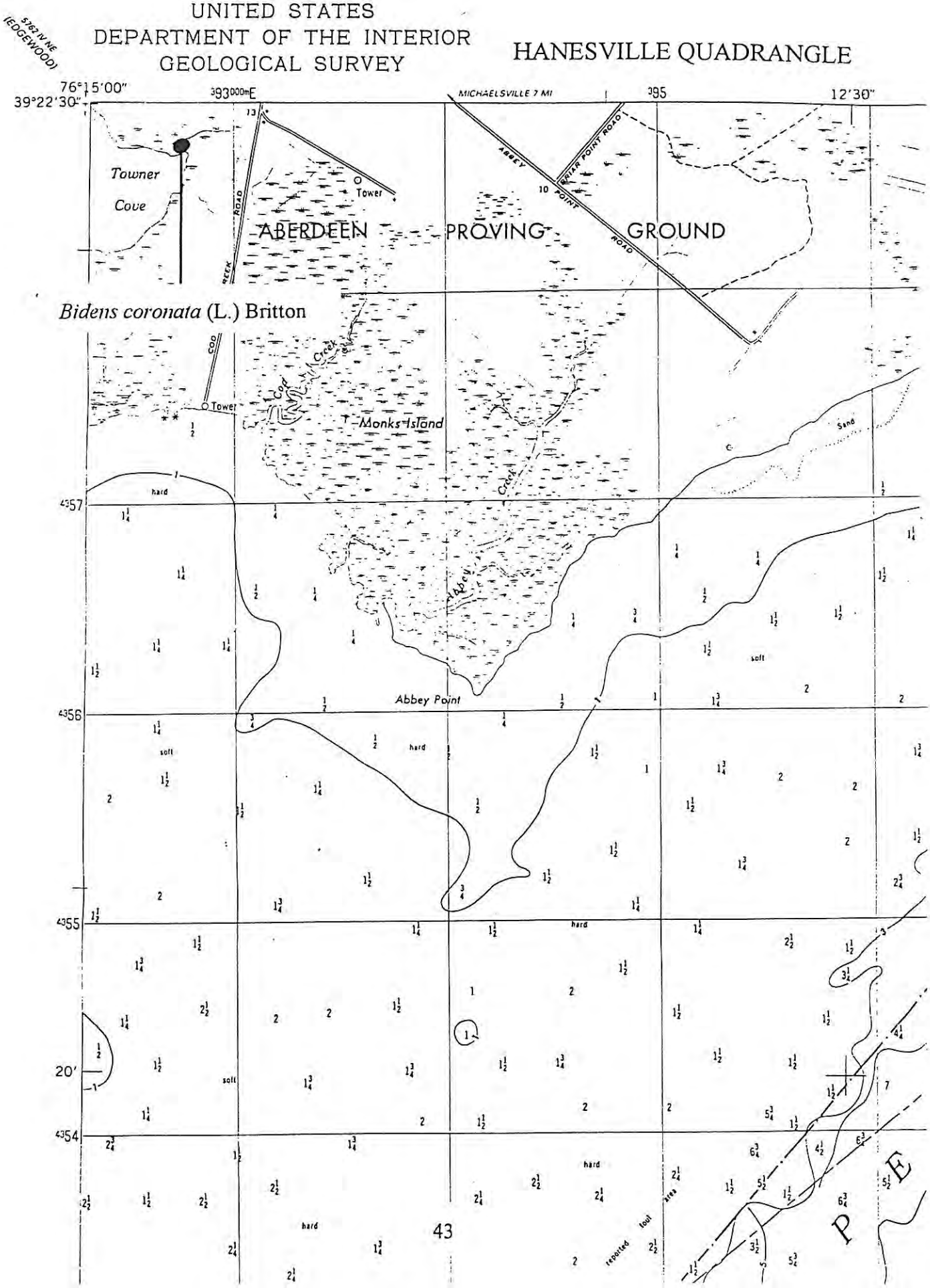

SPESUTIE QUADRANGLE
Sands Cove
Locust Point
Nads Island
Radio Tower
PROVING GROUND
SPESUTIE NARROWS
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
Brier Point
Scutellaria galericulata L.
SPESUTIE ISLAND
Johnson Point
Mulberry Point
Back Creek
Sandy Point
Bear Point
Tower
Light


Maxwell Point
Tower
BOUNDARY
Tower
Graces Quarters
DUNDEE
CREEK
RESERVATION
GUNPOWDER NECK QUADRANGLE
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER CREEK
Scutellaria galericulata L.
White Oak Point
Seneca Park
SENECA CREEK
Carroll Island
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
BALTIMORE
HARFORD
Pile
Lower Island Point
4356
4355

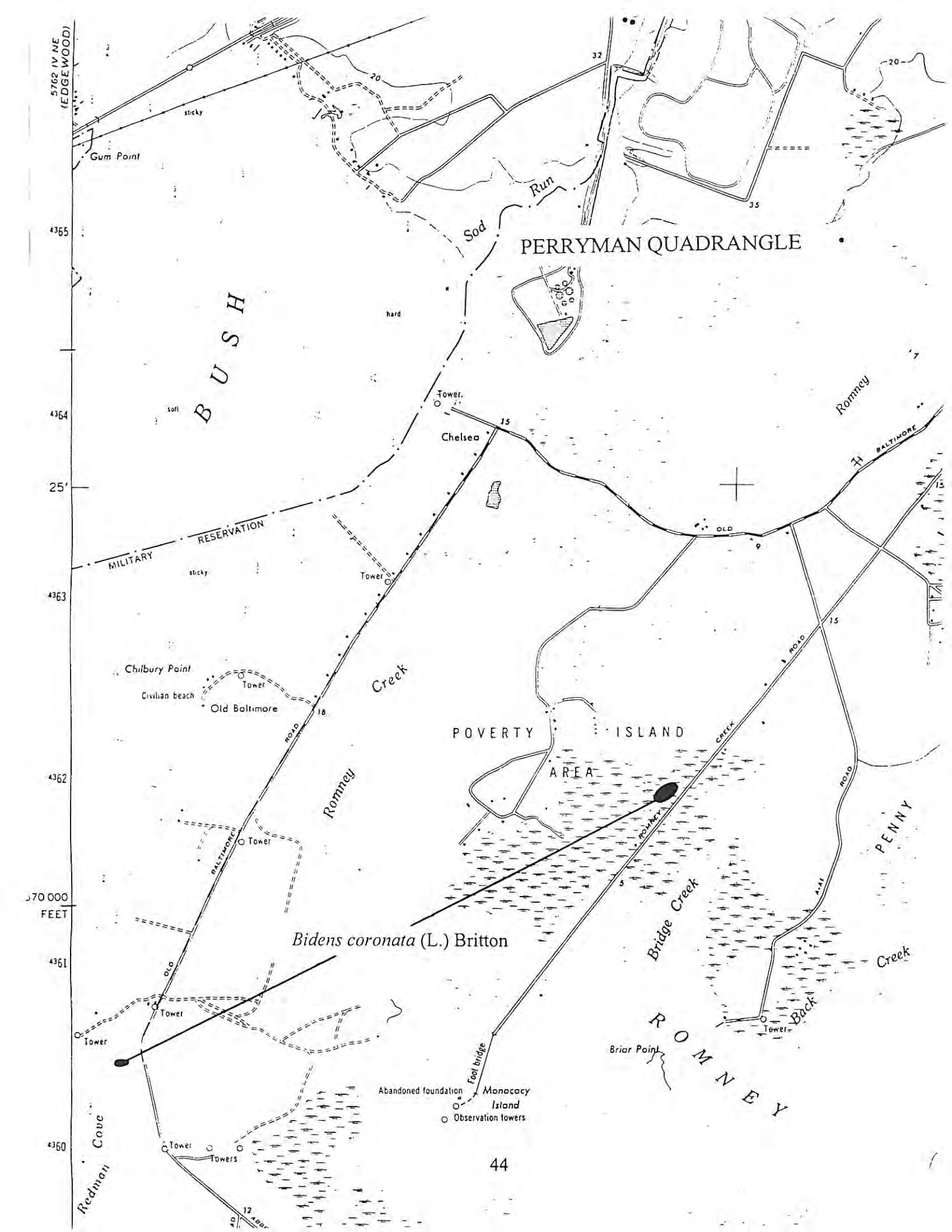


Spirodela punctata (G. Meyer) C. Thompson

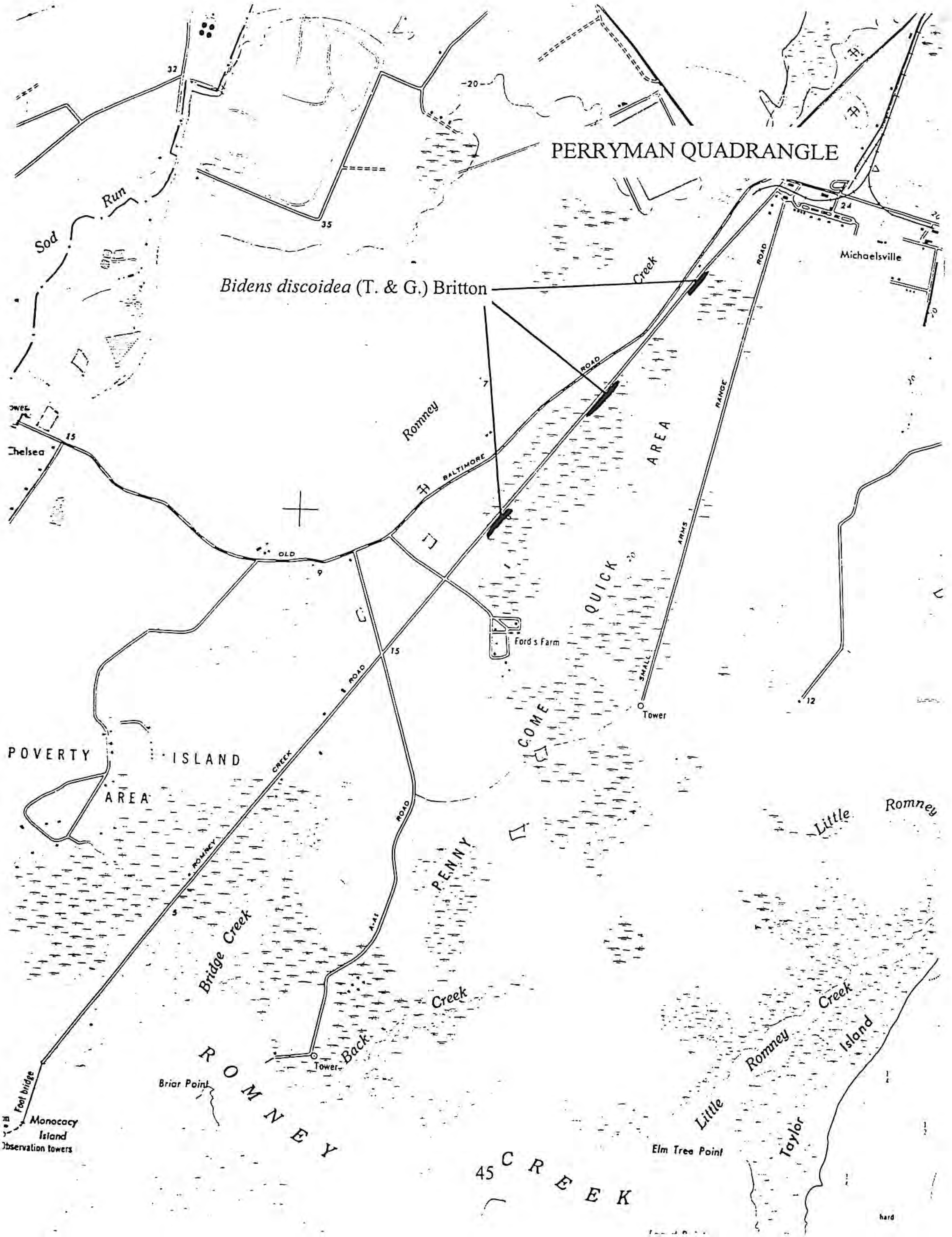

GUNPOWDER NECK QUADRANGLE
Graces Quarters
DUNDEE CREEK
RESERVATION
Sandy Point
MILITAR
Marshy Point
Bengies Point
Battery Point
SALTPETER CREEK
Bidens coronata (L.) Britton
White Oak Point
Seneca Park
Carroll Island
SENECA CREEK
Hawthorn Cove
Brier Point
Pilings
Miami Beach
Miami Beach Park
Weir Point
Lower Island Point
Pile
Spry
MILITAR
4356
4355
4354
4353
4350
17'30"
20'
5762 IV SW (MIDDLE RIVER)

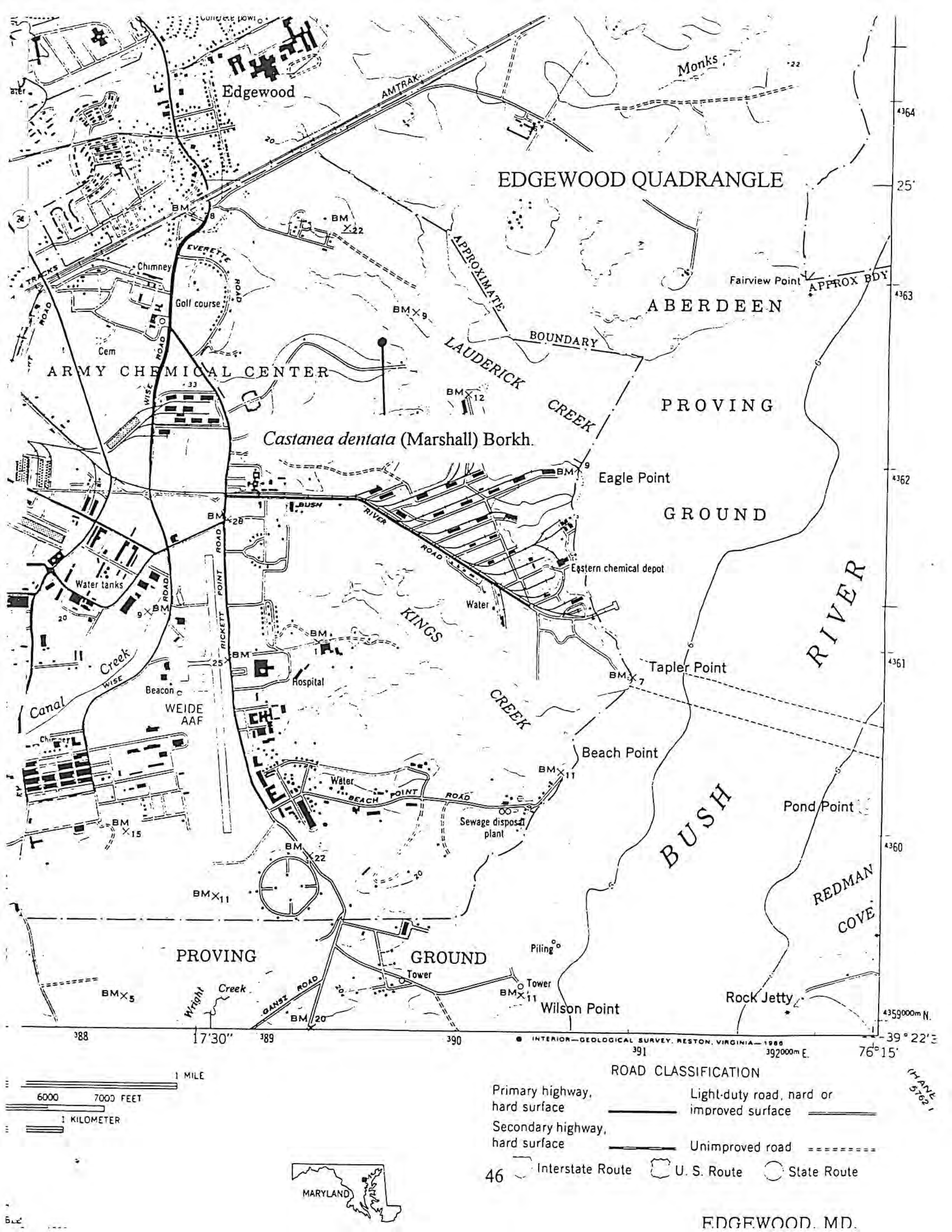


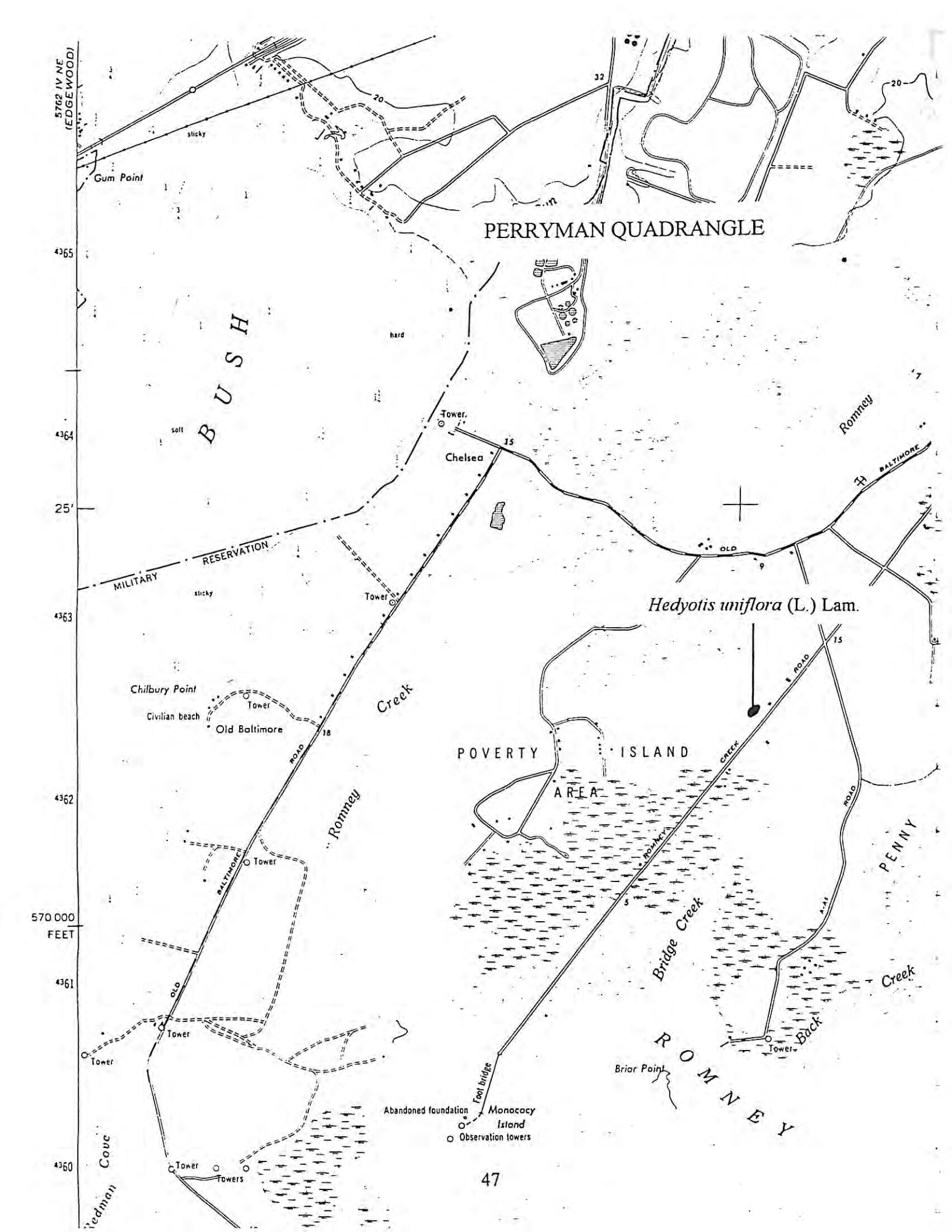
Bidens coronata (L.) Britton

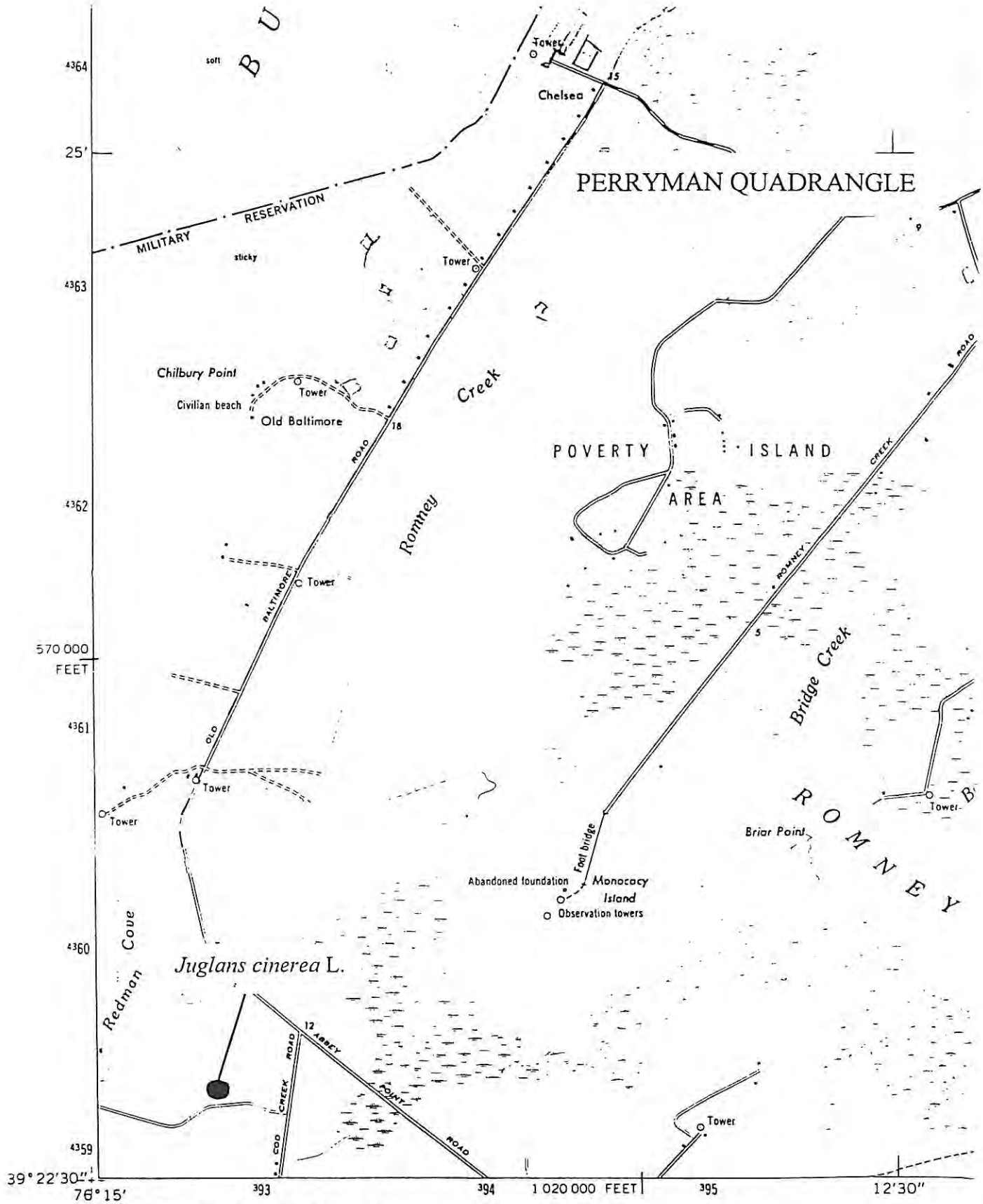


Bidens coronata (L.) Britton


PERRYMAN QUADRANGLE
Bidens discoidea (T. & G.) Britton
Sod Run
Romney
Chelsea
Michaelsville
Creek
BALTIMORE
OLD
ROAD
SMALL ARMS RANGE ROAD
COME QUICK AREA
Ford's Farm
Tower
POVERTY ISLAND AREA
ROMNEY CREEK ROAD
A.A.S. ROAD
PENNY
Bridge Creek
Back Creek
Little Romney
Little Romney Creek
Taylor Island
Elm Tree Point
Briar Point
Foot bridge
Monocacy Island
Observation towers
ROMNEY CREEK


EDGEWOOD QUADRANGLE
Castanea dentata (Marshall) Borkh.
Edgewood
AMTRAK
Monks
ABERDEEN
PROVING
GROUND
APPROXIMATE BOUNDARY
APPROX BDY
Fairview Point
LAUDERICK CREEK
EVERETTE ROAD
Chimney
Golf course
Cem
ARMY CHEMICAL CENTER
WISE ROAD
BUSH RIVER ROAD
Eagle Point
Eastern chemical depot
Water tanks
Water
KINGS CREEK
RICKETT POINT ROAD
Hospital
Tapler Point
Canal Creek
Beacon
WEIDE AAF
Beach Point
BEACH POINT ROAD
Sewage disposal plant
BUSH RIVER
Pond Point
REDMAN COVE
PROVING GROUND
Piling
Tower
Wright Creek
GANSZ ROAD
Wilson Point
Rock Jetty
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1986
17'30"
76°15'
39°22'
ROAD CLASSIFICATION
Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route
1 MILE
6000
7000 FEET
1 KILOMETER
MARYLAND
EDGEWOOD, MD.


5762 IV NE
(EDGEWOOD)
PERRYMAN QUADRANGLE
Gum Point
sticky
hard
soft
BUSH
Tower
Chelsea
Romney
BALTIMORE
OLD
MILITARY RESERVATION
Hedyotis uniflora (L.) Lam.
Chilbury Point
Civilian beach
Old Baltimore
ROAD
Creek
POVERTY ISLAND
AREA
ROMNEY CREEK
PENNY
Bridge Creek
Back Creek
Brior Point
ROMNEY
Abandoned foundation
Foot bridge
Monocacy Island
Observation towers
Towers
Cove
4365
4364
25'
4363
4362
570 000 FEET
4361
4360



(GUNPOWDER NECK) 5762 IV SE

Mapped by the Army Map Service
Published for civil use by the Geological Survey
Control by NOS/NOAA

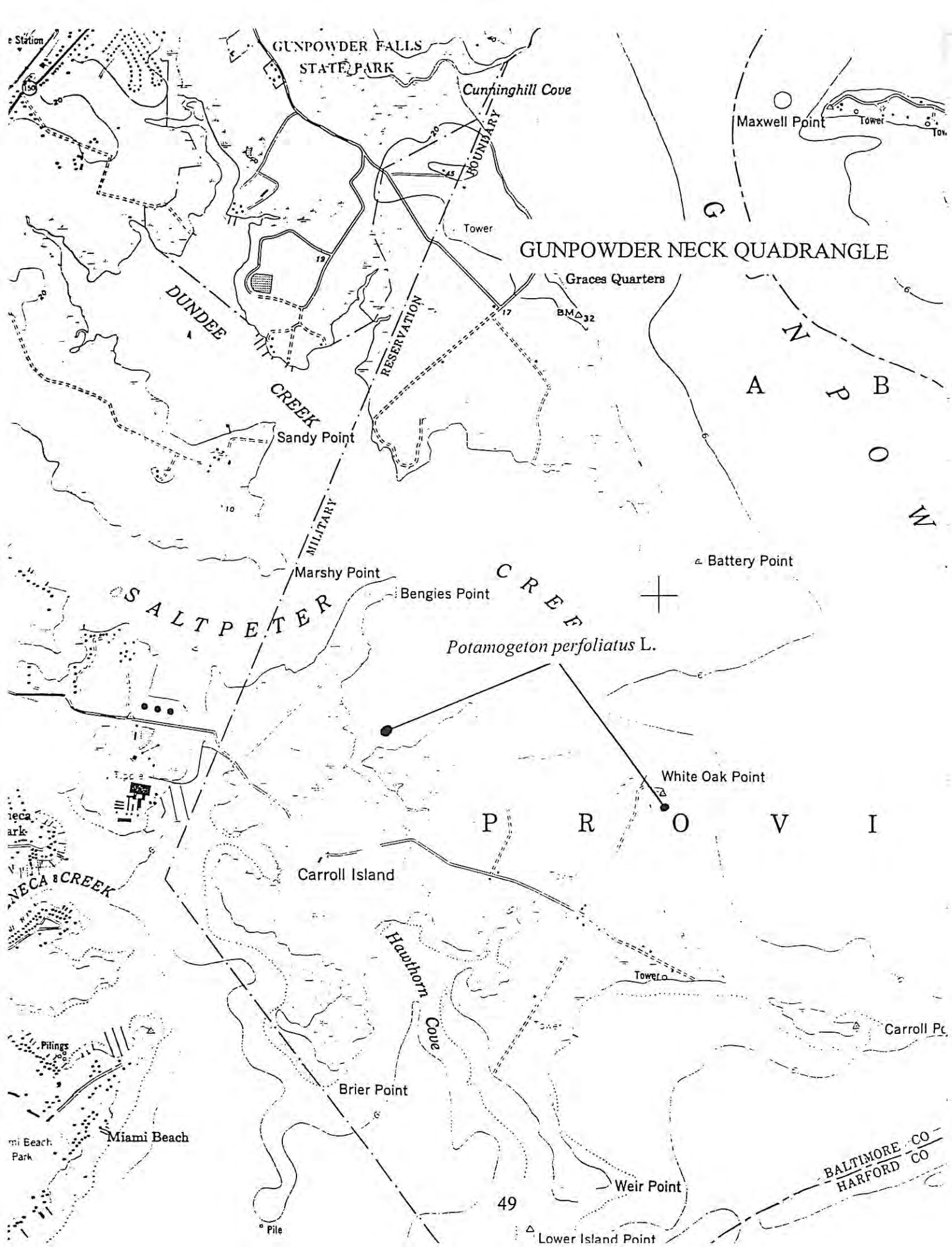
Planimetry by photogrammetric methods from aerial photographs taken 1943. Topography by planetable surveys 1944. Culture revised from aerial photographs taken 1947. Field checked 1948

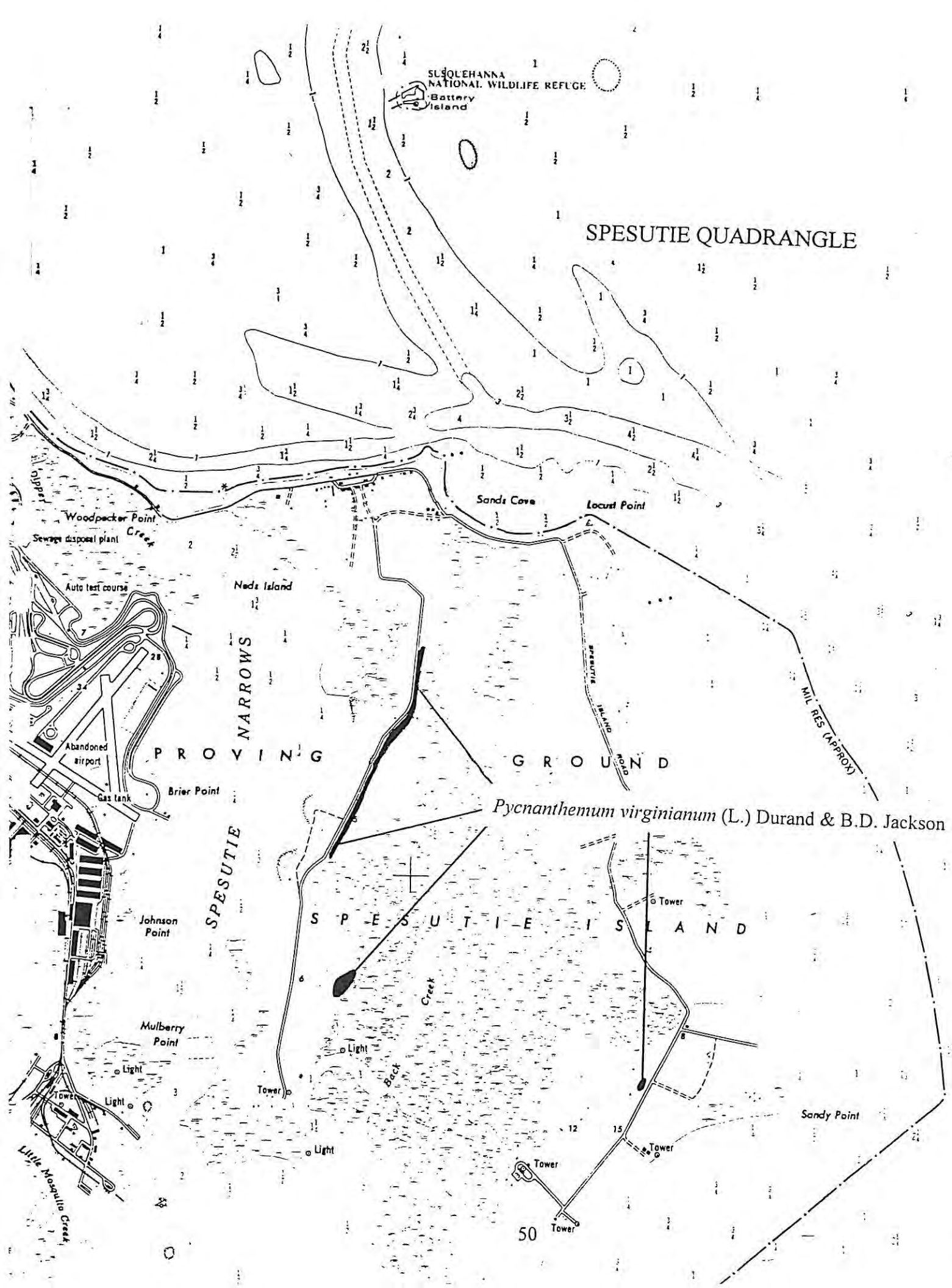
Selected hydrographic data compiled from NOS chart 572 (1947)
This information is not intended for navigational p s

Polyconic projection. 10,000-foot grid ticks bas 48
Maryland coordinate system
1000-meter Universal Transverse Mercator grid ticks, zone 18, shown in blue
1927 North American Datum
To place on the predicted North American Datum 1983

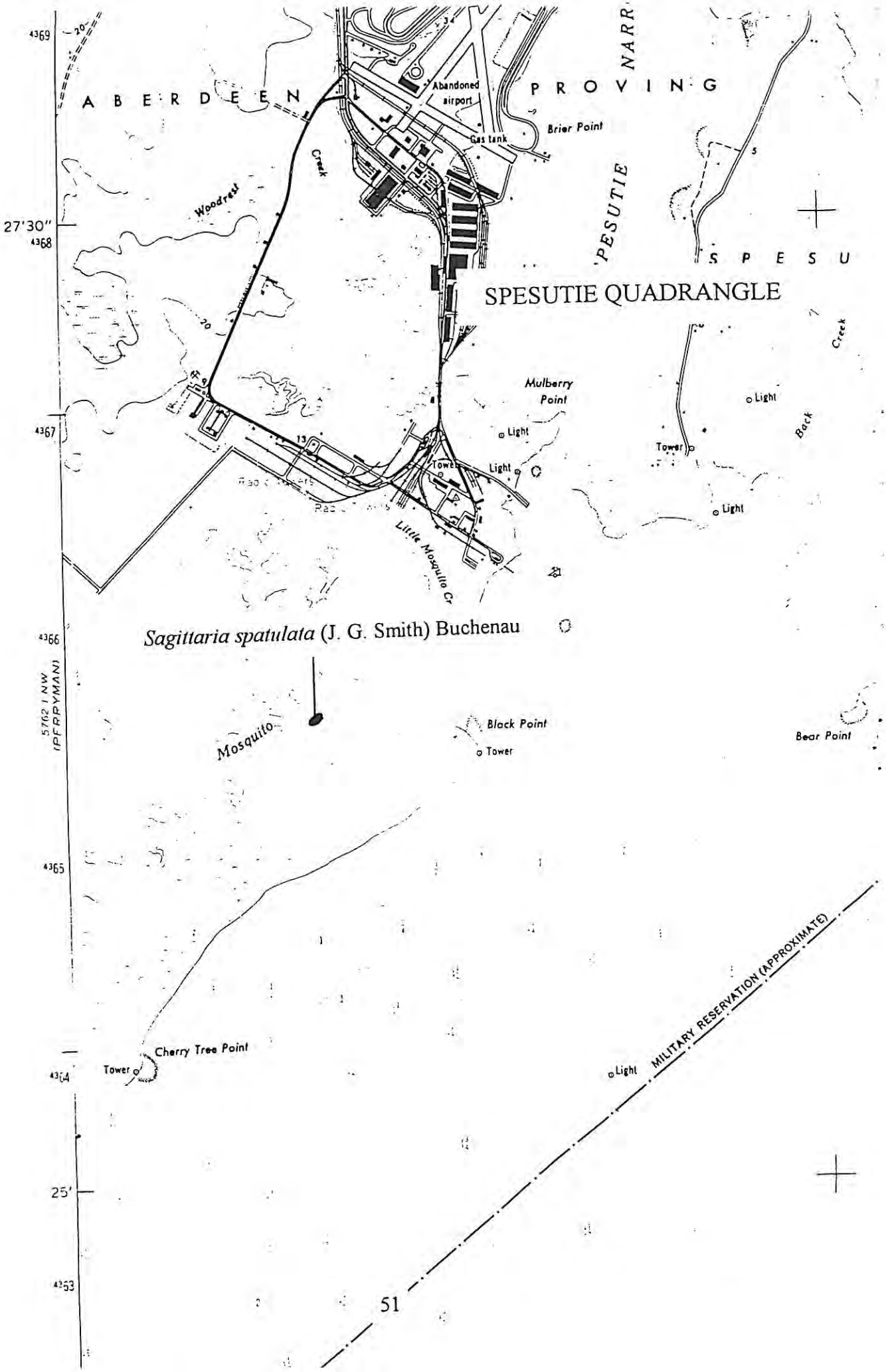
MN GN
10½° 187 MILS
0°45' 13 MILS

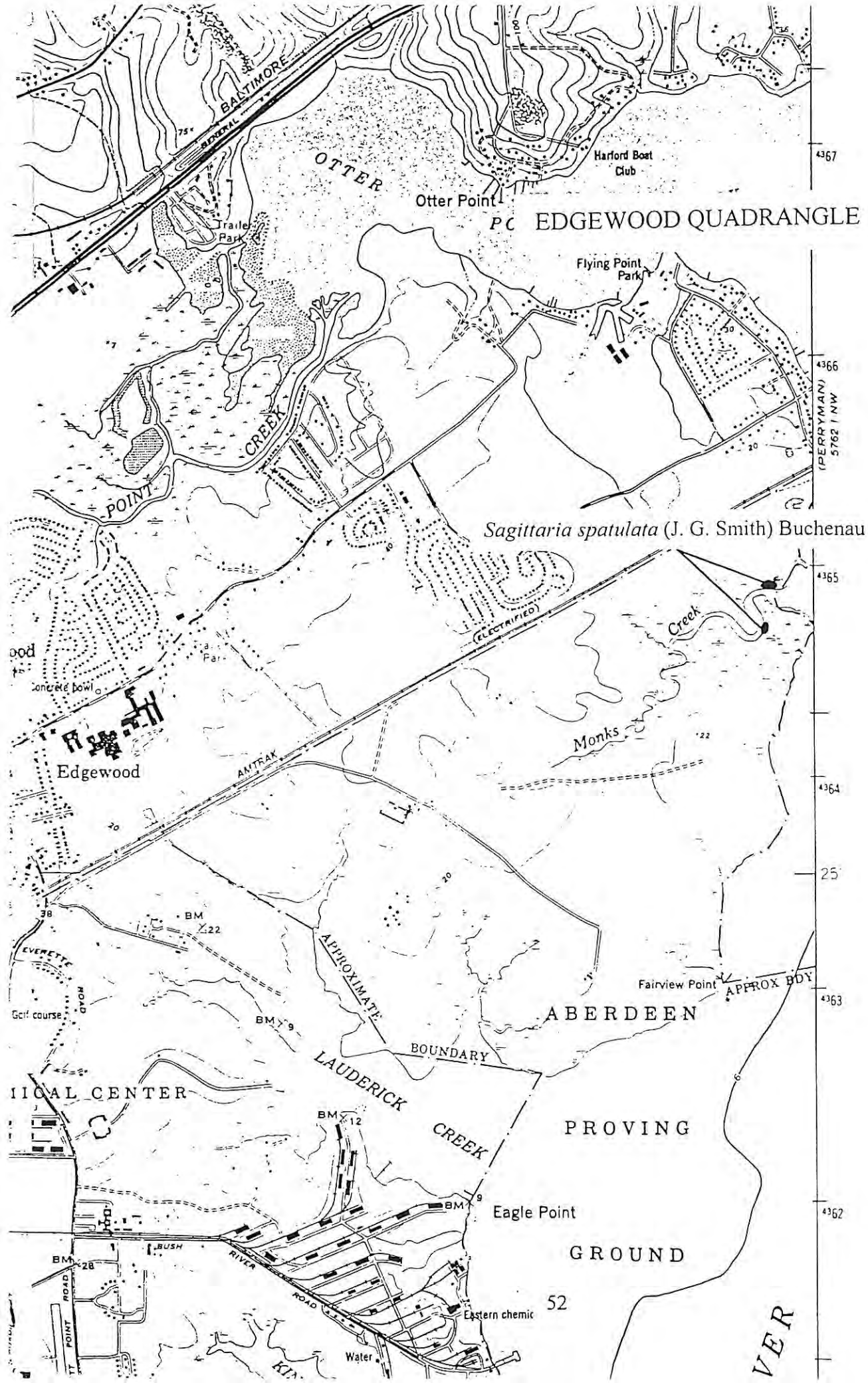
UTM GRID AND 1984 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

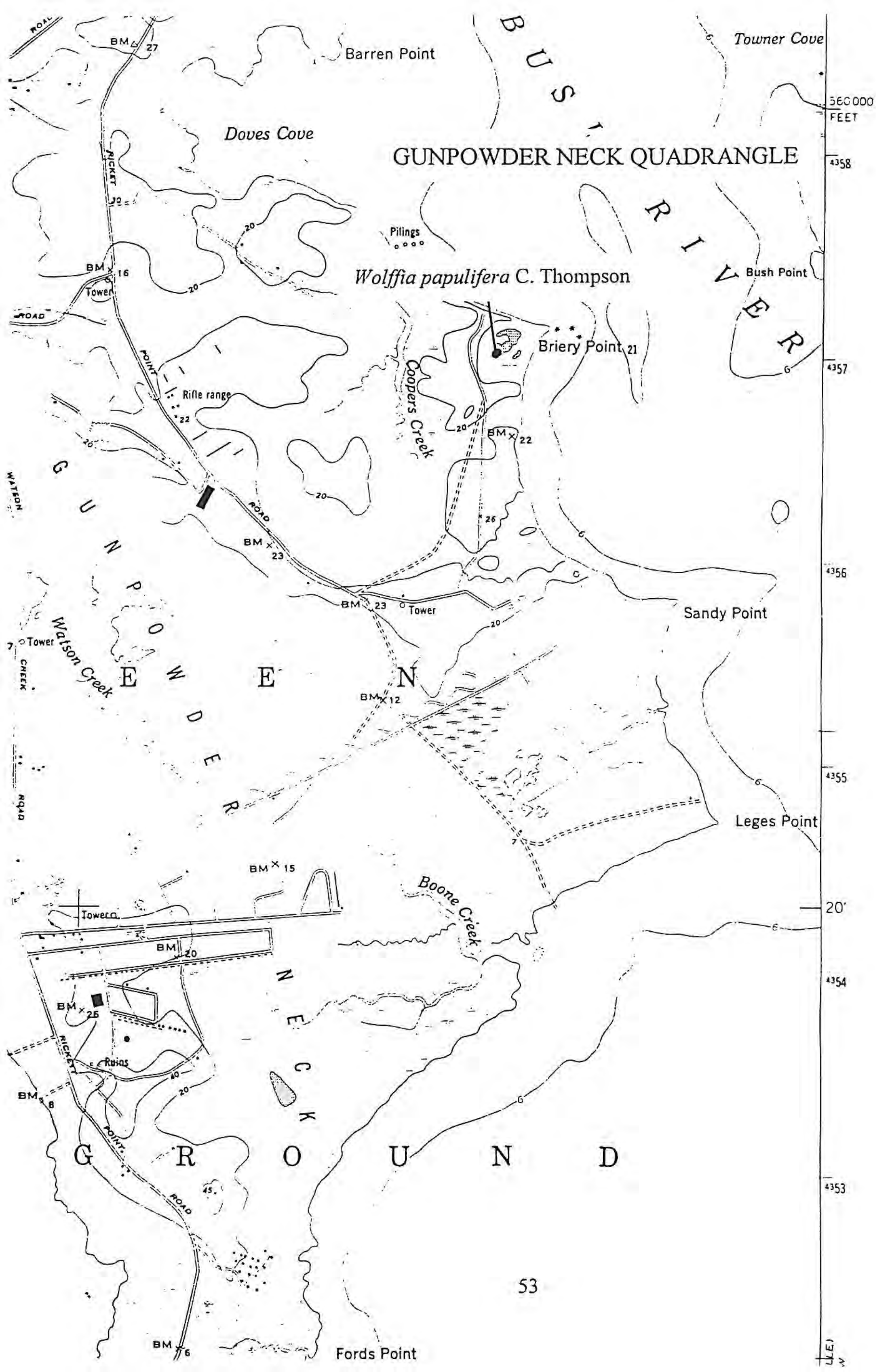

GUNPOWDER FALLS
STATE PARK
Cunninghill Cove
Maxwell Point
Tower
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE
CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER
CREEK
Potamogeton perfoliatus L.
White Oak Point
PROVI
Carroll Island
NECA CREEK
Hawthorn Cove
Tower
Carroll Pt
Pilings
Brier Point
Miami Beach
Weir Point
BALTIMORE CO
HARFORD CO
Pile
Lower Island Point

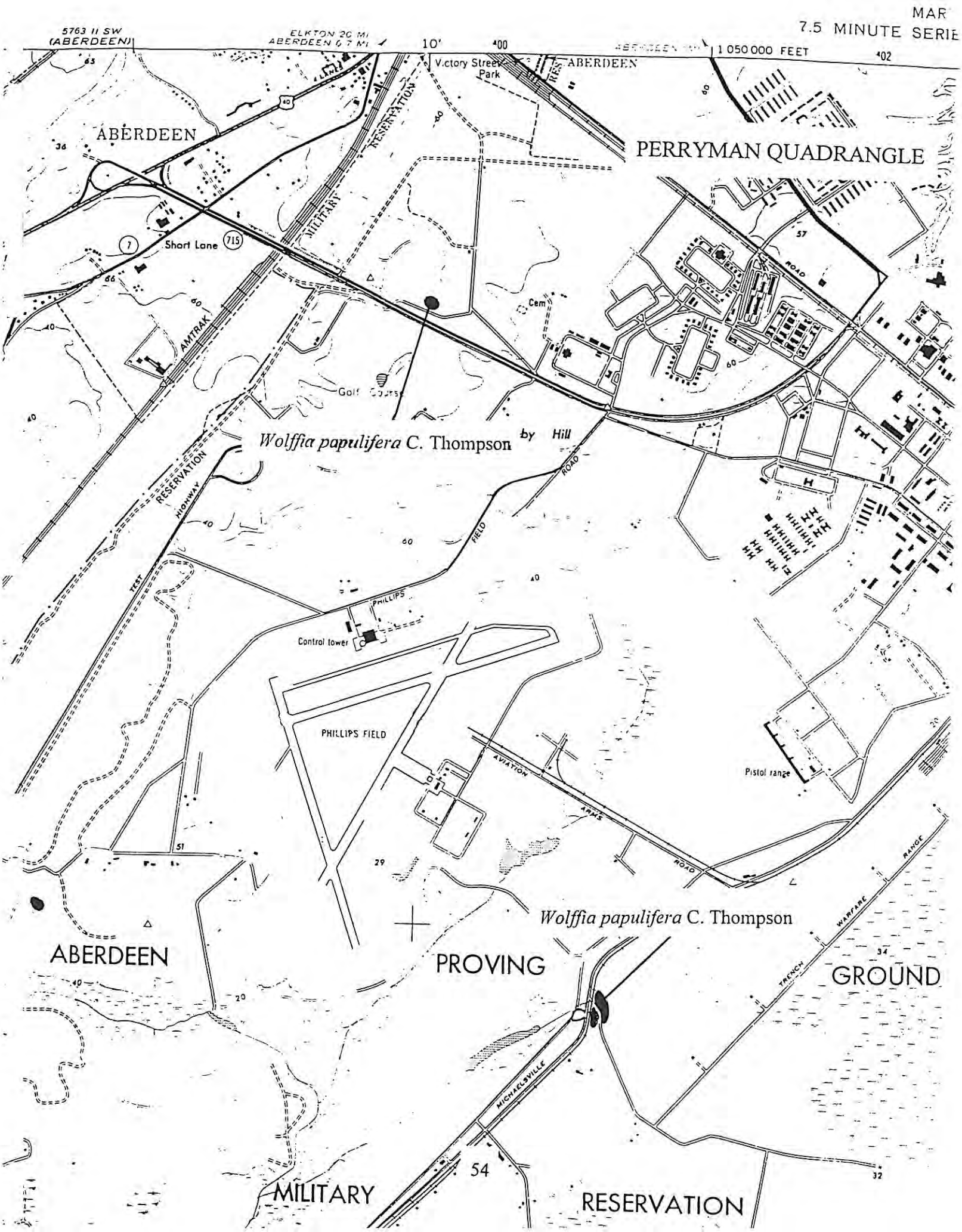


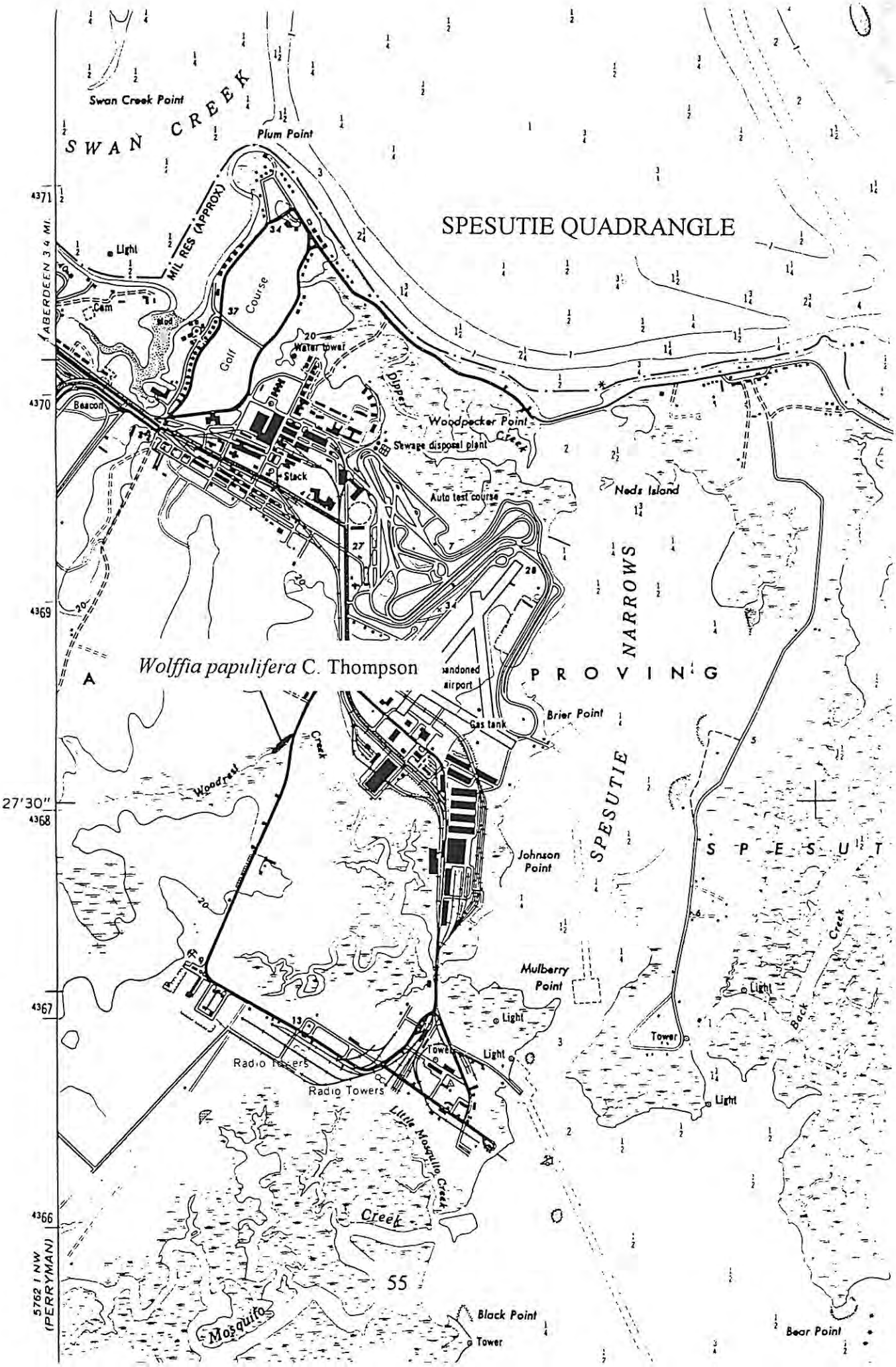
Pycnanthemum virginianum (L.) Durand & B.D. Jackson

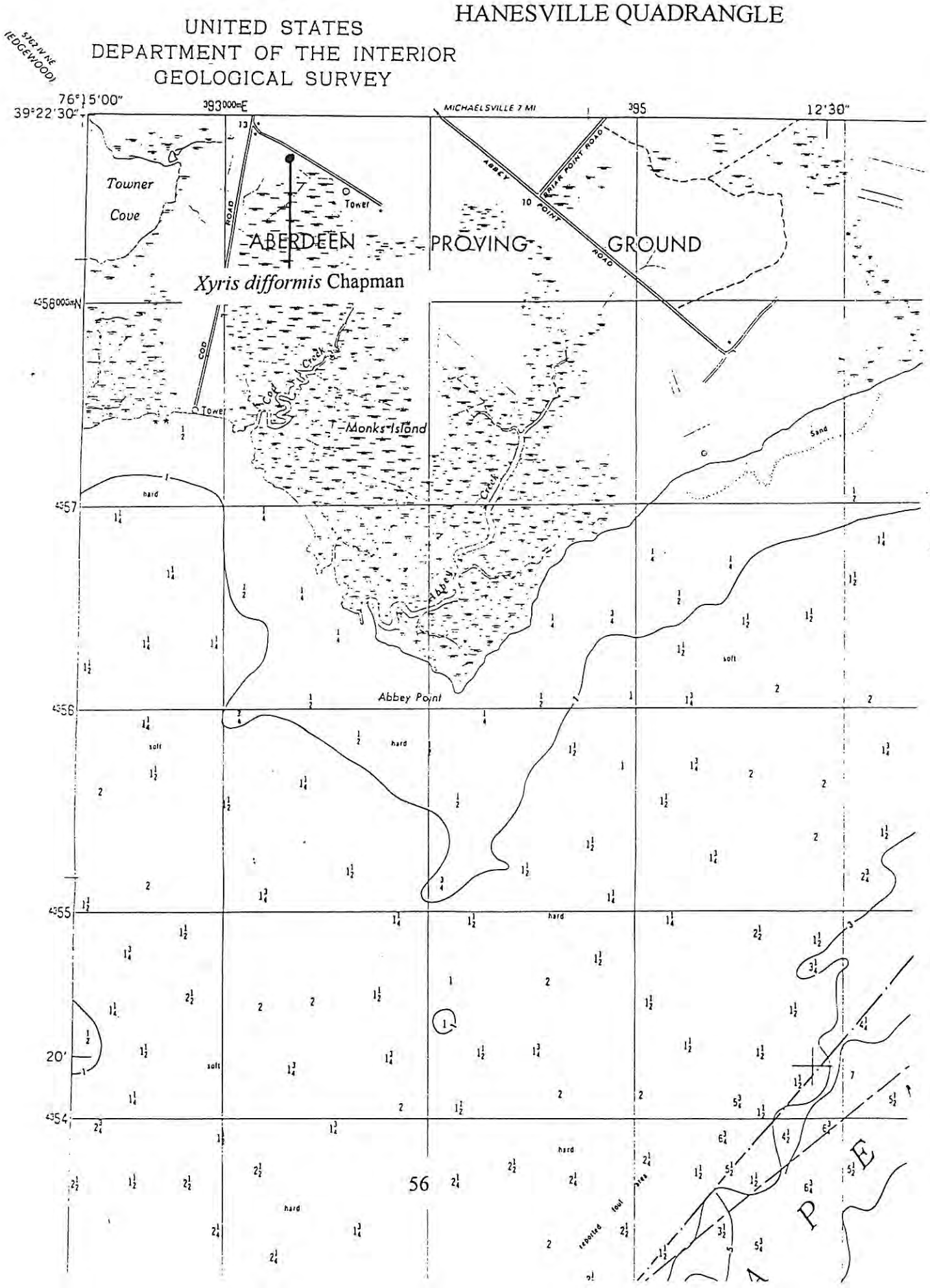

ABERDEEN
PROVING
Abandoned airport
Gas tank
Brier Point
Woodrest
Creek
PESUTIE
SPESU
SPESUTIE QUADRANGLE
Mulberry Point
Light
Tower
Back Creek
Little Mosquito Cr
Sagittaria spatulata (J. G. Smith) Buchenau
Mosquito
Black Point
Bear Point
Cherry Tree Point
MILITARY RESERVATION (APPROXIMATE)
27'30"
25'
4369
4368
4367
4366
4365
4364
4363
5762 I NW
(PERRYMAN)

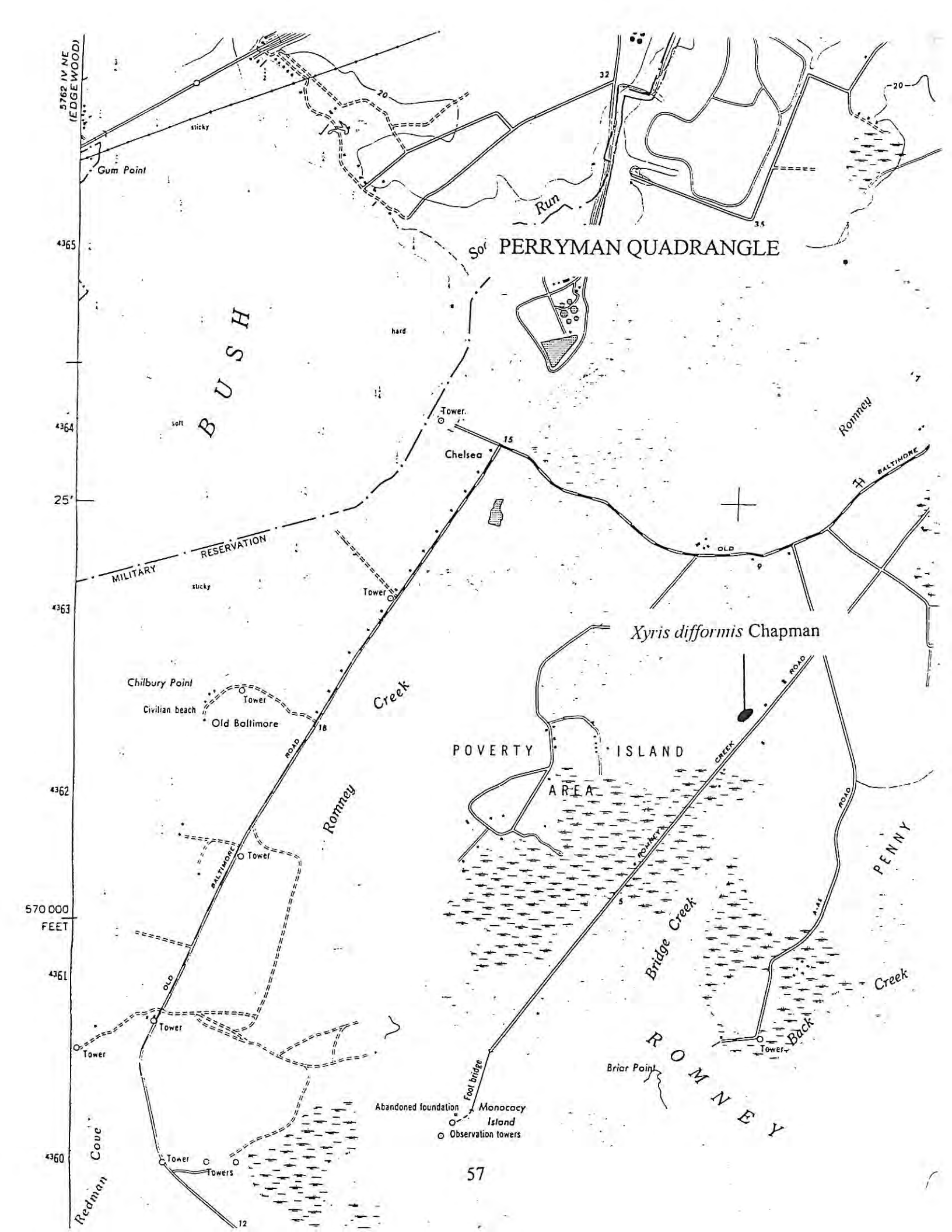

EDGEWOOD QUADRANGLE
Sagittaria spatulata (J. G. Smith) Buchenau
BALTIMORE
Harford Boat Club
Otter Point
Trailer Park
Flying Point Park
CREEK
POINT
(ELECTRIFIED)
Creek
Monks
Edgewood
AMTRAK
Concrete bowl
BM X22
EVERETTE ROAD
Golf course
APPROXIMATE
BOUNDARY
Fairview Point
APPROX BDY
ABERDEEN
LAUDERICK CREEK
PROVING
GROUND
Eagle Point
BM 12
BM 9
BM 28
BUSH RIVER ROAD
POINT ROAD
Eastern chemic
Water
4367
4366
4365
4364
4363
4362
(PERRYMAN) 5762 I NW

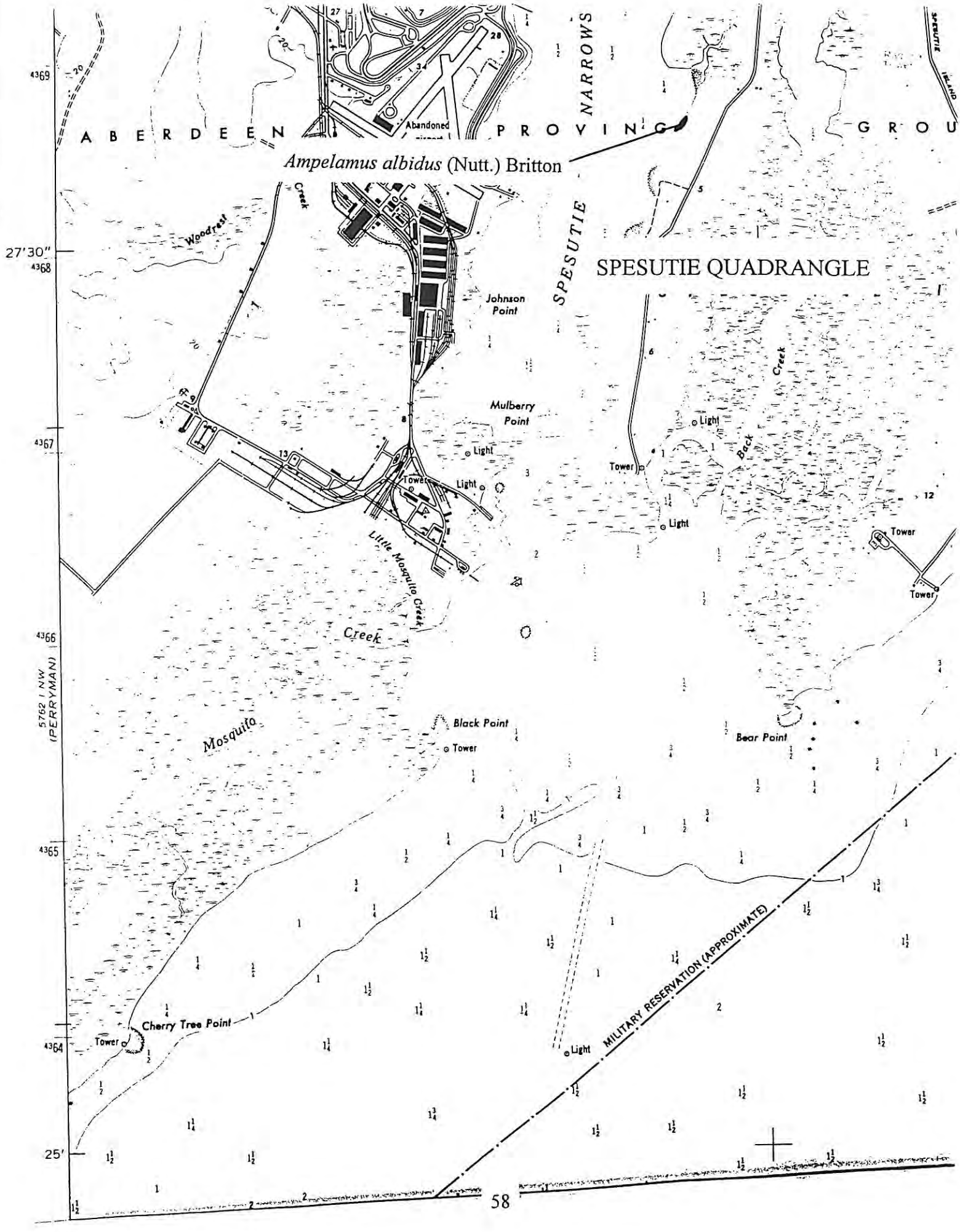

GUNPOWDER NECK QUADRANGLE
Wolffia papulifera C. Thompson
BUSH RIVER
GUNPOWDER NECK
GROUND
Barren Point
Towner Cove
Doves Cove
Pilings
Bush Point
Briery Point
Coopers Creek
Rifle range
Tower
Sandy Point
Watson Creek
Leges Point
Boone Creek
Ruins
Fords Point
RICKET POINT ROAD
560000 FEET
4358
4357
4356
4355
20'
4354
4353

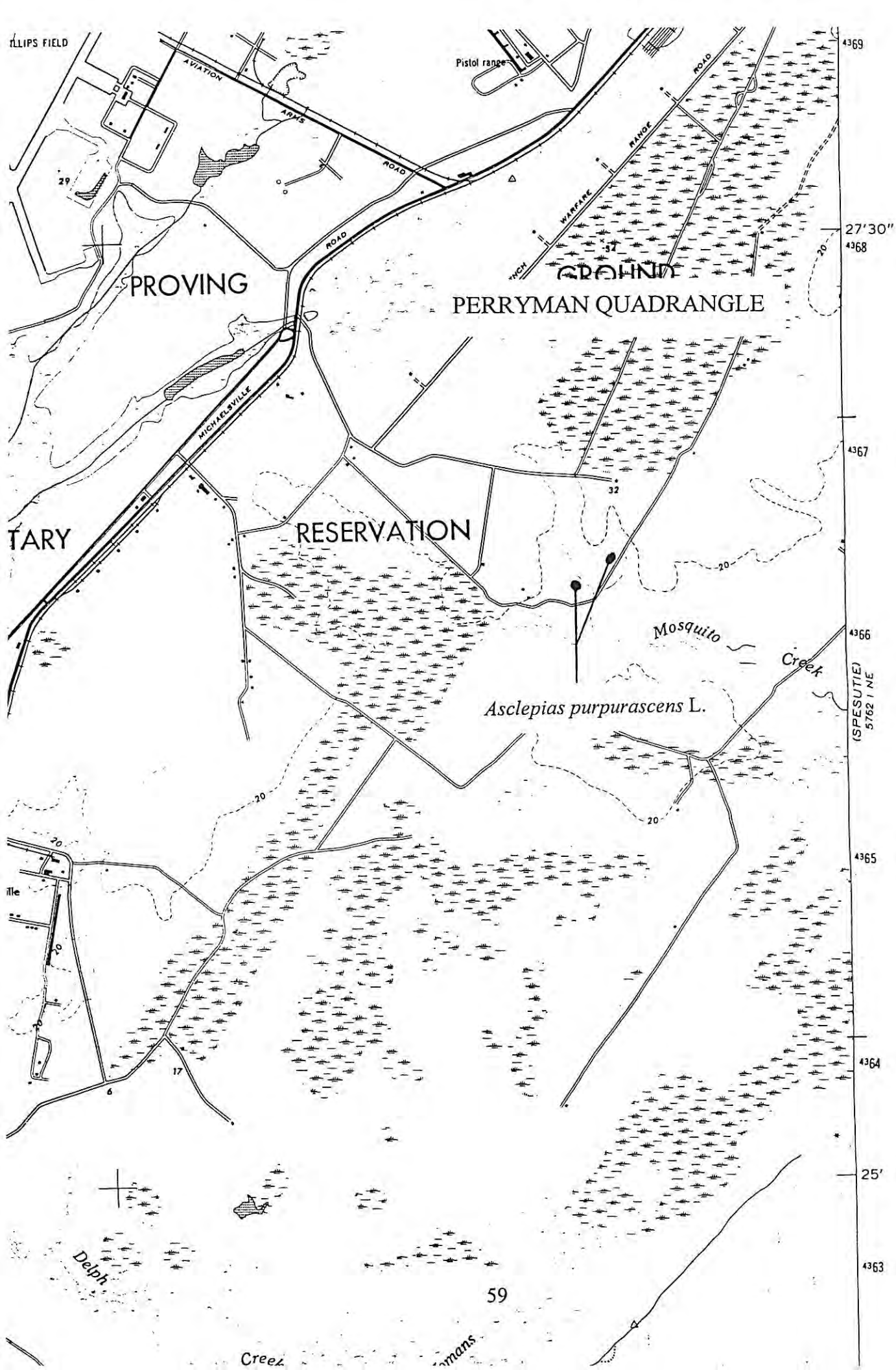

MAR
7.5 MINUTE SERIE
5763 II SW
(ABERDEEN)
ELKTON 20 MI
ABERDEEN 0.7 MI
10'
400
1 050 000 FEET
402
ABERDEEN
PERRYMAN QUADRANGLE
Victory Street Park
MILITARY RESERVATION
Short Lane
715
AMTRAK
Cem
ROAD
Golf Course
Wolffia papulifera C. Thompson by Hill
RESERVATION
HIGHWAY
TEST
FIELD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ARMS
ROAD
Pistol range
Wolffia papulifera C. Thompson
ABERDEEN
PROVING
GROUND
WARFARE
RANGE
TRENCH
MICHAELSVILLE
54
MILITARY
RESERVATION

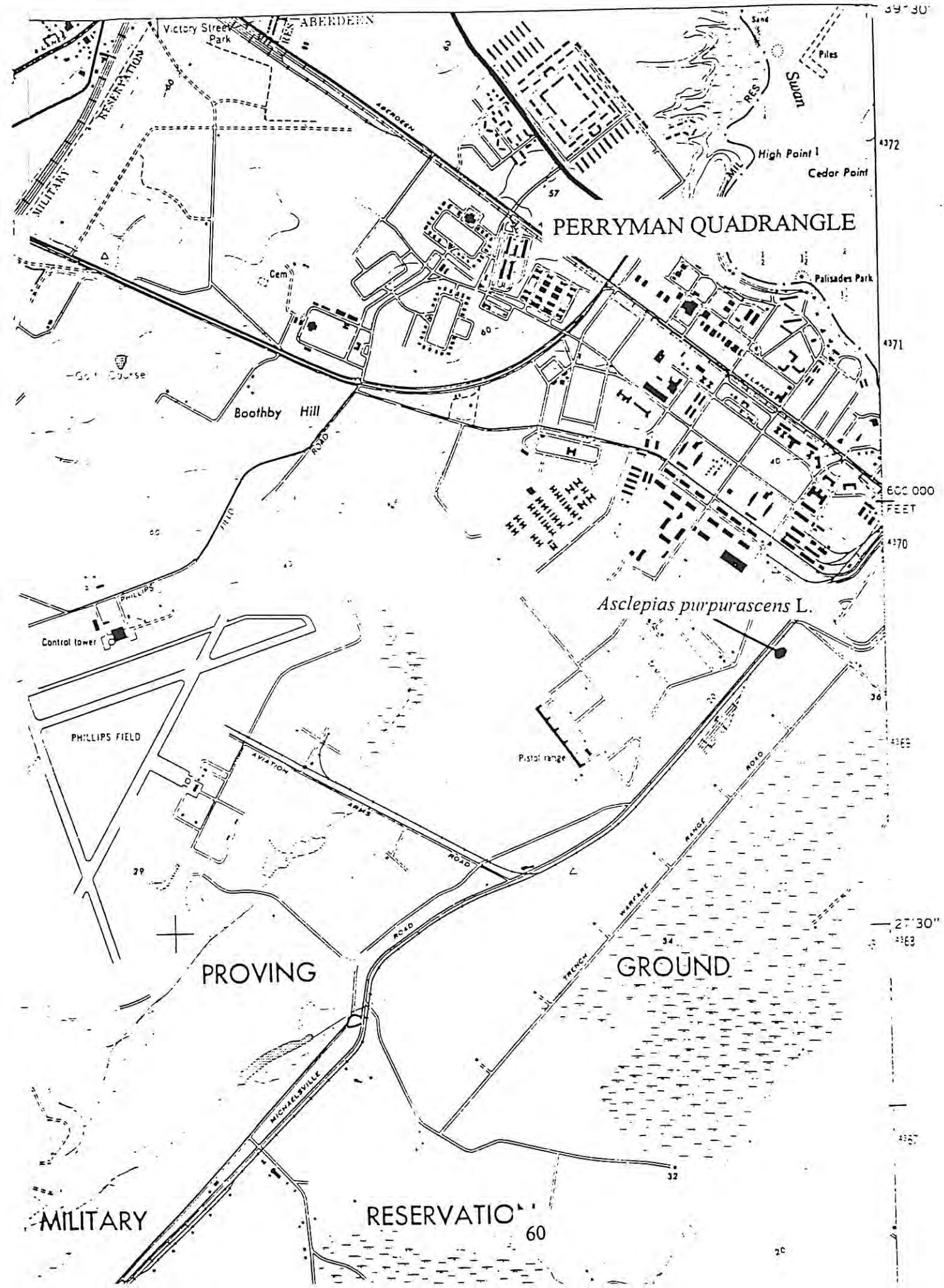

SPESUTIE QUADRANGLE
SWAN CREEK
Swan Creek Point
Plum Point
ABERDEEN 3 4 MI.
MIL RES (APPROX)
Light
Cem
Mud
Course
Golf
Water tower
Beacon
Dipper Creek
Woodpecker Point
Sewage disposal plant
Stack
Auto test course
Neds Island
Wolffia papulifera C. Thompson
PROVING
NARROWS
SPESUTIE
Abandoned airport
Gas tank
Brier Point
Woodreut Creek
Johnson Point
Mulberry Point
Back Creek
Tower
Radio Towers
Little Mosquito Creek
Mosquito Creek
Black Point
Bear Point
27'30"
4371
4370
4369
4368
4367
4366
5762 I NW (PERRYMAN)

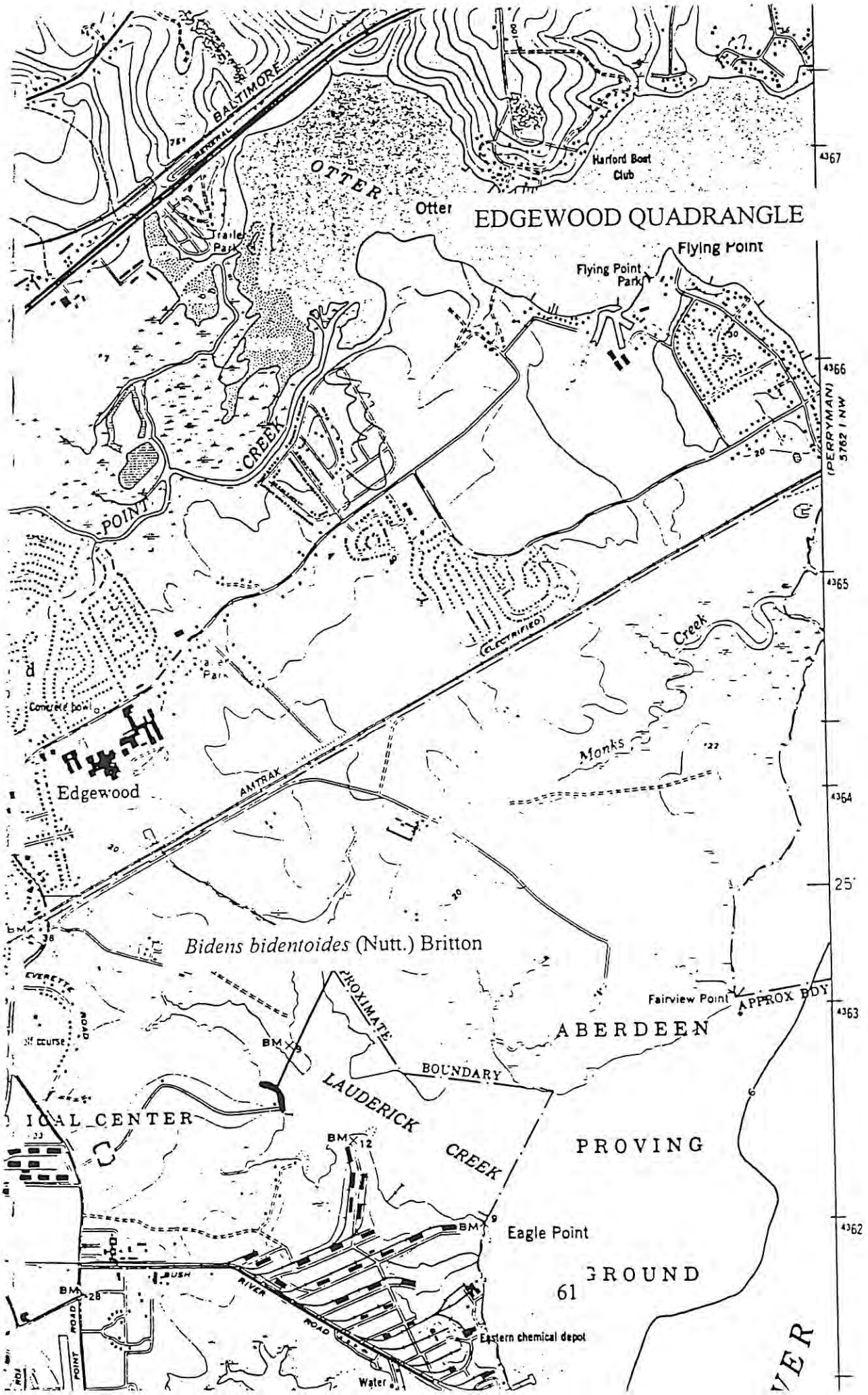

HANESVILLE QUADRANGLE
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
76°15'00"
39°22'30"
393000mE
MICHAELSVILLE 7 MI
395
12'30"
Towner
Cove
ABERDEEN PROVING GROUND
Xyris difformis Chapman
4358000mN
Monks Island
Abbey Point
Sand
4357
4356
4355
4354
20'
56

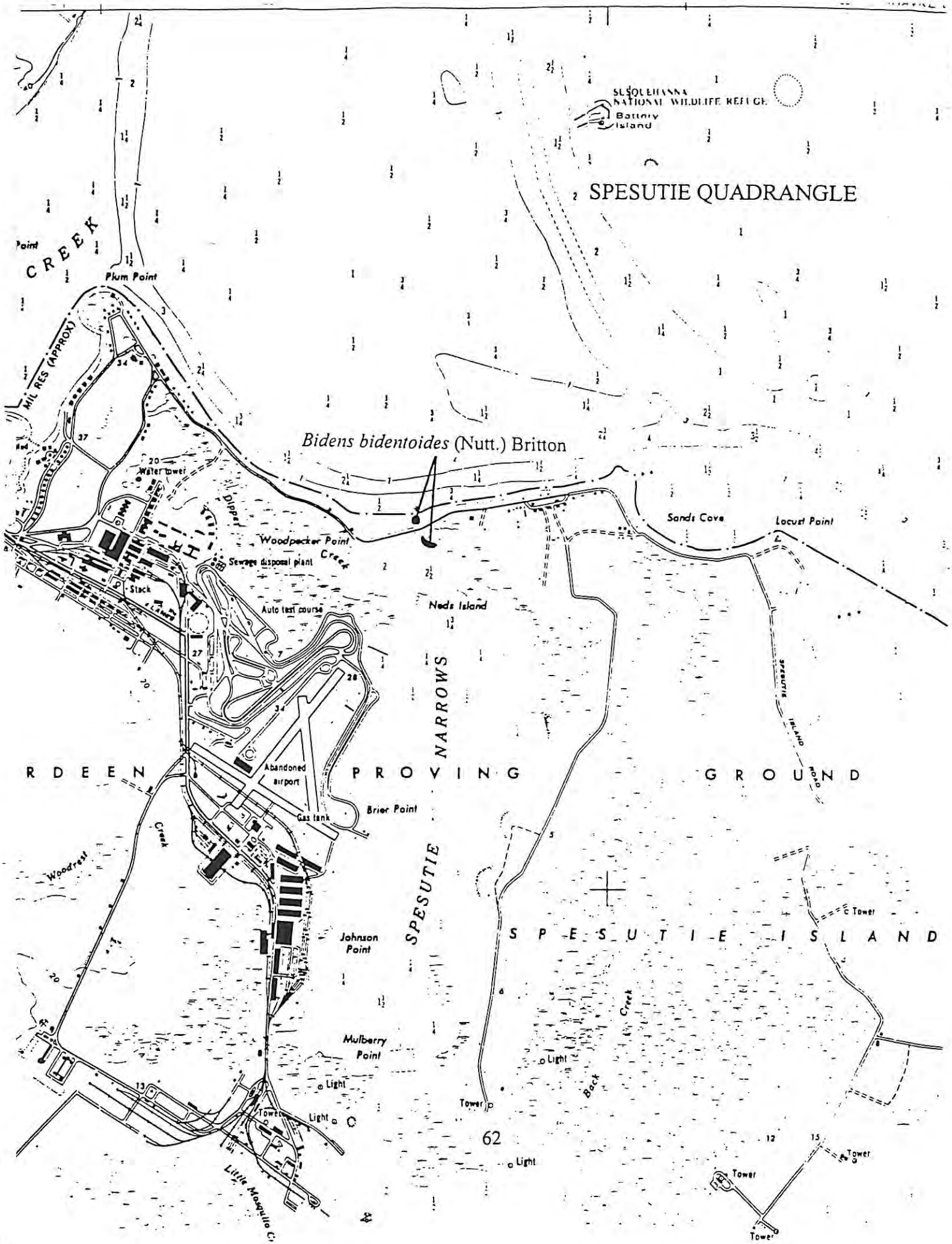

5762 IV NE
(EDGEWOOD)
PERRYMAN QUADRANGLE
Gum Point
Run
sticky
hard
soft
BUSH
MILITARY RESERVATION
Tower
Chelsea
Ronney
BALTIMORE
OLD
Xyris difformis Chapman
Chilbury Point
Civilian beach
Old Baltimore
ROAD
Creek
POVERTY ISLAND
AREA
Romney
Bridge Creek
PENNY
Back Creek
ROMNEY
Briar Point
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
Redman Cove
Towers
4365
4364
4363
4362
4361
4360
25'
570 000 FEET

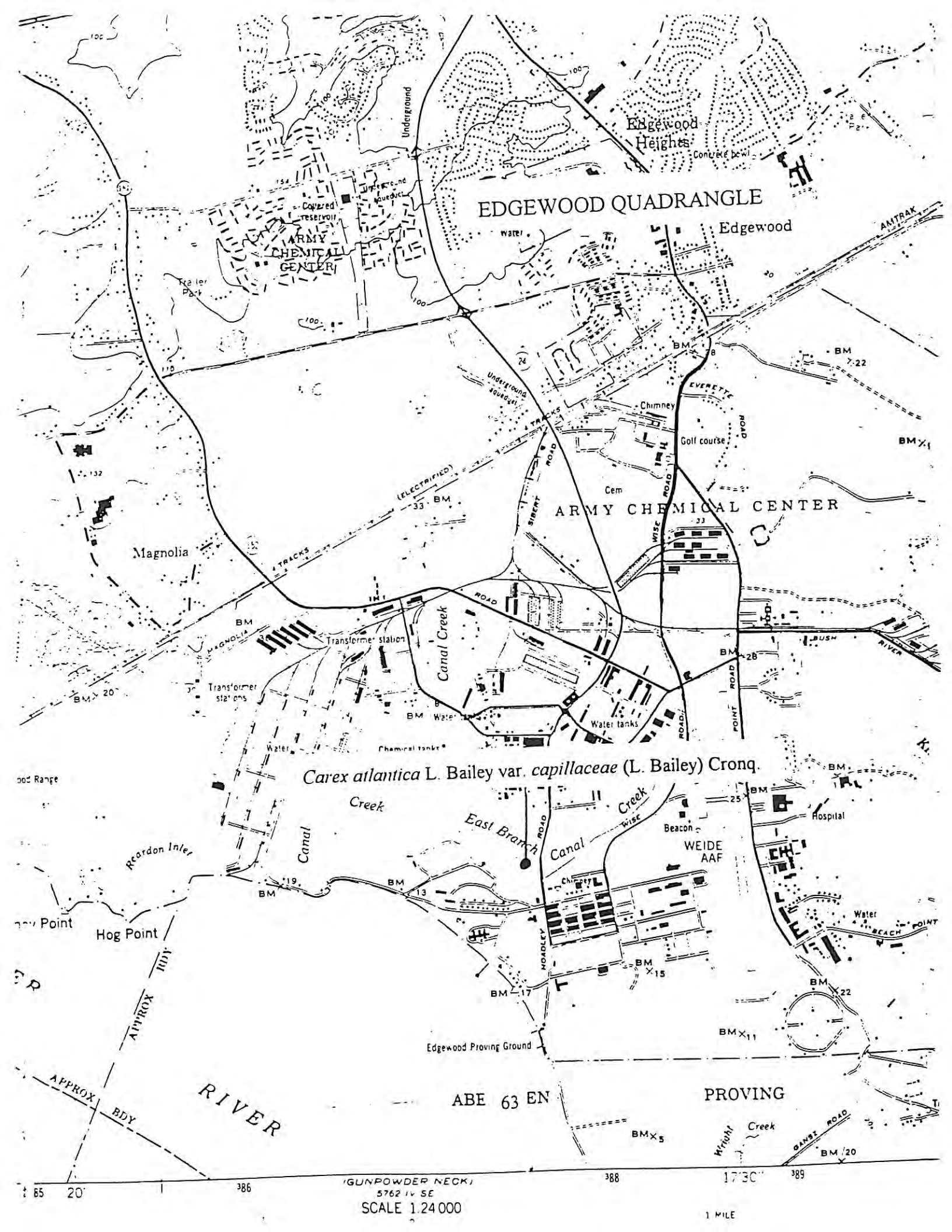

ABERDEEN PROVING GROU
SPESUTIE NARROWS
SPESUTIE ISLAND
Abandoned
Ampelamus albidus (Nutt.) Britton
SPESUTIE QUADRANGLE
27'30"
4369
4368
4367
4366
4365
4364
25'
5762 I NW
(PERRYMAN)
Woodtrail
Creek
Johnson Point
Mulberry Point
Light
Tower
Back Creek
Little Mosquito Creek
Mosquito Creek
Black Point
Bear Point
Cherry Tree Point
MILITARY RESERVATION (APPROXIMATE)

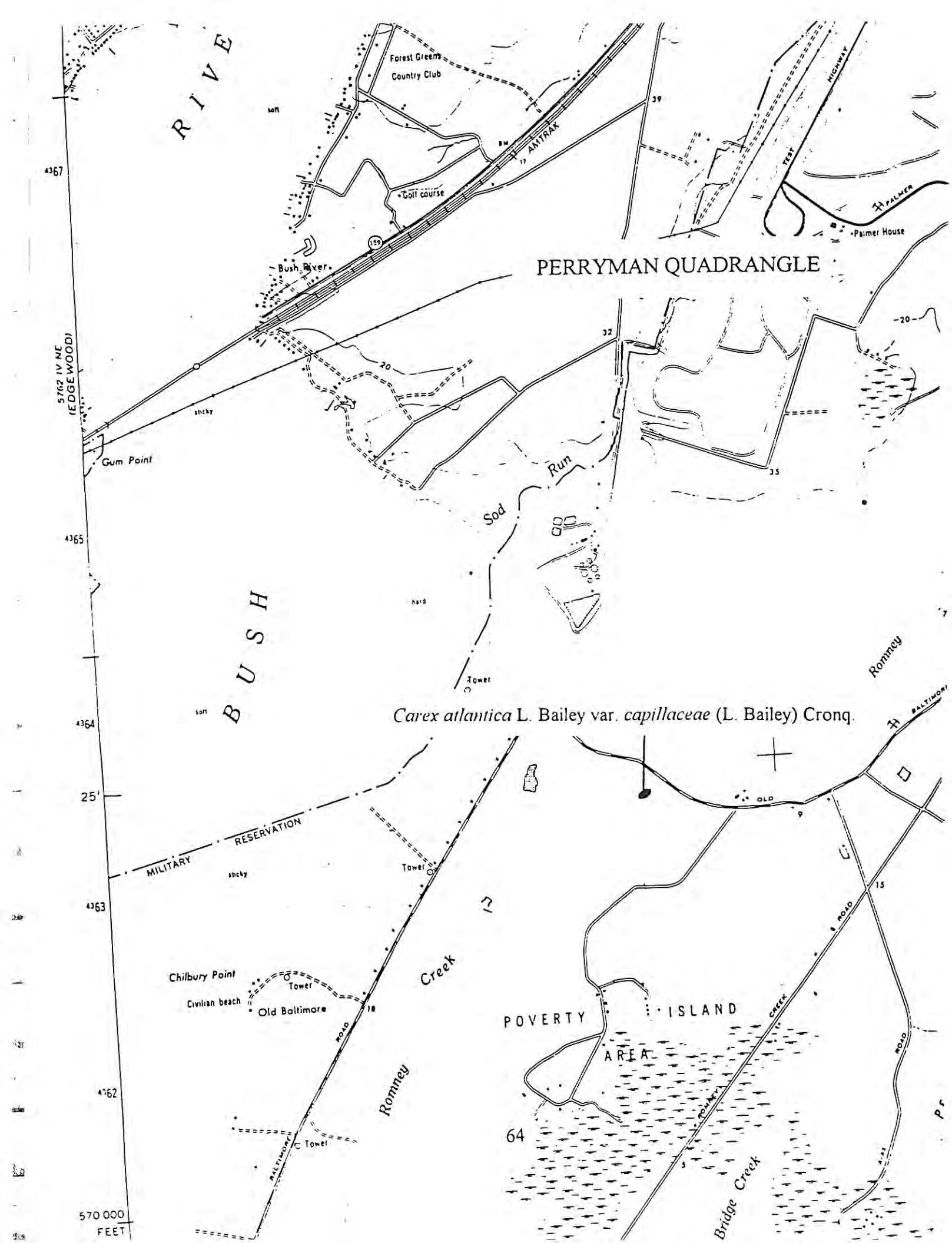

PERRYMAN QUADRANGLE
PROVING
RESERVATION
TARY
Pistol range
AVIATION
ARMS
ROAD
WARFARE
RANGE
MICHAELSVILLE
Mosquito
Creek
Asclepias purpurascens L.
(SPESUTIE)
5762 I NE
27'30"
25'
4369
4368
4367
4366
4365
4364
4363
Delph


PERRYMAN QUADRANGLE
Victory Street Park
ABERDEEN
RESERVATION
MILITARY
Cem
Golf Course
Boothby Hill
ROAD
Sand
Piles
Swan
RES
High Point 1
Cedar Point
MIL
Palisades Park
4372
4371
4370
600 000 FEET
Asclepias purpurascens L.
Control tower
PHILLIPS
PHILLIPS FIELD
Pistol range
AVIATION
ARMS
ROAD
RANGE
WARFARE
TRENCH
MICHAELSVILLE
PROVING
GROUND
MILITARY
RESERVATION
60

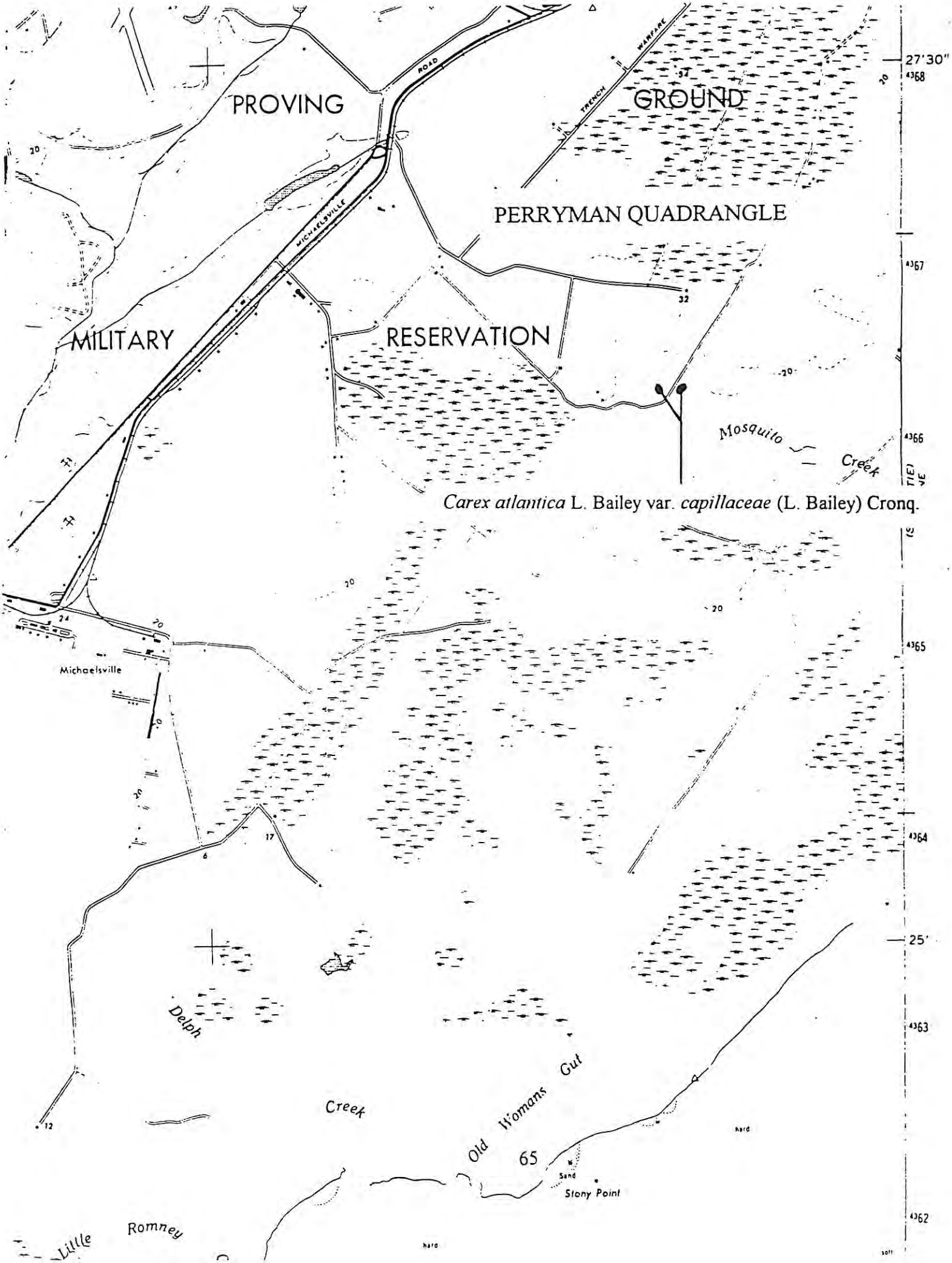

EDGEWOOD QUADRANGLE
BALTIMORE
Harford Boat Club
OTTER
Otter
Trailer Park
Flying Point
Flying Point Park
CREEK
POINT
(PERRYMAN)
5762 I NW
4367
4366
4365
4364
4363
4362
25'
(ELECTRIFIED)
Creek
Monks
Edgewood
AMTRAK
Bidens bidentoides (Nutt.) Britton
PROXIMATE
BOUNDARY
Fairview Point
APPROX BDY
ABERDEEN
LAUDERICK
CREEK
PROVING
GROUND
Eagle Point
Eastern chemical depot
BUSH
RIVER
ROAD
POINT
Water
61


SUSQUEHANNA NATIONAL WILDLIFE REFUGE
Battery Island
SPESUTIE QUADRANGLE
CREEK
Point
Plum Point
MIL RES (APPROX)
Bidens bidentoides (Nutt.) Britton
Water tower
Dipper
Woodpecker Point
Creek
Sewage disposal plant
Stack
Auto test course
Neds Island
Sands Cove
Locust Point
SPESUTIE ISLAND ROAD
R D E E N
P R O V I N G
G R O U N D
Abandoned airport
Gas tank
Brier Point
SPESUTIE NARROWS
Creek
Woodcrest
Johnson Point
S P E S U T I E I S L A N D
Tower
Mulberry Point
Light
Back Creek
Tower
Light
Tower
Light
Tower
Tower
Tower
Little Mosquito C

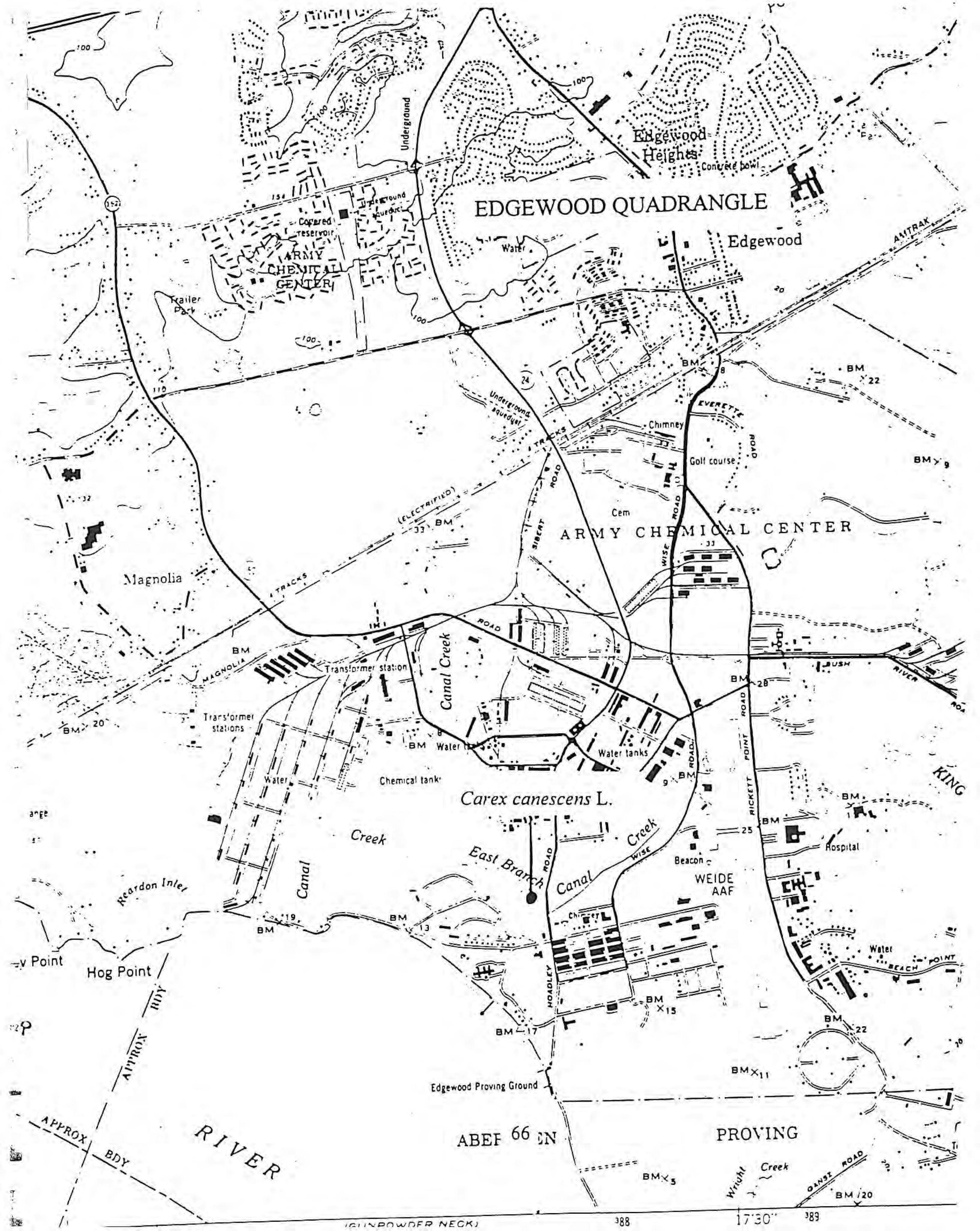

EDGEWOOD QUADRANGLE
Edgewood Heights
Edgewood
ARMY CHEMICAL CENTER
Magnolia
Canal Creek
Transformer station
Transformer stations
Water tanks
Golf course
Chimney
Cem
Hospital
WEIDE AAF
Beacon
East Branch
Canal
Creek
Hog Point
Edgewood Proving Ground
PROVING
RIVER
ABE 63 EN
Carex atlantica L. Bailey var. capillaceae (L. Bailey) Cronq.
(GUNPOWDER NECK)
5762 IV SE
SCALE 1:24 000
1 MILE

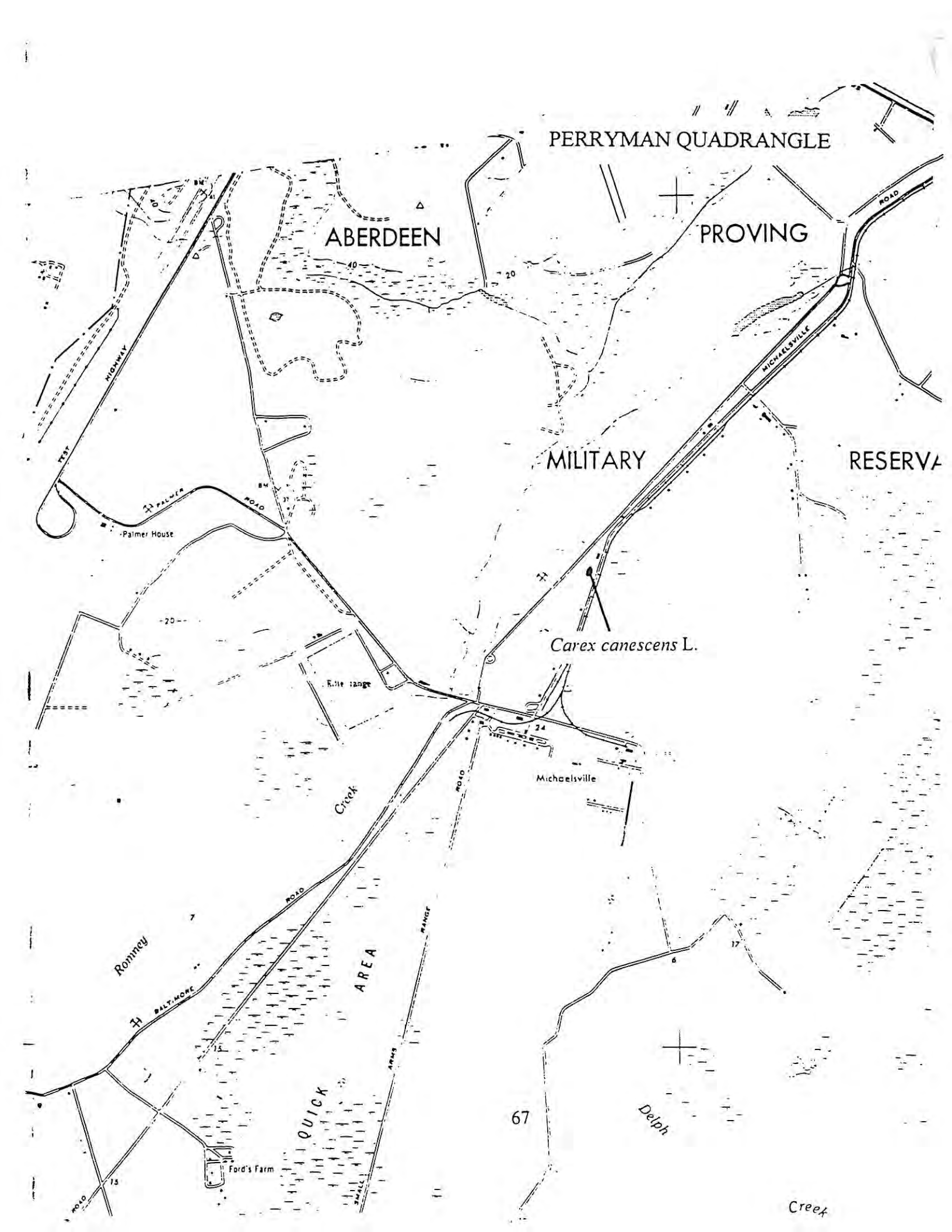


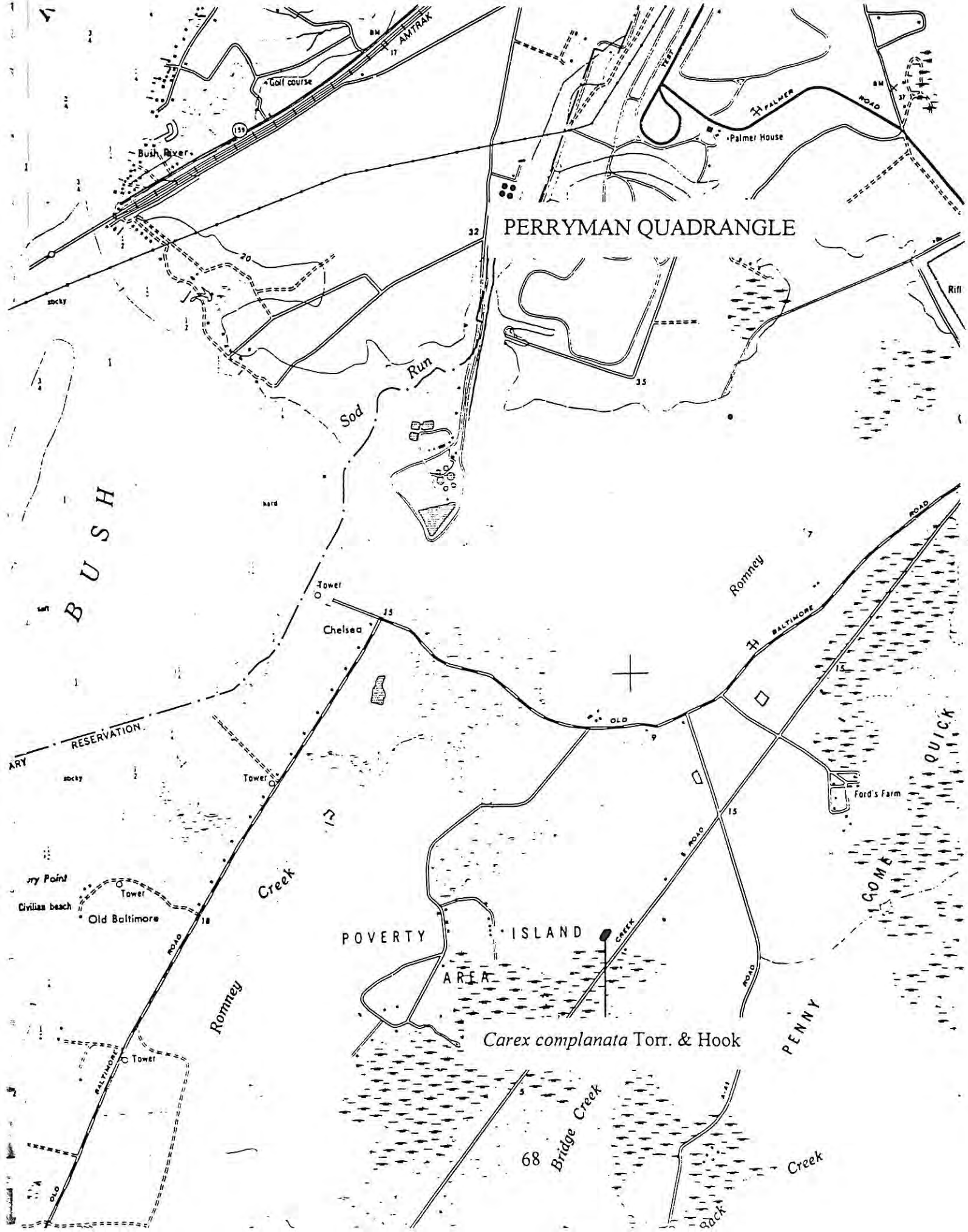
Carex atlantica L. Bailey var. *capillaceae* (L. Bailey) Cronq.



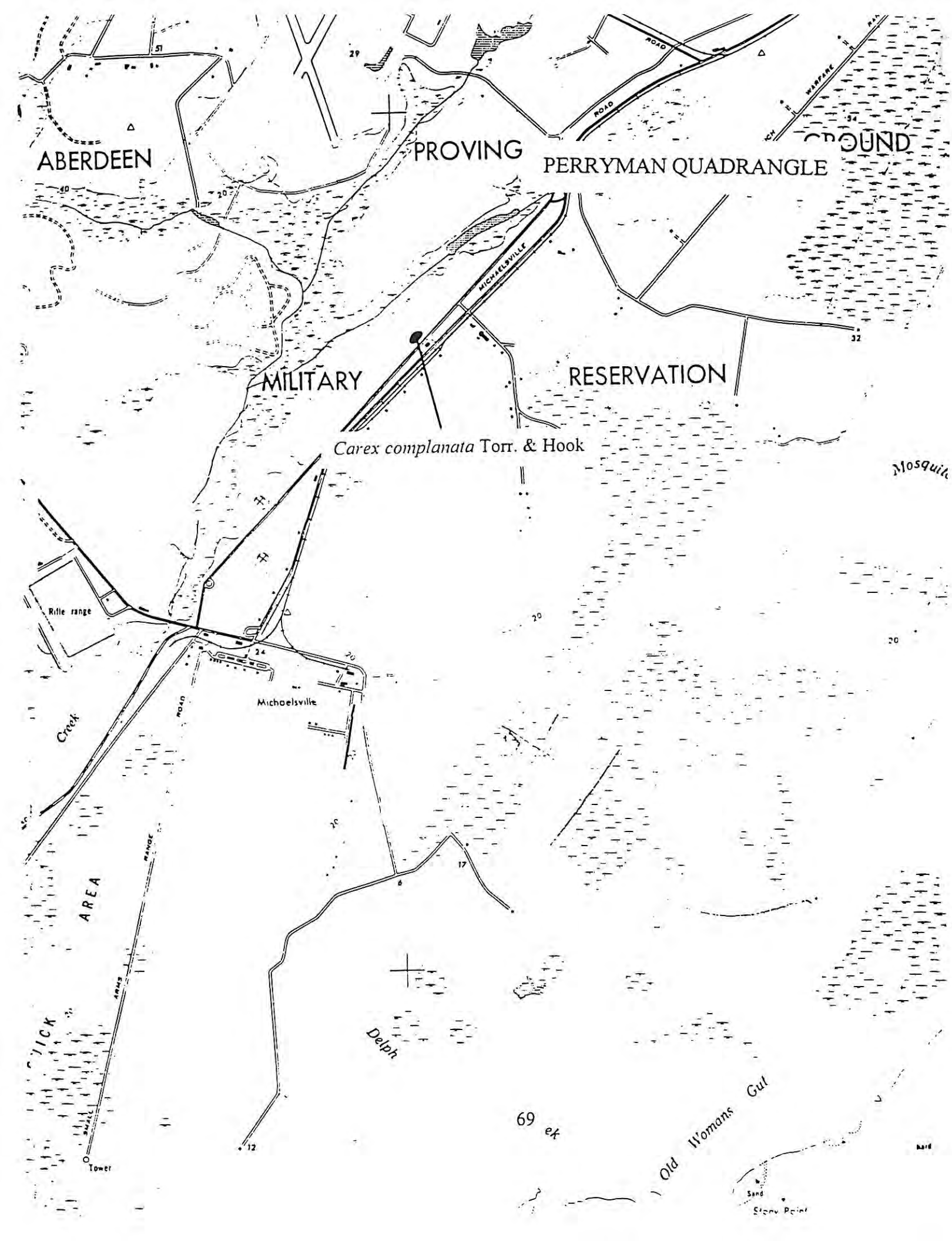
Carex atlantica L. Bailey var. *capillaceae* (L. Bailey) Cronq.


EDGEWOOD QUADRANGLE
Carex canescens L.
Edgewood Heights
Concrete bowl
Edgewood
AMTRAK
Underground
Underground aqueduct
Covered reservoir
ARMY CHEMICAL CENTER
Trailer Park
Water
Underground aqueduct
4 TRACKS
(ELECTRIFIED)
EVERETTE
ROAD
Chimney
Golf course
SIBERT ROAD
WISE ROAD
Cem
ARMY CHEMICAL CENTER
Magnolia
4 TRACKS
MAGNOLIA
ROAD
Canal Creek
Transformer station
Transformer stations
BUSH
RIVER
ROAD
RICKETT POINT ROAD
Water tanks
Water tanks
Water
Chemical tanks
KING
Creek
East Branch
Canal
Canal Creek
WISE
ROAD
Beacon
WEIDE AAF
Hospital
Reardon Inlet
Canal
Chimney
Water
BEACH POINT
Hog Point
HOADLEY
APPROX BDY
Edgewood Proving Ground
APPROX BDY
RIVER
ABER
PROVING
Wright Creek
GANST ROAD
(GUNPOWDER NECK)
388
17'30"
389


PERRYMAN QUADRANGLE
ABERDEEN
PROVING
MILITARY
RESERVA
Carex canescens L.
Palmer House
Michaelsville
Ford's Farm
QUICK AREA
Romney
Delph
Creek
67

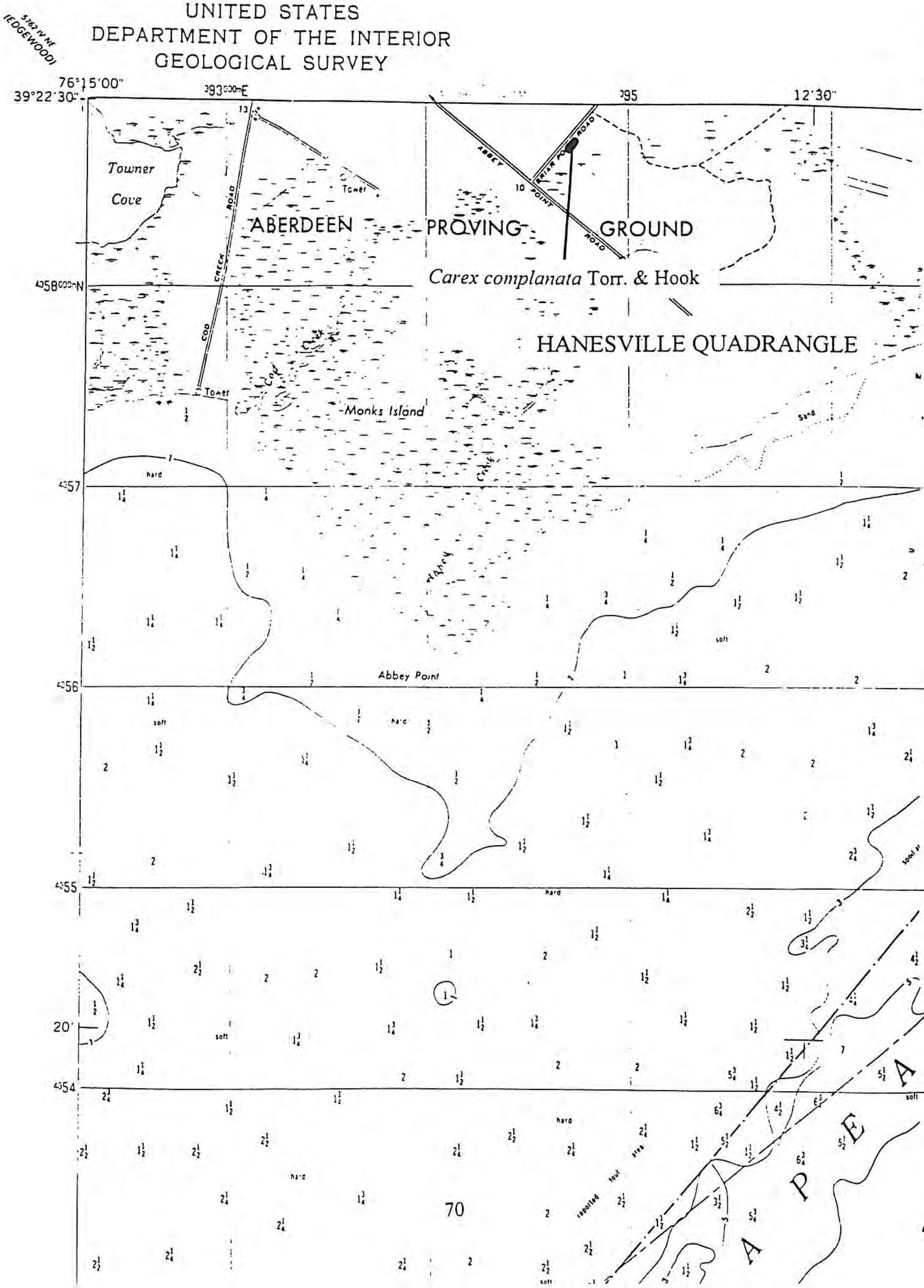


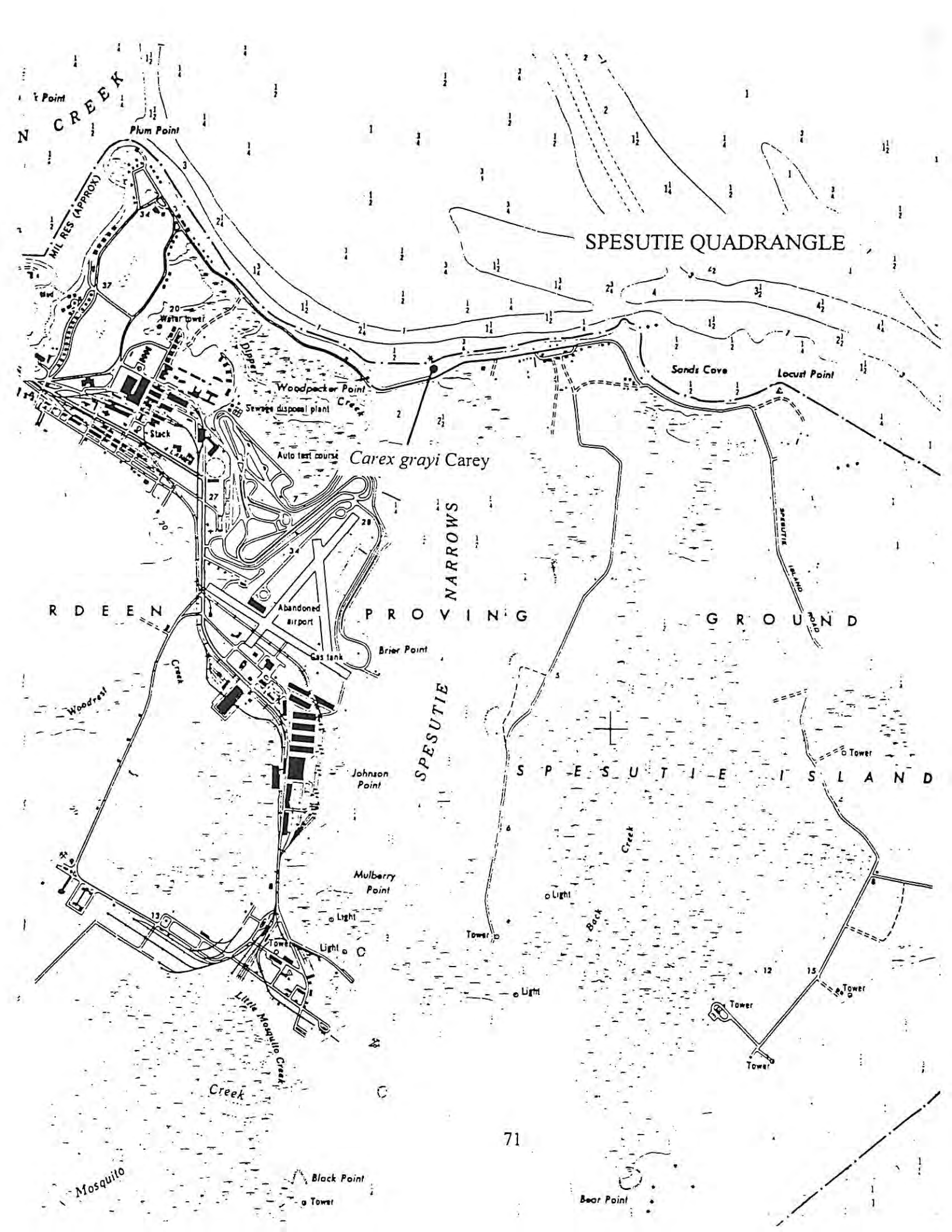
Carex complanata Torr. & Hook

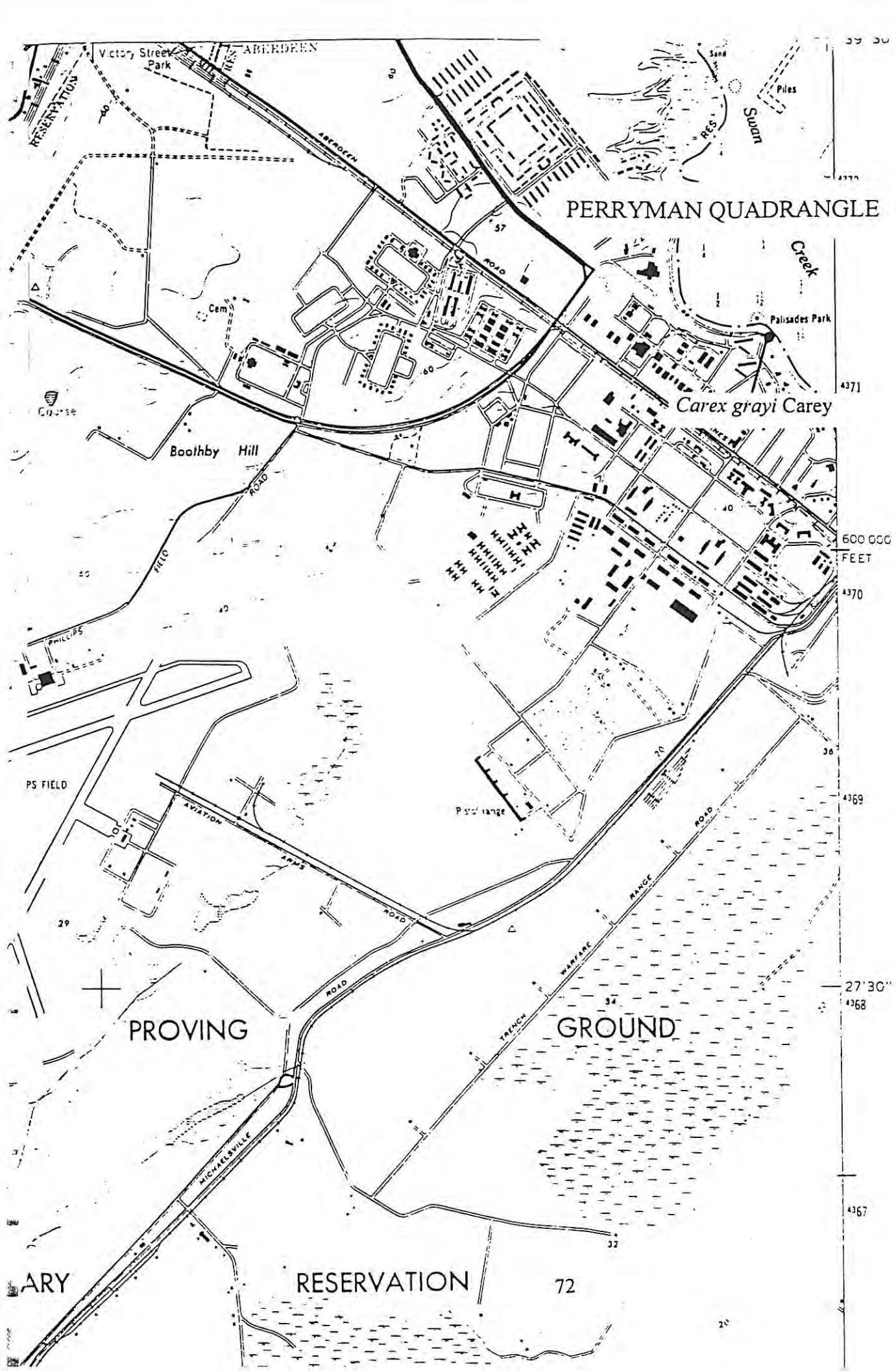


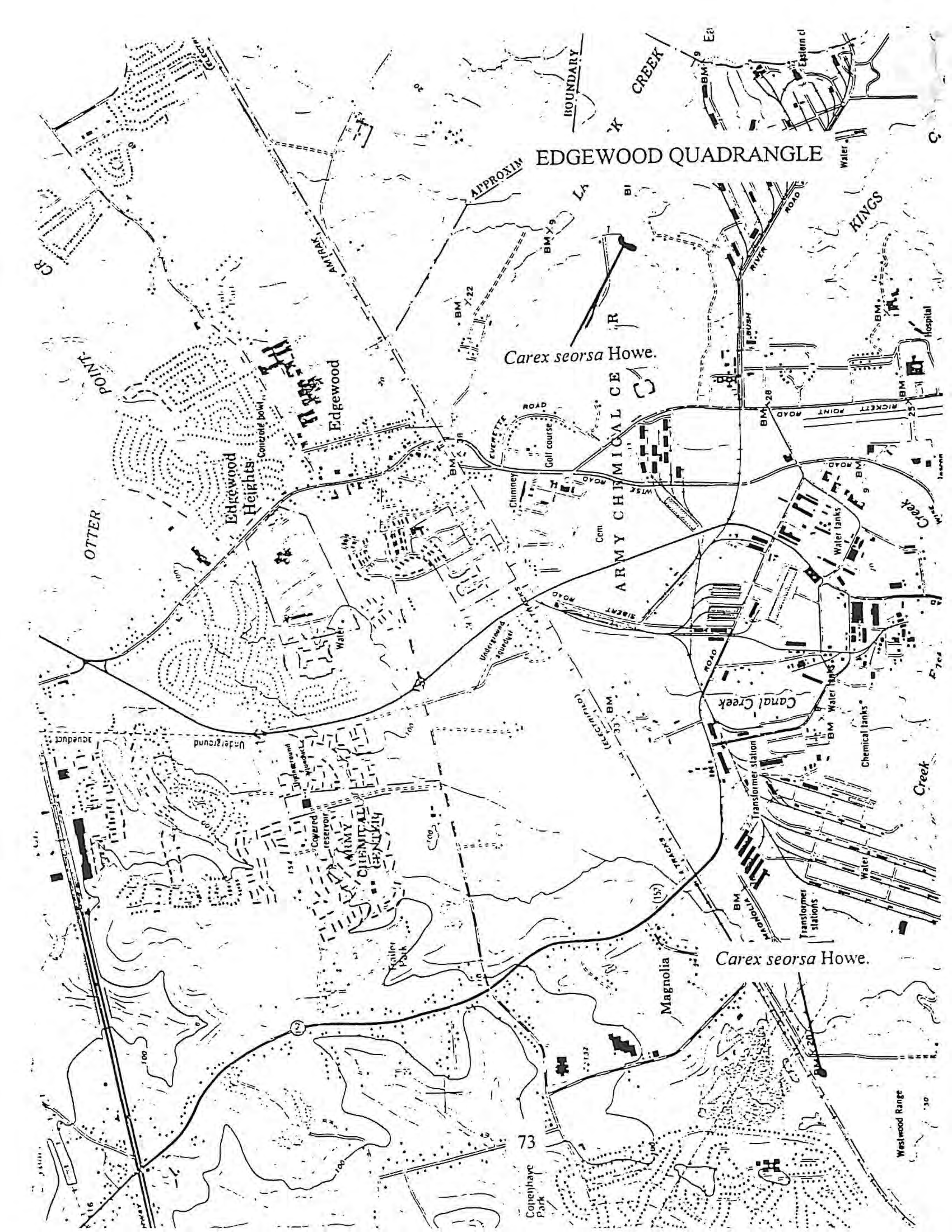
Carex complanata Torr. & Hook

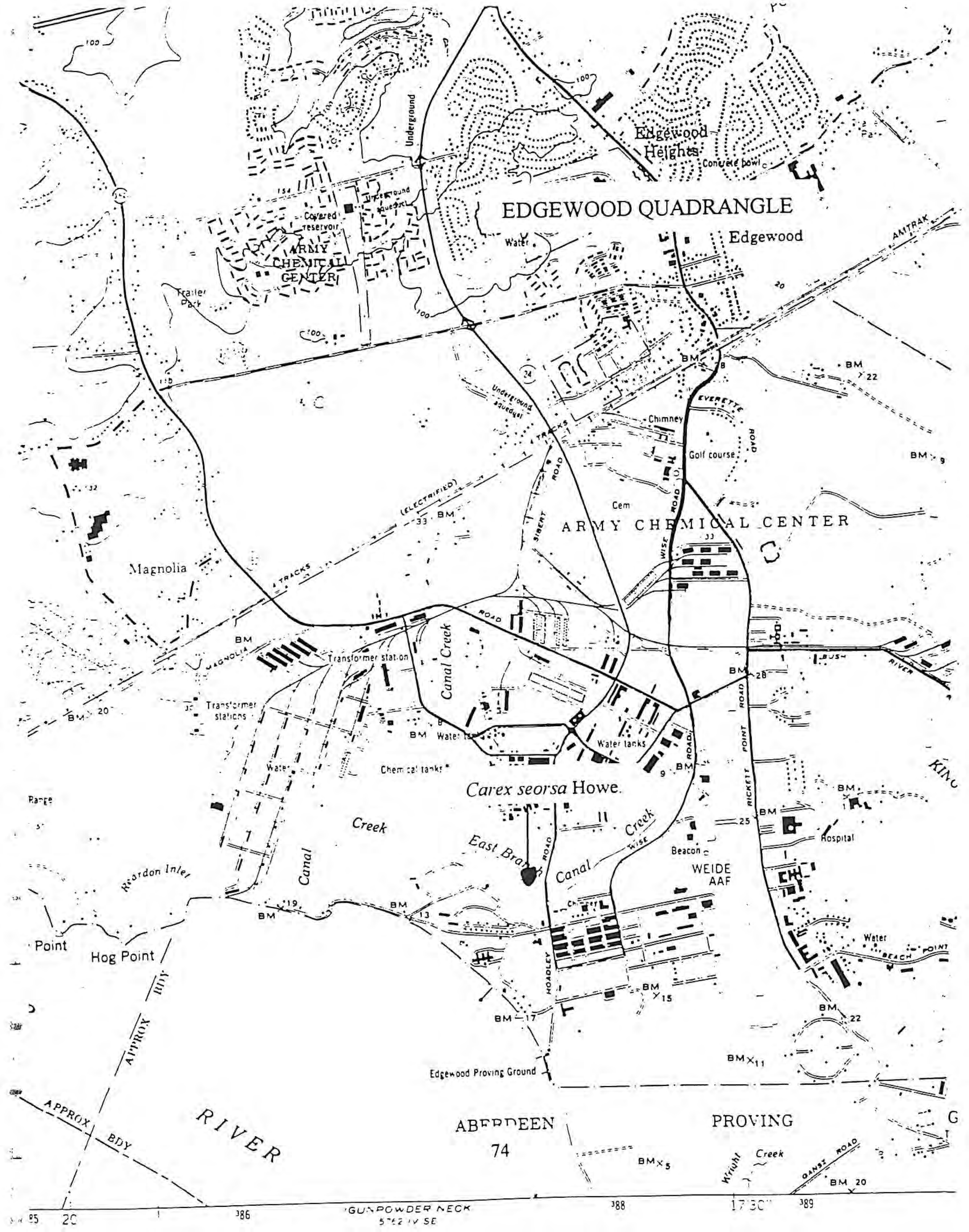
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY




SPESUTIE QUADRANGLE
Plum Point
MIL RES (APPROX)
Water tower
Woodpecker Point
Sewage disposal plant
Stack
Auto test course
Carex grayi Carey
Sands Cove
Locust Point
SPESUTIE ISLAND ROAD
NARROWS
PROVING GROUND
Abandoned airport
Gas tank
Brier Point
Johnson Point
Mulberry Point
Light
Tower
Back Creek
Little Mosquito Creek
Mosquito Creek
Black Point
Bear Point
SPESUTIE ISLAND

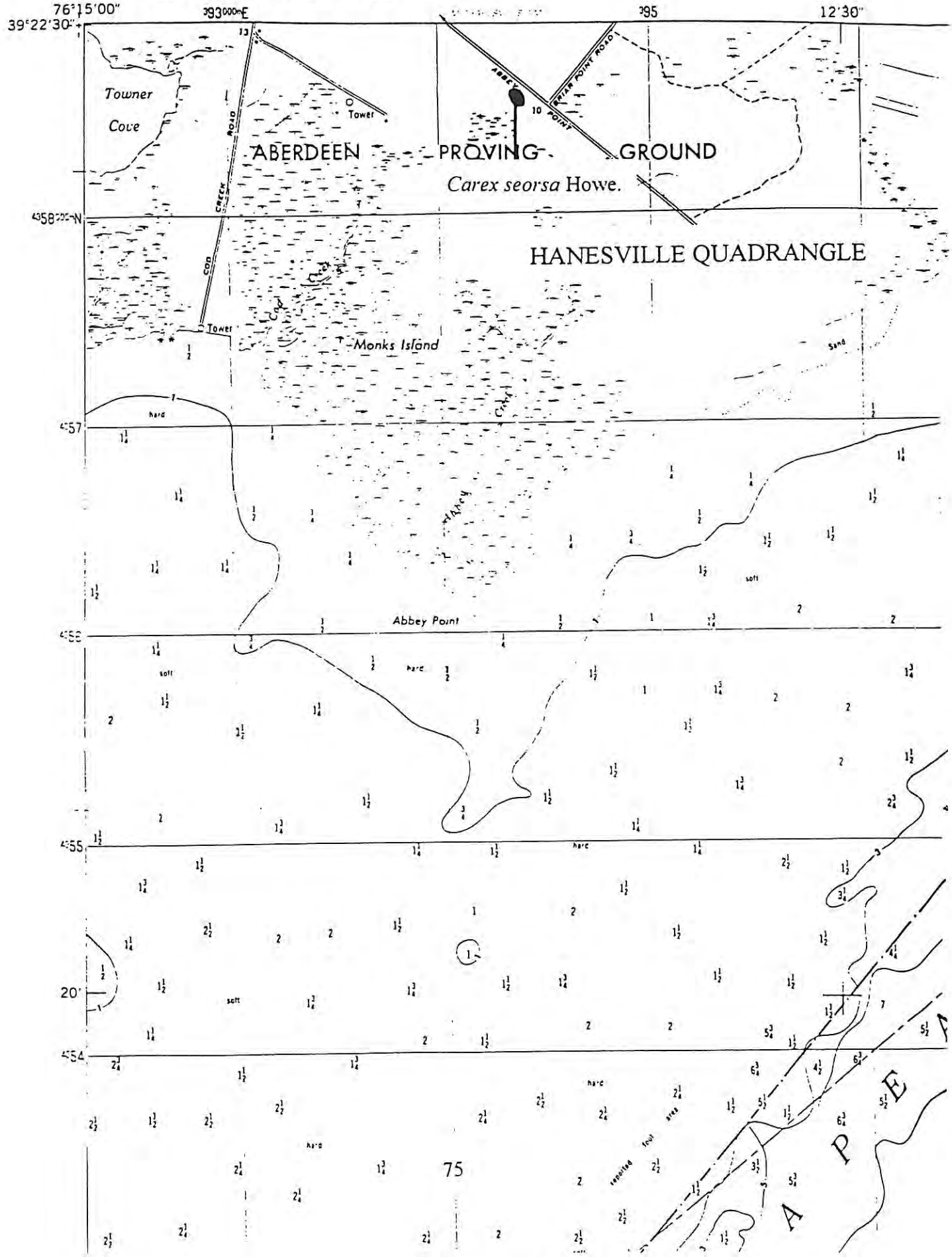

PERRYMAN QUADRANGLE
Carex grayi Carey
PROVING
GROUND
RESERVATION
72
Victoria Street
Park
ABERDEEN
RESERVATION
ABERDEEN
ROAD
Cem
Course
Boothby Hill
ROAD
FIELD
PHILLIPS
PS FIELD
AVIATION
ARMS
ROAD
Pistol range
RANGE
ROAD
WARFARE
TRENCH
ROAD
MICHAELSVILLE
Sand
Piles
Swan
RES
Creek
Palisades Park
600 000
FEET
4371
4370
4369
4368
4367
27'30"

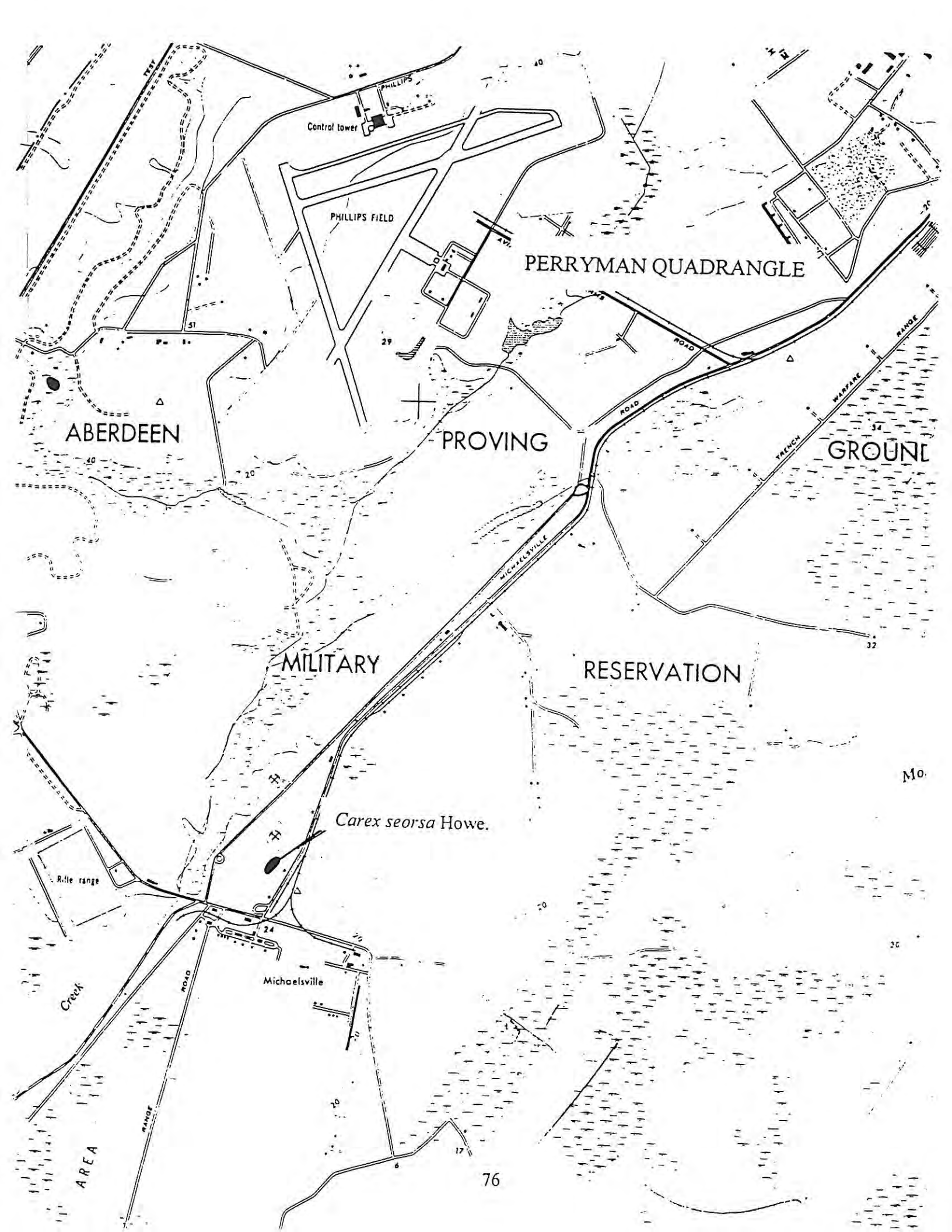

EDGEWOOD QUADRANGLE
Carex seorsa Howe.
Carex seorsa Howe.
Edgewood
Edgewood Heights
Concrete bowl
OTTER
POINT
AMTRAK
APPROXIM
BOUNDARY
CREEK
KINGS
ARMY CHEMICAL CE
Golf course
Chimney
Cem
Canal Creek
Creek
Magnolia
Hospital
Water tanks
Chemical tanks
Transformer station
Transformer stations
Covered reservoir
Underground aqueduct
Trailer Park
Westwood Range
Cokesbury Park
EVERETTE ROAD
WISE ROAD
SIBERT ROAD
RICKETT POINT ROAD
BUSH RIVER ROAD
MAGNOLIA ROAD


EDGEWOOD QUADRANGLE
Edgewood Heights
Concrete bowl
Edgewood
AMTRAK
Underground
Underground aqueduct
Covered reservoir
ARMY CHEMICAL CENTER
Trailer Park
Water
Chimney
EVERETTE ROAD
Golf course
SIBERT ROAD
WISE ROAD
Cem
(ELECTRIFIED)
4 TRACKS
Magnolia
MAGNOLIA ROAD
Transformer station
Transformer stations
Canal Creek
BUSH RIVER
RICKETT POINT ROAD
Water tanks
Chemical tanks
Carex seorsa Howe.
Range
Creek
East Branch
Canal
Hospital
Beacon
WEIDE AAF
Reardon Inlet
Point
Hog Point
HOADLEY ROAD
BEACH POINT
Edgewood Proving Ground
APPROX BDY
RIVER
ABERDEEN
PROVING
Wright Creek
GANST ROAD
GUNPOWDER NECK

5762 IV NE
(EDGEWOOD)

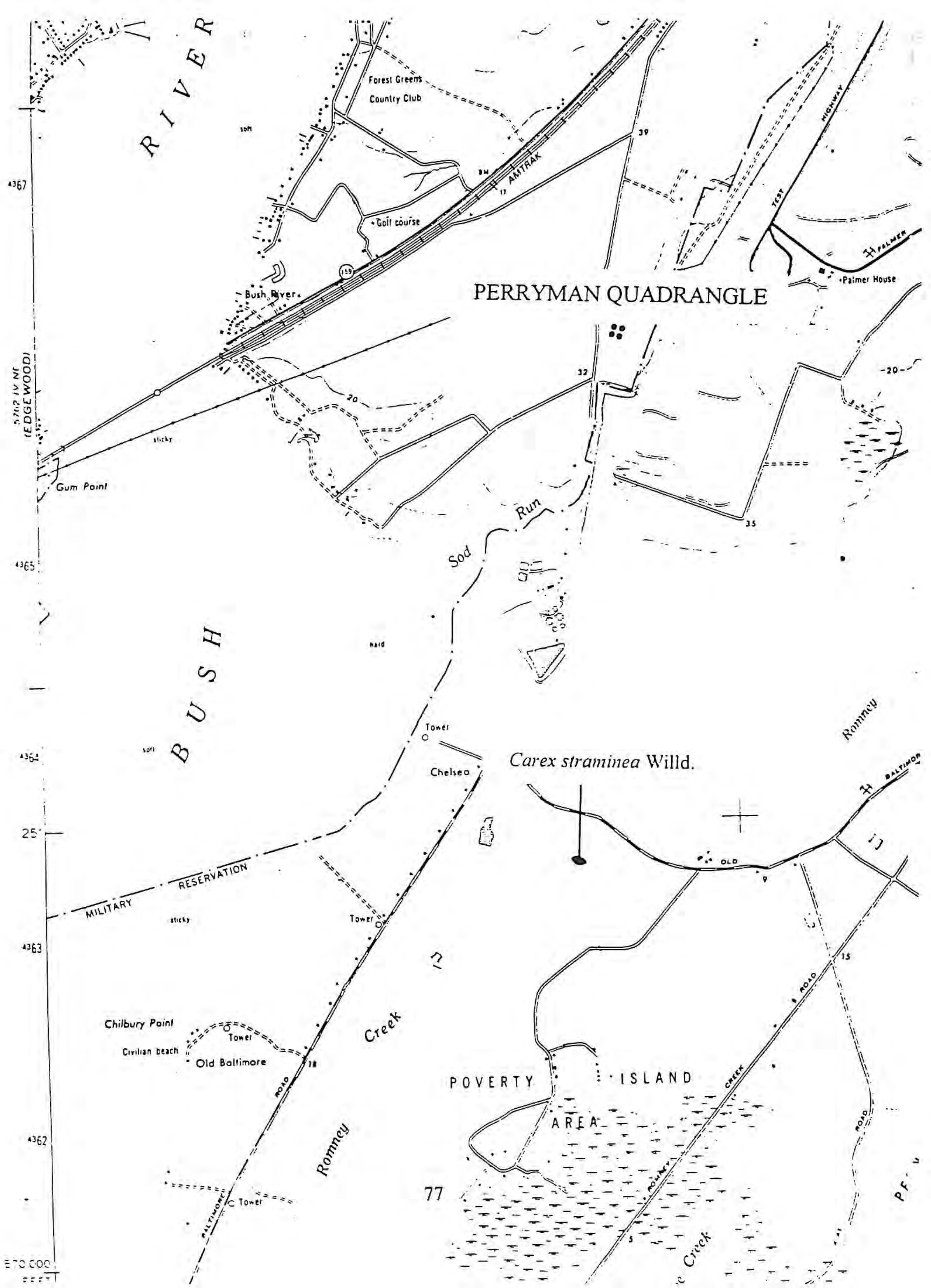
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

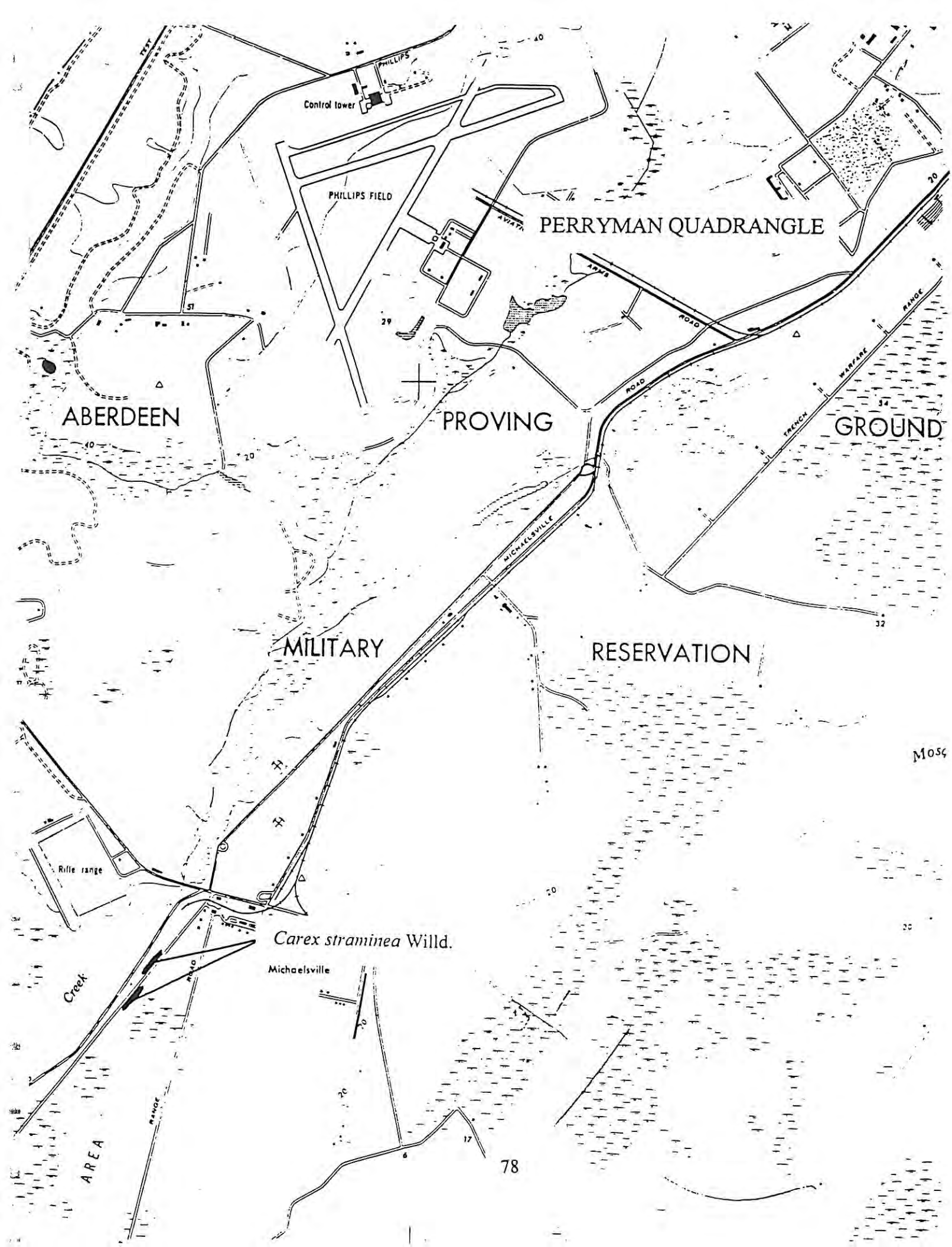


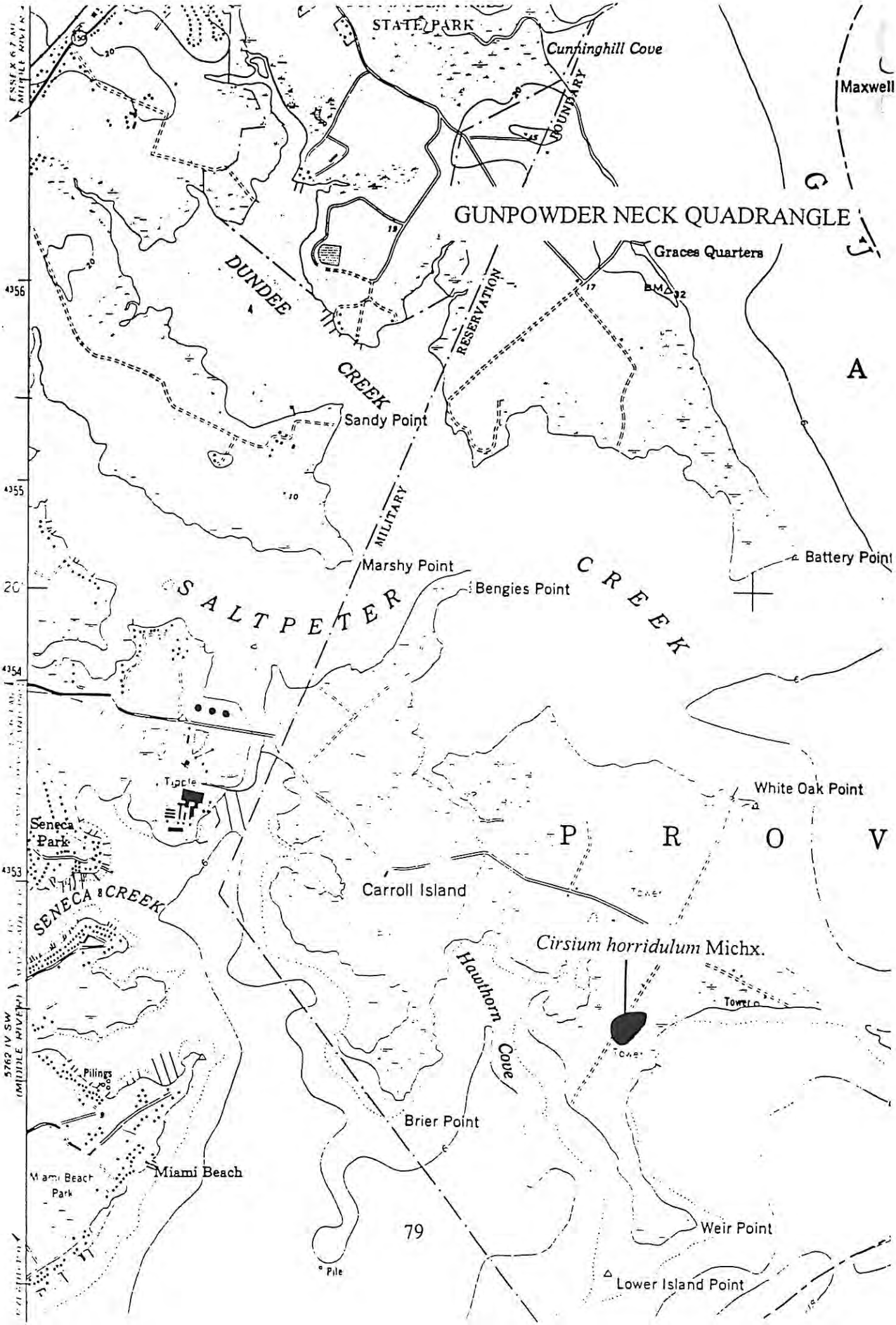

PERRYMAN QUADRANGLE
ABERDEEN
PROVING
GROUND
MILITARY
RESERVATION
Carex seorsa Howe.
Control tower
PHILLIPS FIELD
PHILLIPS
ROAD
RANGE
WARFARE
TRENCH
MICHAELSVILLE
Michaelsville
Rifle range
Creek
AREA

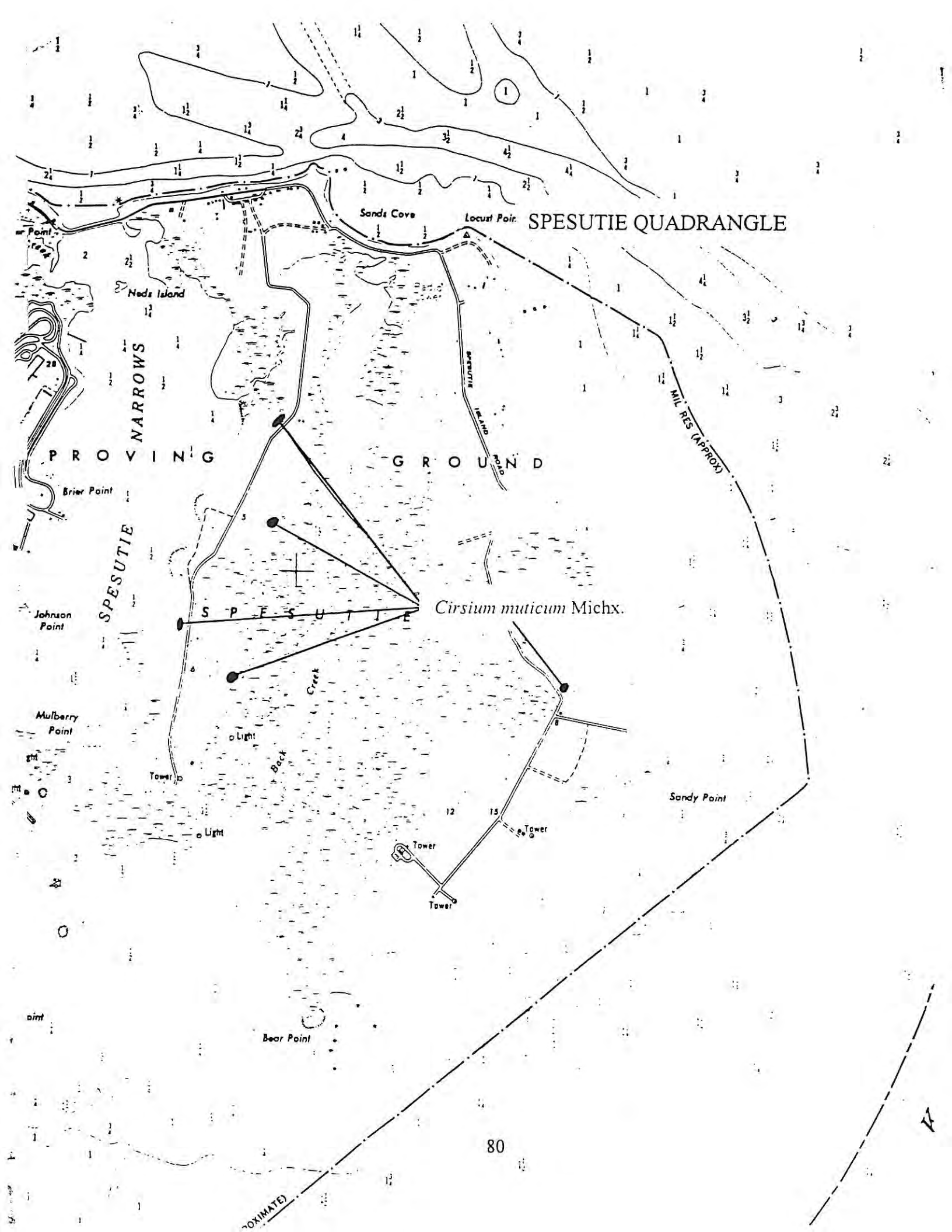
PERRYMAN QUADRANGLE

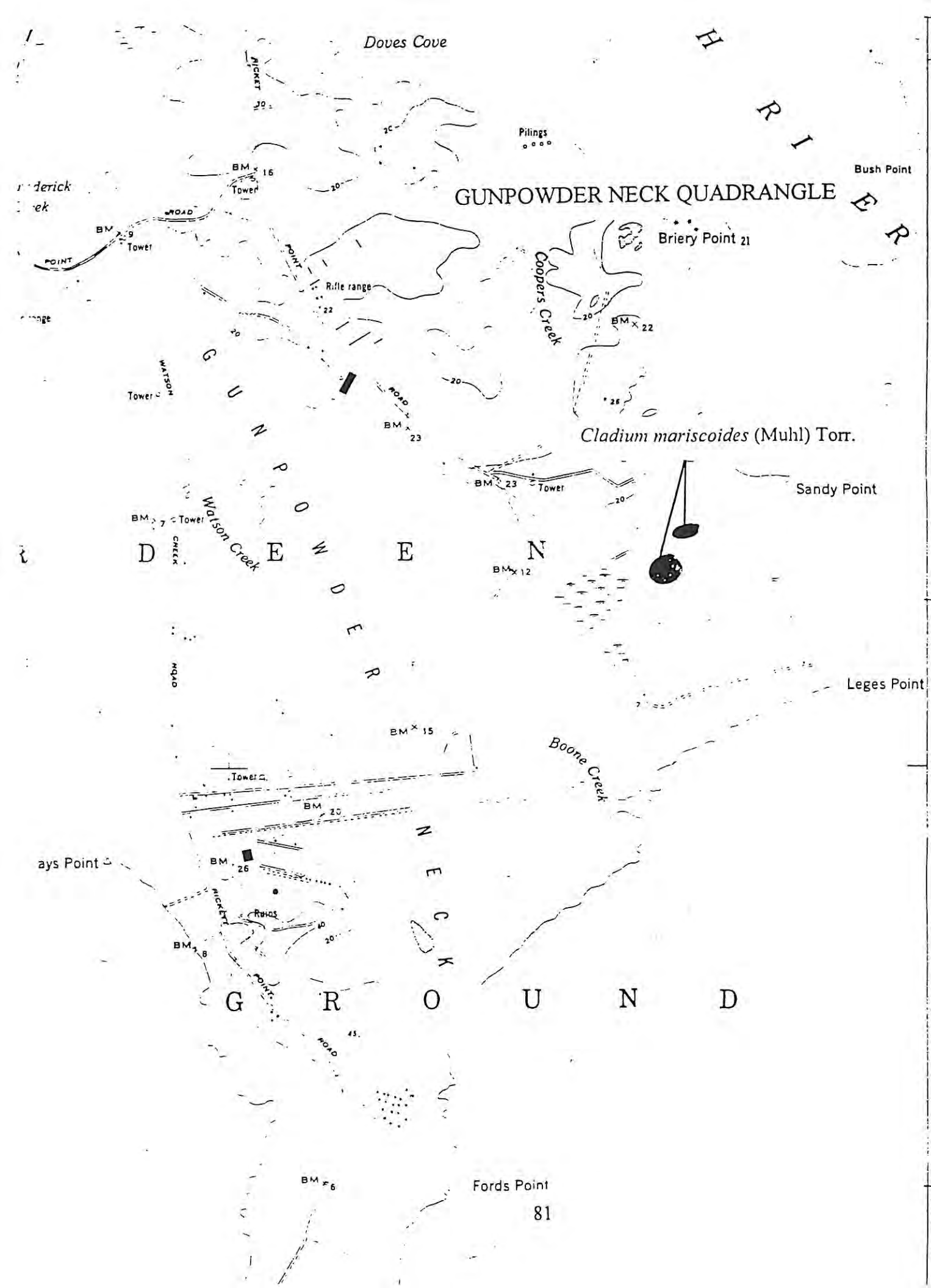
Carex straminea Willd.



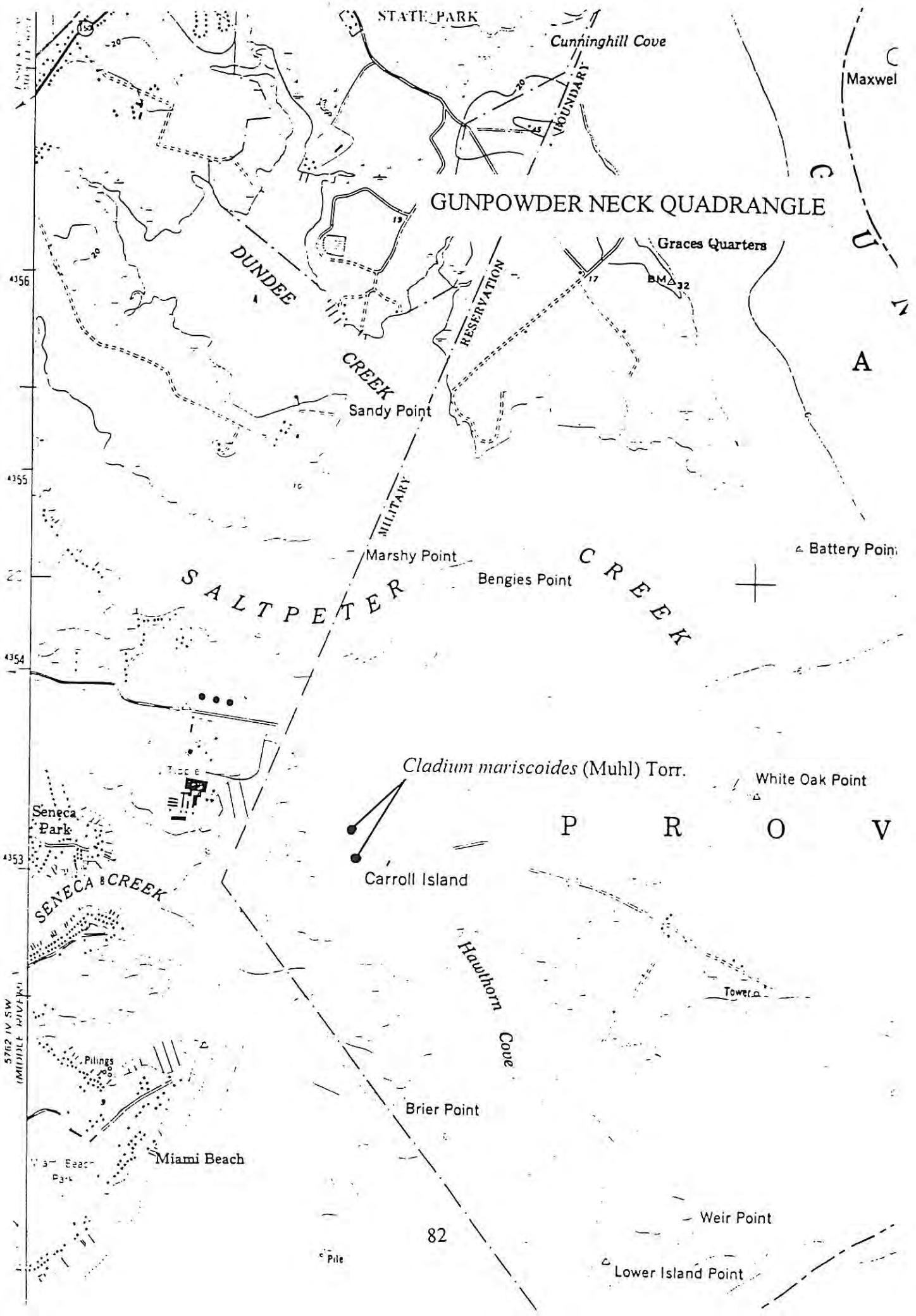

PERRYMAN QUADRANGLE
ABERDEEN
PROVING
GROUND
MILITARY
RESERVATION
Control tower
PHILLIPS
PHILLIPS FIELD
ARMY
ROAD
TRENCH
WARFARE
RANGE
MICHAELSVILLE
Rifle range
Carex straminea Willd.
Michaelsville
Creek
AREA
Mosq

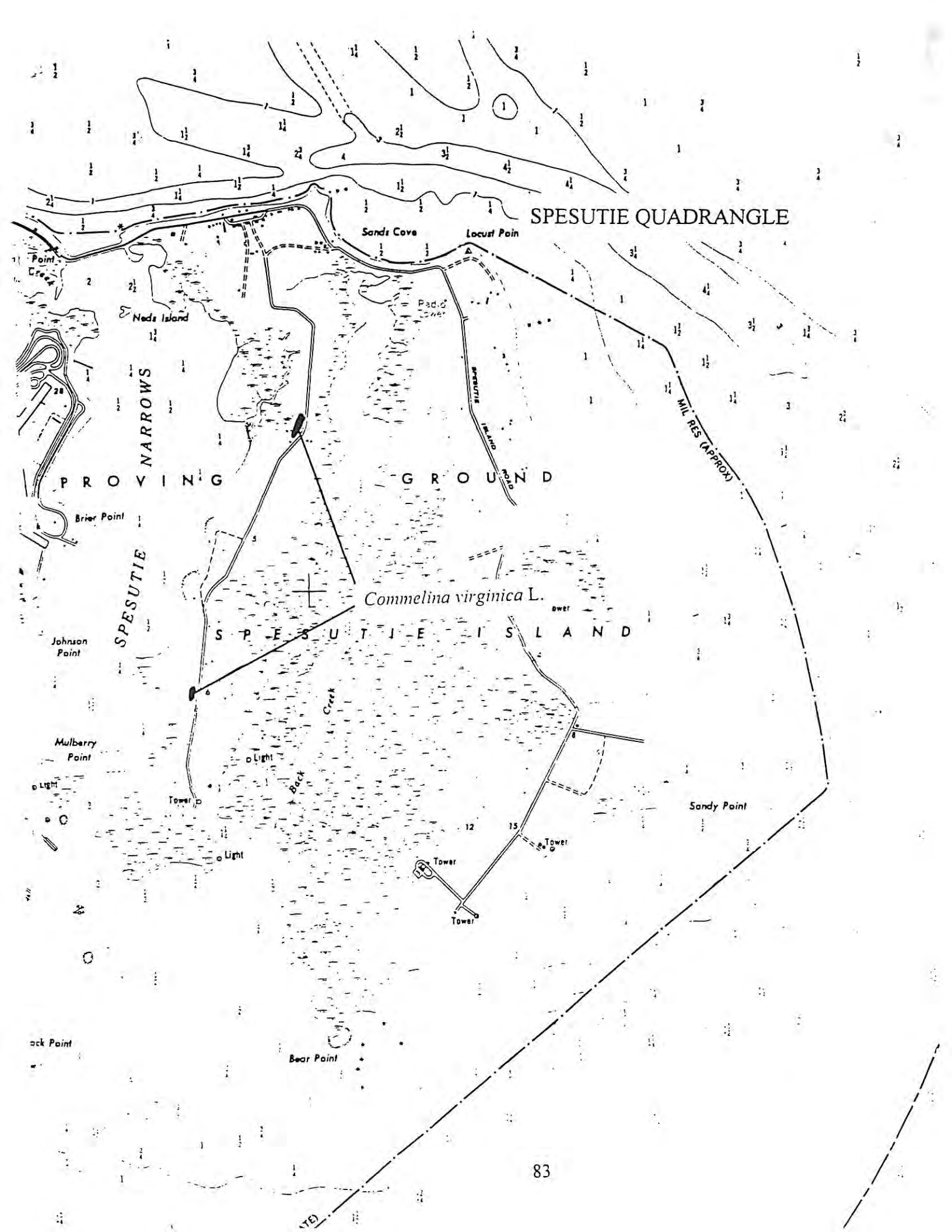

STATE PARK
Cunninghill Cove
BOUNDARY
Maxwell
GUNPOWDER NECK QUADRANGLE
Graces Quarters
DUNDEE CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER CREEK
White Oak Point
Seneca Park
SENECA CREEK
Carroll Island
Cirsium horridulum Michx.
Hawthorn Cove
Brier Point
Miami Beach
Miami Beach Park
Pilings
Weir Point
Lower Island Point
4356
4355
4354
4353
20
5762 IV SW
MIDDLE RIVER

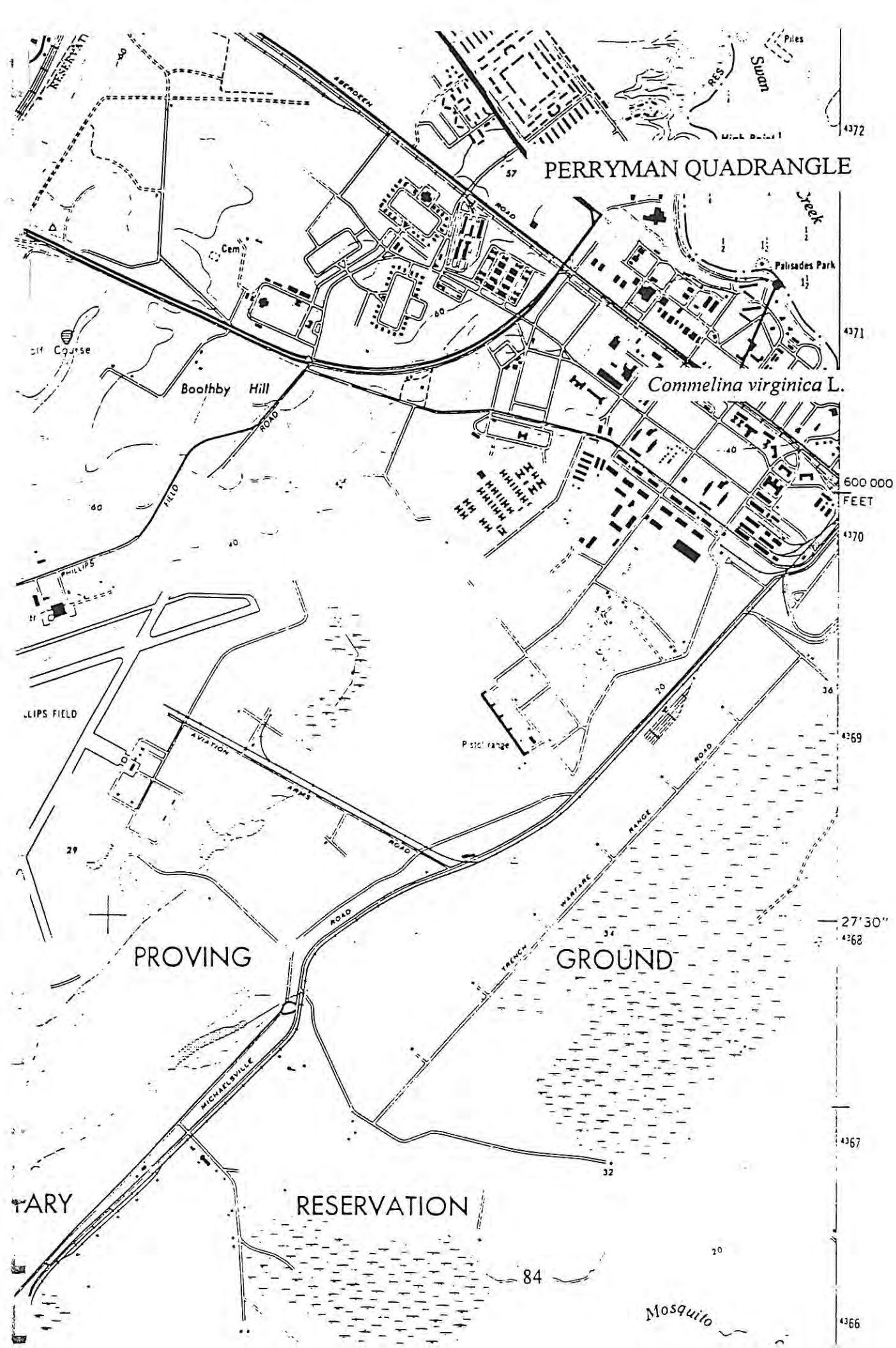

SPESUTIE QUADRANGLE
Sands Cove
Locust Point
Neds Island
NARROWS
PROVING GROUND
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
Brier Point
SPESUTIE
Cirsium muticum Michx.
Johnson Point
Mulberry Point
Back Creek
Light
Tower
Sandy Point
Bear Point

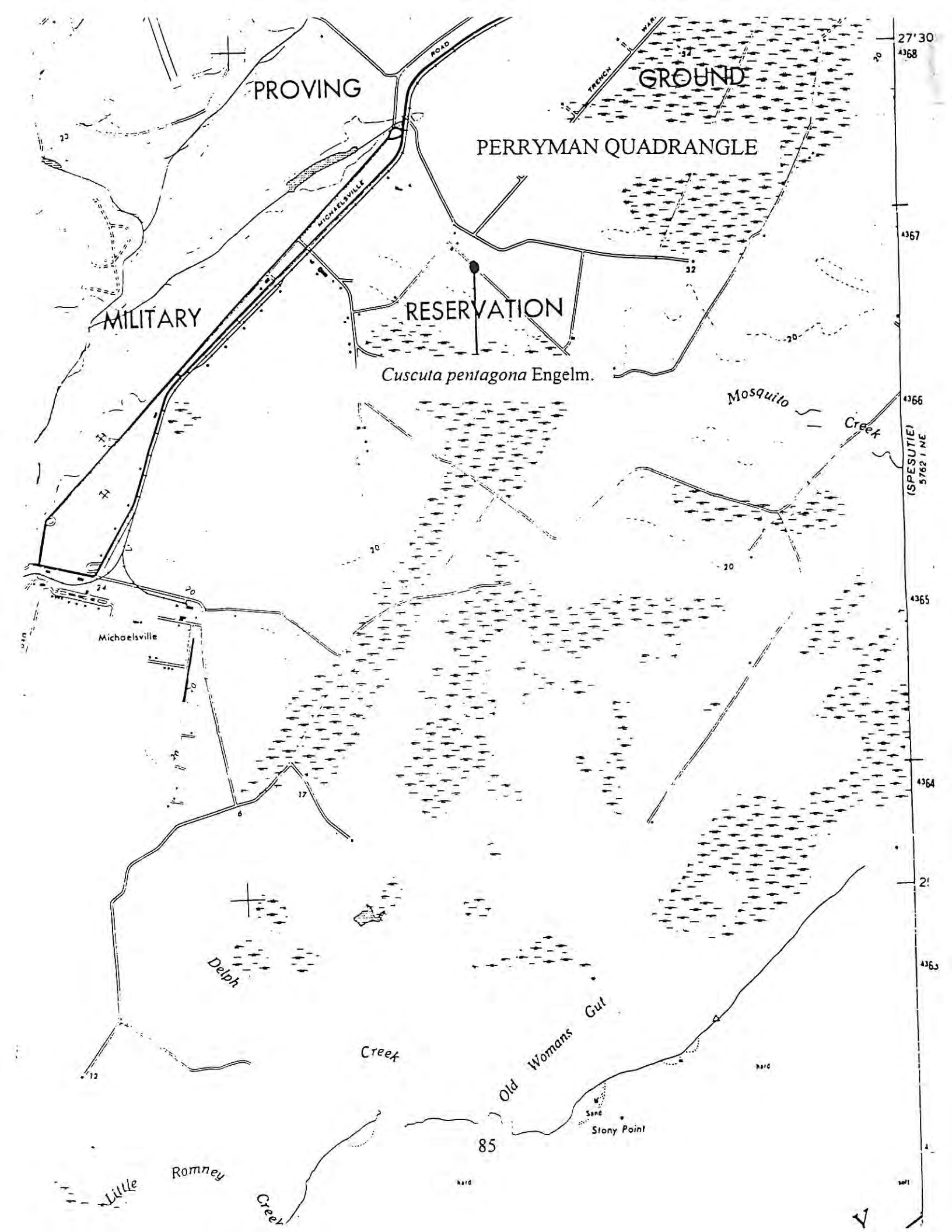


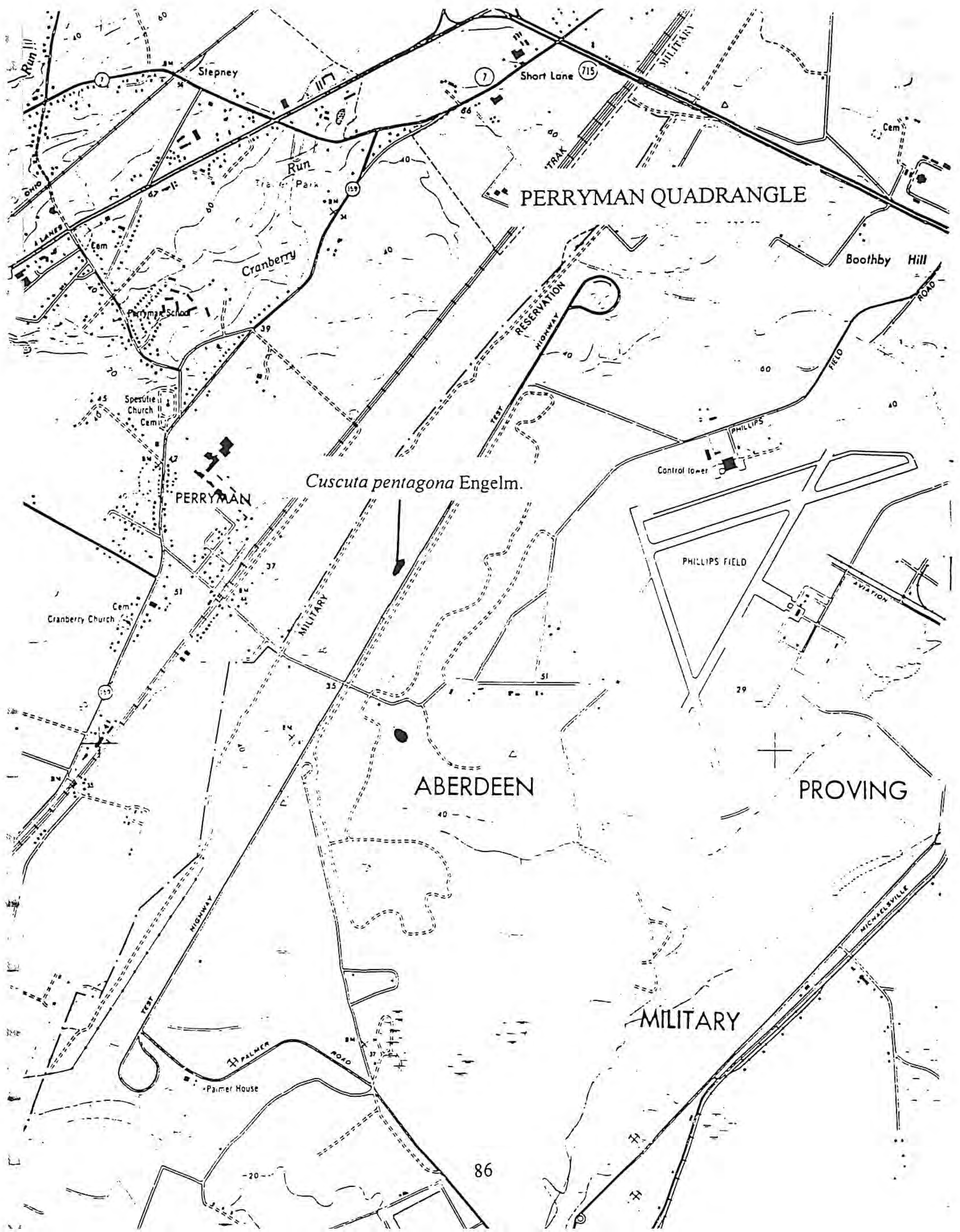
Cladium mariscoides (Muhl) Torr.

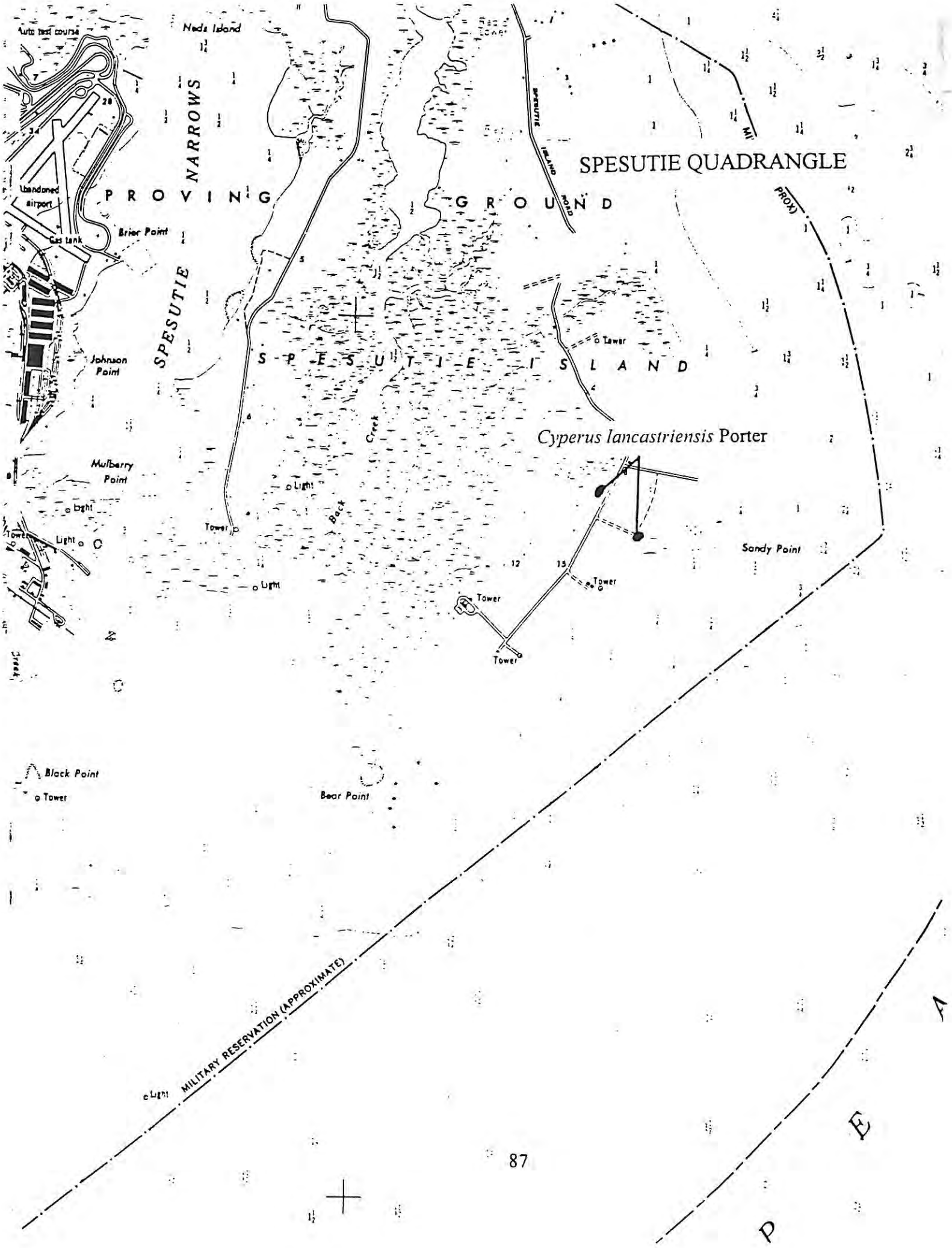

STATE PARK
Cunninghill Cove
Maxwel
BOUNDARY
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM△32
DUNDEE
CREEK
RESERVATION
Sandy Point
4356
4355
4354
4353
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER
CREEK
Cladium mariscoides (Muhl) Torr.
White Oak Point
Seneca Park
Carroll Island
SENECA CREEK
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Pile
Lower Island Point
5762 IV SW
(MIDDLE RIVER)

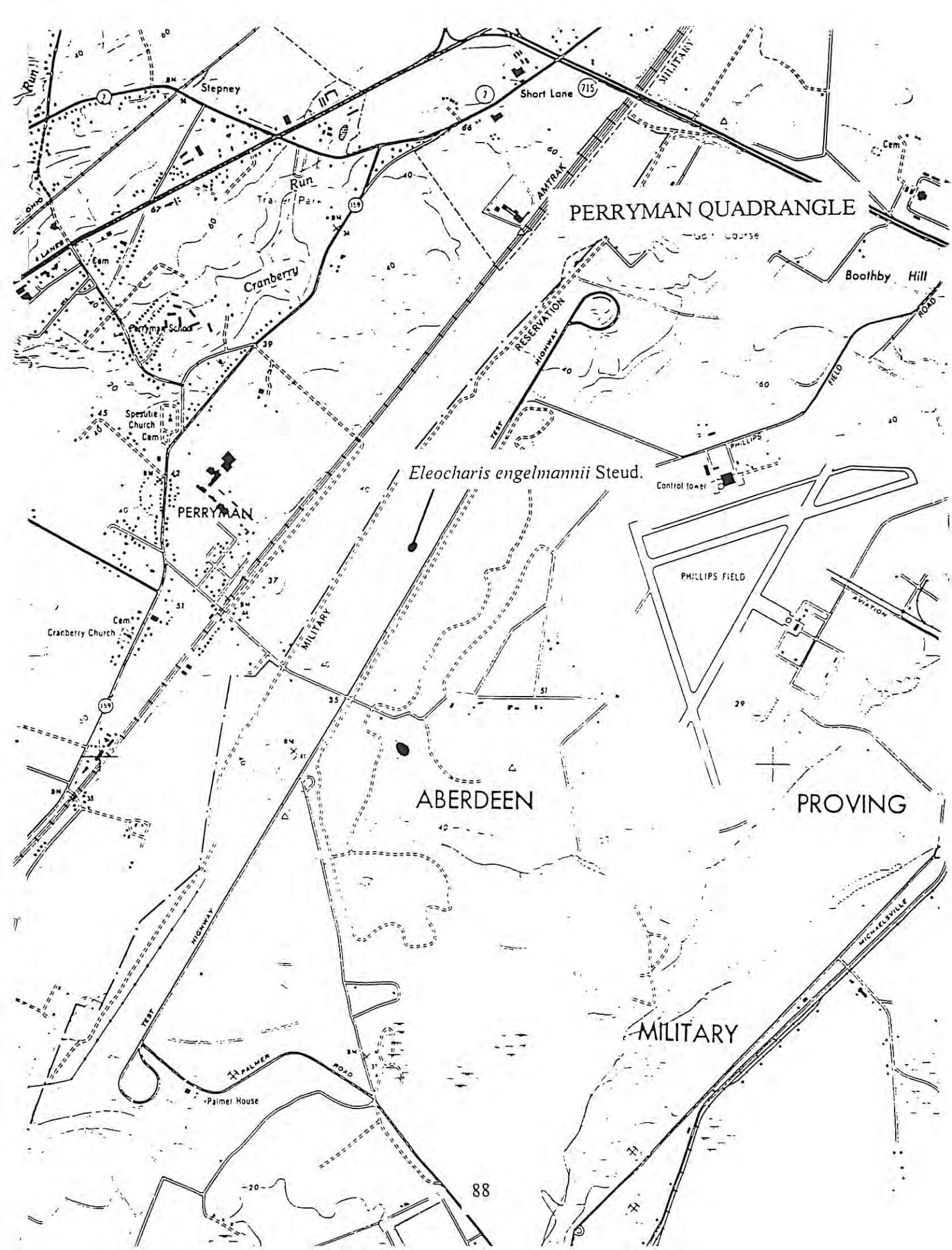

SPESUTIE QUADRANGLE
Sands Cove
Locust Poin
Point Creek
Neds Island
Pad.d Tower
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
PROVING GROUND
NARROWS
Brier Point
SPESUTIE
Commelina virginica L.
SPESUTIE ISLAND
Johnson Point
Back Creek
Mulberry Point
Light
Tower
Sandy Point
Bear Point

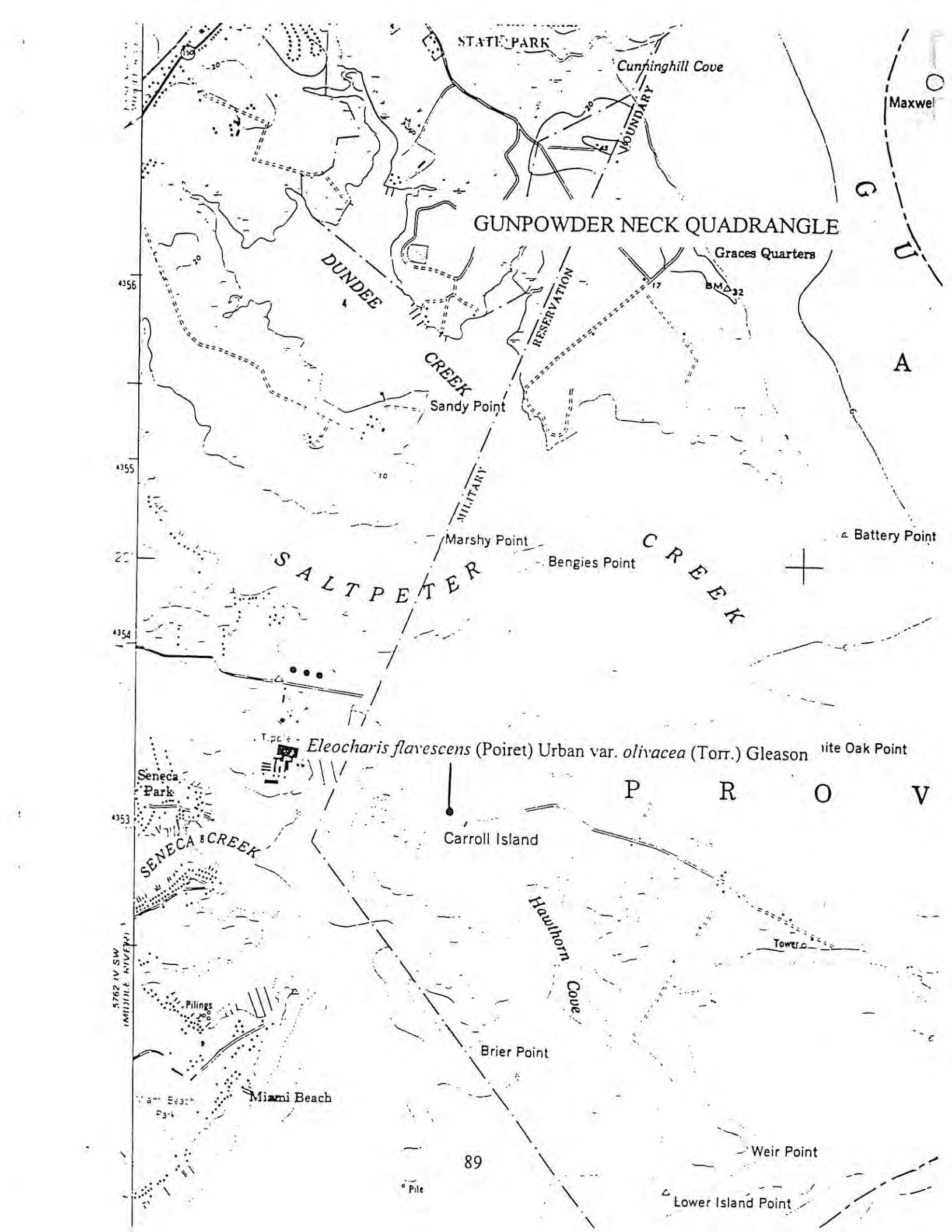

PERRYMAN QUADRANGLE
Commelina virginica L.
PROVING
GROUND
RESERVATION
Boothby Hill
ROAD
ABERDEEN
Swan
Creek
Palisades Park
Cem
Golf Course
FIELD
PHILLIPS
AVIATION
ARMS
ROAD
RANGE
ROAD
WARFARE
TRENCH
MICHAELSVILLE
Mosquito
Pistol range
600 000
FEET
27'30"
4372
4371
4370
4369
4368
4367
4366
84

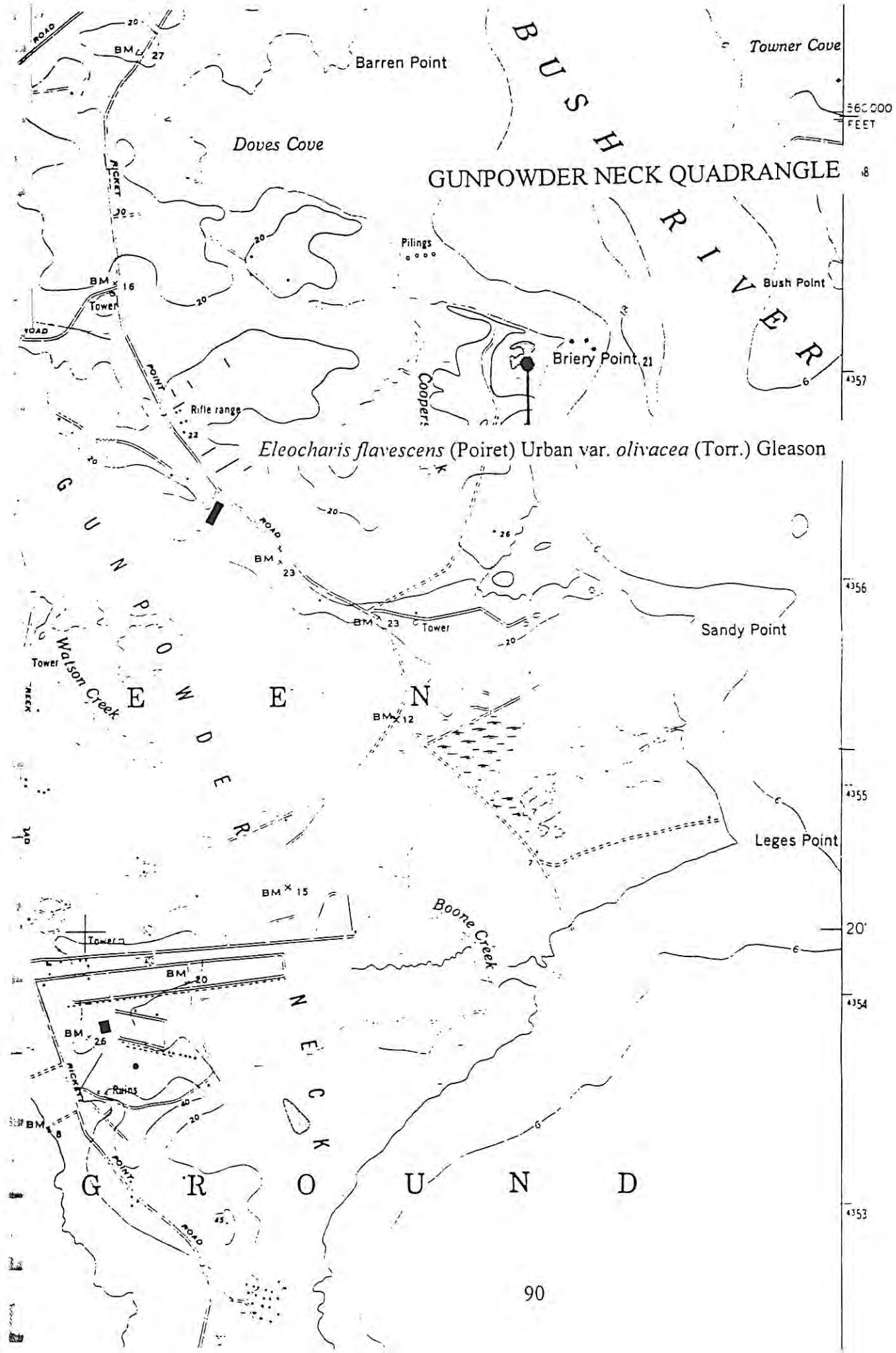

PROVING
GROUND
PERRYMAN QUADRANGLE
MILITARY
RESERVATION
Cuscuta pentagona Engelm.
Mosquito
Creek
(SPESUTIE)
5762 I NE
Michaelsville
Delph
Creek
Old Womans Gut
Stony Point
Little
Romney
Creek
85
27'30
4368
4367
4366
4365
4364
4363


PERRYMAN QUADRANGLE
Cuscuta pentagona Engelm.
Stepney
Short Lane
Run
Trailer Park
Cranberry
Cem
Perryman School
Spesutie Church Cem
PERRYMAN
Cranberry Church
Boothby Hill
RESERVATION
HIGHWAY
TEST
MILITARY
PHILLIPS
FIELD
ROAD
Control tower
PHILLIPS FIELD
AVIATION
ABERDEEN
PROVING
MILITARY
MICHAELSVILLE
PALMER ROAD
Palmer House
AMTRAK
OHIO
LANES

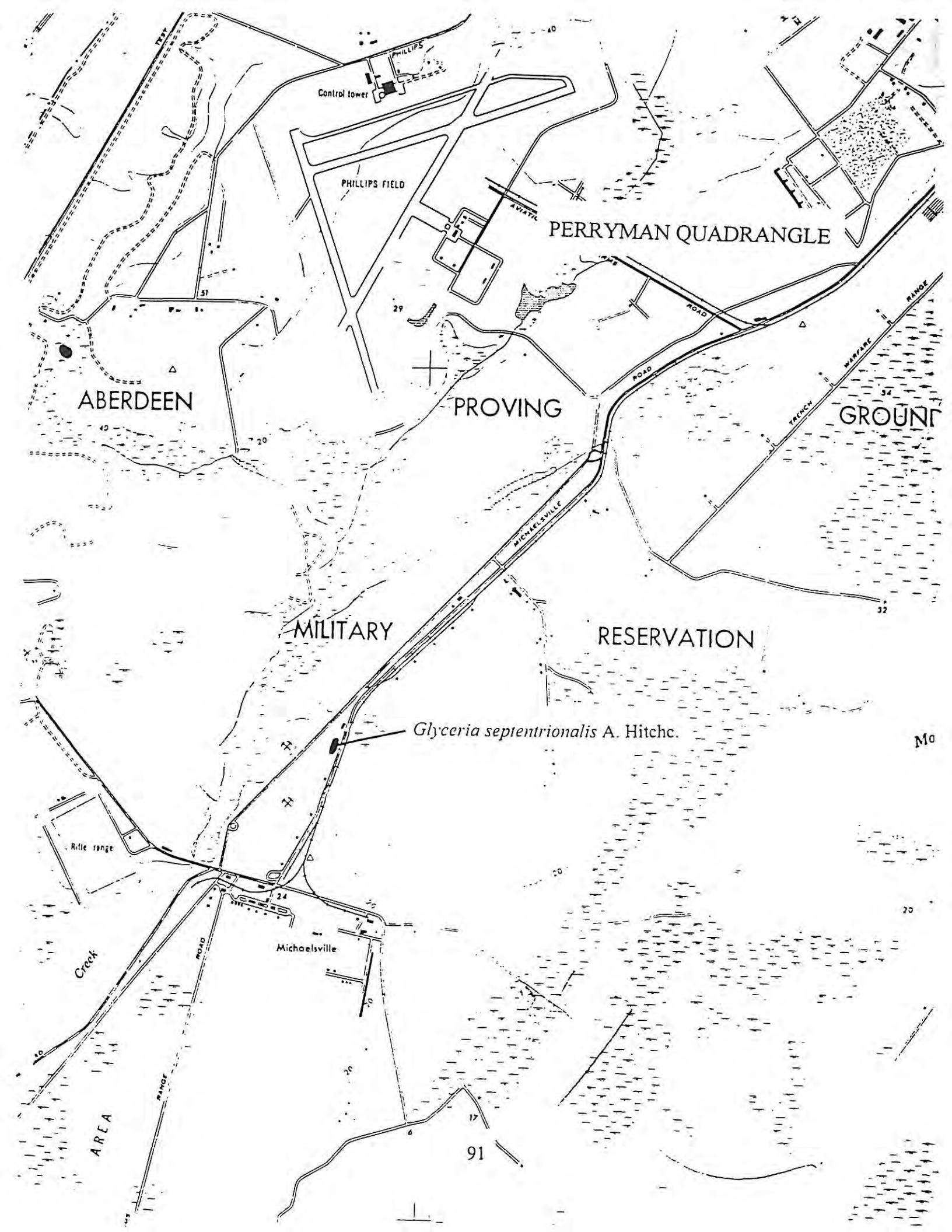

SPESUTIE QUADRANGLE
Auto test course
Nads Island
PROVING GROUND
SPESUTIE NARROWS
Abandoned airport
Gas tank
Brier Point
Johnson Point
SPESUTIE ISLAND
Mulberry Point
Light
Tower
Back Creek
Sandy Point
Black Point
Bear Point
MILITARY RESERVATION (APPROXIMATE)
Cyperus lancastriensis Porter

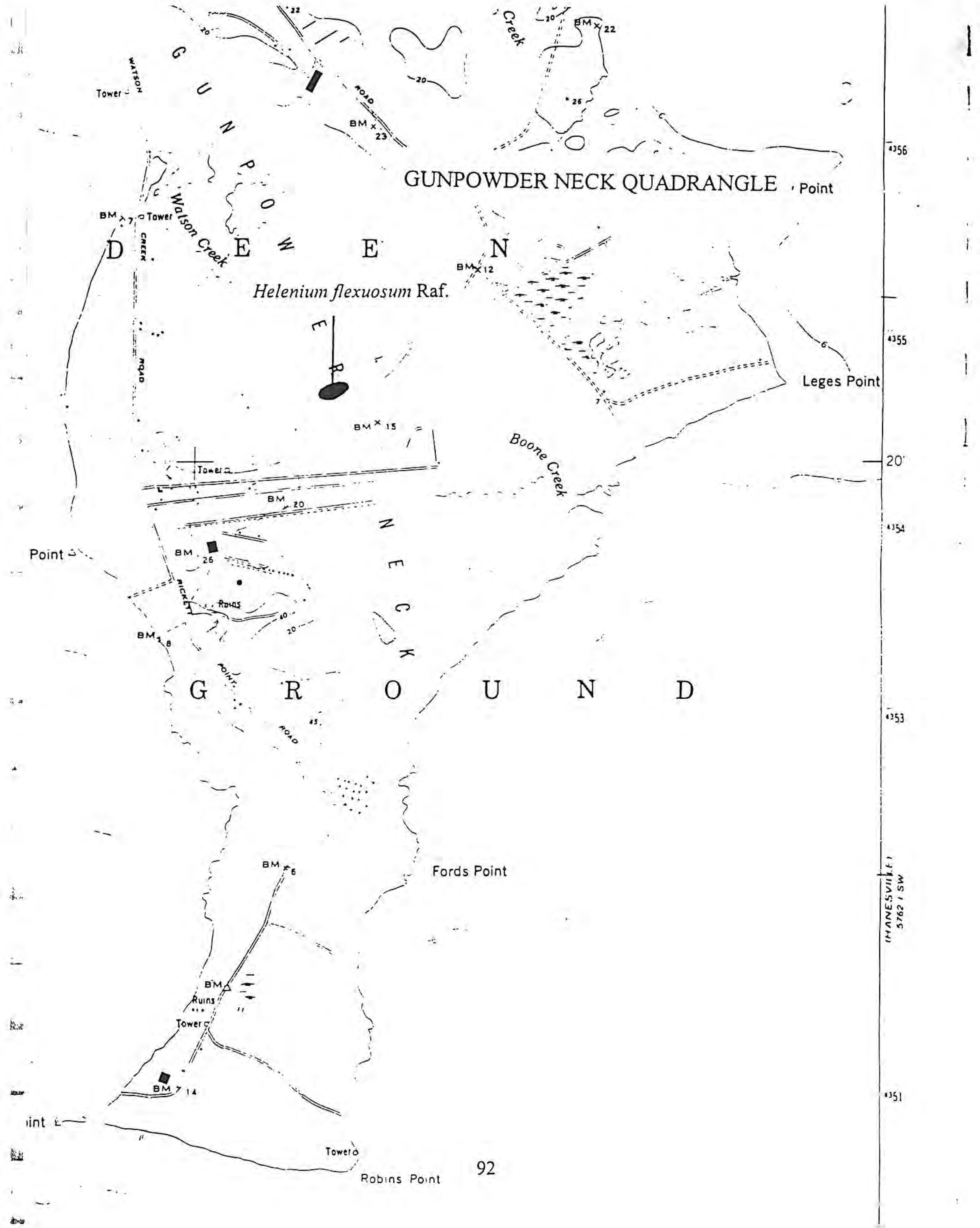

PERRYMAN QUADRANGLE
Eleocharis engelmannii Steud.
Stepney
Short Lane
Run
Cranberry
Perryman School
Spesutie Church Cem
PERRYMAN
Cranberry Church
MILITARY
ABERDEEN
PROVING
MILITARY
AMTRAK
Boothby Hill
ROAD
RESERVATION
HIGHWAY
FIELD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
MICHAELSVILLE
TEST
PALMER ROAD
Palmer House

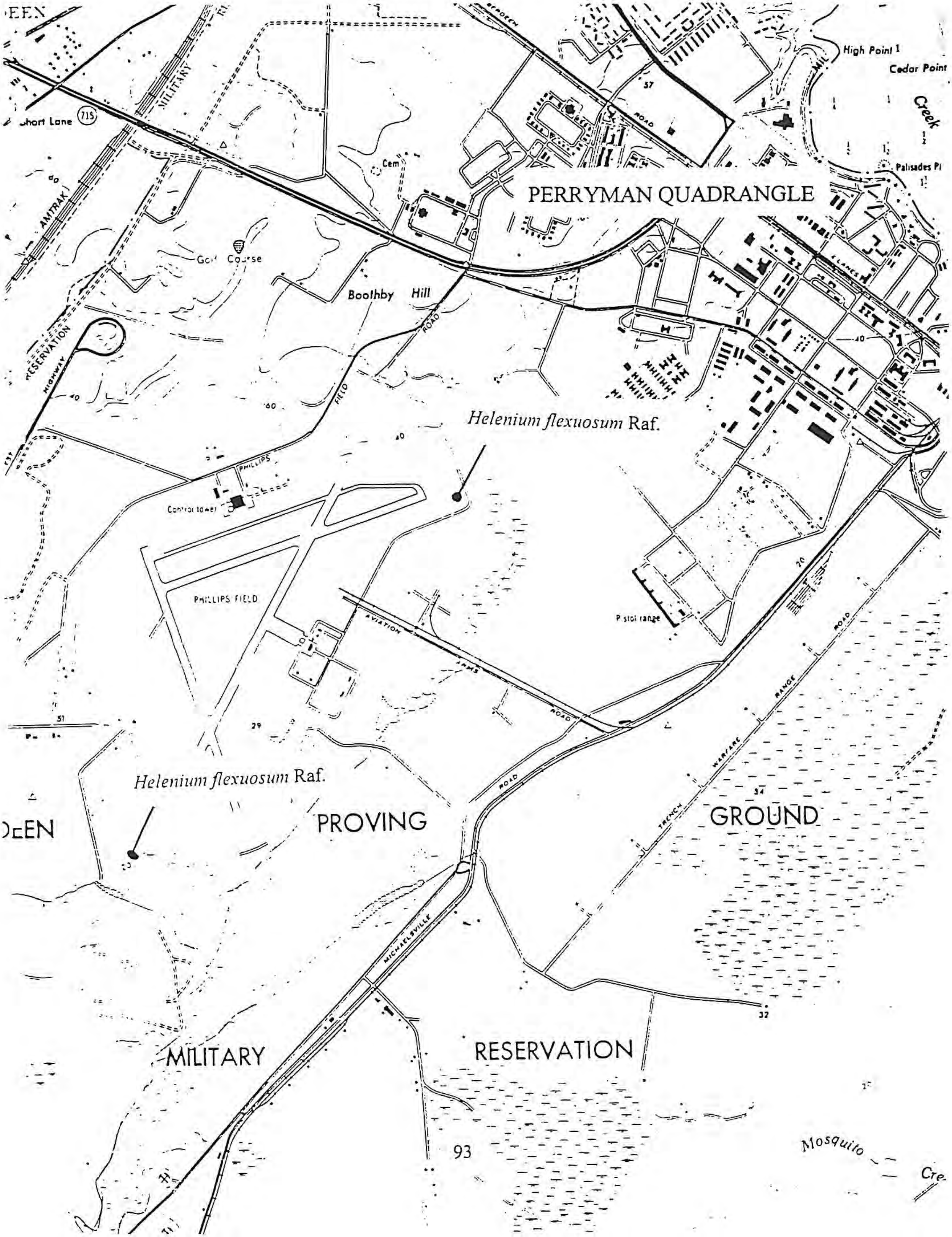

STATE PARK
Cunninghill Cove
BOUNDARY
Maxwel
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER CREEK
Eleocharis flavescens (Poiret) Urban var. olivacea (Torr.) Gleason
Seneca Park
SENECA CREEK
Carroll Island
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Lower Island Point
4356
4355
4354
4353

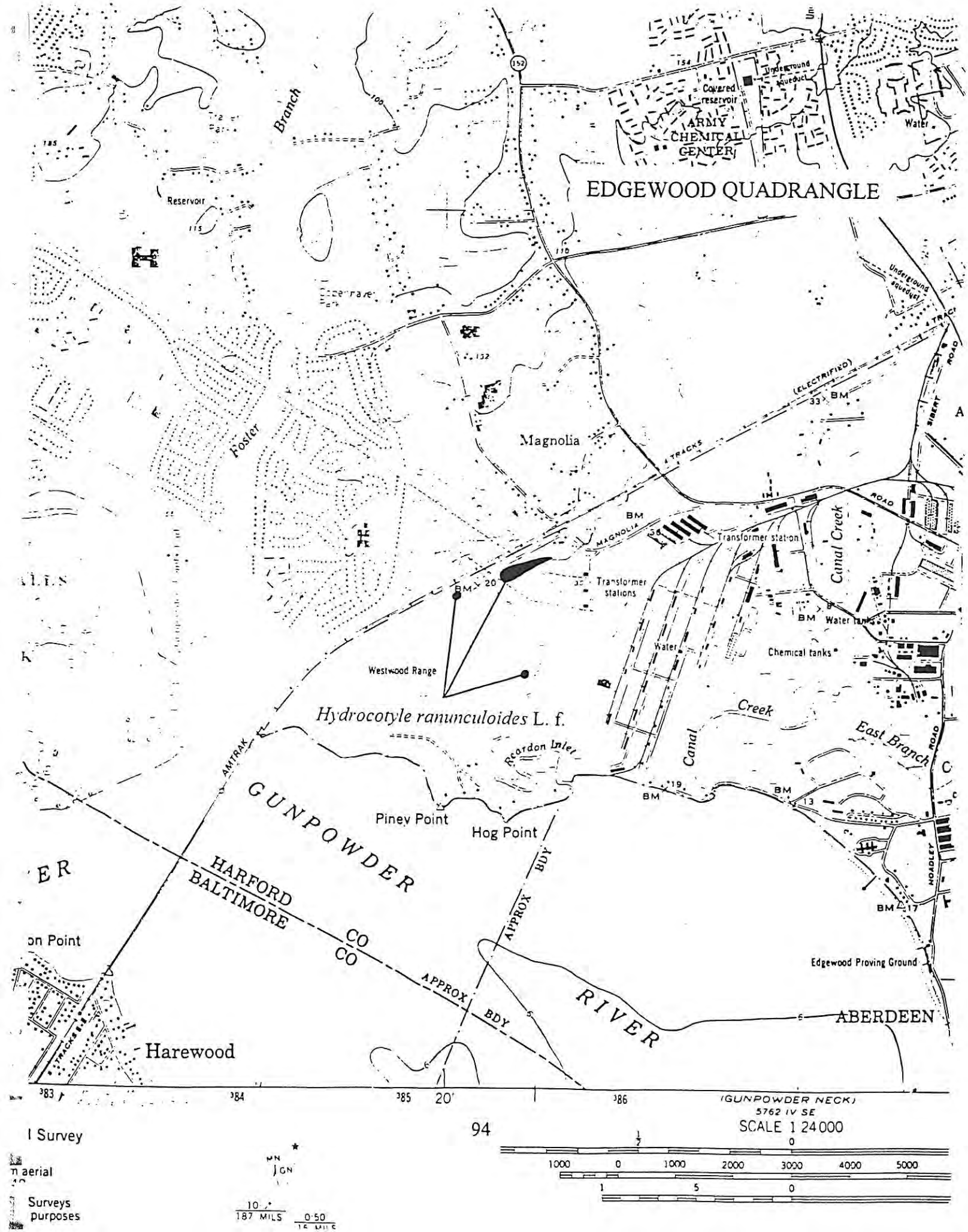


Eleocharis flavescens (Poiret) Urban var. *olivacea* (Torr.) Gleason


PERRYMAN QUADRANGLE
ABERDEEN
PROVING
GROUND
MILITARY
RESERVATION
Glyceria septentrionalis A. Hitchc.
PHILLIPS FIELD
Control tower
AVIATION
ROAD
TRENCH
RANGE
MICHAELSVILLE
Rifle range
Michaelsville
Creek
AREA


GUNPOWDER NECK QUADRANGLE
Helenium flexuosum Raf.
D E E N
G R O U N D
GUNPOW
ER
NECK
Watson Creek
WATSON
CREEK
ROAD
Creek
Boone Creek
Tower
BM 22
BM 23
BM 12
BM 15
BM 20
BM 26
BM 8
BM 6
BM 14
BM 7
Ruins
POINT
RICKETT
Point
Leges Point
Fords Point
Robins Point
4356
4355
4354
4353
4351
20'
5762 I SW


PERRYMAN QUADRANGLE
Helenium flexuosum Raf.
Helenium flexuosum Raf.
High Point
Cedar Point
Creek
Palisades Pt
Short Lane
715
AMTRAK
MILITARY
RESERVATION
HIGHWAY
Cem
Golf Course
Boothby Hill
ROAD
FIELD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ARMS
ROAD
Pistol range
RANGE
ROAD
WARFARE
TRENCH
PROVING
GROUND
MICHAELSVILLE
MILITARY
RESERVATION
Mosquito
Cre

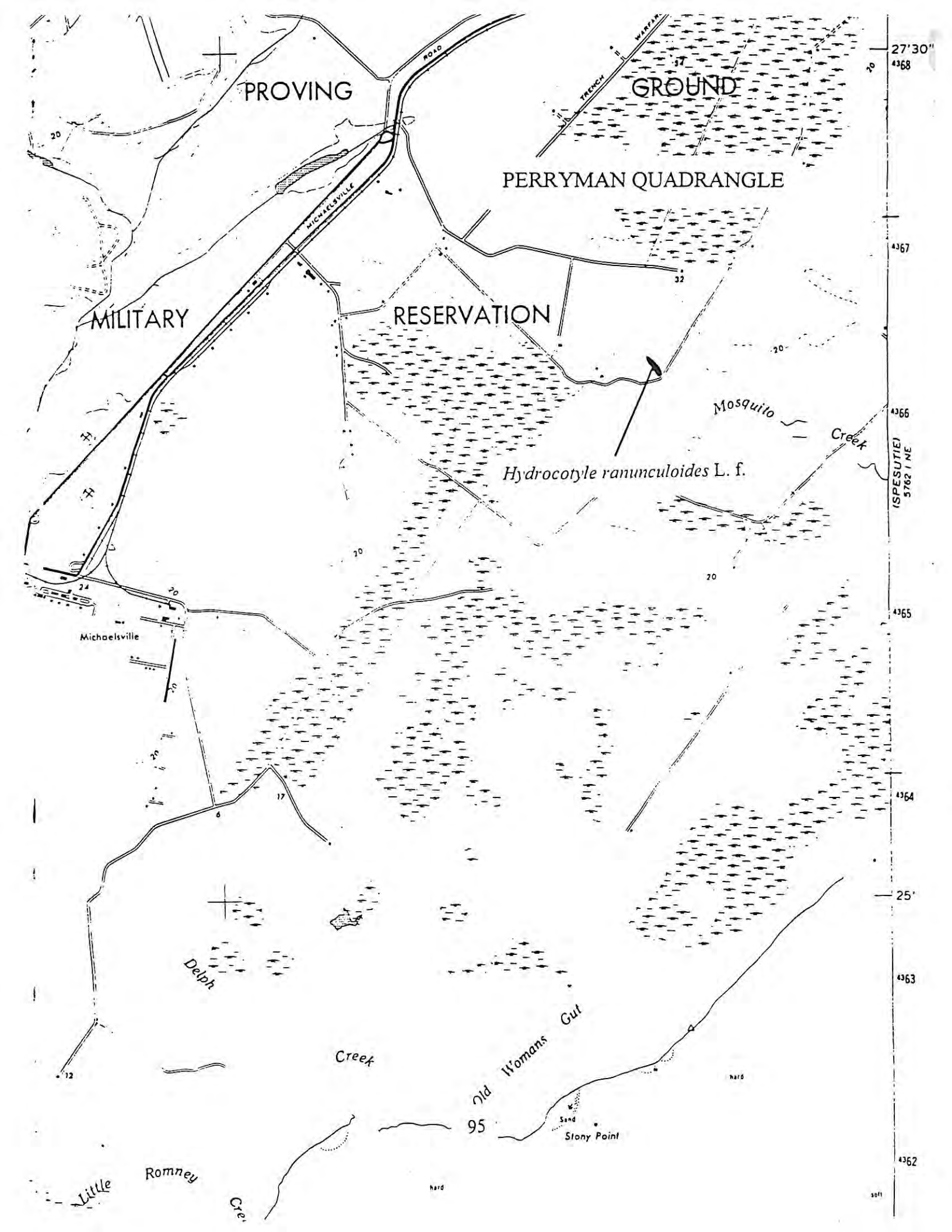


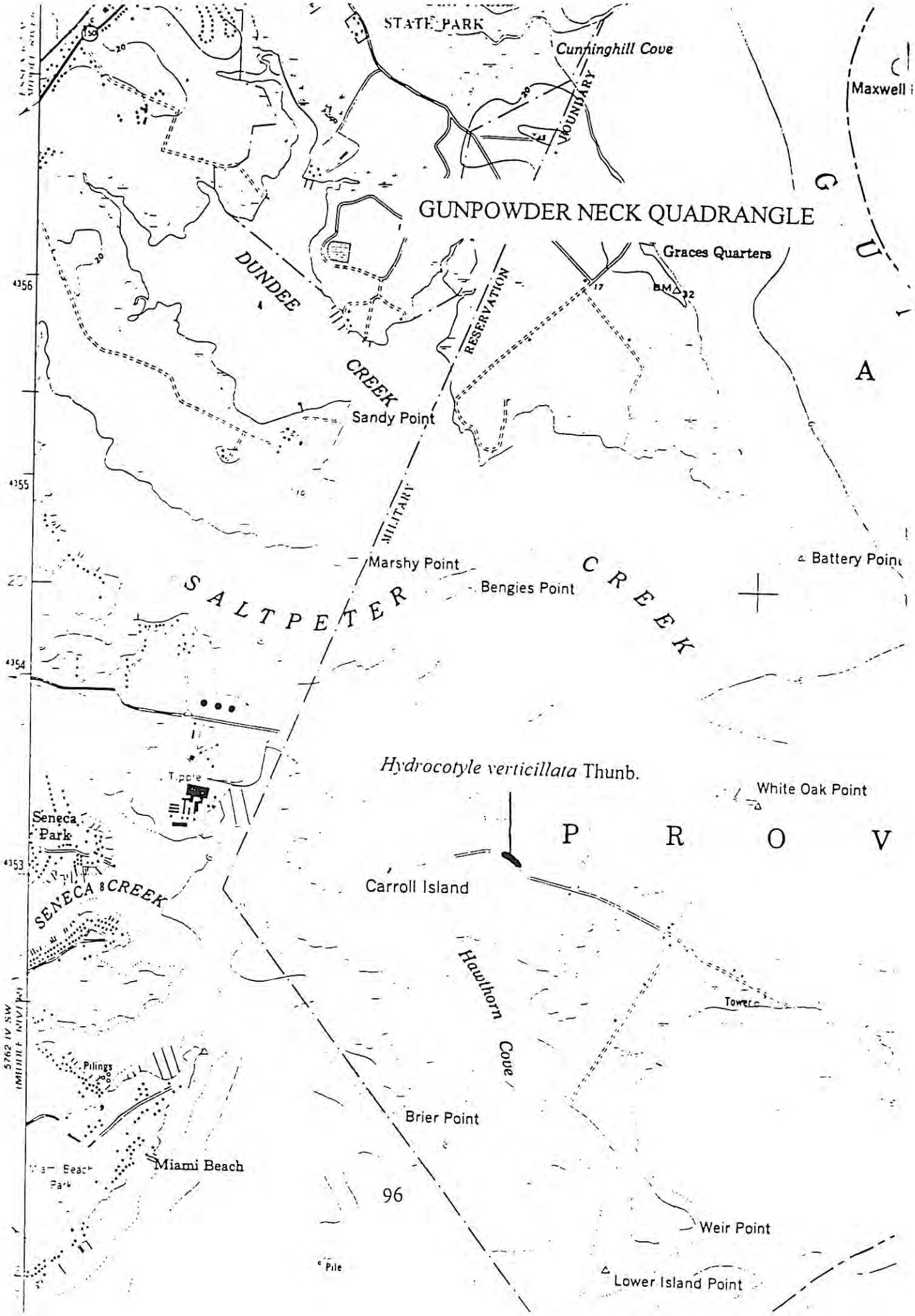
I Survey

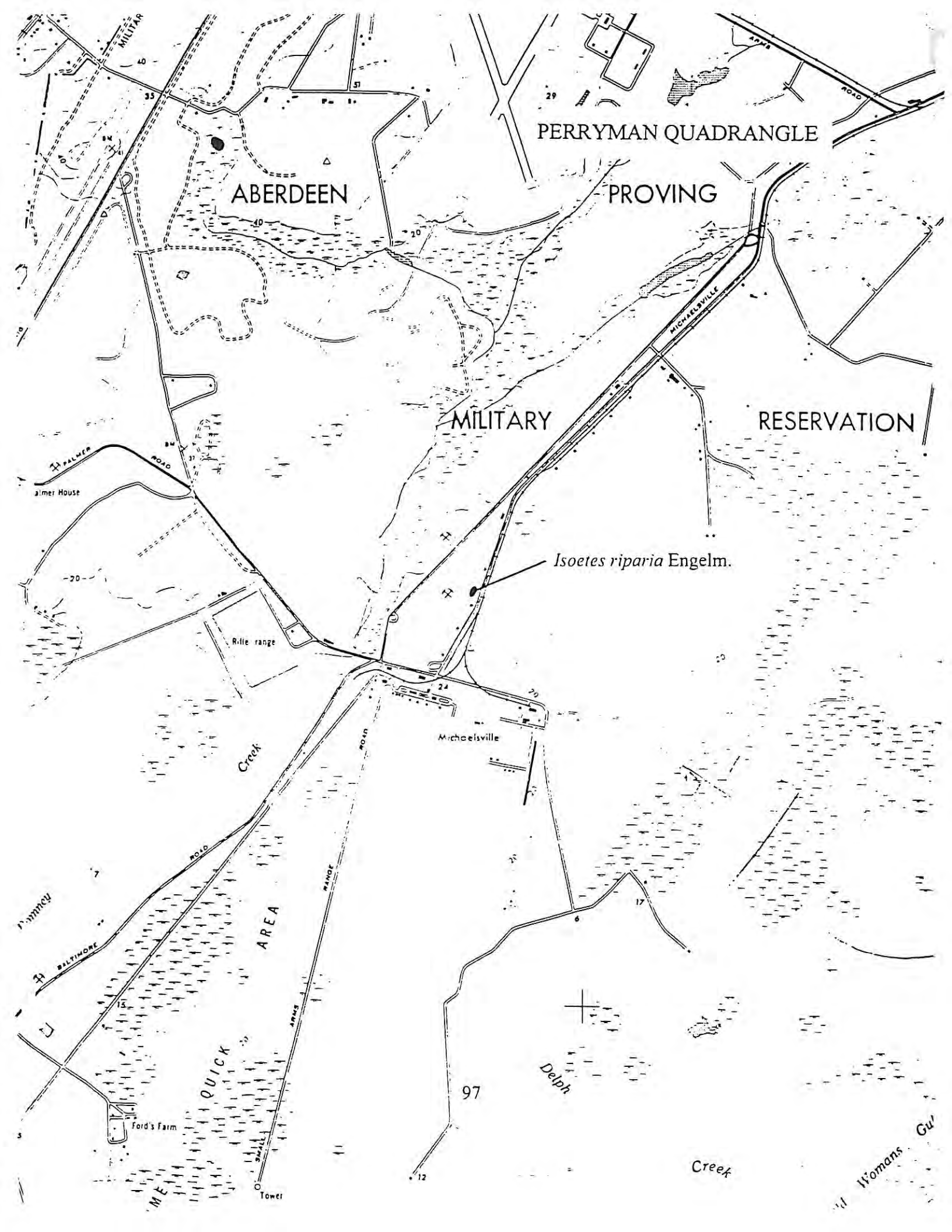
aerial

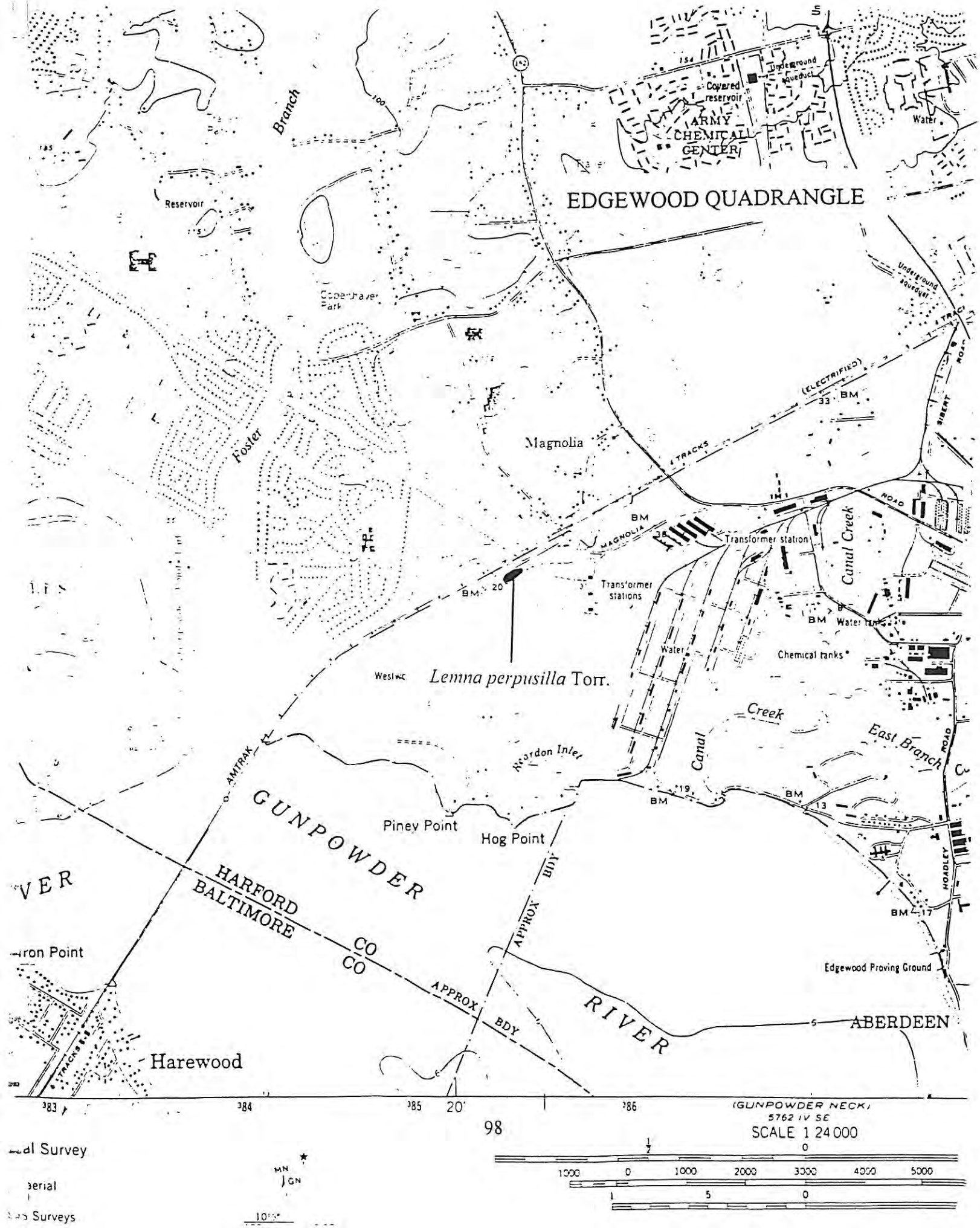
Surveys purposes

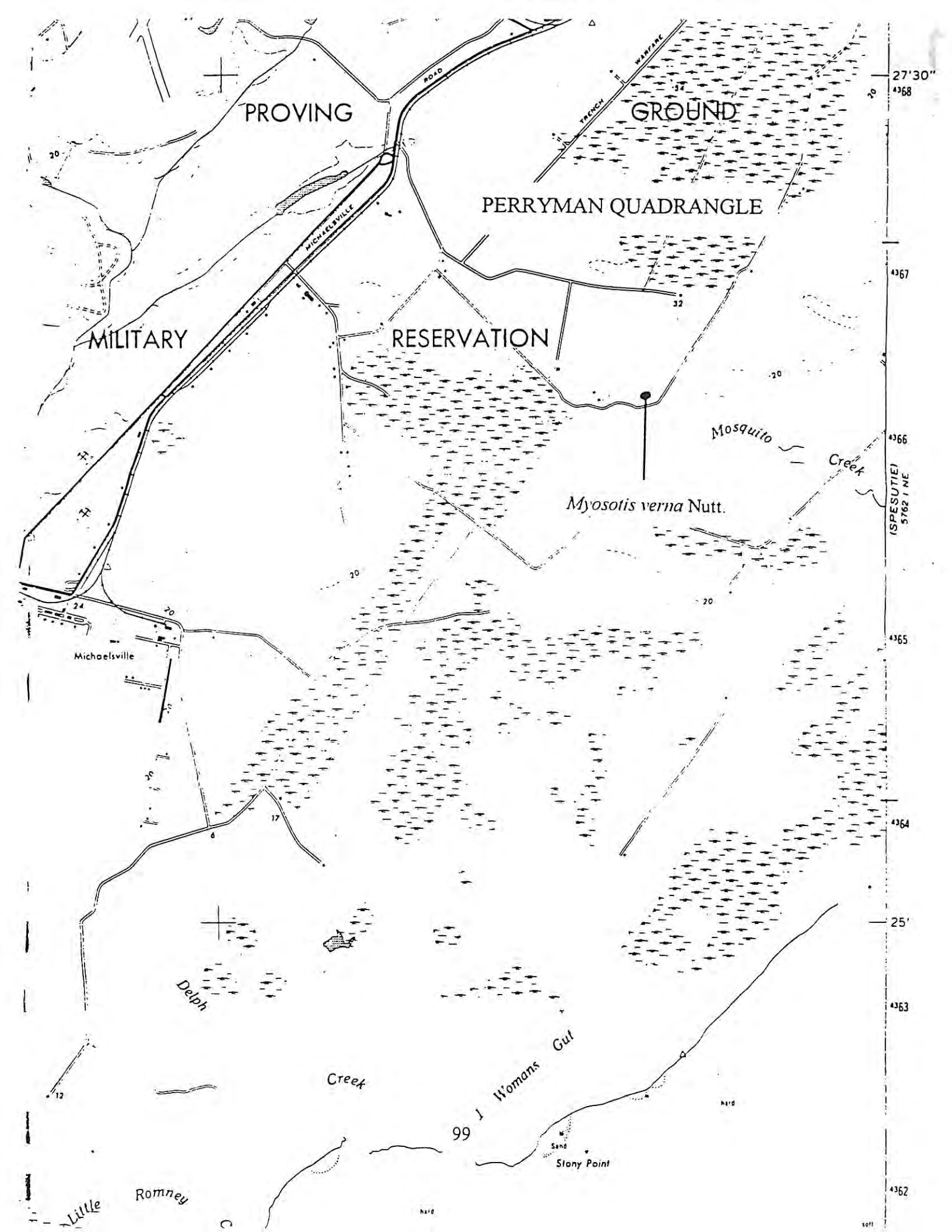
94

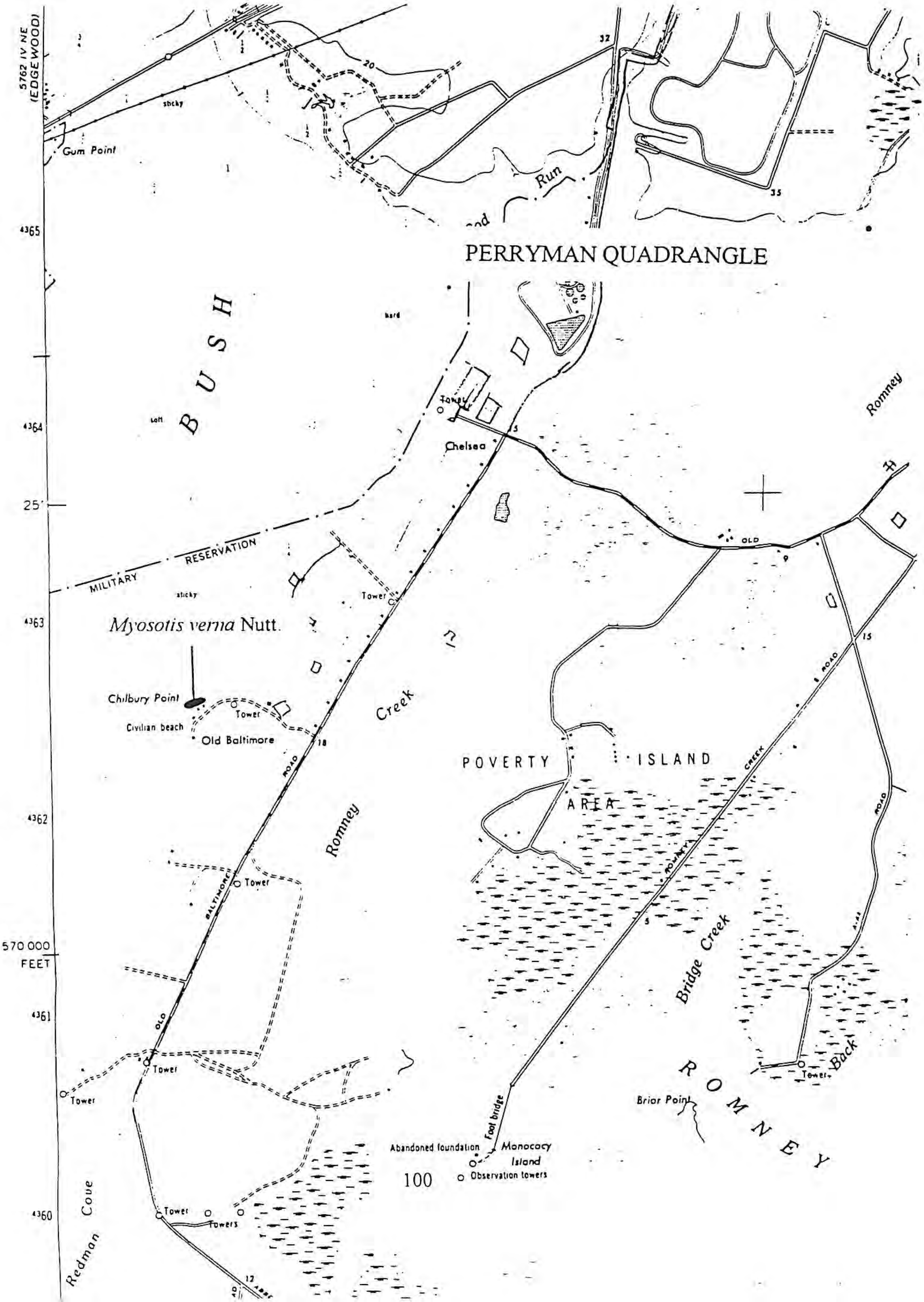

PROVING
GROUND
PERRYMAN QUADRANGLE
MILITARY
RESERVATION
Mosquito
Creek
Hydrocotyle ranunculoides L. f.
Michaelsville
Delph
Creek
Old Womans Gut
Stony Point
Little
Romney
27'30"
4368
4367
4366
4365
4364
4363
4362
(SPESUTIE)
5762 I NE

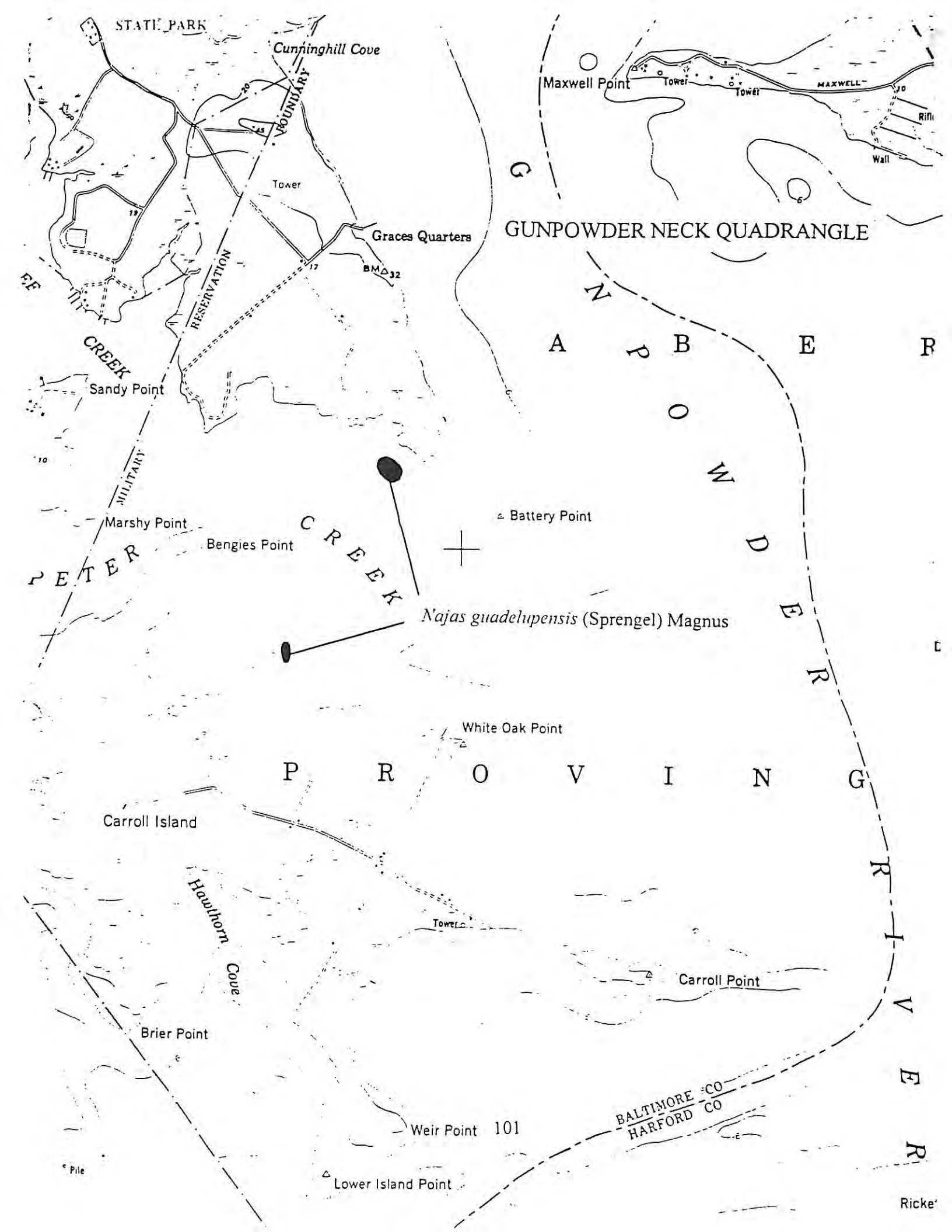

STATE PARK
Cunninghill Cove
Maxwell
BOUNDARY
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Bengies Point
Battery Point
SALTPETER CREEK
Hydrocotyle verticillata Thunb.
White Oak Point
Seneca Park
SENECA CREEK
Carroll Island
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Lower Island Point
4356
4355
4354
4353

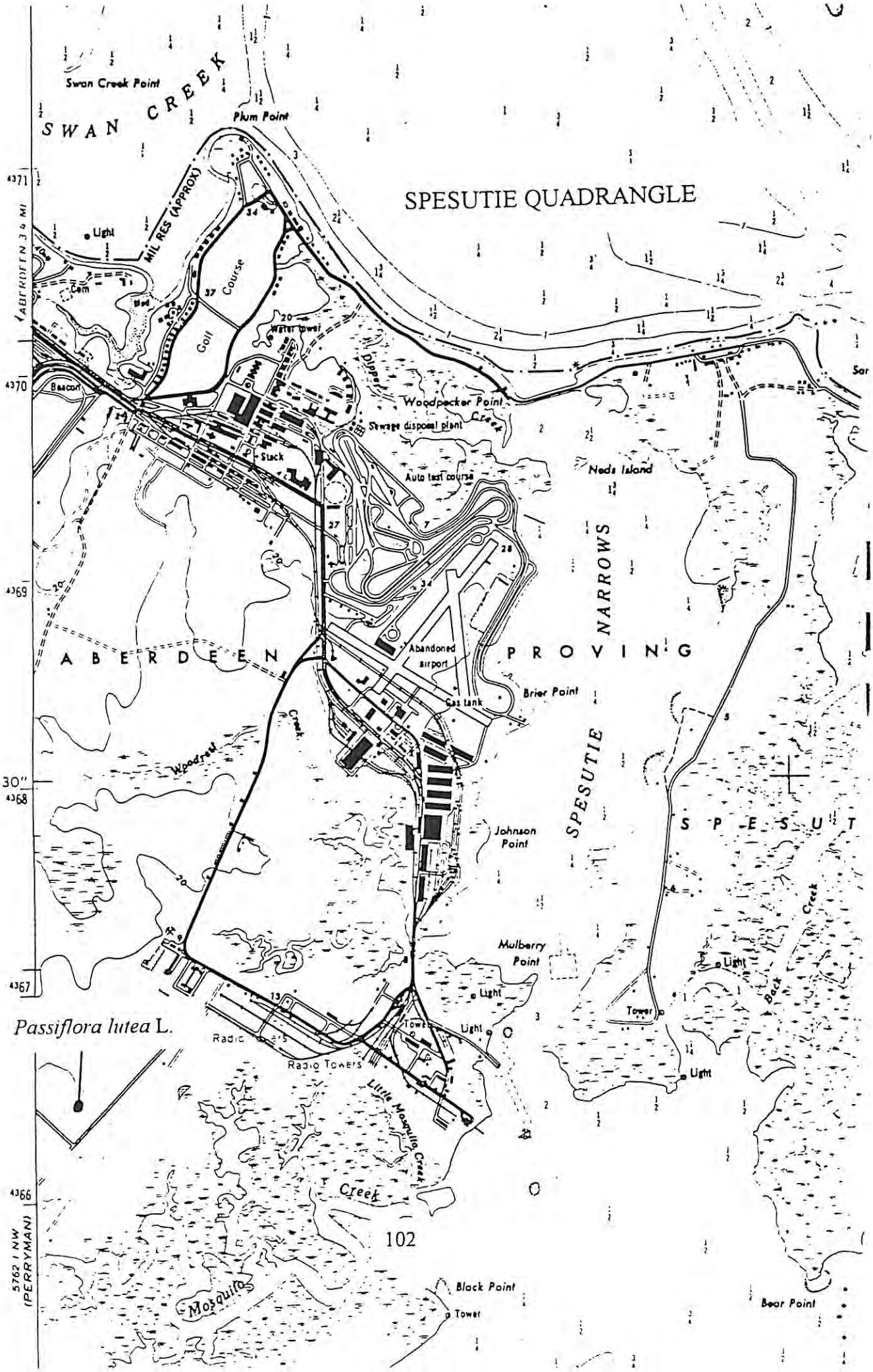

PERRYMAN QUADRANGLE
ABERDEEN
PROVING
MILITARY
RESERVATION
Isoetes riparia Engelm.
Rifle range
Michaelsville
Creek
AREA
Ford's Farm
Tower
Delph
Creek
97


EDGEWOOD QUADRANGLE
ARMY CHEMICAL CENTER
Covered reservoir
Underground aqueduct
Water
Reservoir
Branch
Foster
Magnolia
Transformer station
Transformer stations
Canal Creek
Chemical tanks
Water
Lemma perpusilla Torr.
Aberdeen Inlet
Canal Creek
East Branch
Piney Point
Hog Point
GUNPOWDER
HARFORD
BALTIMORE
CO
CO
APPROX BDY
APPROX BDY
RIVER
ABERDEEN
Edgewood Proving Ground
Harewood
AMTRAK
TRACKS
ELECTRIFIED
4 TRACKS
BM 33
BM 20
BM 19
BM 13
BM 17
383
384
385
20'
386
98
(GUNPOWDER NECK)
5762 IV SE
SCALE 1 24 000
1000 0 1000 2000 3000 4000 5000

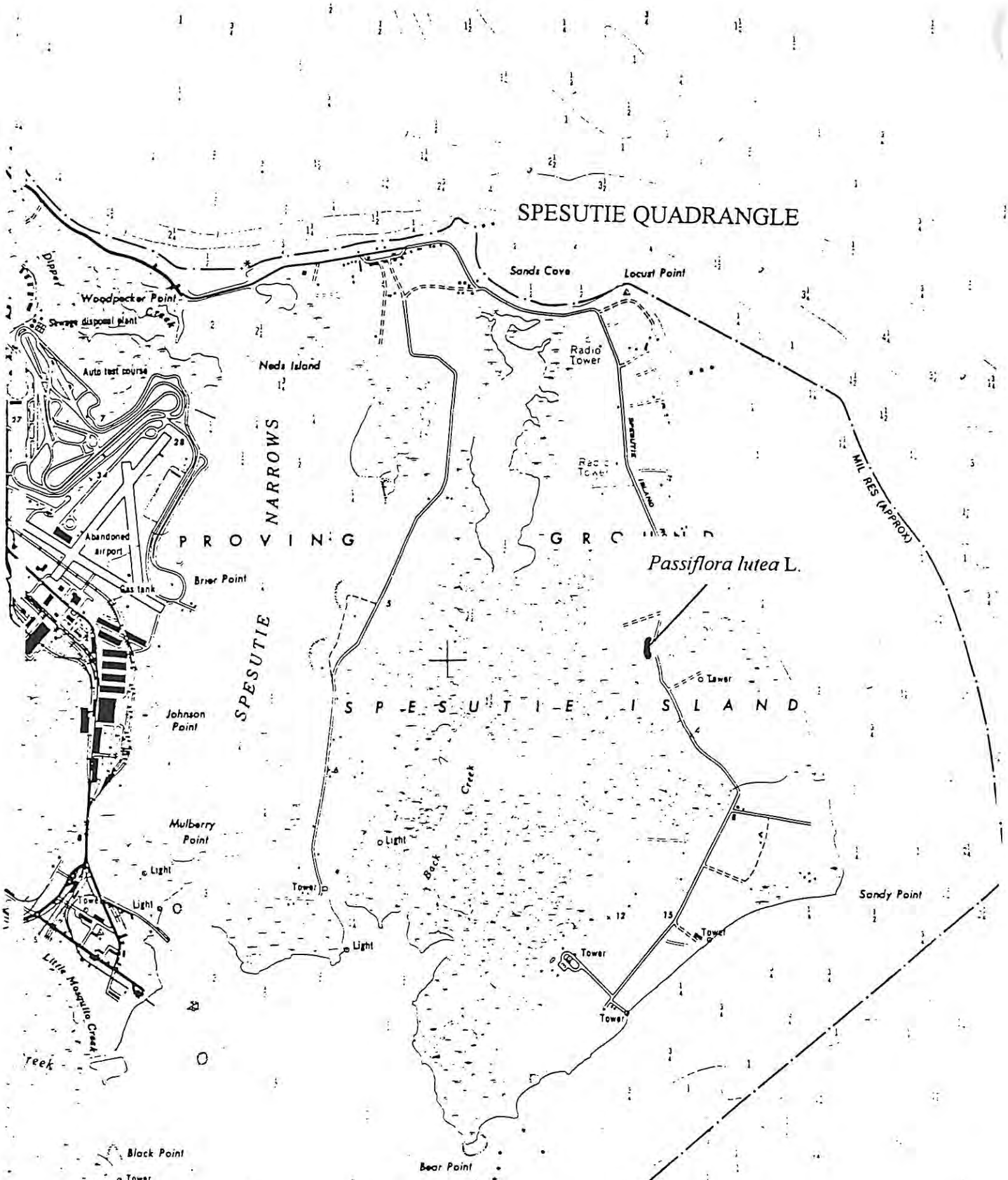

PROVING
GROUND
PERRYMAN QUADRANGLE
MILITARY
RESERVATION
MICHAELSVILLE
ROAD
TRENCH
WARFARE
Mosquito
Creek
Myosotis verna Nutt.
Michaelsville
Delph
Creek
Womans Gut
Sand
Stony Point
Little
Romney
27'30"
4368
4367
4366
4365
4364
25'
4363
4362
(SPESUTIE)
5762 I NE

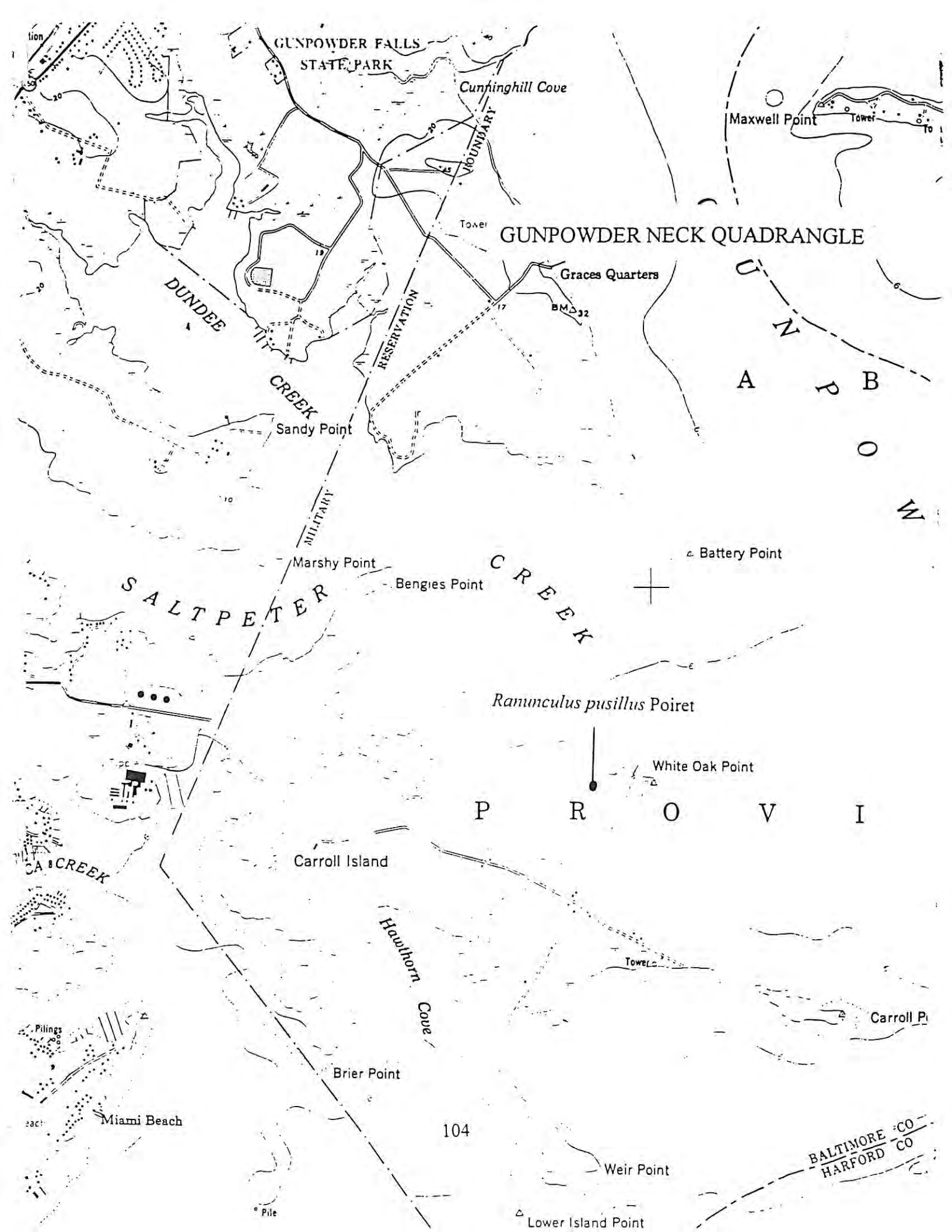

PERRYMAN QUADRANGLE
Myosotis verna Nutt.
5762 IV NE (EDGEWOOD)
Gum Point
4365
4364
25'
4363
4362
570 000 FEET
4361
4360
BUSH
MILITARY RESERVATION
Chelsea
Tower
Chilbury Point
Civilian beach
Old Baltimore
Romney Creek
OLD BALTIMORE ROAD
POVERTY ISLAND AREA
ROMNEY CREEK ROAD
Bridge Creek
Back
ROMNEY
Briar Point
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
Towers
Redman Cove
Romney
Run
sticky
hard
soft

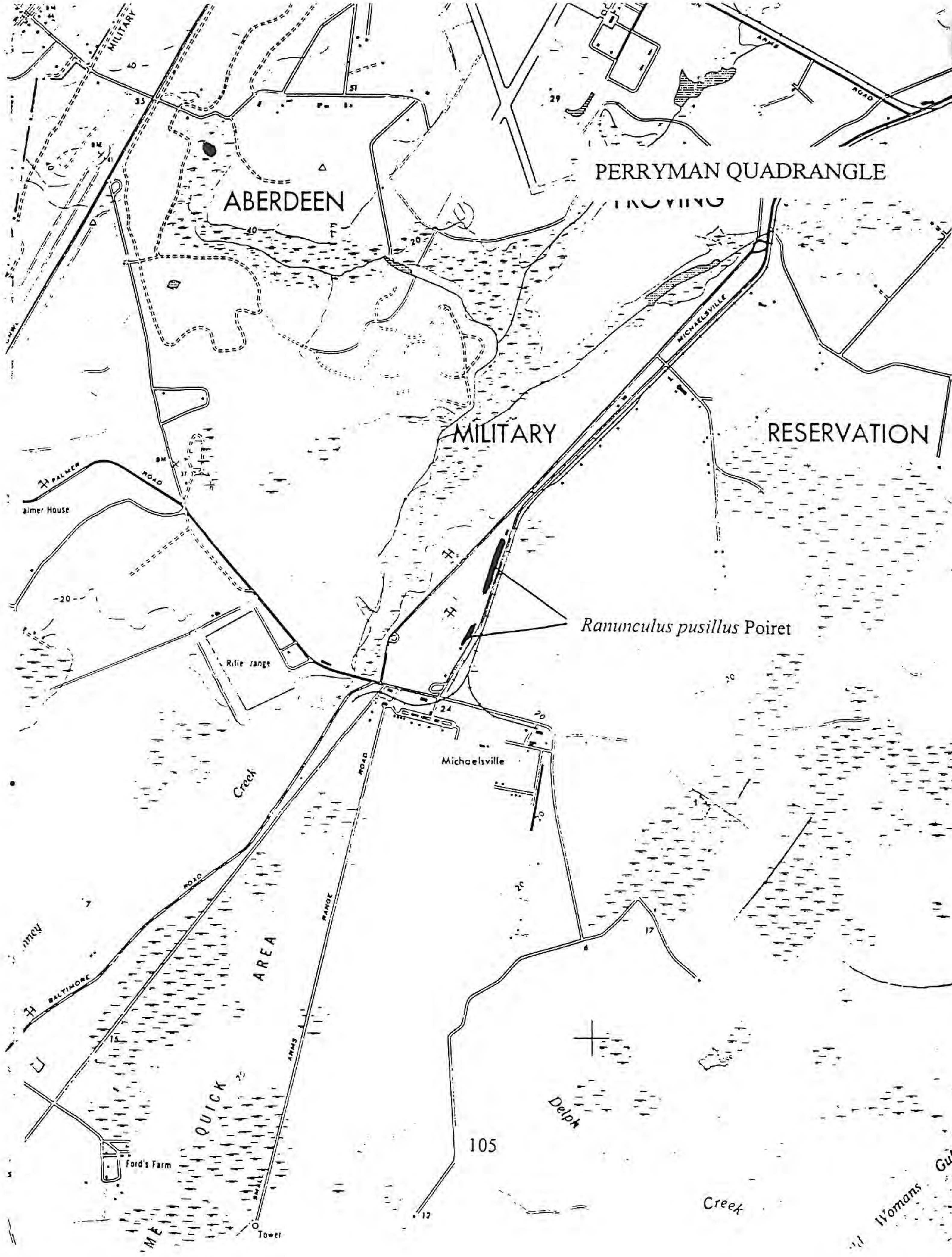

STATE PARK
Cunninghill Cove
BOUNDARY
Tower
Graces Quarters
BM 32
RESERVATION
CREEK
Sandy Point
MILITARY
Marshy Point
Bengies Point
PETER
CREEK
Battery Point
Najas guadelupensis (Sprengel) Magnus
White Oak Point
Carroll Island
Hawthorn Cove
Carroll Point
Brier Point
Weir Point
Lower Island Point
BALTIMORE CO
HARFORD CO
Maxwell Point
Tower
Tower
MAXWELL
Wall
GUNPOWDER NECK QUADRANGLE
GUNPOWDER RIVER
PROVING

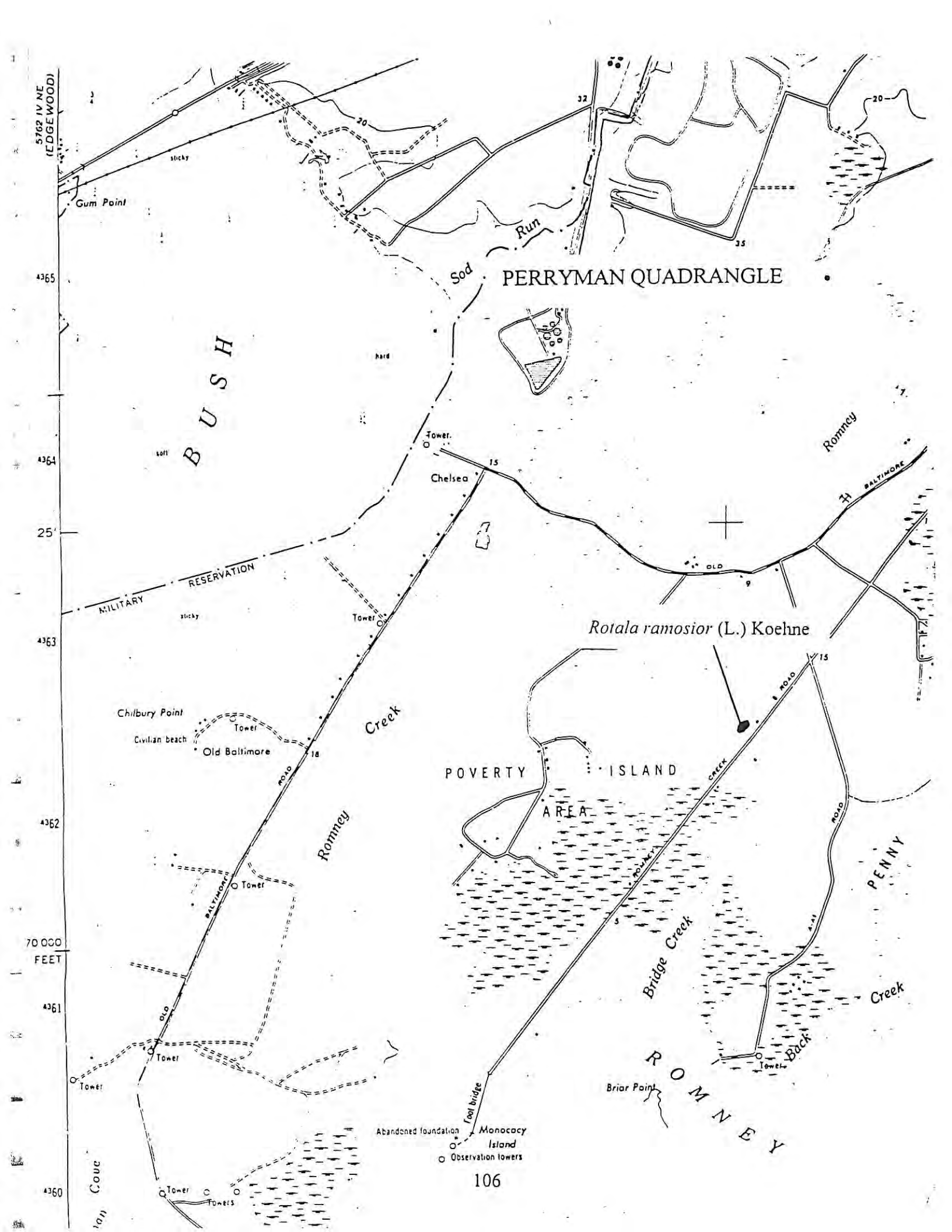


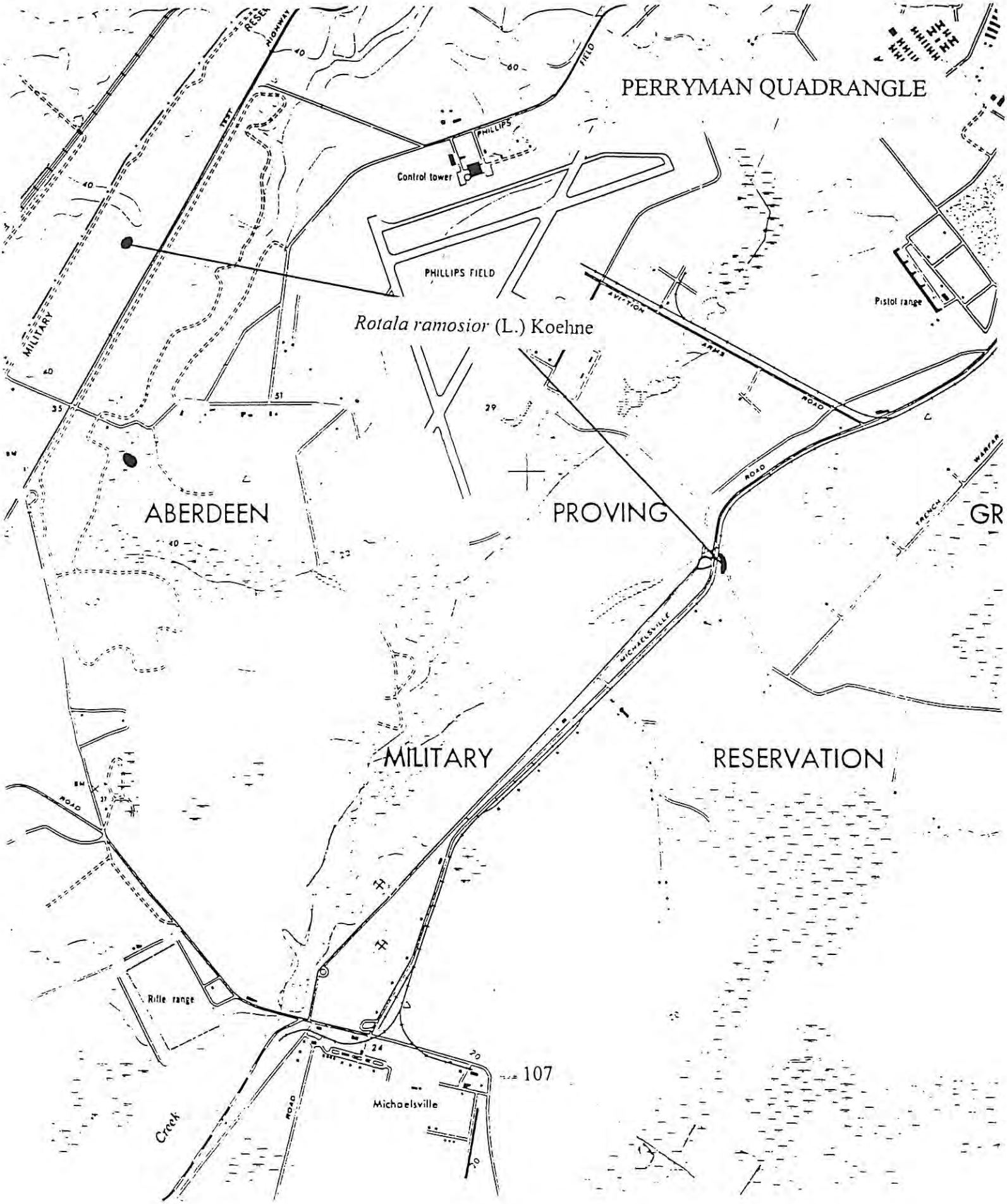
Passiflora lutea L.

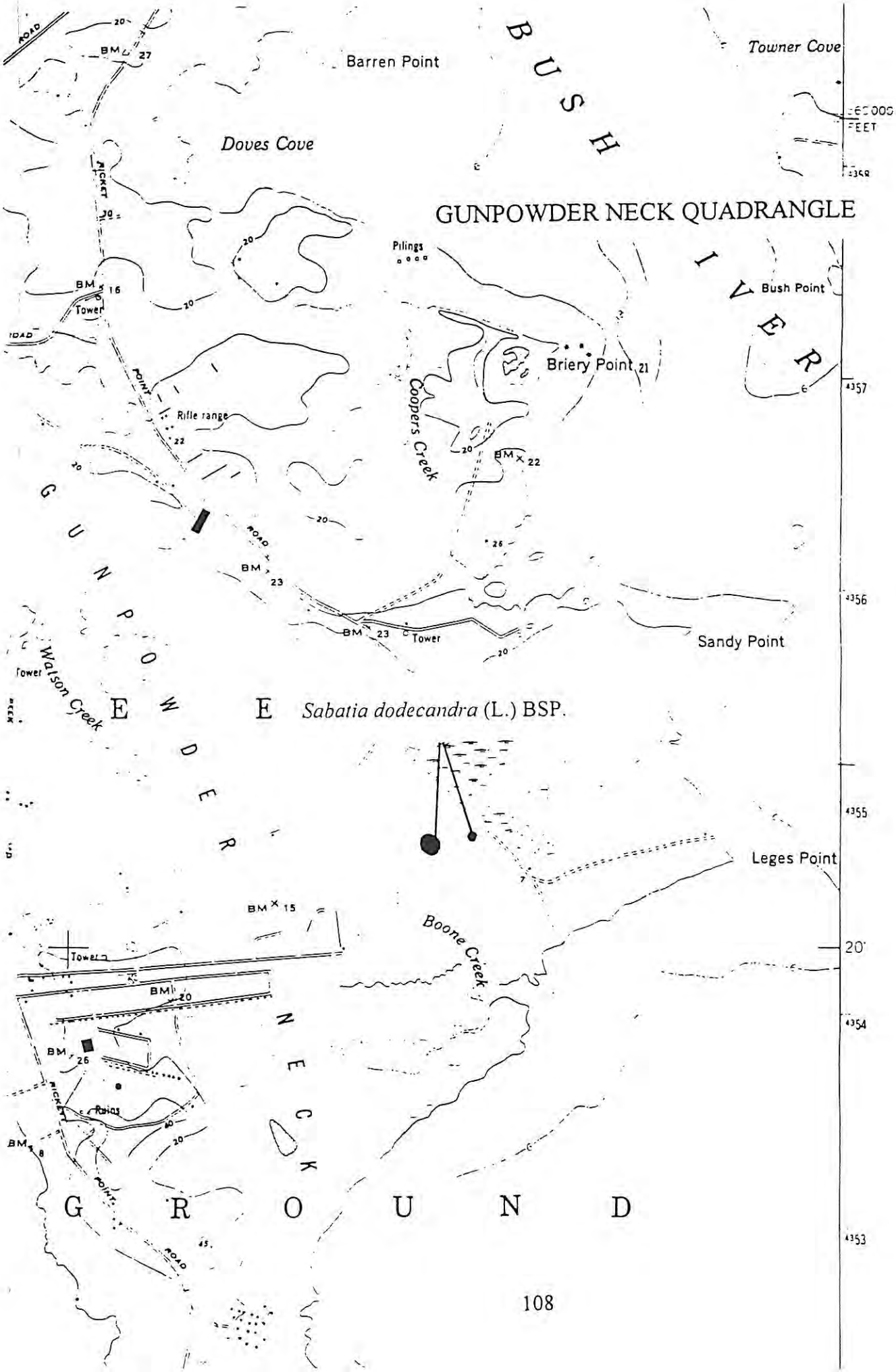

SPESUTIE QUADRANGLE
Sands Cove
Locust Point
Woodpecker Point
Sewage disposal plant
Auto test course
Neds Island
Radio Tower
PROVING GROUND
Abandoned airport
Gas tank
Brier Point
SPESUTIE NARROWS
SPESUTIE ISLAND
MIL RES (APPROX)
Passiflora lutea L.
Johnson Point
Mulberry Point
Back Creek
Sandy Point
Little Mosquito Creek
Black Point
Bear Point
Tower
Light


GUNPOWDER FALLS
STATE PARK
Cunninghill Cove
Maxwell Point
Tower
BOUNDARY
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE
CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Bengies Point
Battery Point
SALTPETER
CREEK
Ranunculus pusillus Poiret
White Oak Point
Carroll Island
Hawthorn Cove
Brier Point
Miami Beach
Weir Point
Lower Island Point
BALTIMORE CO
HARFORD CO
Pilings
Pile

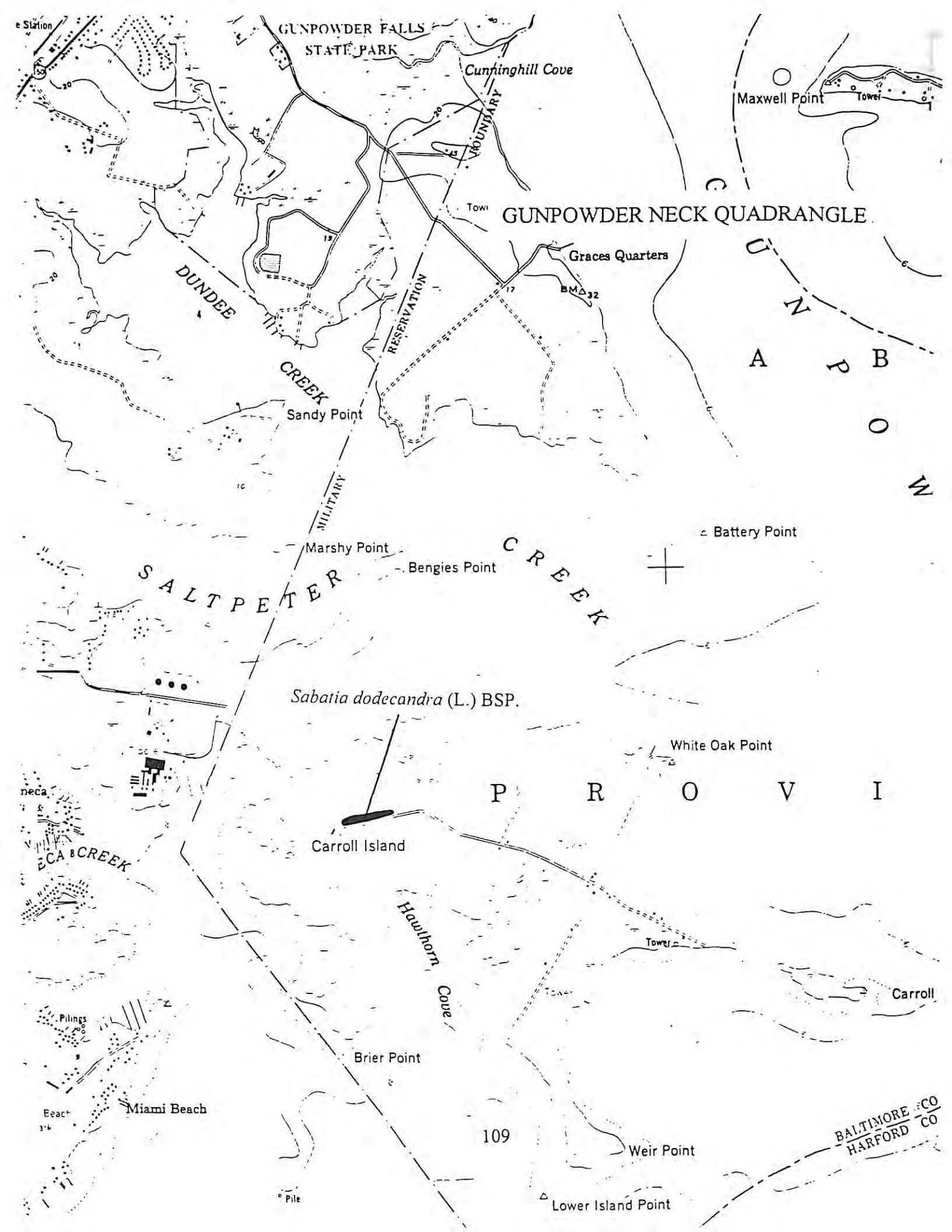

PERRYMAN QUADRANGLE
ABERDEEN
PROVING
MILITARY
RESERVATION
Ranunculus pusillus Poiret
MICHAELSVILLE
PALMER ROAD
almer House
Rifle range
Michaelsville
Creek
BALTIMORE ROAD
SMALL ARMS RANGE ROAD
QUICK AREA
Ford's Farm
Tower
Delph Creek
Womans Gu

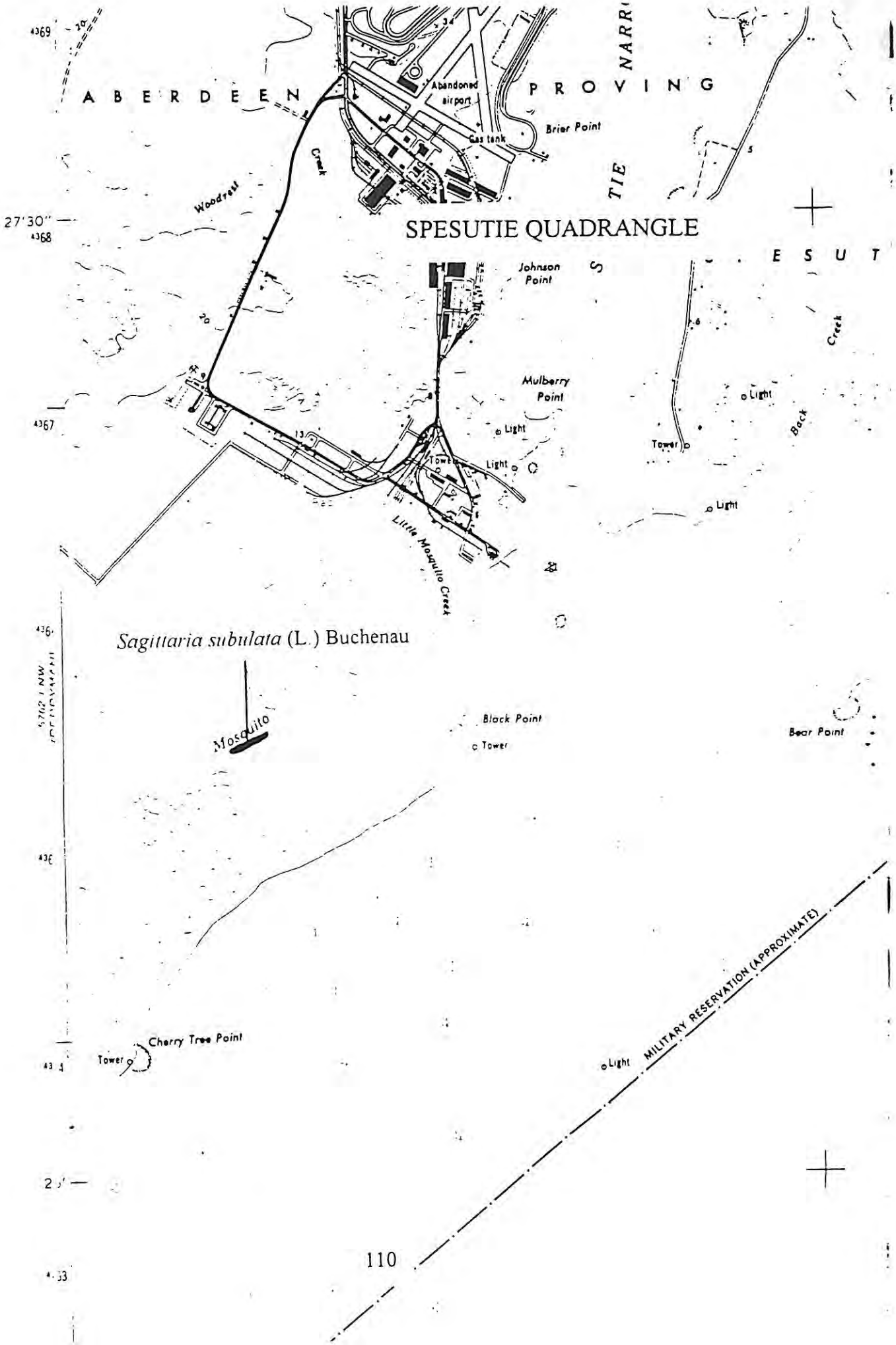

5762 IV NE
(EDGEWOOD)
PERRYMAN QUADRANGLE
Gum Point
Sod Run
BUSH
Tower
Chelsea
Romney
BALTIMORE
OLD
MILITARY RESERVATION
Rotala ramosior (L.) Koehne
Chilbury Point
Civilian beach
Old Baltimore
Creek
POVERTY ISLAND
AREA
Bridge Creek
PENNY
Back Creek
ROMNEY
Briar Point
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
4365
4364
4363
4362
4361
4360
25'
70 000 FEET


PERRYMAN QUADRANGLE
Control tower
PHILLIPS FIELD
Pistol range
Rotala ramosior (L.) Koehne
ABERDEEN
PROVING
MILITARY
RESERVATION
Rifle range
Michaelsville
Creek

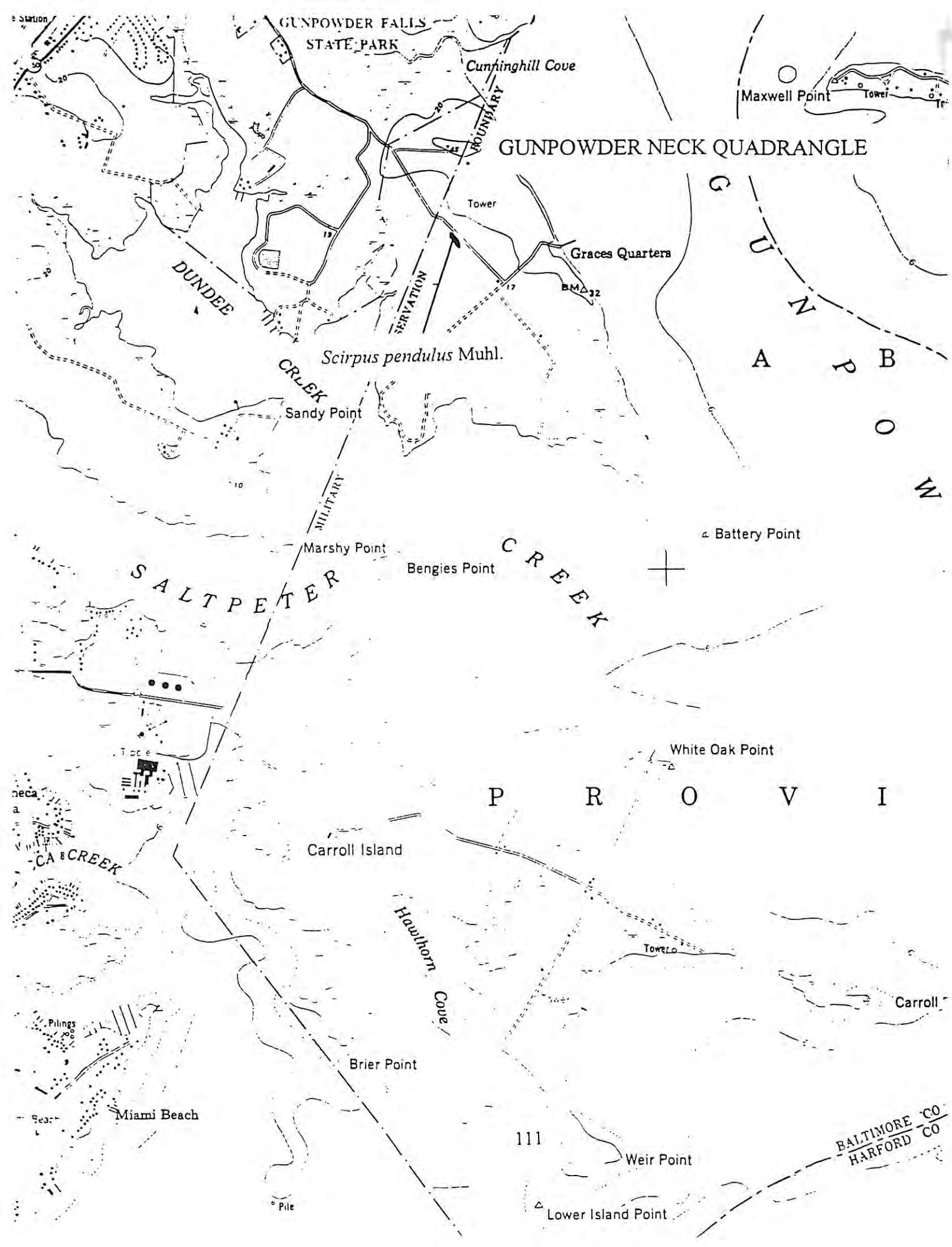


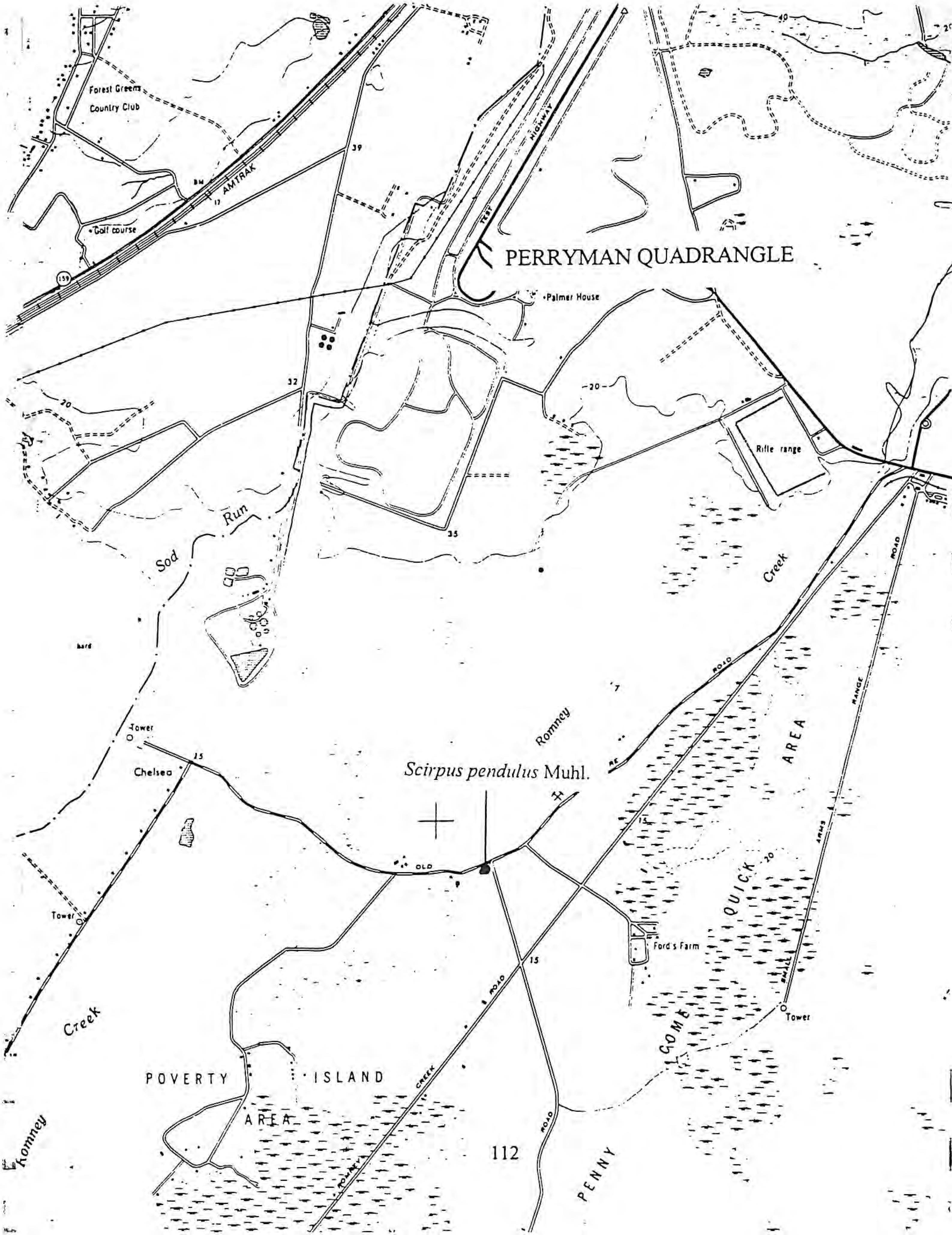
Sabatia dodecandra (L.) BSP.


GUNPOWDER FALLS
STATE PARK
Cunninghill Cove
Maxwell Point
Tower
BOUNDARY
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BM 32
DUNDEE
CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Bengies Point
Battery Point
SALTPETER
CREEK
Sabatia dodecandra (L.) BSP.
White Oak Point
Carroll Island
CREEK
Hawthorn Cove
Tower
Carroll
Pilings
Brier Point
Miami Beach
Weir Point
BALTIMORE CO
HARFORD CO
Pile
Lower Island Point

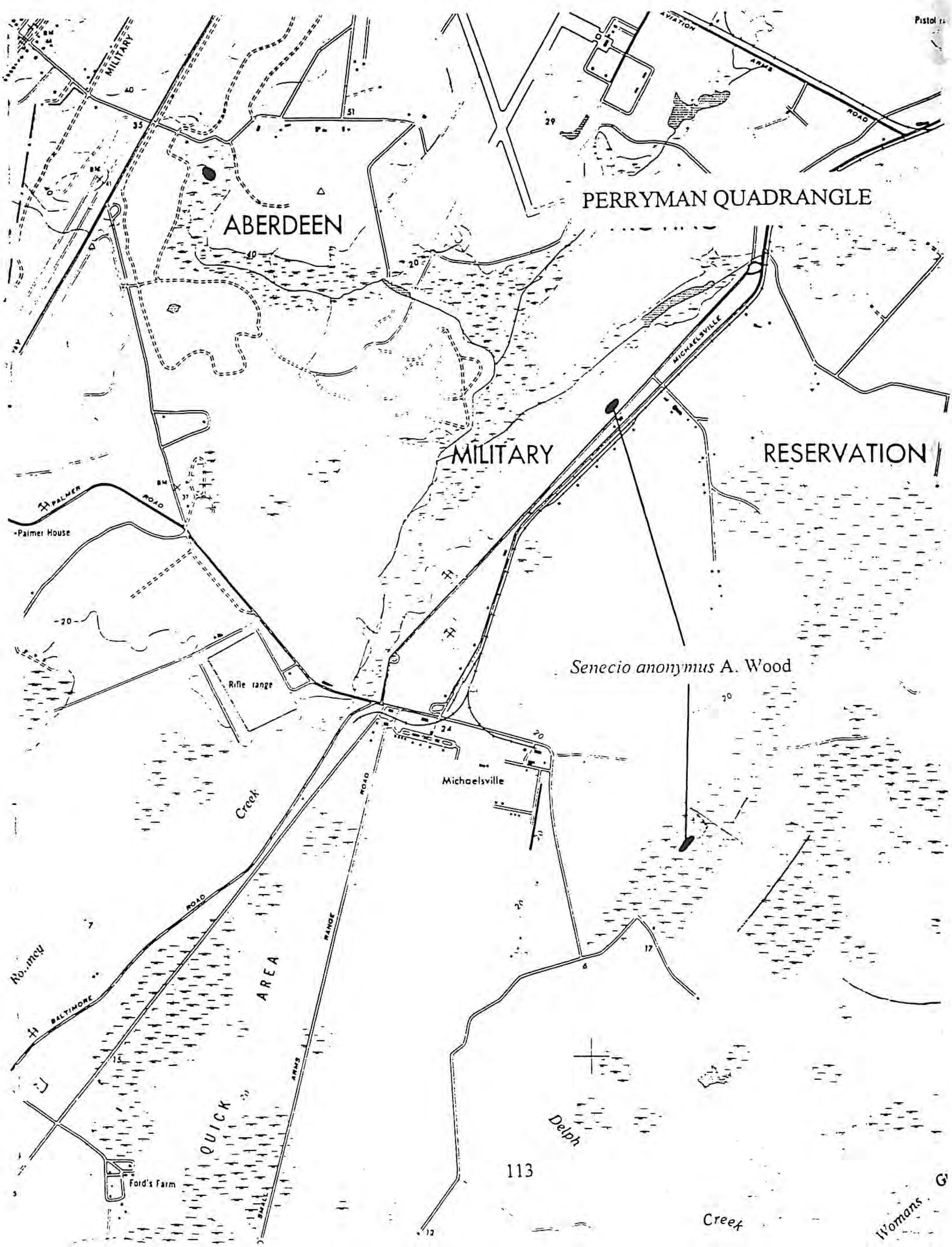


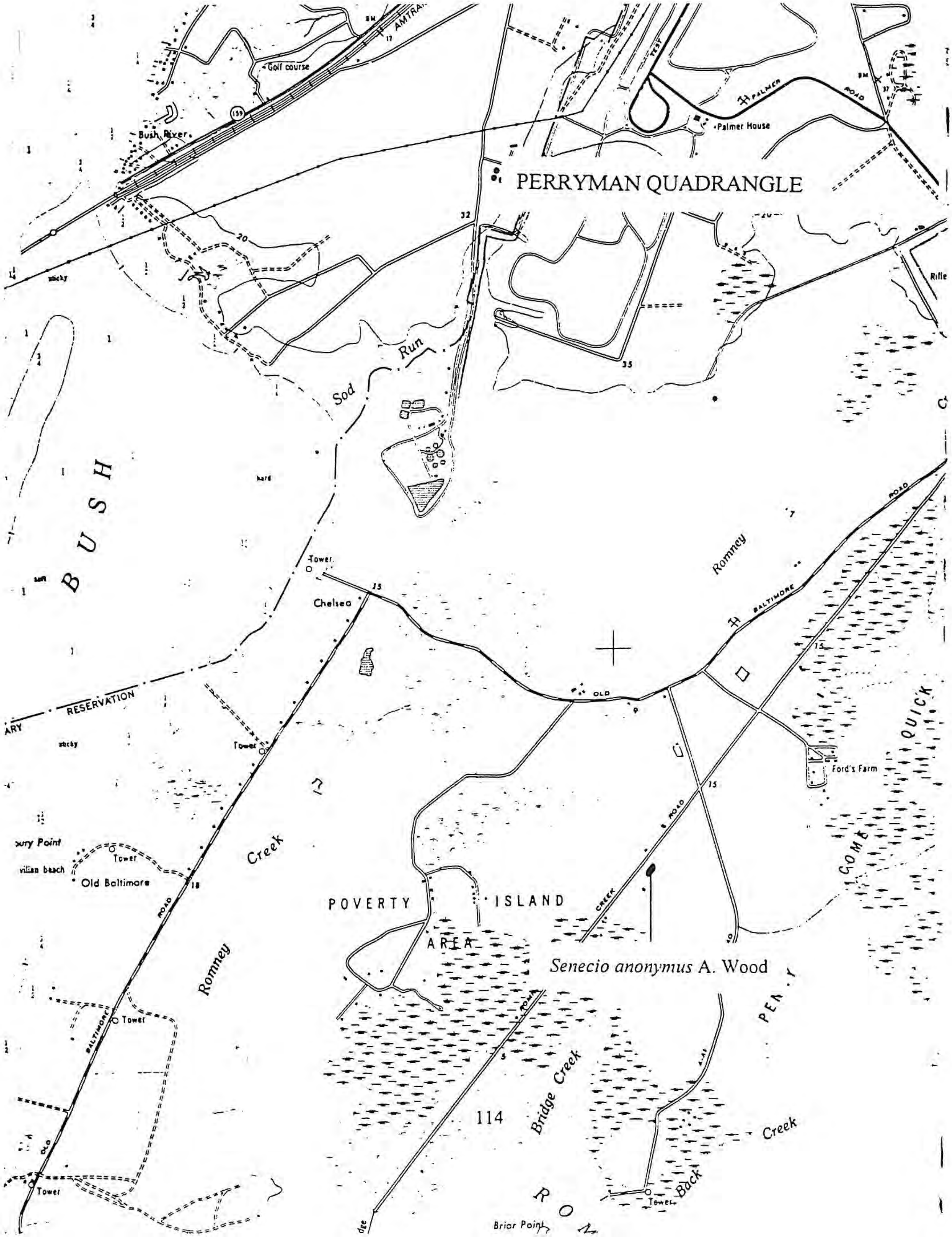
Sagittaria subulata (L.) Buchenau


GUNPOWDER FALLS
STATE PARK
Cunninghill Cove
Maxwell Point
GUNPOWDER NECK QUADRANGLE
Tower
Graces Quarters
BM 32
DUNDEE
CREEK
Scirpus pendulus Muhl.
Sandy Point
GUNPOWDER
Marshy Point
Bengies Point
Battery Point
SALTPETER
CREEK
White Oak Point
PROVI
Carroll Island
Hawthorn Cove
Carroll
Brier Point
Miami Beach
Weir Point
Lower Island Point
BALTIMORE CO
HARFORD CO



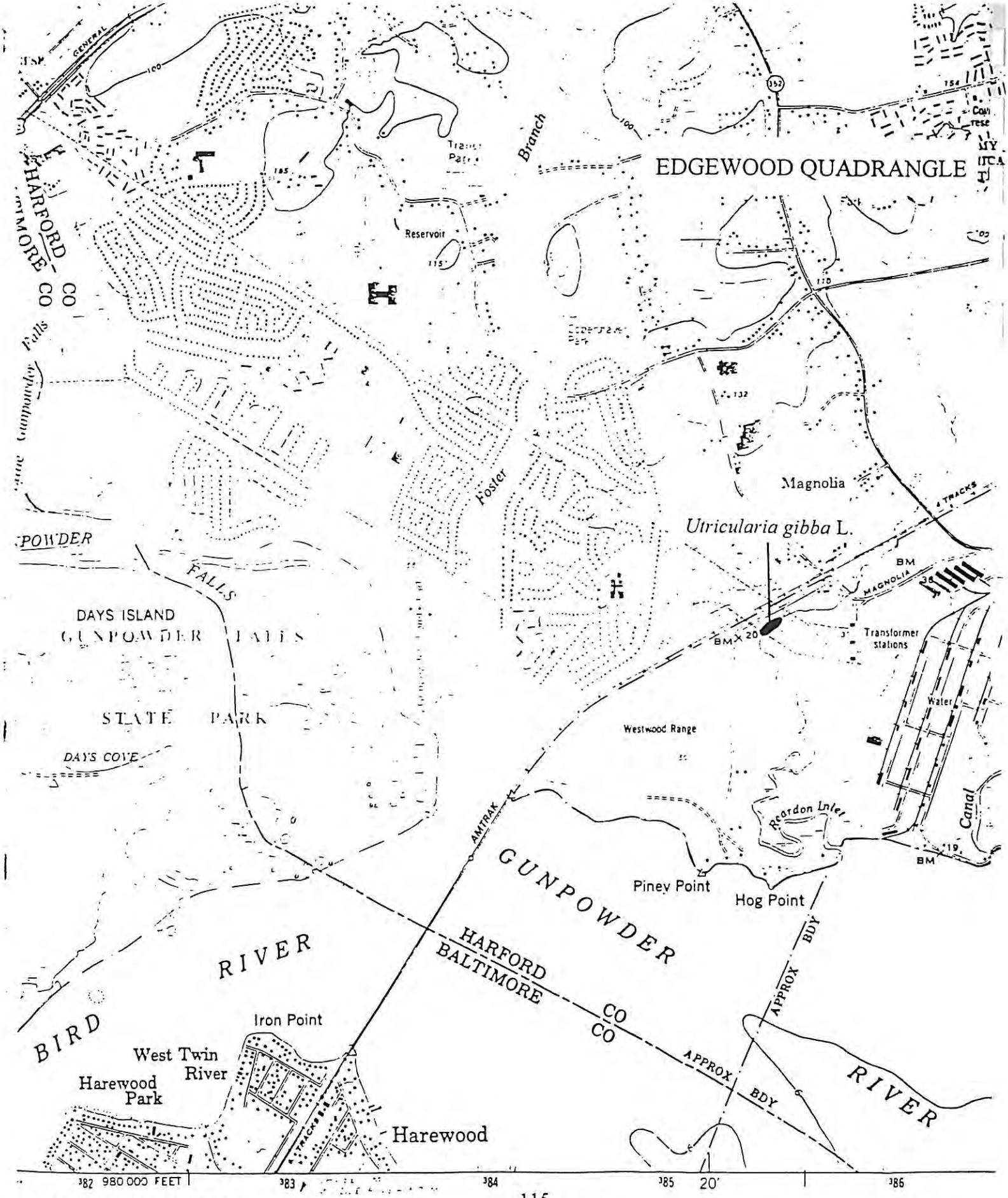
PERRYMAN QUADRANGLE
Forest Greens
Country Club
AMTRAK
Golf course
Palmer House
Rifle range
Sod
Run
Creek
Romney
Tower
Chelsea
Scirpus pendulus Muhl.
OLD
Ford's Farm
Tower
Tower
Creek
POVERTY
ISLAND
AREA
Romney
ROMNEY
CREEK
ROAD
PENNY
COME
QUICK
AREA
SMALL
ARMS
RANGE
ROAD
HIGHWAY


PERRYMAN QUADRANGLE
ABERDEEN
MILITARY
RESERVATION
Senecio anonymus A. Wood
MILITARY
AVIATION
ARMS
ROAD
PALMER
ROAD
Palmer House
Rifle range
Michaelsville
MICHAELSVILLE
ROAD
BALTIMORE
ROAD
SMALL
ARMS
RANGE
ROAD
QUICK
AREA
Creek
Delph
Creek
Womans
Ford's Farm



PERRYMAN QUADRANGLE

Senecio anonymus A. Wood



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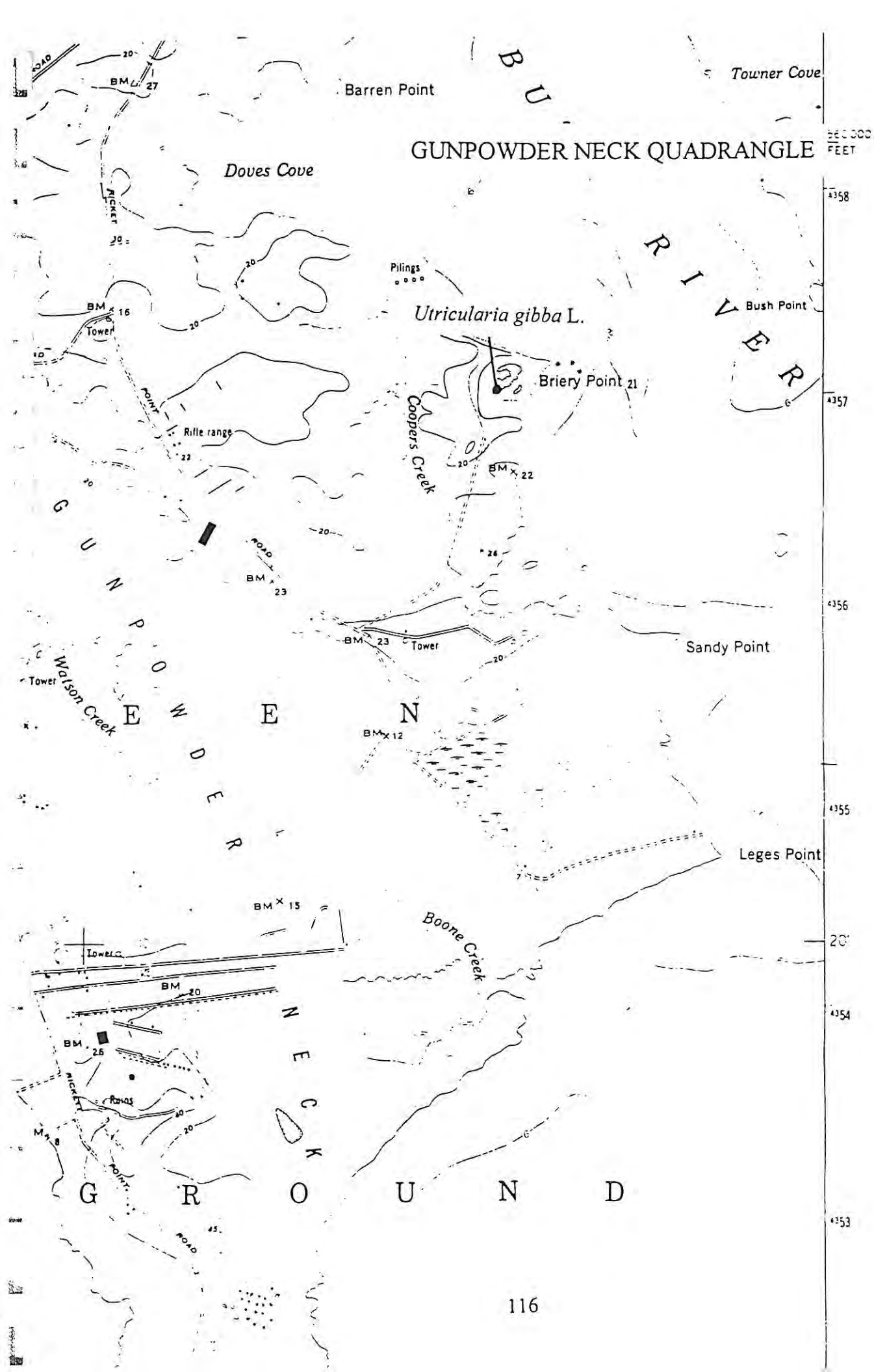
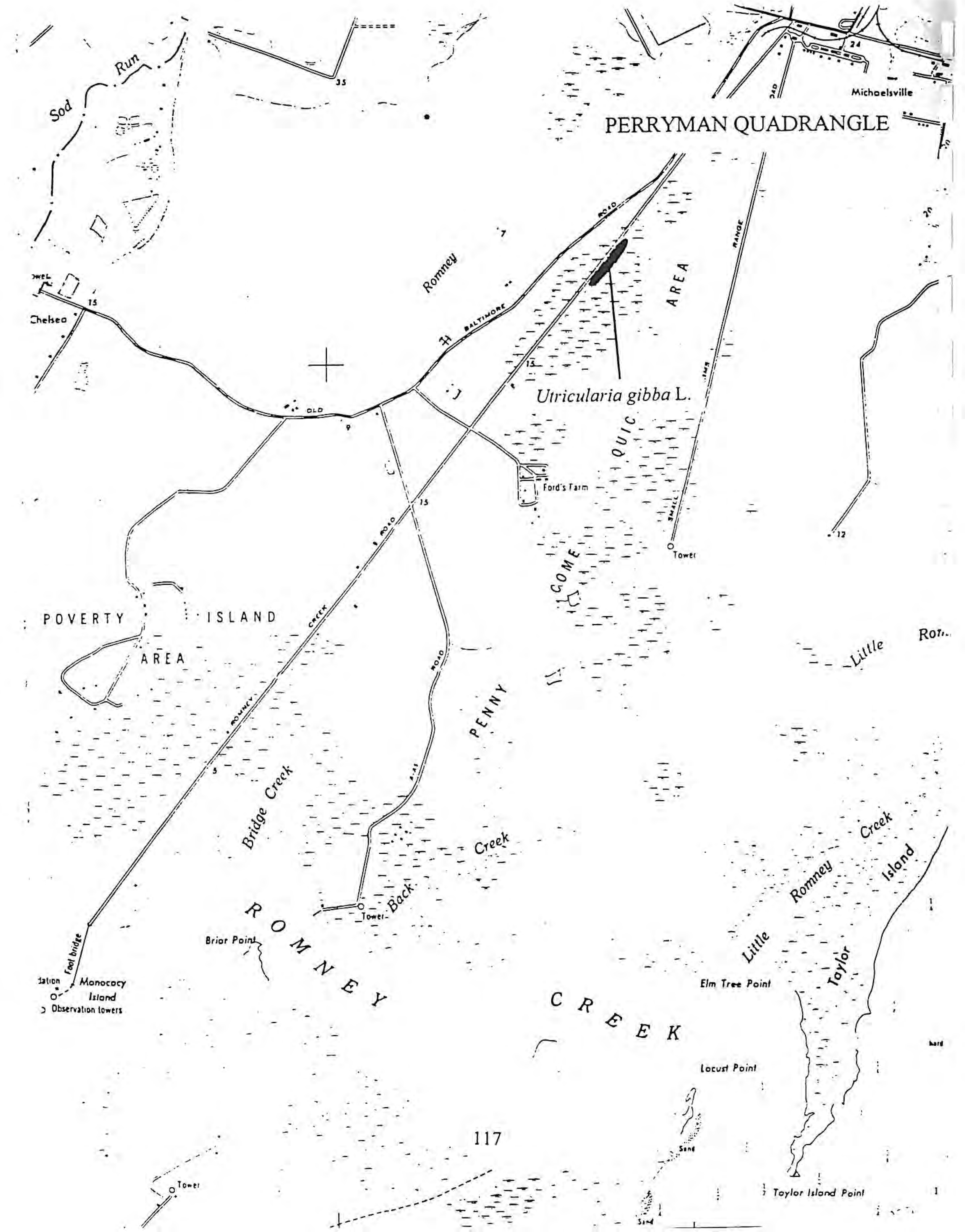
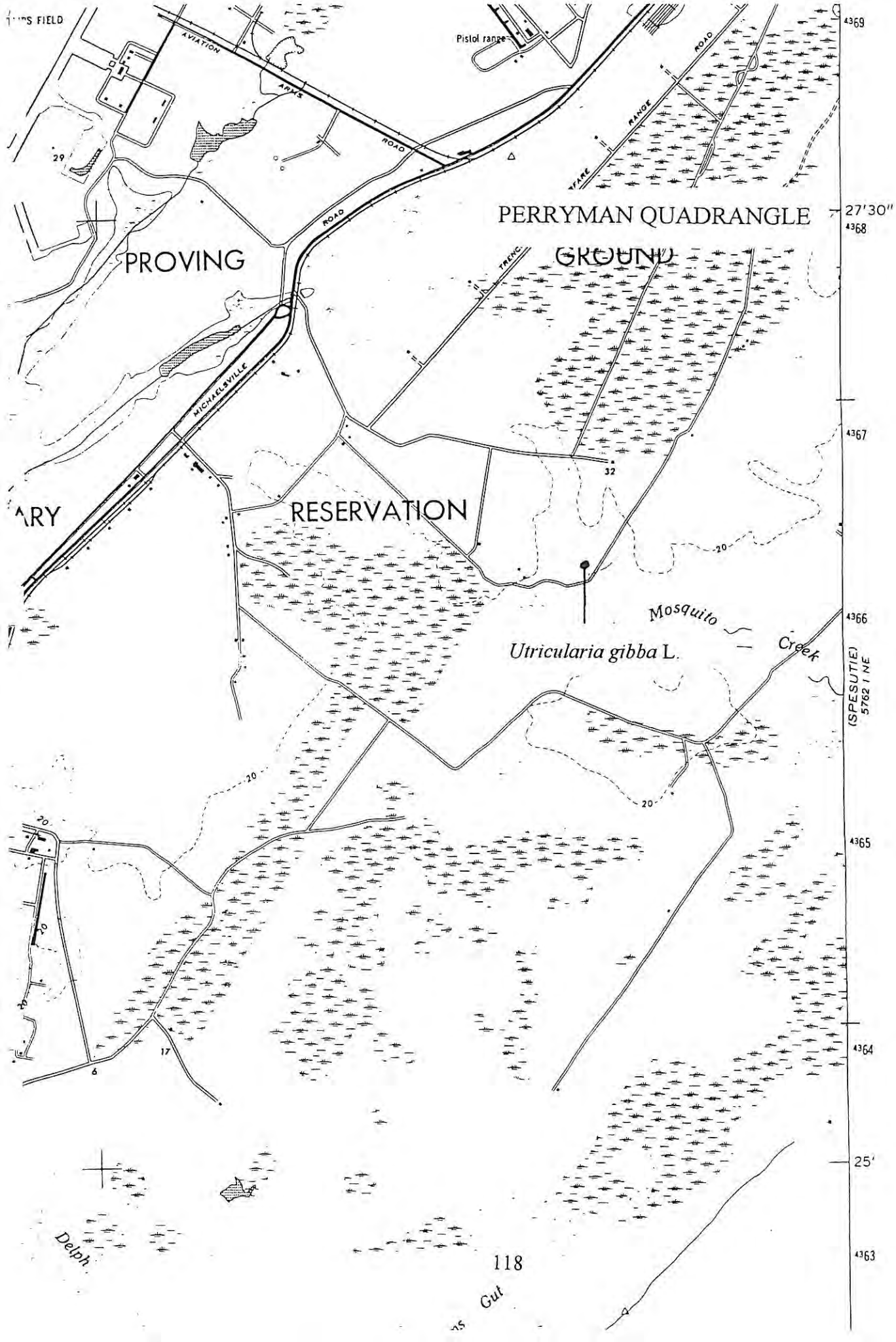
ed and published by the Geological Survey
ol by NOS NOAA, USCE, and USGS
raphy by photogrammetric methods from aerial graphs taken 1947. Field checked 1949
ted hydrographic data compiled from NOS Surveys
nformation is not intended for navigational purposes

MN
GN
10°
187 MILS
0 50'

1 1/2
1000 0 1000
1 5


GUNPOWDER NECK QUADRANGLE
Barren Point
Towner Cove
Doves Cove
Pilings
Utricularia gibba L.
Bush Point
Briery Point
Cooper's Creek
Rifle range
Sandy Point
Watson Creek
Leges Point
Boone Creek
GUNPOWDER NECK GROUND
4358
4357
4356
4355
4354
4353


PERRYMAN QUADRANGLE
Utricularia gibba L.
Sod Run
Michaelsville
Romney
OLD BALTIMORE ROAD
Chelsea
Ford's Farm
Tower
SMALL RANGE
COME QUIC AREA
POVERTY ISLAND AREA
ROMNEY CREEK ROAD
PENNY
Bridge Creek
Back Creek
ROMNEY CREEK
Brior Point
Foot bridge
Monocacy Island
Observation towers
Little Romney Creek
Taylor Island
Elm Tree Point
Locust Point
Sand
Taylor Island Point


PERRYMAN QUADRANGLE
PROVING
GROUND
RESERVATION
Mosquito
Creek
Utricularia gibba L.
AVIATION
ARMS
ROAD
Pistol range
RANGE
MICHAELSVILLE
TRENC
(SPESUTIE)
5762 I NE
4369
4368
4367
4366
4365
4364
4363
27'30"
25'
Delph
Gut

RARE PLANTS ASSOCIATED WITH WETLAND HABITATS

Scientific Name and Author	State Rank
1. Spirodela punctata (G. Meyer) C. Thompson	State Record
2. Carex radiata (Wahlenb.) Small	S1
3. Ceratophyllum echinatum A. Gray	S1
4. Eleocharis rostellata (Torr.) Torr.	S1
5. Hottonia inflata Elliott	S1
6. Iris prismatica Pursh	S1
7. Juncus torreyi Cov.	S1
8. Lathyrus palustris L.	S1
9. Lysimachia hybrida Michx.	S1
10. Pedicularis lanceolata Michx.	S1
11. Potamogeton foliosus Raf.	S1
12. Potamogeton pusillus L.	S1
13. Scutellaria galericulata L.	S1
14. Hedyotis uniflora (L.) Lam.	S2
15. Potamogeton perfoliatus L.	S2
16. Sagittaria spatulata (J. G. Smith) Buchenau	S2
17. Wolffia papulifera C. Thompson	S2
18. Xyris difformis Chapman	S2
19. Bidens coronata (L.) Britton	S2S3
20. Bidens discoidea (T. & G.) Britton	S2S3
21. Bidens bidentoides (Nutt.) Britton	S3.1
22. Carex atlantica L. Bailey	S3
23. Carex canescens L.	S3
24. Carex grayi Carey	S3
25. Carex seorsa Howe.	S3
26. Carex straminea Willd.	S3
27. Cirsium muticum Michx.	S3
28. Cladium mariscoides (Muhl) Torr.	S3
29. Commelina virginica L.	S3
30. Eleocharis engelmannii Steud.	S3
31. Eleocharis flavescens (Poiret) Urban var. olivacea (Torr.) Gleason	S3
32. Glyceria septentrionalis A. Hitchc.	S3
33. Hydrocotyle ranunculoides L. f.	S3
34. Hydrocotyle verticillata Thunb.	S3
35. Isoetes riparia Engelm.	S3
36. Lemna perpusilla Torr.	S3
37. Najas guadelupensis (Sprengel) Magnus	S3
38. Ranunculus pusillus Poiret	S3

39. Sabatia dodecandra (L.) BSP.	S3
40. Sagittaria subulata (L.) Buchenau	S3
41. Utricularia gibba L.	S3
42. Rotala ramosior (L.) Koehne	S3S4

RARE PLANTS ASSOCIATED WITH DRY - MESIC HABITATS

Scientific Name and Author	State Rank
1) Apocynum sibiricum Jacq.	SH
2) Lycopodium carolinianum L.	SH
3) Carex typhina Michx.	S1
4) Gymnocladus dioica (L.) K. Koch	S1
5) Myosotis macrosperma Engelm.	S1
6) Rhynchospora globularis (Chapman) Small	S1
7) Pycnanthemum virginianum (L.) Durand & B.D. Jackson	S2
8) Castanea dentata (Marshall) Borkh.	S2S3
9) Juglans cinerea L.	S2S3
10) Ampelamus albidus (Nutt.) Britton	S3
11) Asclepias purpurascens L.	S3
12) Carex complanata Torr. & Hook	S3
13) Cirsium horridulum Michx.	S3
14) Cuscuta pentagona Engelm.	S3
15) Cyperus lancastriensis Porter	S3
16) Helenium flexuosum Raf.	S3
17) Myosotis verna Nutt.	S3
18) Passiflora lutea L.	S3
19) Senecio anonymus A. Wood	S3
20) Scirpus pendulus Muhl.	S3

SOILS ASSOCIATED WITH RARE PLANT POPULATIONS

The soil series and pedon descriptor following Ranson and Levan (1998) are listed below for each rare plant taxon reported from the Aberdeen Proving Grounds. Taxa are listed alphabetically by genus.

Ampelamus albidus - Nassawango Series, Nassawango silt loam, very deep (more than 152 cm), moderately permeable and well drained. Parent material - silty eolian deposits and/or fluvio-marine sediments.

Asclepias purpurascens - Elkton Series, Elkton silt loam, very deep, slowly permeable and poorly drained. Parent material - silty eolian deposits and/or fluvio-marine sediments. Longmarsh Series, Longmarsh sandy loam, very deep, very poorly drained with moderate permeability. Parent material - loamy alluvial sediments.

Bidens bidentoides - Lenape Series, Lenape mucky peat, very deep, moderately permeable and very poorly drained. Parent material - organic deposits over loamy fluvio-marine sediments. The Skippers Point population was observed on tidal sand with some mud and the population on the northwest corner of Spesutie Island occurred on tidal gravelly sand and mud.

Bidens coronata - Puckum Series, Puckum muck, very deep, moderately permeable, and very poorly drained. Parent material - organic woody deposits. Lenape Series, Lenape mucky peat.

Bidens discoidea - Pone Series, Pone mucky loam, very deep, moderately permeable, and very poorly drained. Parent material - organic deposits over fluvio-marine sediments.

Carex atlantica - Longmarsh Series, Longmarsh sandy loam and Lenape Series, Lenape mucky peat.

Carex canescens - Romney Series, Romney silt loam, very deep, moderately slow permeability, and somewhat poorly drained. Parent material - silty eolian deposits and/or fluvio-marine sediments. Observed in wet roadside ditch.

Carex complanata - Romney Series, Romney silt loam and Elkton Series, Elkton silt loam. Observed on dry crest microtopography.

Carex grayi- Romney Series, Udorthents, sandy loam, very deep and Manahawkin Series, Mattapex silt loam, very deep, moderately slow permeability, moderately well drained. Parent material - silty eolian deposits and/or fluvio-marine sediments.

Carex radiata - Romney Series, Romney silt loam.

Carex seorsa - Romney Series, Romney silt loam; Elkton Series, Elkton silt loam; Pone Series, Pone mucky loam; and Lenape Series, Lenape mucky peat.

Carex straminea - Corsica Series, Corsica loam, very deep, very poorly drained. Parent material - loamy alluvial sediments. Also, Pone Series, Pone mucky loam.

Carex typhina - Romney Series, Romney silt loam and Manahawkin Series, Mattapex silt loam.

Castanea dentata - Beltsville Series, Beltsville silt loam, very deep, moderately well drained. Dominant parent material - loamy fluviomarine sediments.

Ceratophyllum echinatum - Submerged aquatic on silty mud and sand.

Cirsium horridulum - Romney Series, Romney silt loam.

Cirsium muticum - Longmarsh Series, Longmarsh sandy loam; Puckum Series, Puckum muck and Manahawkin Series, Mattapex silt loam.

Cladium mariscoides - Puckum Series, Puckum muck; Lenape Series, Lenape mucky peat and Elkton Series, Elkton silt loam.

Commelina virginica - Lenape Series, Lenape mucky peat; Romney Series, Romney silt loam; and Manahawkin Series, Mattapex silt loam.

Cuscuta pentagona - Udorthents, sandy loam. Parasitic, observed on dry sandy soil and along a stone road.

Cyperus lancastriensis - Hambrook Series, Hambrook sandy loam, very deep, well drained, moderately permeable. Parent material - loamy fluviomarine sediments. Also, Manahawkin Series, Mattapex silt loam.

Eleocharis engelmannii - Udorthents, sandy loam. Observed on wet sandy soil.

Eleocharis flavescens var. *olivacea* - Puckum Series, Puckum muck and Longmarsh Series, Longmarsh sandy loam.

Eleocharis rostellata - Puckum Series, Puckum muck.

Glyceria septentrionalis - Romney Series, Romney silt loam. Observed in a wet roadside ditch.

Gymnocladus dioica - Hambrook Series, Hambrook sandy loam.

Hedyotis uniflora - Woodstown Series, Woodstown sandy loam, very deep, moderately permeable and moderately well drained. Parent material - loamy fluviomarine sediments. Throughout the bottom of a draught drawn down pool.

Helenium flexuosum - Romney Series, Romney silt loam; and Indiantown Series, Indiantown mucky silt loam, very deep, very poorly drained with moderate permeability. Parent material - loamy alluvial sediments. Edging on Manahawkin Series, Mattapex silt loam.

Hottonia inflata - Aquatic, rooted in Pone Series, Pone mucky loam.

Hydrocotyle ranunculoides - Hambrook Series, Hambrook sandy loam according to (Ranson and Levan 1998), but observed on peaty mud at this site. Also, Longmarsh Series, Longmarsh sandy loam.

Hydrocotyle verticillata - Puckum Series, Puckum muck.

Iris prismatica - Fallsington Series, Fallsington sandy loam, very deep, poorly drained, moderately permeable. Parent material - loamy fluviomarine sediments. Also Manahawkin Series, Mattapex silt loam; Elkton Series, Elkton silt loam; Romney Series, Romney silt loam. Observed to be restricted to moist/wet shallow depressions.

Isoetes riparia - Romney Series, Romney silt loam. Observed in an inundated roadside ditch on mud.

Juglans cinerea - Woodstown Series, Woodstown sandy loam. Bordering on Romney Series, Romney silt loam.

Juncus torreyi - Puckum Series, Puckum muck.

Lathyrus palustris - Lenape Series, Lenape mucky peat. Soils at this site were also observed to have some sand.

Lemna perpusilla - Wholly aquatic.

Lycopodium carolinianum - Romney Series, Romney silt loam / Elkton Series, Elkton silt loam.

Lysimachia hybrida - Udorthents, sandy loam. Observed to be restricted to moist/wet shallow depressions on these soils.

Myosotis macrosperma - Manahawkin Series, Mattapex silt loam.

Myosotis verna - Longmarsh Series, Longmarsh sandy loam and Hambrook Series, Hambrook sandy loam.

Najas guadelupensis - Submerged aquatic, rooted in silty mud under brackish water as deep as 3 m, plants not reaching the water's surface.

Passiflora lutea - Romney Series, Romney silt loam and Manahawkin Series, Mattapex silt loam.

Pedicularis lanceolata - Nassawango Series, Nassawango silt loam. This site appeared to be regularly flooded.

Potamogeton foliosus - Submerged aquatic, rooted in silty mud under fresh water not over 45 cm deep.

Potamogeton perfoliatus - Submerged aquatic, rooted in muddy sand under brackish water approximately 1 m deep, plants often reaching the water's surface.

Potamogeton pusillus - Submerged aquatic, rooted in silty mud under brackish water as deep as 3 m, plants not reaching the water's surface.

Pycnanthemum virginianum - Manahawkin Series, Mattapex silt loam. In some areas these soils appeared to contain more sand.

Ranunculus pusillus - Romney Series, Romney silt loam, in wet roadside ditch; and Zekiah Series, Zekiah loam, very deep, poorly drained, moderately permeable. Parent material - loamy alluvial sediments. Observed in a wet vernal depression.

Rhynchospora globularis - Lenape Series, Lenape mucky peat and Elkton Series, Elkton silt loam. Soils appeared sandy at these sites.

Rotala ramosior - Romney Series, Romney silt loam and Udorthents, sandy loam and Woodstown Series, Woodstown sandy loam. Observed along edges of wet depressions and pools within these areas.

Sabatia dodecandra - Puckum Series, Puckum muck. Soils appeared to contain some peat at this site. Also, Woodstown Series, Woodstown sandy loam

Sagittaria spatulata - Lenape Series, Lenape mucky peat and Puckum Series, Puckum muck.

Sagittaria subulata - Puckum Series, Puckum muck. Soils appeared to contain some peat at this site.

Scirpus pendulus - Woodstown Series, Woodstown sandy loam bordering Romney Series, Romney silt loam. Soils may be seasonally wet due to roadside runoff at this site. Also, Indiantown Series, Indiantown mucky silt loam.

Scutellaria galericulata - Puckum Series, Puckum muck.

Senecio anonymus - Woodstown Series, Woodstown sandy loam and Romney Series, Romney silt loam.

Spirodela punctata - Entirely aquatic.

Utricularia gibba - Floating aquatic, generally over Pone Series, Pone mucky loam and Longmarsh Series, Longmarsh sandy loam.

Wolffia papulifera - Entirely aquatic.

Xyris difformis - Woodstown Series, Woodstown sandy loam and Romney Series, Romney silt loam / Elkton Series, Elkton silt loam.

POPULATION SIZES OF RARE, THREATENED AND ENDANGERED PLANTS OBSERVED AT ABERDEEN PROVING GROUNDS

TABLE III

STATE RANK	GENUS	SPECIES	POPULATION SIZE ESTIMATES
S3	Ampelamus	albidus	Five vines climbing to 4 m occurred at one site.
SH	Apocynum	sibiricum	One site with three plants was seen.
S3	Asclepias	purpurascens	Approximately 30 plants collectively occurred at three sites.
S3.1	Bidens	bidentoides	Thirteen plants collectively occurred at two sites approximately 25 m apart on Spesutie Island and at least 125 plants occurred at Skippers Point on the Edgewood Facility.
S2S3	Bidens	coronata	At least 65 plants collectively occurred at two sites on Carroll Island and 95 plants collectively occurred at three sites in Harford County.
S2S3	Bidens	discoidea	An estimated 50 plants occurred at one site over a distance of approximately 1 km.
S3	Carex	atlantica	Hundreds of tufts collectively occurred at three sites. The species was most common along Mosquito Creek.
S3	Carex	canescens	One tuft was observed along Michaelsville Road and 18 tufts were found along East Branch near Canal Creek.
S3	Carex	complanata	Fourty tufts collectively occurred at three sites.
S3	Carex	grayi	Two patches, neither larger than 1 x 1 m, collectively occurred at two sites.
S1	Carex	radiata	Fourteen tufts collectively occurred at three sites. Observed at both the Edgewood and Aberdeen Facilities.
S3	Carex	seorsa	Two small populations of not more than 10 tufts each were observed at the Edgewood Facility and two additional populations occurred at the Aberdeen Facility, the largest population at Skippers Point measured 15 x .5 m.
S3	Carex	straminea	Approximately 100 tufts collectively occurred at two sites.
S1	Carex	typhina	A single tuft was observed at each of the two sites where it was found. Each tuft contained about 20 fruiting culms.
S2S3	Castanea	dentata	Three trees occurred at one site, the largest tree was approximately 9 m tall.
S1	Ceratophyllum	echinatum	Two populations collectively occurred in freshwater ponds on the Edgewood and Aberdeen Facilities. Both populations covered areas of at least 10 x 10 m.
S3	Cirsium	horridulum	An estimated 35 plants occurred at one site over an area of approximately 80 x 80 m.
S3	Cirsium	muticum	At least 5 populations on Spesutie Island, the largest population contained not more than 21 plants.
S3	Cladium	mariscoides	An estimated 25 tufts occurred at one site in Baltimore County and at least 100,000 plants occurred near Sandy Point in Harford County.
S3	Commelina	virginica	Two populations collectively occurred at two sites. The largest population occurred on Spesutie Island and contained at least 150 plants.
S3	Cuscuta	pentagona	Two populations were observed, the largest measured 3.3 x .8 m.
S3	Cyperus	lancastriensis	Fifteen plants collectively occurred at two sites.
S3	Eleocharis	engelmannii	One population with a single tuft containing approximately 40 fruiting stems was observed.
S3	Eleocharis	flavescens	One population containing 18 tufts was observed on Carroll Island and at least 1500 tufts occurred at Briery Point.
S1	Eleocharis	rostellata	At least 100 tufts occurred over an area of approximately 65 x 65 m.
S3	Glyceria	septentrionalis	One patch measuring 3 x 2 meters was observed.
S1	Gymnocladus	dioica	At least 25 trees, some in fruit, occurred at one site.
S2	Hedyotis	uniflora	An estimated 1000 plants were observed over the bottom of a drought drawn down pool over an area of approximately 40 x 20 m.
S3	Helenium	flexuosum	At least 40 plants collectively occurred at two sites near Phillips Field and at least 1000 plants occurred on Gunpowder Neck.
S1	Hottonia	inflata	An estimated 800 plants occurred at one site.

STATE RANK	GENUS	SPECIES	POPULATION SIZE ESTIMATES
S3	Hydrocotyle	ranunculoides	Three populations occurred at the Edgewood facility, the largest covering an area of at least 25 x 50 m. It also occurred along Mosquito Creek at Aberdeen.
S3	Hydrocotyle	verticillata	One population occurred over an area of 2 x .5 m.
S1	Iris	prismatica	At least 1000 plants collectively occurred at six sites, restricted to moist depressions, the largest population occurred over an area of approximately 20 x 15 m on Gunpowder Neck and contained at least 500 plants.
S3	Isoetes	riparia	Only one plant was observed.
S2S3	Juglans	cinerea	Seven trees in fruit were observed at one site.
S1	Juncus	torreyi	Approximately 50 plants occurred at one site along .5 km of moist roadside.
S1	Lathyrus	palustris	An estimated 85 plants occurred at one site along approximately .7 km of roadside.
S3	Lemna	perpusilla	At least one site with thousands of plants was observed.
SH	Lycopodium	carolinianum	At least 1000 fruiting stems were observed at one site.
S1	Lysimachia	hybrida	Approximately 50 plants restricted to moist depressions at one site over an area of .7 x .7 km.
S1	Myosotis	macrosperma	One population with eight plants was observed.
S2	Myosotis	verna	Two populations were found, the largest population contained at least 30 plants.
S3	Najas	guadelupensis	At least 2 populations occurred, the largest population sporadically occurred over an area of at least 15 x 20 m.
S3	Passiflora	lutea	Two populations were found, the largest on Spesutie Island cover an area of 10 x 20 m.
S1	Pedicularis	lanceolata	One populations with at least 25 plants was observed.
S1	Potamogeton	foliosus	One population that covered an area of many meters was observed in a beaver pond at Edgewood.
S2	Potamogeton	perfoliatus	Two populations, neither larger than 2 x 2 m, were observed.
S1	Potamogeton	pusillus	Observed at three sites, the largest population occurred sporadically over an area of 20 x 20 m.
S2	Pycnanthemum	virginianum	Very common on Spesutie Island, absent elsewhere. Total number of plants estimated to be at least 1000.
S3	Ranunculus	pusillus	Observed at two sites. The largest population along Michaelsville Road contained an estimated 1000 plants.
S1	Rhynchospora	globularis	At least 250 plants occurred at three sites on Sandy Point at Gunpowder Neck.
S3S4	Rotala	ramosior	Observed at three sites. The largest population along Michaelsville Road contained an estimated 40 plants.
S3	Sabatia	dodecandra	The Carroll Island population contained at least 35 plants while at least 200 plants were found on Gunpowder Neck.
S2	Sagittaria	spatulata	34 plants occurred at two sites on Monks Creek and approximately 50 plants occurred at one site on Mosquito Creek.
S3	Sagittaria	subulata	An estimated 5000 plants occurred at one site along Mosquito Creek.
S3	Scirpus	pendulus	Six plants occurred at Graces Quarters and 16 plants were seen along Old Baltimore Road.
S1	Scutellaria	galericulata	Two populations collectively occured at two sites. The largest population occurred on Carroll Island and measured 6 x .5 m. On Spesutie Island, only 5 plants were observed.
S3	Senecio	anonymus	Observed at three sites, each population contained approximately 20 plants.
S?	Spirodela	punctata	Observed to be abundant at the only site where it was found.
S3	Utricularia	gibba	Observed at two Edgewood sites and two at Aberdeen. The Aberdeen population at Penny Come Quick was the largest containing at least 200 flowering stems.
S2	Wolffia	papulifera	Very common at the four sites where it was observed, least common at Briery Point.
S2	Xyris	difformis	Approximately 50 plants occurred off Romney Creek Road and 6 plants were observed off Cod Creek Road.

PHENOLOGY OF NOTEWORTHY ENDANGERED AND THREATENED VASCULAR PLANTS OF THE ABERDEEN PROVING GROUNDS, HARFORD AND BALTIMORE COUNTIES, MARYLAND (TABLE III)

STATE RANK	STATE STATUS	SPECIES	SYNONYMS	SOURCE	MONTHS J	F	M	A	M	J	J	A	S	O	N	D
SH	extirpated	*Apocynum sibiricum* Jacq.		G&C					X	X	X	X	X			
				BBH						X	X	X				
				GMB						X	X	X				
S1	extirpated	*Lathyrus palustris* L.		G&C						X	X					
				BBH						X	X	X	X			
				GMB						X	X	X	X			
				RAB					X	X	X	X	X			
SH	extirpated	*Lycopodium carolinianum* L.		RAB							X	X	X			
S1	endangered	*Ceratophyllum echinatum* A. Gray		BBH							X	X	X			
				RAB			X	X	X	X	X	X	X			
S1	endangered	*Hottonia inflata* Elliott		G&C					X	X	X	X				
				BBH				X	X	X						
				GMB				X	X	X						
				RAB				X	X	X						
S1	endangered	*Iris prismatica* Pursh.		G&C						X	X					
				BBH					X	X						
				GMB					X	X	X					
				RAB					X	X	X					
S1	endangered	*Juncus torreyi* Cov.		GMB							X	X	X	X		
S1	endangered	*Lysimachia hybrida* Michx.		G&C						X	X	X				
				BBH						X	X	X				
				GMB							X	X				
			Lysimachia lanceolata Walter var. *hybrida* (Michaux) Gray	RAB						X	X	X	X	X		
S1	endangered	*Pedicularis lanceolata* Michx.		G&C								X	X			
				BBH								X	X	X		
				GMB								X	X	X		
				RAB								X	X	X		
S1	endangered	*Rhynchospora globularis* (Chapman) Small		BBH						X	X					
				GMB							X	X	X			
				RAB						X	X	X	X			
S1	threatened	*Eleocharis rostellata* (Torr.) Torr.		BBH							X	X	X	X		
				GMB							X	X	X	X		
				RAB							X	X	X			

STATE RANK	STATE STATUS	SPECIES	SYNONYMS	SOURCE	MONTHS											
					J	F	M	A	M	J	J	A	S	O	N	D
S1	threatened	*Myosotis macrosperma* Engelm.		BBH				X	X							
				RAB				X	X							
				GMB				X	X							
S1	none	*Carex typhina* Michx.		BBH						X	X	X	X			
				GMB						X	X	X	X			
				RAB						X	X					
S1	none	*Scutellaria galericulata* L.		G&C						X	X	X				
				BBH						X	X	X				
			Scutellaria epilobiifolia A. Hamilton	GMB						X	X	X	X			
S1	none	*Pycnanthemum virginianum* (L.) Durand & B.D. Jackson		BBH							X	X	X			
				GMB							X	X	X			
				RAB							X	X	X	X		
S2	none	*Bidens coronata* (L.) Britton		G&C								X	X	X		
				BBH								X	X	X		
				GMB								X	X	X		
				RAB								X	X	X		
S2	none	*Hedyotis uniflora* (L.) Lam.	*Oldenlandia uniflora* L.	BBH							X	X	X	X		
			Oldenlandia uniflora L.	RAB								X	X	X		
S2	none	*Xyris difformis* Chapman		BBH							X	X	X	X		
				RAB								X	X	X		
				GMB							X	X	X	X		
S2S3	none	*Bidens bidentoides* (Nutt.) Britton		G&C							X	X	X	X		
				BBH								X	X	X		
			Bidens mariana Blake	GMB									X	X		

KEY TO SOURCE CODES

BBH = Brown and Brown 1984
G&C = Gleason and Cronquist 1991
GMB = Fernald 1950
RAB = Radford et al. 1968

OTHER MARYLAND SITES FOR EXTANT POPULATIONS OF THE ENDANGERED AND THREATENED PLANTS WHICH OCCURRED AT THE ABERDEEN PROVING GROUNDS

This information, unless noted otherwise, is a tally of the number of records that have been processed into the Maryland Wildlife and Heritage Division's Biological and Conservation Data System (BCD) as of January, 1999. Extant populations are defined by reports occurring within the last 25 years.

Apocynum sibiricum - This is the first known record from Harford County. Other extant populations are known from single sites in Calvert, Kent, Montgomery and Washington Counties.

Bidens bidentoides - This taxon is known in Maryland from extant populations in two counties, Cecil (30 sites) and two other sites in Harford County.

Bidens coronata - Extant populations from Maryland of this taxon are known from two sites in Somerset County, from single sites in Charles, Dorchester, Talbot, and Wicomico Counties and from one other site in Baltimore County.

Bidens discoidea - This is the only extant population of this taxon known from Harford County. Seventeen extant populations collectively occur in the State from single sites in Queen Annes and Talbot Counties, two sites each in Anne Arundel, Carroll, Dorchester, Kent, and Prince Georges Counties, and from three sites in Worcester County. In addition, Steury (1997, 1998) reported the species from two sites in Calvert County.

Carex radiata - Historically regarded as endangered in Maryland (Maryland Natural Heritage Program 1994) extant populations of this sedge are now known statewide (C. Frye, Maryland Natural Heritage Program, pers. comm. 1997).

Carex typhina - This is the first known record for Harford County. Other Maryland Counties with extant populations of this taxon are Carroll (2 sites), Charles (1 site) and Prince Georges (1 site).

Ceratophyllum echinatum - In Maryland, this taxon is known from a total of four extant populations in four counties: Kent County (Steury et al 1996), Dorchester and Queen Annes Counties and from one other site in Harford County.

Eleocharis rostellata - This is the only known population of this spike rush in Baltimore County and the northern most population in the State of Maryland. Other extant populations are known from single sites in Anne Arundel and Wicomico Counties and from eleven sites in Worcester County.

Gymnocladus dioica - This is the only population of this tree known from Harford County. Only two other extant populations are known from the State in Baltimore and Washington Counties.

Hedyotis uniflora - This is the first known record for Harford County. In Maryland, seventeen other extant populations of this taxon collectively occur in 8 Counties: Anne Arundel (1 site), Carroll (3 sites), Dorchester (1 site), Kent (1 site), Somerset (1 site), Queen Annes (1 site), Wicomico (2 sites), and Worcester (5 sites).

Hottonia inflata - This is the only population of this taxon known from Harford County. Other extant populations in Maryland occur in Carroll (3 sites), Kent (3 sites), Queen Annes (1 site) and Talbot (1 site) Counties.

Iris prismatica - No other populations are known from Harford County but two other sites have been reported in Baltimore County. Six other extant populations collectively occur statewide in Kent (1 site), Wicomico (2 sites), and Worcester (3 sites) Counties.

Juglans cinerea - This is the only population of this taxon known in Harford County. In Maryland, butternut is known from a total of ten extant populations in six counties: Allegany (2 sites), Dorchester (2 sites), Frederick (1 site), Garrett (2 sites) and Washington (2 sites). The author has also observed two specimens of this tree growing in Fort Washington National Park in Prince Georges County.

Juncus torreyi - Only two other known extant populations collectively occur in the State of Maryland in Prince Georges County (Davis 1995), and from one other site in Baltimore County.

Lathrus palustris - This is the only population known from Harford County. One other population was reported from Maryland in Montgomery County in 1983.

Lycopodium caroliniamum - This is the first known record for Harford County. No other extant populations are known from the State of Maryland. The taxon was last collected in Worcester County in 1932.

Lysimachia hybrida - This is the only population known in Harford County. Nine other extant populations collectively occur in Dorchester (1 site), Montgomery (3 sites), Queen Annes (1 site), Washington (2 sites) and Worcester (2 sites).

Myosotis macrosperma - This is the first known record from Harford County. Sixteen other extant populations are known to collectively occur in 4 Maryland Counties: Calvert (6 sites), Charles (7 sites), Prince Georges (2 sites), and St. Marys (1 site).

Pedicularis lanceolata - This is the only extant population known from Harford County. In Maryland, this species is extant at a total of five sites in four counties: Prince Georges (Davis 1995), and Baltimore (1 site), Cecil (1 site) and Garrett (2 sites).

Potamogeton foliosus - Three other extant populations are known from the State in Howard and Calvert Counties and from one other site in Harford County.

Potamogeton perfoliatus - Apparently a declining species in Maryland, no other extant populations are reported from the State in the BCD. At least 28 populations were known in seven Maryland Counties prior to 1968 when the taxon was last entered in the BCD. However, Orth et al. (1997), does report this taxon from at least four Maryland counties.

Potamogeton pusillus - This is the only population known from Baltimore County. Extant populations are reported from two other Maryland Counties, Charles (1 site) and Queen Annes (1 site). At least 12 populations were known in five other Maryland Counties prior to 1969 according to BCD entries. The taxon is also recorded from at least two other Maryland counties by Orth et al. 1997.

Pycnanthemum virginianum - This is the only population known from Harford County. Seven extant populations collectively occur in three other Maryland Counties, Allegany (3 sites), Baltimore (2 sites) and Washington (2 sites).

Rhynchospora globularis - This taxon is known from three other extant populations collectively occurring in Anne Arundel, Dorchester and Worcester Counties.

Sagittaria spatulata - In Maryland, eighteen extant populations are reported from eight counties. It is most common in Cecil County (8 sites), but is also reported from Anne Arundel (1 site), Charles (1 site), Dorchester (2 sites), Kent (2 sites), Prince Georges (1 sites), and Wicomico (2 site) Counties and from one other site in Harford County.

Scutellaria galericulata - Extant populations in Maryland of this mint are known from a total of four sites in Howard, Montgomery, Calvert (Steury 1997) and Kent (Steury 1996) Counties.

Wolffia papulifera - No other extant populations are known from Maryland. The only other record of this species is from Worcester County in 1971.

Xyris difformis - This is the first known record for Harford County. Ten other extant Maryland populations are known from Dorchester (1 site), Somerset (1 site), Wicomico (1 site) and Worcester (7 sites) Counties.

THREATS TO THE RARE PLANTS OF ABERDEEN PROVING GROUNDS

Many of the populations of rare plants observed at the Aberdeen Proving Grounds were threatened by anthropogenic activity such as mowing or by their juxtaposition with a population of the Common Reed (*Phragmites australis*). The Common Reed, possibly a native species, displaces other native vegetation and forms dense monocultures, thus acting as an invasive species.

The following list includes each species population threatened by mowing or displacement by the Common Reed. Some populations were threatened by both types of disturbances. For rare taxa with more than one population, the location of the threatened populations are noted. A few populations were threatened by other types of anthropogenic activities. These are also noted below. Rare taxa listed in this report and not included below, had no apparent threats.

ENDANGERED PLANTS (S1 SPECIES)

Carex radiata	The northernmost population along Michaelsville Road is regularly mowed over.
Eleocharis rostellata	This population was observed to be surrounded by *Phragmites australis*.
Juncus torreyi	Occurred along a regularly mowed roadside within 2 m of a *Phragmites australis* marsh.
Lathyrus palustris	Occurred along an edge of shrub/scrub meadow and a mowed roadside.
Lysimachia hybrida	These populations occurred along a dirt road in an area used to test tanks.
Pedicularis lanceolata	Occurred at the edge of a shrub/scrub meadow and a regularly mowed roadside. Plants just inside the shrub/ scrub habitat flowered, while those in the abutting mowed area remained small and did not flower.
Rhynchospora globularis	The western most population is in an area that is occasionally mowed.
Scutellaria galericulata	Both populations occurred along a mowed roadside/ *Phragmites australis* marsh ecotone.

THREATENED PLANTS (S2 and S2S3 SPECIES)

Hedyotis uniflora	This population was restricted to the bottom of a drought drawn down pond near a roadside. Bulldozer activity was evident near this site.
Pycnanthemum virginianum	Less than 10 percent of the plants in this large population occurred along an edge of mowed roadside.
Xyris difformis	The population along Romney Creek Road was restricted to the bottom of a drought drawn down pond near a roadside. Bulldozer activity was evident along this roadside.
Bidens coronata	The largest population was observed to be surrounded by *Phragmites australis*.

WATCHLISTED PLANTS (S3 and S3S4 SPECIES)

Asclepias purpurascens	The area of this population was mowed before the fruits of these plants reached maturity.
Bidens bidentoides	The northern most population on Spesutie Island occurred along a riprapped shoreline. At Skippers Point, the southern tip of the population occurred between a boat dock and a boat ramp.
Carex canescens	This plant occurred along a frequently mowed roadside ditch.
Carex complanata	The population near Michaelsville Road occurred along a frequently mowed roadside.
Carex grayi	The population on Spesutie Island occurred at the edge of a mowed area and a stone parking lot. This area is often used by fishermen.
Cirsium muticum	A few of the plants in these populations occurred within 1 m of a mowed roadside.

Cladium mariscoides	This population was surrounded by *Phragmites australis*.
Commelina virginica	The population on Spesutie Island occurred at the ecotone of a mowed roadside and a shrub/scrub meadow.
Cuscuta pentagona	This population occurred within 10 m of a dirt road used to test tanks.
Eleocharis engelmannii	This population occurred along the edge of a wet dirt road used to test tanks.
Eleocharis flavescens var. *olivacea*	This population occurred within 15 m of a stand of *Phragmites australis*.
Glyceria septentrionalis	This population occurred along a frequently mowed roadside.
Helenium flexuosum	The northernmost population of this taxa was mowed over before its fruits were mature.
Hydrocotyle verticillata	Occurred in a mowed roadside ditch 2 m distant from a *Phragmites australis* marsh.
Isoetes riparia	This population occurred in a wet roadside ditch that was mowed over.
Myosotis verna	The population on Chilbury Point is in an area that is regularly mowed.
Ranunculus pusillus	The population along Michaelsville Road occurred in a moist roadside ditch that is often mowed.
Rotalla ramosior	The northernmost population occurred within a tank testing area.
Sabatia dodecandra	This population occurred in a frequently mowed, wet roadside depression, approximately 3 m from a large stand of *Phragmites australis*.
Scirpus pendulus	Both populations occurred within 5 m of a paved road.
Senecio anonymus	The northernmost population of this taxa occurred in an area that is regularly mowed.

UNRANKED PLANTS VOUCHERED FROM THE ABERDEEN PROVING GROUNDS

During the course of this study a few vascular plants were collected that are not ranked as state rare but were previously unvouchered from the Aberdeen Proving Grounds. These taxa are listed below along with their collection numbers and repositories.

Allium tricoccum Aiton var. *burdickii* Hanes (ramps), 990508.4 (US)
Andropogon gerardii Vitman (big bluestem or turkeyfoot bluejoint), 990807.7 (US)
Aster umbellatus Miller (tall flat-topped white aster), 991009.1 (US)
Campanula aparinoides Pursh (marsh bellflower), 990626.6 (US)
Cardamine rhomboidea (Pers.) DC. (spring-cress), 990508.1 (US)
Carex frankii Kunth (frank's sedge), 980821.3 (US)
Carex lupulina Muhl. (hop sedge), 980918.1 (MICH)
Carex umbellata Schk. (umbel bearing sedge), 980529.99 (US)
Carya illinoinensis (Wangenh.) K. Koch (pecan), 980720.5 (US)
Diodia virginiana L. (virginia buttonweed), 980807.3 (US)
Eleocharis acicularis (L.) Roemer & Schultes (least spikerush), 990724.1 (US)
Eleocharis tenuis (Willd.) Schultes var. *pseudoptera* (Weath.) Svenson (a spikerush), 990626.5 (US)
Eryngium aquaticum L. (marsh eryngo or marsh rattlesnake master) 990911.6 (US)
Gentiana saponaria L. (soapwort gentian) 990925.3 (US)
Hedyotis crassifolia Raf. (small bluets), 980417.3 (US)
Helianthemum canadense (L.) Michx. (frostweed), 990612.5 (US)
Juncus debilis A. Gray (weak rush), 991009.4 (US)
Lespedeza capitata Michx. (round-headed bush-clover), 980904.7 (US)
Lespedeza intermedia (S. Watts) Britton (intermediate bush-clover), 980904.9 (US)
Lespedeza virginica (L.) Britton (slender bush-clover), 980904 (US)
Lilaeopsis chinensis (L.) Kuntze (creeping finger carrot), 990710.6 (US)
Lobelia puberula Michx. (downy lobelia), 990911.4 (US)
Ludwigia peploides (HBK) Raven (creeping primrose willow), 980724.17 (US)
Lycopodiella appressa (Chapman) Small (southern clubmoss) 990911.8 (US)
Lysimachia vulgaris L. (garden loosestrife), 990710.5 (US)
Myriophyllum pinnatum (Walter) BSP. (pinnate water milfoil), 990807.5 (US)
Phalaris arundinacea L. (reed canary grass), 990710.4 (US)
Polygala sanguinea L. (purple milkwort), 980904.6 (US)
Polygala verticillata L. (whorled milkwort), 980724.11 (US)
Poncyrus trifolia (L.) Raf. (flying dragon), 980821 (US)
Potamogeton epihydrus Raf. (floating pondweed), 990724.2 (US)
Pycnanthemum muticum (Michx.) Pers (gray mountain-mint), 980821.1 (US)
Quercus x *dubia* Ashe = *Q. phellos* x *Q. velutina* (hybrid willow/black oak), 990925.4 (US)
Quercus x *ludoviciana* Sarg. = *Q. falcata* x *Q. phellos* (hybrid southern red/willow oak), 991009.3 (US)
Quercus michauxii Nutt. (basket or swamp chestnut oak), 990925.2 (US)

Senna herbecarpa (Fern.) Irwin & Barneby (wild senna), 980724.7 (US)
Spiranthes cernua (L.) Rich (nodding ladies' tresses), 991009.2 (NYS)
Stachys byzantina C. Koch (wooly hedge-nettle), 980515.9 (US)
Stachys tenuifolia Willd. (smooth hedge-nettle), 980807.6 (US)
Stellaria graminea L. (common stitchwort), 990522.3 (US)
Tilia americana L. (american basswood), 980904.4 (US)

SPECIES OF RARE PLANTS PREVIOUSLY REPORTED IN ERROR FROM THE ABERDEEN PROVING GROUNDS

Prior to this survey, the only inventory of the vascular flora of the Aberdeen Proving Grounds was conducted by Johnson et al. 1995. This report documented 407 species (410 taxa). Of the species reported, 21 were ranked as rare, threatened or endangered in the state of Maryland (Maryland Natural Heritage Program 1994). The voucher specimens for this study are deposited at the Bebb Herbarium at the University of Oklahoma in Norman, Oklahoma. Duplicates of most of this collection were laminated and delivered to the U. S. Army Construction and Engineering Research Laboratories.

In the spring of 1998, Dr. Forrest Johnson of the Bebb Herbarium examined the voucher specimens of the 21 rare Maryland taxa. Of the 21 rare plants reported, Dr. Johnson determined that 12 were misidentified. The eight taxa correctly identified were relocated during the course of this study and are cited in table I of this report. The 12 taxa reported in error and their amended identifications are given below.

Silene nivea (Nutt.) Otth.	amended to	*Lychnis alba* Mill.
Carex lupiliformis Sartw.	amended to	*Carex lupulina* Muhl.
Senna marilandica (L.) Link	amended to	*Senna hebecarpa* (Fern.) Irwin & Barneby
Lycopus rubellus Moench	amended to	*Lycopus americanus* Muhl.
Spiranthes laciniata (Small) Ames	amended to	*Spiranthes vernalis* Engelm. & Gray
Polygala curtissii Gray	amended to	*Polygala mariana* Mill.
Lysimachia tonsa (A. Wood)	amended to	*Lysimachia ciliata* L.
Ranunculus fascicularis Muhl.	amended to	*Ranunculus hispidus* Michx.
Malus angustifolia (Ait.) Michx.	amended to	*Pyrus communis* L.
Agalinis fasciculata (Elliott) Raf.	amended to	*Agalinis purpurea* (L.) Raf.
Limosella subulata E. Ives	amended to	*Lilaeopsis chinensis* (L.) Kuntze
Hybanthus concolor (T.F. Forest.) Spreng.	amended to	*Viola canadensis* L.

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APPENDIX C

List of Fauna Species Known to Occur on APG

List of Fauna Species Known to Occur on APG

Scientific Name	Common Name
Mammals	
Blarina brevicauda	Short-tailed shrew
Canis latrans	Coyote
Castor canadensis	American beaver
Condylura cristata	Star-nosed mole
Didelphis virginiana	Virginia opossum
Eptesicus fuscus	Big brown bat*
Glaucomys volans	Southern flying squirrel
Lasionycteris noctivagans	Silver-haired bat*
Lasiurus borealis	Eastern red bat*
Lasiurus cinereus	Hoary bat*
Lontra canadensis	Northern river otter
Marmota monax	Groundhog
Mephitis mephitis	Striped skunk
Microtus pennsylvanicus	Meadow vole
Microtus pinetorum	Woodland vole
Mus musculus	House mouse
Myotis lucifugus	Little brown bat*
Neovison vison	American mink*
Odocoileus virginianus	White-tailed deer
Ondatra zibethicus	Muskrat
Oryzomys palustris	Marsh rice rat
Perimyotis subflavus	Tricolored bat*
Peromyscus leucopus	White-footed mouse
Procyon lotor	Raccoon
Rattus norvegicus	Brown rat
Scalopus aquaticus	Eastern mole
Sciurus carolinensis	Eastern gray squirrel
Sciurus niger	Eastern fox squirrel
Sylvilagus floridanus	Eastern cottontail
Tamias striatus	Eastern chipmunk
Vulpes vulpes	Red fox
Zapus hudsonius	Meadow jumping mouse
Birds	
<u>Passerines</u>	
Agelaius phoeniceus	Red-winged blackbird
Ammodramus savannarum	Grasshopper sparrow*
Baeolophus bicolor	Tufted titmouse
Bombycilla cedrorum	Cedar waxwing
Cardinalis cardinalis	Northern cardinal
Cardellina pusilla	Wilson’s warbler

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Carduelis tristis	American goldfinch
Certhia americana	Brown creeper*
Contopus virens	Eastern wood-pewee
Corvus brachyrhynchos	American crow
Corvus ossifragus	Fish crow
Cyanocitta cristata	Blue jay
Dumetella carolinensis	Gray catbird
Empidonax virescens	Acadian flycatcher*
Geothlypis formosa	Kentucky warbler*
Geothlypis trichas	Common yellowthroat
Haemorhous mexicanus	House finch
Helmitheros vermivorus	Worm-eating warbler*
Hirundo rustica	Barn swallow
Hylocichla mustelina	Wood thrush*
Icteria virens	Yellow-breasted chat*
Icterus galbula	Baltimore oriole
Icterus spurius	Orchard oriole
Junco hyemalis	Dark-eyed junco*
Melospiza georgiana	Swamp sparrow
Melospiza georgiana nigrescens	Coastal plain swamp sparrow*
Melospiza melodia	Song sparrow
Mimus polyglottos	Northern mockingbird
Molothrus ater	Brown-headed cowbird
Myiarchus crinitus	Great crested flycatcher
Passer domesticus	House sparrow
Passerina caerulea	Blue grosbeak
Passerina cyanea	Indigo bunting
Pipilo erythrophthalmus	Eastern towhee
Piranga olivacea	Scarlet tanager*
Piranga rubra	Summer tanager
Plegadis falcinellus	Glossy ibis
Poecile carolinensis	Carolina chickadee
Polioptila caerulea	Blue-gray gnatcatcher
Protonotaria citrea	Prothonotary warbler*
Quiscalus quiscula	Common grackle
Regulus satrapa	Golden-crowned kinglet
Sayornis phoebe	Eastern phoebe
Seiurus aurocapillus	Ovenbird*
Setophaga americana	Northern parula*
Setophaga coronata	Yellow-rumped warbler
Setophaga discolor	Prairie warbler*
Setophaga petechia	Yellow warbler
Setophaga ruticilla	American redstart*

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Setophaga striata	Blackpoll warbler
Sialis sialis	Eastern bluebird
Sitta carolinensis	White-breasted nuthatch
Spizella arborea	American tree sparrow
Spizella passerina	Chipping sparrow
Spizella pusilla	Field sparrow
Sturnella magna	Eastern meadowlark*
Sturnus vulgaris	European starling
Tachycineta bicolor	Tree swallow
Thryothorus ludovicianus	Carolina wren
Toxostoma rufum	Brown thrasher
Troglodytes aedon	House wren
Turdus migratorius	American robin
Tyrannus tyrannus	Eastern kingbird
Vireo griseus	White-eyed vireo
Vireo olivaceus	Red-eyed vireo
Vireo flavifrons	Yellow-throated vireo*
Wilsonia citrina	Hooded warbler
Zonotrichia albicollis	White-throated sparrow
Non-Passerines	
Antrostomus vociferus	Eastern whip-poor-will*
Archilochus colubris	Ruby-throated hummingbird
Chaetura pelagica	Chimney swift*
Charadrius vociferus	Killdeer
Chordeiles minor	Common nighthawk*
Coccyzus americanus	Yellow-billed cuckoo
Coccyzus erythropthalmus	Black-billed cuckoo
Colaptes auratus	Northern flicker
Colinus virginianus	Northern bobwhite*
Columba livia	Rock pigeon
Dryocopus pileatus	Pileated woodpecker
Melanerpes carolinus	Red-bellied woodpecker
Meleagris gallopavo	Wild turkey
Picoides pubescens	Downy woodpecker
Picoides villosus	Hairy woodpecker
Scolopax minor	American woodcock*
Zenaida macroura	Mourning dove
Accipiter cooperii	Cooper's hawk
Accipiter striatus	Sharp-shinned hawk*
Aquila chrysaetos	Golden eagle (winter transient)*
Asio flammeus	Short-eared owl**

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Bubo virginianus	Great horned owl
Buteo jamaicensis	Red-tailed hawk
Buteo lineatus	Red-shouldered hawk
Cathartes aura	Turkey vulture
Circus cyaneus	Northern harrier*
Coragyps atratus	Black vulture
Falco sparverius	American kestrel*
Haliaeetus leucocephalus	Bald eagle*
Megascops asio	Eastern screech owl
Pandion haliaetus	Osprey
Strix varia	Barred owl
Tyto alba	Barn owl*
Aix sponsa	Wood duck
Anas acutu	Northern pintail
Anas americana	American wigeon
Anas clypeata	Northern shoveler
Anas crecca	Green-winged teal
Anas discors	Blue-winged teal*
Anas penelope	Eurasian wigeon
Anas platyrhynchos	Mallard
Anas rubripes	Black duck*
Anas strepera	Gadwall
Ardea alba	Great egret*
Ardea herodias	Great blue heron*
Aythya affinis	Lesser scaup
Aythya americana	Red head duck
Aythya collaris	Ring-necked duck
Aythya valioneria	Canvasback*
Branta canadensis	Canada goose
Bucepha albeola	Bufflehead
Bucephala clangule	Common goldeneye
Butorides virescens	Green heron
Cygnus columbianus	Tundra swan
Cygnus olor	Mute swan
Egretta thula	Snowy egret*
Fulica americana	American coot
Larus argentatus	Herring gull
Larus delawarensis	Ring-billed gull
Lophodytes cucullatus	Hooded merganser
Megaceryle alcyon	Belted kingfisher
Nycticorax nycticorax	Black-crowned night heron*
Oxyura jamaicensis	Ruddy duck*

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Phalacrocorax auritus	Double-crested cormorant
Rallus elegans	King rail*
Rallus limicola	Virginia rail
Amphibians	
Acris crepitans	Eastern cricket frog
Ambystoma maculatum	Spotted salamander
Ambystoma opacum	Marbled salamander
Anaxyrus a. americanus	Eastern American toad
Anaxyrus fowleri	Fowler's toad
Hemidactylium scutatum	Four-toed salamander
Hyla cinerea	Green tree frog
Hyla chrysosalis/versicolor	Cope's/Eastern gray treefrog complex
Notophthalmus v. viridescens	Red-spotted newt
Plethodon cinereus	Eastern red-backed salamander
Plethodon glutinosus	Northern slimy salamander
Pseudacris crucifer	Northern spring peeper
Pseudacris feriarum	Upland chorus frog
Lithobates catesbeianus	American bullfrog
Lithobates clamitans	Northern green frog
Lithobates palustris	Pickerel frog
Lithobates sphenocephalus	Southern leopard frog
Lithobates sylvaticus	Wood frog
Scaphiopus holbrookii	Eastern spadefoot
Reptiles	
Agkistrodon contortrix mokasen	Northern copperhead
Carphophis amoenus amoenus	Eastern worm snake
Chelydra serpentina	Eastern snapping turtle
Chrysemys p. picta	Eastern painted turtle
Clemmys guttata	Spotted turtle*
Coluber c. constrictor	Northern black racer
Diadophis punctatus edwardsii	Northern ring-necked snake
Kinosternon subrubrum	Eastern mud turtle
Lampropeltis triangulum	Eastern milksnake
Nerodia s. sipedon	Northern water snake
Pantherophis alleghaniensis	Eastern ratsnake
Plestiodon fasciatus	Five-lined skink
Pseudemys rubriventris	Northern red-bellied cooter
Terrapene carolina	Eastern box turtle*
Thamnophis s. sauritis	Common ribbonsnake*
Thamnophis s. sirtalis	Eastern garter snake
Trachemys scripta elegans	Red-eared slider

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Finfish	
Acipenser oxyrhynchus	Atlantic sturgeon**
Acipenser brevirostrum	Shortnose sturgeon**
Alosa aestivalis	Blueback herring
Alosa mediocris	Hickory shad*
Alosa pseudoharengus	Alewife
Alosa sapidissima	American shad*
Ameiurus catus	White catfish*
Ameiurus nebulosus	Brown bullhead
Anchoa mitchilli	Bay anchovy
Anguilla rostrata	American eel
Catostomus commersoni	White sucker
Channa argus	Northern snakehead
Cyprinus carpio	Common carp
Dorosoma cepedianum	Gizzard shad
Fundulus diaphanous	Banded killifish
Fundulus heteroclitus	Mummichog
Gobiosoma bosci	Naked goby
Ictalurus punctatus	Channel catfish
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Menidia beryllina	Inland silverside
Micropterus salmoides	Largemouth bass
Morone americana	White perch
Morone saxatilis	Striped bass
Notemigonus crysoleucas	Golden shiner
Notropis hudsonius	Spottail shiner
Perca flavescens	Yellow perch
Pomoxis nigromaculatus	Black crappie
Shellfish	
Callinectes sapidus	Blue crab
Dreissena polymorpha	Zebra mussel (likely; not yet documented)

*Species of Greatest Conservation Need in Maryland
**Maryland endangered

APPENDIX D

List of Priority Bird Species for Conservation Management
that Have Potential to Occur on APG

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Acadian flycatcher						High Overall Priority (B)			Moderate (G5,S5B)	
American bittern									Highest (Threatened, G4,S1B, S1N)	
American black duck		X			Highest	High Overall Priority (B,W)			Moderate (G5,S4B,S5N)	
American kestrel									Moderate (G5,S4B,S3N)	
American oystercatcher	X					High Overall Priority (B,W)	High Concern		Moderate (G5,S3B,S2N)	
American redstart									Moderate (G5,S4B)	
American wigeon		X								
American woodcock		X				High Overall Priority (W), Additional Watch List (B)	High Concern		Moderate (G5,S4B,S4N)	
Audobon's shearwater	X								Uncertain (G4G5,SNR)	
Bald eagle						High Overall Priority (W)			Moderate (G5,S4)	
Baltimore oriole						High Overall Priority (B)				
Bank swallow									Moderate (G5,S3B)	
Barn owl									High (In Need of Conservation, G5,S2)	
Bicknell's thrush	X							Listing not warranted	Uncertain (G4,SNA)	
Black-and-white warbler						High Regional Priority (B)			Moderate (G5,S4B)	
Black-bellied plover							Moderate Concern		Moderate (G5,S3N)	
Black-billed cuckoo	X					High Regional Priority (B)				X
Blackburnian warbler						High Regional Priority (B)			Moderate (G5,S3B)	
Black-crowned night-heron				Moderate Concern					Moderate (G5,S3B,S2N)	
Black rail						High Overall Priority (B,W)		Threatened (Eastern subspecies)	Highest (Endangered, G3G4,S1)	
Black scoter					High				Moderate (G5,S3N)	
Black skimmer	X			High Concern		High Overall Priority (B)			Highest (Endangered, G5,S1B)	
Black-throated blue warbler						High Overall Priority (B)			Moderate (G5,S3S4B)	
Black-throated green warbler									Moderate (G5,S4B)	
Blue-winged teal					Identified in Previous Yrs				High (G5,S2B,S3N)	
Blue-winged warbler	X					High Overall Priority (B)			Moderate (G5,S4B)	
Boat-tailed grackle									Moderate (G5,S4B,S3N)	
Bobolink	X					Additional Watch List (B)			Moderate (G5,S3S4B)	
Bonaparte's gull				Moderate Concern						
Brant	X	X			High				Moderate (G5,S4S3N)	
Broad-winged hawk						High Regional Priority (B)			Moderate (G5,S3S4B)	
Brown creeper									Moderate (G5,S3B,S4N)	

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG (continued)

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Brown pelican	X			Moderate Concern					Highest (G4,S1B)	
Brown thrasher						High Regional Priority (B)				
Bufflehead					High	High Regional Priority (W)				
Canada warbler	X					High Overall Priority (B)			Moderate (G5,S3B)	X
Canvasback		X			High	High Overall Priority (W)			Moderate (G5,S3S4N)	
Carolina chickadee						High Regional Priority (B,W)				
Cerulean warbler	X					High Overall Priority (B)			Moderate (G4,S3B)	X
Chimney swift	X					High Regional Priority (B)			Moderate (G5,S5B)	
Chuck-will's-widow	X								Moderate (G5,S4B)	
Clapper rail						High Overall Priority (B,W)				
Coastal plain swamp swallow									Highest (In Need of Conservation, G5T3,S2S3B,SUN)	
Common gallinule									High (In Need of Conservation, G5,S2S3B)	
Common goldeneye					Moderately High					
Common loon						High Regional Priority (W)			Moderate (G5,S4N)	
Common merganser									High (G5,S2B,S3S4N)	
Common nighthawk	X								High (G5,S2S3B)	
Common snipe							Moderate Concern			
Common tern	X					High Regional Priority (B)			Highest (Endangered, G5,S1B)	
Dark-eyed junco									Moderate (G5,S3B,S5N)	
Dunlin						High Overall Priority (W)	Moderate Concern		Moderate (G5,S3N)	
Eastern kingbird						High Regional Priority (B)				
Eastern meadowlark	X								Moderate (G5,S5B,S3N)	
Eastern towhee						High Regional Priority (B,W)				
Eastern whip-poor-will	X					High Overall Priority (B)			Moderate (G5,S3S4B)	X
Eastern wood-pewee						High Regional Priority (B)				
Field sparrow	X					High Regional Priority (B,W)				
Fish crow						Additional Watch List (B)				
Forster's tern	X			Moderate Concern					High (In Need of Conservation, G5,S2B,S2N)	
Gadwall					Identified in Previous Yrs				High (G5,S2B,S4N)	
Glossy ibis				Low Concern		Additional Watch List (B)			Moderate (G5,S3B)	
Golden eagle									High (G5,S2N)	X
Golden-crowned kinglet									Moderate (G5,S3B,S4N)	
Golden-winged warbler	X					High Overall Priority (B)		Under Review	High (In Need of Conservation, G4,S2B)	X

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG (continued)

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Grasshopper sparrow	X					High Regional Priority (B)			Moderate (G5,S5B)	X
Gray catbird						High Regional Priority (W), Additional Watch List (B)				
Green-winged teal					Identified in Previous Yrs					
Great blue heron									Moderate (G5,S5B,S3S4N)	
Great crested flycatcher						High Regional Priority (B)				
Great egret									Moderate (G5,S3S4B)	
Greater scaup		X			High	High Overall Priority (W)				
Greater yellowlegs							Moderate Concern		High (G5,S2S3N)	X
Gull-billed tern	X			High Concern					Highest (Endangered, G5,S1B)	
Henslow's sparrow	X					High Overall Priority (B)			High (In Need of Conservation, G4,S2B)	X
Hooded merganser					Identified in Previous Yrs					
Hooded warbler									Moderate (G5,S4B)	
Horned grebe						High Regional Priority (W)			Moderate (G5,S4N)	
Kentucky warbler	X					High Overall Priority (B)			Moderate (G5,S4B)	X
King rail	X	X							High (G4,S2B,S2N)	X
Laughing gull				Not Currently at Risk		Additional Watch List (B)			Highest (G5,S1B,S2N)	
Least bittern									High (In Need of Conservation, G5,S2S3B)	
Least flycatcher									Moderate (G5,S3S4B)	
Least tern	X			High Concern				Endangered (interior population only)	High (Threatened G4,S2B)	X
Lesser black-backed gull				Moderate Concern						
Lesser scaup		X			High					
Lesser yellowlegs	X						Moderate Concern		Highest (G5,S1N)	
Little blue heron	X			High Concern					Moderate (G5,S3B)	
Little gull				High Concern						
Loggerhead shrike	X					High Regional Priority (B,W)			Highest (Endangered, G4,S1B)	X
Long-eared owl	X					High Regional Priority (W)			Highest (G5,S1B,S1N)	
Long-tailed duck (Oldsquaw)					High				Moderate (G5,S4N)	
Louisiana waterthrush						High Overall Priority (B)			Moderate (G5,S5B)	
Magnolia warbler									Moderate (G5,S3S4B)	
Mallard		X			High					
Marbled godwit	X						High Concern			
Marsh wren						High Overall Priority (B)			Moderate (G5,S4B,S2N)	
Mourning dove		X								
Mourning warbler									Highest (Endangered, G5,S1B)	

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG (continued)

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Nashville warbler									Highest (Threatened, G5,S1B)	
Nelson's sparrow									Highest (G5,S1N)	
Northern bobwhite			X						Moderate (G5,S4)	X
Northern flicker						High Regional Priority (B)				
Northern goshawk									Highest (Endangered, G5,S1B,SNA)	
Northern harrier	X					High Regional Priority (W)			High (In Need of Conservation, G5,S2B,S4N)	
Northern parula									Moderate (G5,S5B)	
Northern pintail		X			Identified in Previous Yrs					
Northern saw-whet owl	X								Highest (G5,S1B,S1N)	
Northern waterthrush									High (In Need of Conservation, G5,S2B)	
Olive-sided flycatcher	X								Endangered Extirpated, G4,SHB	X
Ovenbird									Moderate (G5,S5B)	
Painted bunting	X									
Pied-billed grebe									High (G5,S2S3B,S3N)	
Pine siskin									High (G5,S2B,S1S3N)	
Piping plover						High Overall Priority (B,W)	Highly Imperiled	Threatened	Highest (Endangered, G3,S1B)	
Prairie warbler	X					High Overall Priority (B)			Moderate (G5,S4B)	X
Prothonotary warbler	X					Additional Watch List (B)			Moderate (G5,S4B)	X
Red-breasted nuthatch									Moderate (G5,S3B,S3S4N)	
Redhead		X			Identified in Previous Yrs	High Regional Priority (W)			Moderate (G5,S3S4N)	
Red-headed woodpecker	X					High Overall Priority (B,W)			Moderate (G5,S4)	X
Red knot	X					Additional Watch List (W)	High Concern	Threatened	Uncertain (Threatened, G4T2,SNA)	
Red-necked phalarope									Uncertain (G4G5,SNA)	
Red phalarope									Uncertain (G5,SNA)	
Red-throated loon									Moderate (G5,S3S4N)	
Ring-necked duck		X			Identified in Previous Yrs					
Roseate tern				High Concern				Endangered	Endangered Extirpated, G4,SXB,S1N	
Rose-breasted grosbeak	X					High Regional Priority (B)				
Royal tern				Moderate Concern					Highest (Endangered, G5,S1B)	
Ruddy duck									Moderate (G5,S3N)	
Ruddy turnstone							High Concern		High (G5,S2N)	
Ruffed grouse									Moderate (G5,S4)	
Rusty blackbird	X								High (G4,S2S3N)	X

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG (continued)

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Saltmarsh sharp-tailed sparrow	X					High Overall Priority (B,W)			High (In Need of Conservation, G4,S2B,S1N)	
Sanderling							High Concern		Moderate (G5,S3N)	
Sandwich tern	X								Highest (G5,S1B)	
Savannah sparrow									Moderate (G5,S4B,S4N)	
Scarlet tanager	X					High Overall Priority (B)			Moderate (G5,S5B)	
Seaside sparrow	X					High Overall Priority (B,W)			Moderate (G4,S4B,S2N)	
Sedge wren						High Overall Priority (B), High Regional Priority (W)			Highest (Endangered, G5,S1B)	
Semipalmated sandpiper	X								Uncertain (G5,SNA)	
Sharp-shinned hawk									High (G5,S2S3B,S4N)	
Short-billed dowitcher	X						High Concern		Uncertain (G5,SNA)	
Short-eared owl	X					High Overall Priority (W), High Regional Priority (B)			Highest (Endangered, G5,S1B,S2N)	
Snow goose		X			High					
Snowy egret				High Concern					Moderate (G5,S3B)	
Sora									Highest (G5,S1B,S1N)	
Spotted sandpiper									Moderate (G5,S3S4B)	
Surf scoter					High				Moderate (G5,S4N)	
Swainson’s thrush									Endangered Extirpated, G5,SHB	
Swainson’s warbler									Highest (Endangered, G4,S1B)	
Tricolored heron				High Concern					Moderate (G5,S3B)	
Tundra swan					High					
Upland sandpiper	X					High Overall Priority (B)			Highest (Endangered, G5,S1B)	
Veery	X								Moderate (G5,S4B)	
Vesper sparrow									Moderate (G5,S4B,S2N)	
Virginia rail						High Regional Priority (B)				
Wayne’s black-throated green warbler									Uncertain (G5T3,SUB)	
Western sandpiper							High Concern			
Whimbrel	X						High Concern		Uncertain (G5,SNA)	
White-winged scoter					High				High (G5,S2S3N)	
Willet	X						Moderate Concern		Moderate (G5,S4B,S2N)	
Willow flycatcher									Moderate (G5,S4B)	
Wilson's plover	X					High Overall Priority (B)	High Concern		Highest (Endangered, G5,S1B)	
Winter wren									High (G5,S2B,S3N)	

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG (continued)

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Wood duck		X			Identified in Previous Yrs	High Regional Priority (W)				
Wood thrush	X					High Overall Priority (B)			Moderate (G5,S5B)	X
Worm-eating warbler						High Overall Priority (B)			Moderate (G5,S4B)	
Yellow-bellied sapsucker									Highest (G5,S1B,S3S4N)	
Yellow-breasted chat	X								Moderate (G5,S5B)	
Yellow-crowned night-heron				Moderate Concern					Moderate (G5,S3S4B)	
Yellow-throated vireo						High Overall Priority (B)			Moderate (G5,S4B)	

BoCC = USFWS Birds of Conservation Concern
GBBDC = Game Birds Below Desired Condition
NMBSC = Non-Migratory Bird Species of Concern
NAWBCP = North American Waterbird Conservation Plan
NAWMP = North American Waterfowl Management Plan
PIF = Partners in Flight
SCP = U.S. Shorebird Conservation Plan
ESA = Federal Endangered Species Act
SWAP = Maryland State Wildlife Action Plan (Draft 2015-2025)
DoD = DoD Mission-Sensitive Priority Bird Species (October 2015 Fact Sheet)

PIF:
B = Breeding
W = Wintering

SWAP:
G1 or S1 = Critically Imperiled/Highly State Rare at Global (G) or State (S) level; at very high risk of extinction or extirpation due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors; typically occurring in fewer than five populations
G2 or S2 = Imperiled/State Rare at Global (G) or State (S) level; at high risk of extinction or extirpation due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors; typically occurring in 6-20 populations
G3 or S3 = Vulnerable/Watchlist at Global (G) or State (S) level; at moderate risk of extinction or extirpation due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors; typically occurring in 21-80 populations
G4 or S4 = Apparently Secure at Global (G) or State (S) level; at fairly low risk of extinction or extirpation due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors
G5 or S5 = Demonstrably Secure at Global (G) or State (S) level; at very low risk of extinction or extirpation due to a very extensive range, abundant populations or occurrences, or little to no concern from declines or threats
GU or SU = Status Uncertain at Global (G) or State (S) level; a numerical rank cannot be established with confidence for reasons including lack of historical records, low survey effort, cryptic nature of the species, or concerns that the species may not be native to the state; uncertainty spans a range of 4- 5 ranks as defined above
GNR or SNR = Not ranked at Global (G) or State (S) level; conservation status has not yet been fully assessed
SNA = Not a conservation target; species is not a suitable target for most conservation actions because of its transient occurrence or other factors
B = Breeding
N = Nonbreeding
M = Migrant

Data compiled from DoD PIF website (https://www.denix.osd.mil/dodpif/groups/mission-sensitive-species/msswg/index.html) and MDDNR SWAP.

APPENDIX E

Memorandum of Understanding for
Federal Consistency and Maryland Enforceable Policies

Memorandum of Understanding Between The State of Maryland And The United States Department of Defense

This Memorandum of Understanding is entered into this 8th day of May, 2013, to evidence and affirm the mutual understanding of the State of Maryland and the United States Department of Defense, the Parties to the Agreement herein, concerning the Federal consistency requirements of the Coastal Zone Management Act (16 U.S.C. § 1451 et seq) and the application and implementation of certain enforceable policies of Maryland's Coastal Zone Management Program.

WHEREAS, the Department of Defense and the State of Maryland are committed to using the Federal consistency process to protect coastal uses and resources within Maryland's Coastal Zone;

WHEREAS, the Coastal Zone Management Act was enacted by Congress on October 27, 1972 to encourage coastal States, Great Lakes States and U.S. territories and commonwealths to be proactive in managing natural resources for their benefit and for the benefit of the Nation with the main objectives of preserving, protecting, developing, and where possible, restoring or enhancing the resources of the Nation's Coastal Zone;

WHEREAS, the Department of Defense is required under the Coastal Zone Management Act to demonstrate consistency to the maximum extent practicable with the approved, enforceable policies of Maryland's Coastal Zone Management Program, as approved by the National Oceanographic and Atmospheric Administration, for all projects and activities having reasonably foreseeable effects on land or water use or natural resources of Maryland's Coastal Zone. The review of activities on Federal lands for consistency with Maryland's Enforceable Coastal Policies only applies to the extent that those activities have reasonably foreseeable effects on coastal uses or resources of the State. Federal lands subject solely to the discretion of the Federal Government, its officers or agents, are excluded from the Coastal Zone under the Coastal Zone Management Act (16 U.S.C. § 1453 (1));

WHEREAS, the State of Maryland first prepared its Coastal Zone Management Program in 1978 and, on November 19, 2010, submitted a Routine Program Change updating its Coastal Zone Management Program to the National Oceanic and Atmospheric Administration for approval. This Routine Program Change, approved by National Oceanic and Atmospheric Administration on March 18, 2011, updates, clarifies, and improves access to Maryland's Enforceable Coastal Policies;

WHEREAS, the Department of Defense participated in the public review of Maryland's November 2010 Routine Program Change, and this participation led to a series of discussions between the Parties and the National Oceanic and Atmospheric Administration Office of Ocean and Coastal Resource Management in which several agreements and understandings were reached on the application of Maryland's Coastal Zone Management Program to Department of Defense activities;

AND, WHEREAS, the parties agreed to reduce those agreements and understandings to writing;

NOW THEREFORE, the Parties agree as follows:

Article I: General

Section 1.01 Terminology: As used throughout this document, "Department of Defense" means components, subordinate services, commands, and installations and not necessarily Cabinet-level activities. Also as used throughout this document, "Policies" refers to Maryland's Enforceable Coastal Policies, effective April 8, 2011 and implemented pursuant to Maryland's Coastal Zone Management Program. "Policy" refers to a specific Maryland Enforceable Coastal Policy.

Section 1.02 State Permits: In general, the obligation of the Department of Defense under the Coastal Zone Management Act is to demonstrate consistency to the maximum extent practicable with the substantive requirements identified in Maryland's Enforceable Coastal Policies. Unless otherwise required under Federal law, the Department of Defense is not required to obtain State permits or comply with any specific State procedural requirements to demonstrate consistency with Maryland's Enforceable Coastal Policies. The Department of Defense may, at its discretion, take advantage of an existing State permitting process or existing State procedural requirement if it determines these processes or requirements are the most convenient and efficient way of demonstrating consistency. The act of the Department of Defense submitting a permit application in such cases does not expand the jurisdiction of any State agency over Department of Defense activities.

Section 1.03 Early Coordination: Prior to providing a consistency determination, the Department of Defense should confer with relevant Maryland agencies early in the planning process on the nature and expected complexity of planned Department of Defense projects and activities. Attachment 1 is appended hereto and lists the Maryland Federal Coastal Consistency

Review Points of Contact. The Department of Defense welcomes Maryland's assistance in determining which Policies are applicable to a given project or activity and developing strategies for achieving and demonstrating consistency with those Policies. At the earliest possible time, Maryland shall notify the Department of Defense of an action that the Department of Defense has not provided a consistency determination for, but which may have a reasonably foreseeable effect on Maryland's Coastal Zone.

Section 1.04 List of *de minimis* and Environmentally Beneficial Activities and General Consistency Determinations: The Department of Defense and Maryland agree to work together to develop a list of *de minimis* activities and a list of environmentally beneficial activities, as these terms are defined in 15 C.F.R. § 930.33. The List of *de minimis* and Environmentally Beneficial Activities will be appended hereto as Attachment 2 following completion of the procedures outlined in 15 C.F.R. § 930.33. Absent unusual circumstances, the projects and activities on these lists will require no individual consistency determination. Either Party may recommend revisions to this list at any time. Projects and activities can be added to this list with the agreement of both Parties through the process under 15 C.F.R. §930.33. Either Party can modify or remove an item from this list in accordance with Section 3.03 of this Memorandum of Understanding.

Section 1.05 Federal Consistency Determination Process: In accordance with 15 C.F.R. § 930.33(a), the Department of Defense shall determine which of its activities affect coastal uses or resources. For Federal agency projects and activities that have reasonably foreseeable effects on any coastal use or coastal resource on Maryland's Coastal Zone, the Department of Defense will submit a consistency determination in accordance with 15 C.F.R. § 930 et seq, identifying the relevant Maryland Enforceable Coastal Policies and demonstrating the consistency of the project or activity with those Policies. Attachments 1, 3 and 4 contain the Federal consistency submission and approval process.

Section 1.06 Exceptions: Any time the circumstances of a particular project or activity that would otherwise fall under Attachment 2 indicate that there may be adverse coastal effects, the Department of Defense will prepare and submit a Federal Coastal Consistency Determination for that individual project or activity.

Section 1.07 Options for Demonstrating Consistency: The Department of Defense and Maryland agree that Integrated Natural Resources Management Plans ("INRMPs") or consultation with Maryland may be appropriate options for demonstrating consistency. Consulting with Maryland or implementing an INRMP does not however relieve the Department of Defense of its obligation to submit a written consistency determination when required by the Coastal Zone Management Act. Rather, the Department of Defense may, where appropriate, point to relevant provisions of an INRMP or consultation with Maryland in a written consistency determination to demonstrate consistency with certain Maryland Enforceable Coastal Policies. Additionally, the Department of Defense may, at its discretion, utilize Maryland's administrative processes,

including but not limited to permits, to assist in demonstrating consistency with the substantive requirements of Maryland's Enforceable Coastal Policies. When resources are available and environmental benefits will accrue, the Department of Defense may, at its discretion and with Maryland concurrence, perform mitigation above and beyond that required to demonstrate consistency. These additional mitigation measures will be documented by the Department of Defense and Maryland, and may be used to meet mitigation requirements for future Department of Defense projects and activities.

Section 1.08 Mapping / Alternative Sites - Oyster Reefs, Trout Waters and Colonial Bird Nesting Sites: To address potential impacts to specific habitats that would have reasonably foreseeable effects to coastal uses or resources of Maryland and to provide greater specificity to the application of the policies, Maryland is creating a coastal atlas which will delineate the geographic areas of significance referred to in Maryland's Enforceable Coastal Policies B.1.1, B.2.1 and B.6.5. Maryland will make the coastal atlas available to the Department of Defense and the general public. The Department of Defense may share with Maryland any information previously collected and included in the INRMP that the State could use in creating the coastal atlas.

Article II. Specific Maryland Enforceable Coastal Policies for the Purpose of Federal Consistency Determinations:

Section 2.01 General Policies: Core Policies (Noise): The Department of Defense will demonstrate consistency with this Policy for new activities having a reasonably foreseeable effect on the Coastal Zone, other than aircraft operations. Compliance with internal Department of Defense and military service component noise abatement policies will be sufficient to demonstrate consistency with this Policy for such projects.

Section 2.02 General Policies: Water Quality (Pesticide Storage): The Department of Defense will demonstrate consistency with Maryland's Enforceable Coastal Policies regarding pesticide storage through compliance with Department of Defense Instruction 4150.07, "DoD Pest Management Program".

Section 2.03 General Policies: Water Quality (Toxic Discharges): The Department of Defense will continue to demonstrate consistency with this Policy by applying for and complying with permits required under the Clean Water Act and the relevant section of the Code of Maryland Regulations, currently 26.08.03.01.

Section 2.04 General Policies: Flood Hazards: The Department of Defense and Maryland agree that Policy A.3.2 does not establish absolute prohibitions against development on Department of Defense lands by Federal agencies.

Section 2.05 Coastal Resources: The Chesapeake and Atlantic Coastal Bays Critical Area: The Department of Defense and Maryland agree to continue discussing appropriate measures to demonstrate consistency with Maryland's Enforceable Coastal Policies related to the Chesapeake Bay and Atlantic Coastal Bays Critical Areas, including the development and maintenance of a List of *de minimis* and Environmentally Beneficial Activities, addressed in Section 1.04.

Section 2.06 Coastal Resources: Tidal and Non-Tidal Wetlands: The Department of Defense will consult with Maryland to ensure projects that may alter wetlands are consistent to the maximum extent practicable with the intent of this Policy. Maryland and the Department of Defense recognize that wetland impacts may be unavoidable due to mission requirements. In instances where adverse wetland impacts cannot be avoided, the Department of Defense and Maryland will work together to ensure any adverse effects to the Maryland Coastal Zone are minimized, any environmental benefits are maximized, and Department of Defense's operational flexibility is maximized. By submitting a Joint Permit Application under Clean Water Act Sections 404/401 to the appropriate regulatory agencies, the Department of Defense demonstrates consistency with the substantive requirements of Maryland's Enforceable Coastal Policies.

Section 2.07 Coastal Resources: Forests: The Department of Defense will demonstrate consistency with the underlying conservation goals of the Forest Conservation Act as embodied in Maryland's Enforceable Coastal Policies to the maximum extent practicable. An installation's INRMP may be sufficient for this purpose. For land-disturbing activities of 40,000 square feet or greater occurring on an installation, the Department of Defense will submit to Maryland either a negative determination with a finding of no effect to coastal uses or resources, or a consistency determination. If the Department of Defense proposes an action that will have reasonably foreseeable effects on uses or resources of Maryland's Coastal Zone, then the Department of Defense must be consistent to the maximum extent practicable with the substantive provisions of the Forest Conservation Act related to the reasonably foreseeable effects. The Department of Defense is not required to meet the procedural requirements of the Forest Conservation Act, such as creating and submitting forest conservation plans, forest stand delineation plans, or Long-Term Protective Agreements to Maryland. Likewise, the Department of Defense may not contribute to the State Forest Conservation Fund. However, the Department of Defense may, at its discretion and consistent with Federal fiscal legal requirements, follow Maryland's administrative process to assist in demonstrating consistency with the substantive requirements of Maryland's Enforceable Coastal Policies.

Section 2.08 Coastal Resources: Historical and Archaeological Sites: The Department of Defense will continue to use procedures in accordance with the requirements of the National Historic Preservation Act that are consistent with Maryland's Historical Preservation Program. Maryland agrees that meeting the consultation requirements under the National Historic

Preservation Act is sufficient to demonstrate consistency with Policies relating to historic preservation. In the event a tidal shore erosion project affects historical or archaeological resources, the Department of Defense will continue to use the consultation procedures under the National Historic Preservation Act that are consistent with Maryland's Historic Preservation Program.

Section 2.09 Coastal Resources: Living Aquatic Resources: Each INRMP maintains a relevant and updated baseline list of plant and animal species located at each installation for all pertinent taxonomic and regionally important groups, and may include State-listed endangered and threatened species. INRMPs are prepared, maintained, and implemented for all installations and ranges that contain significant natural resources for which the Department of Defense has authority for, or control of, natural resources management pursuant to the Sikes Act, 16 U.S.C. § 670 et seq. Maryland will continue to participate in the development and review of all INRMPs. Each Department of Defense component should ensure, to the extent practicable, that current and planned installation programs, plans, and projects that affect natural resources are integrated and compatible with INRMPs. Each INRMP requires that biologically or geographically significant or sensitive natural resources, such as ecosystems or species, are monitored and managed for their protection and long-term sustainability. The INRMP reflects the mutual agreement between Maryland Department of Natural Resources, the United States Fish and Wildlife Service and the Department of Defense concerning conservation, protection, and management of fish and wildlife resources, and it may be used to demonstrate consistency with Maryland's Enforceable Coastal Policies. If there are reasonably foreseeable effects on living aquatic resources as described in Maryland's Enforceable Coastal Policies, the Department of Defense and Maryland will work together to ensure any adverse effects are minimized, any environmental benefits are maximized, and the Department of Defense's operational flexibility is maximized.

Section 2.10 Coastal Uses: Tidal Shore Erosion Control (Living Shoreline): When, after consultation with Maryland, the Department of Defense determines that mission requirements or safety may be threatened by wildlife attracted to living shoreline habitats, less preferred alternatives for shoreline stabilization, such as hardened structures, should be considered consistent to the maximum extent practicable with this Policy. By submitting a Joint Permit Application under Clean Water Act Sections 404/401 to the appropriate regulatory agencies, the Department of Defense demonstrates consistency with the substantive requirements of Maryland's Enforceable Coastal Policies.

Article III. General Statements of Understanding

Section 3.01 Effective Date: This Memorandum of Understanding shall be effective as of the date of the last signature shown below and shall not expire.

Section 3.02 Pursuant to the Anti-Deficiency Act, 31 U.S.C. §§ 1341 and 1342, this Memorandum of Understanding makes no commitments of funds. Nothing in this Memorandum

of Understanding will be construed by the Parties to require the obligation, appropriation, or expenditure of any money from the U.S. Treasury.

Section 3.03 Amendment and Termination: This Memorandum of Understanding and attachments may be modified or amended upon written request of any Party hereto and the subsequent written concurrence of the other Party. Moreover, this Memorandum of Understanding may be terminated sixty (60) days after providing written notice of such termination to the other Party.

Section 3.04 This Memorandum of Understanding does not create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by any person or Party against the United States, its agencies, its officers; or against the State of Maryland, its agencies, its officers; or against any other person. This Memorandum of Understanding is to be construed in a manner consistent with all existing laws and regulations.

Section 3.05 This Memorandum of Understanding neither expands nor is in derogation of those powers and authorities vested in the Parties by applicable law, statutes, regulations, or Executive Orders, nor is it intended to modify or supersede any other applicable interagency agreements existing as of the date of this Memorandum of Understanding. The Parties enter into this agreement in good faith and intend to fully carry out the terms of this Memorandum of Understanding.

Section 3.06 The Parties will meet at least every two years to discuss this Memorandum of Understanding and its Attachments.

Signed this 8th day of May, 2013.

For the State of Maryland:

John Griffin, Secretary
Maryland Department of Natural Resources

David Costello, Deputy Secretary
Maryland Department of the Environment

For the U.S. Department of Defense:

Donald R. Schregardus, Deputy Assistant Secretary of the Navy for Environment

Hershell E. Wolfe, Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health

Gerald F. (Fred) Pease Jr, Deputy Assistant Secretary of the Air Force for Environment, Safety and Occupational Health

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 1: List of De Minimis and Environmentally Beneficial Activities

This process is for federal consistency purposes pursuant to the Coastal Zone Management Act (16 U.S.C. § 1451 et seq.) only and in no way relieves the United States Department of Defense (hereinafter "DoD") from any other applicable federal, state, or local laws, regulations or other requirements.

Section I contains a list of federal agency activities (hereinafter "activities") that typically have minor or *de minimis* effects on coastal uses and resources in the Maryland Coastal Zone. *De minimis* activities are activities that are expected to have insignificant direct or indirect (cumulative and secondary) coastal effects and which the State agency concurs are *de minimis*.

Section II contains environmentally beneficial activities that have beneficial impacts on Maryland's Coastal Zone resources. "Environmentally beneficial activities" means an activity or activities that protect, preserve, or restore the natural resources of the coastal zone.

Upon approval by Maryland in accordance with 15 C.F.R. 930.33(a)(3) or 15 C.F.R. 930.36(c), DoD may generally carry out these activities without submitting a negative Federal Coastal Consistency Determination unless the circumstances of a particular Federal Development Project (hereinafter "Project") or activity indicate that the activity will have a greater than *de minimis* adverse effect on coastal uses or resources. In determining whether a particular activity qualifies as *de minimis* or as having an environmentally beneficial impact, each project or activity should be evaluated individually, taking into account the cumulative effects of all previous, current, and planned activities on and around the installation and the proximity of the project or activity to any coastal uses or resources. For an activity to be considered *de minimis*, wetland impacts shall be limited to 5,000 square feet or less. Land disturbing activities that include grubbing may require further assessment.

Best management practices (hereinafter "BMPs") will be implemented for each activity to protect water quality, coastal uses, and coastal resources. For the list of *de minimis* or environmentally beneficial activities BMPs are defined as resource management decisions that are based on the latest professional and technical standards for the protection, enhancement, and rehabilitation of natural resources. BMPs include schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce pollution. BMPs also include treatment requirements, operating procedures, and control practices. (*Department of Defense Instruction, Number 4715.03, "Natural Resources Conservation Program"*, March 18, 2011)

I. Examples of *De Minimis* Activities: Pursuant to 15 C.F.R. § 930.33(a)(3)(i), the list of *de minimis* activities identifies those activities not subject to further state agency review for federal consistency in accordance with the Coastal Zone Management Act.

   a. Existing buildings, facilities or structures: The following list of projects on existing buildings or structures are considered *de minimis* so long as the building or structure

is not eligible for listing on the National Register of Historic Places. If the structure is determined eligible for listing, the project must have been determined by the appropriate cultural resources manager to have no adverse effect on the building or structure.

1. Exterior painting, staining or sealing of existing building/infrastructure
2. Brick repointing
3. Repair but not replacement of building foundations
4. Repair and replacement of roofs, windows, scuppers, gutters, or snow guards
5. HVAC modernization to include a new pad in the same footprint as the current pad so long as the new pad is not larger than the current pad
6. Water softener restoration
7. Repair and replacement of sump pump(s)
8. Repair and replacement of exterior door(s)
9. Installation, repair, and maintenance of solar panel(s) and wall(s) taking place within or upon existing structures or existing impervious surface area(s)
10. Exclusively external structural and cosmetic alterations to existing buildings or structures as long as any ground disturbance is within the same foot print (e.g., installation of a canopy that is harmonious and compatible with the appearance and character of the existing building and does not contribute to additional storm water pollution)

b. Road Maintenance and Parking Maintenance (within the same footprint or less):

1. Routine repairs including but not limited to milling, grooving, stripping, repairing (patching or slurry seal), striping, or resurfacing that does not result in a net increase in stormwater discharge
2. Barrier skirt and pop up barrier maintenance and repair

c. Grounds Maintenance:

1. Grading and sodding of existing athletic and parade fields
2. Routine grounds maintenance, including but not limited to mowing existing mowed areas; seeding/reseeding; planting and replacement of flowers, trees and shrubs; and hiking trail maintenance
3. Maintenance of vegetation within existing firebreaks, airfield/radar clear zones, airfield imaginary surfaces, firing lines, lines of sight, ranges, anti-terrorism/force protection fence lines, and building clearance requirements not involving grubbing or other excavation
4. Maintenance and in-kind replacement of existing fencing

d. Utilities:

1. Repair and in-kind replacement of underground utility lines (such as fiber optic, water, and electric lines)
2. Maintenance of vegetation within existing utility clearance zones, rights-of-way and easements that does not involve grubbing or other excavation
3. Utility line maintenance and repair including but not limited to maintenance and repair of sewer lines, steam lines, gas lines, fire mains, and water lines
4. Cleaning of storm drain inlets and swales
5. Repair and maintenance of existing piping under roads and culverts
6. Maintenance and repair of aboveground storage tanks, underground storage tanks, and fuel lines
7. Studies (such as archeological investigations, periodic sampling, and geotechnical studies) for utility projects that require excavation but do not exceed 5,000 square feet of land disturbance and does not include grubbing
8. Maintenance, repair, and replacement of streetlights
9. Cleaning, maintenance, repair, and replacement of the following facilities and devices, to include removal of vegetation, including trees and shrubs, without grubbing or excavation, when other state or federal permits are not required:
    a. Existing drainage facilities,
    b. Storm water management devices, and
    c. Water quality facilities and devices
10. Roadside ditch regrading
11. Retrofit and redesign of existing drainage facilities that use environmental site design to the maximum extent practicable
12. In-kind replacement, reconstruction, repair, and modification of existing lighting, guardrails, traffic and pedestrian signals, curbs and gutters, sidewalks and ramps, variable message signs, and Americans with Disabilities Act compliant retrofits
13. Maintenance, repair, and replacement of existing railroad structures

g. Military Operations and Training: Activities described in this section shall be under 5,000 square feet of new land disturbance.

1. Installation of temporary metal plates, target poles, and targets and maintenance and replacement of catch boxes on existing ranges
1. Temporary placement and use of simulated target fields (e.g., inert mines, simulated mines, or passive hydrophones) in fresh, estuarine, and marine waters for the purpose of non-explosive research, development, test, and evaluation

2. Short term increases in air operations up to 50 percent of the typical operation rate, or increases of 50 operations per day, whichever is greater
3. Routine testing and evaluation of military equipment on a military reservation or an established range, restricted area, or operating area; similar in type, intensity and setting, including physical location and time of year, to other actions for which it has been determined, through NEPA analysis where a Department of Defense agency was a lead or cooperating agency, that there are no significant impacts; and conducted in accordance with all applicable standard operating procedures protective of the environment
4. Routine military training associated with transits, maneuvering, safety and engineering drills, replenishments, flight operations, and weapons systems conducted at the unit or minor exercise level; similar in type, intensity and setting, including physical location and time of year, to other actions for which it has been determined, through NEPA analysis where a Department of Defense was a lead or cooperating agency, that there are no significant impacts; and conducted in accordance with all applicable standard operating procedures protective of the environment.

h. Miscellaneous:

1. Preliminary engineering and technical studies
2. Non-invasive inspections, educational programs, and environmental surveys
3. Normal agricultural operations performed as part of an agricultural out-lease contract as described in the installation's approved Integrated Natural Resources Management Plan (hereinafter "INRMP")
4. Recreational hunting and fishing programs and routine fish and wildlife habitat management projects as described in the installation's approved INRMP
5. Prescribed burning for purposes of natural resources management, maintaining military operations, and wildfire prevention as described in the installation's approved INRMP
6. Installation, maintenance, repair, and replacement of signage that does not significantly affect coastal resources
7. Renewal of existing lease agreements, licenses, and easements under the same or nearly the same conditions that existed prior to renewal
8. Hosting or participating in military ceremonies and public events such as air shows, open houses, Earth Day events, National Public Lands Day events, conferences, concerts, and athletic events where no permanent changes to installation infrastructure are required to accommodate all aspects of the event
9. Routine movement, handling, and distribution of materials, including hazardous materials and wastes, that are moved, handled, or

distributed in accordance with existing, applicable regulatory requirements and permits

10. Transfer of real property from DoD to another federal agency
11. Receipt of real property from another federal agency when there is no anticipated or proposed substantial change in land use
12. Disposal of excess easement interests to the underlying fee owner where the easement is not part of an existing DoD environmental impact mitigation measure
13. Relocation of personnel into existing federally-owned or commercially leased space that does not involve a substantial change affecting the supporting infrastructure (e.g. no increase in vehicular traffic beyond the capacity of the existing road network to support such an increase)
14. Installation of devices to protect human or animal life (e.g., raptor electrocution prevention devices, fencing to restrict wildlife movement onto airfields, and fencing and grating to prevent accidental entry into hazardous areas)

II. Environmentally Beneficial Activities: Pursuant to 15 C.F.R. § 930.33(a)(4), the list of environmentally beneficial activities are excluded from further state agency consistency review.

a. The following activities are considered beneficial, and are not primarily for the purpose and benefit of stormwater best management practices ("BMPs") or mitigation as a result of a permitted activity:

1. Stand alone low-impact development retrofit or enhancement activities including but not limited to:
    a. Replacement of impervious surface with permeable materials or any form of low impact development design
    b. Storm water retrofits
    c. Demolition, disposal, or improvement of National Register of Historic Places ineligible structures or infrastructure that includes Maryland-approved sediment/erosion control measures and results in reduced impervious surface or increased ecosystem service providing vegetation.
    d. Construction and installation of grass swales
    e. Installation, maintenance, repair, and replacement of rain barrels, dry wells, and cisterns to manage storm water runoff from existing structures
    f. Installation, maintenance, and repair of green roof
2. Vegetative invasive species removal pursuant to the installation's approved INRMP
3. Reintroduction of endemic or native species (other than endangered or threatened species) into their historic habitat where no substantial site preparation is involved

4. Existing living shoreline restoration, maintenance and repair so long as any coastal disturbance is returned to its pre-disturbance condition. During staging operations, BMPs will be applied
5. Wetland creation and enhancement that does not involve excavation or clearing of forested buffers
6. Forest enhancement (clearing and replanting) in accordance with the installation's approved INRMP
7. Silviculture in accordance with the installation's approved INRMP
8. Implementation of an Urban Forest Management Plan in accordance with the installation's approved INRMP
9. Replacement of aboveground utilities with underground utilities using directional drilling and avoiding coastal uses and resources

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 2: Contents of Consistency Determinations

Consistency Determinations shall generally conform to the following format, when appropriate:

1. Enclosure 1: Proposed Project Description
    a. Project Location
    b. Project Description
    c. Public Participation Section
    d. Other Consultations (e.g., National Historic Preservation Act Section 106 Consultations)
2. Enclosure 2: Site Location
    a. Site Location Map
    b. Photographs
3. Enclosure 3: Basis of Determination: Each affected and unaffected Enforceable Coastal Policy should be addressed as relevant or not relevant in the Consistency Determination.
    a. General Policies
        i. Core Policies
        ii. Water Quality
        iii. Flood Hazards
    b. Coastal Resources
        i. Chesapeake and Atlantic Coastal Bays Critical Area
        ii. Tidal Wetlands
        iii. Nontidal Wetlands
        iv. Forests
        v. Historic and Archaeological Sites

vi. Living Aquatic Resources

c. Coastal Uses

i. Mineral Extraction

ii. Electrical Generation and Transmission

iii. Tidal Shore Erosion Control

iv. Oil and Natural Gas Facilities

v. Dredging and Disposal of Dredged Material

vi. Navigation

vii. Transportation

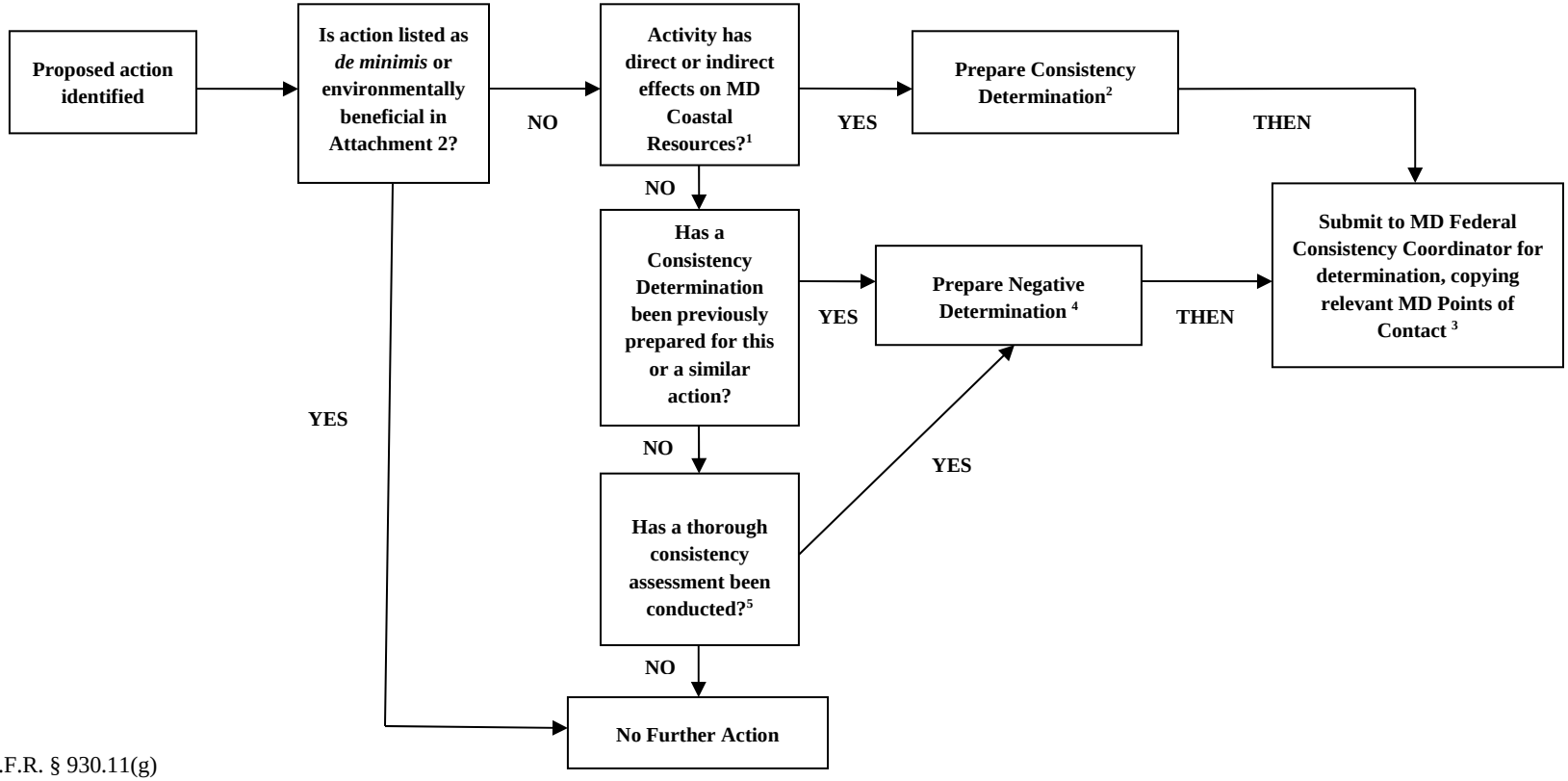
viii. Agriculture

ix. Development

x. Sewage Treatment

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 3: Federal Consistency Flow Chart



[1]15 C.F.R. § 930.11(g)

[2]See Contents of Consistency Determinations (Attachment 4) for a consistency determination template. Consistency determinations shall indicate whether such proposed activities will be undertaken in a manner consistent to the maximum extent practicable with Maryland's Enforceable Coastal Policies. See 15 C.F.R. § 930.32.

[3]See Maryland Federal Consistency Review Points of Contact (Attachment 1). The Maryland Federal Consistency Coordinator shall inform the DoD-identified point of contact of Maryland's concurrence with, or objection to, the DoD's consistency determination at the earliest practicable time, after providing for public participation in Maryland's review of the consistency determination. DoD may presume Maryland's concurrence if Maryland's response is not received within 60 days from the receipt of the DoD's consistency determination and supporting information. According to 15 C.F.R. § 930.41(a), the 60 day review period begins when the Maryland Federal Consistency Coordinator receives the consistency determination and supporting information required by 15 C.F.R. § 930.39(a).

[4]In accordance with 15 C.F.R. § 930.35,the DoD shall provide the negative determination to the Maryland Federal Consistency Coordinator and relevant points of contact, listed in Attachment 4, at least 90 days before final approval of the DoD activity. Maryland has 60 days to respond, and may request an extension of 15 days or less. The Maryland Federal Consistency Coordinator is not obligated to respond to a negative determination. If the Maryland Federal Consistency Coordinator does not respond to the Department of Defense's negative determination within 60 days, Maryland Federal Consistency Coordinator concurrence with the negative determination shall be presumed. See 15 C.F.R. § 930.35(c) and (e) for guidance on how to proceed should Maryland object to the negative determination.

[5]An EA or EIS prepared pursuant to NEPA which evaluates effects to coastal uses or resources is a thorough consistency assessment triggering the requirement to prepare a Negative Determination. However, in cases where the activity is on the list of *de minimis* and environmentally beneficial activities, a Negative Determination would not be required.

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 4: Maryland Federal Consistency Review Points of Contact Dated January 9, 2013

All federal consistency reviews for proposed Department of Defense activities shall be sent to:

Elder Ghigiarelli
Federal Consistency Coordinator
Deputy Program Administrator
Maryland Department of the Environment
Wetlands and Waterways Program
1800 Washington Boulevard, Suite 430
Baltimore, MD 21230-1708
(410) 537-3763
Email: eghigiarelli@mde.state.md.us

Joe Abe
Coastal Policy Coordination Section Chief
Chesapeake and Coastal Service
Maryland Department of Natural Resources
580 Taylor Avenue, E-2
Annapolis, Maryland 21401
(410) 260-8740
Email: jabe@dnr.state.md.us

When the Department of Defense evaluates Maryland's enforceable coastal policies in the following policy areas the consistency statement and supporting information must be transmitted to the relevant points of contact when the consistency statement is transmitted to the Maryland Federal Consistency Coordinator. The indicated point of contact should also be included in any early coordination.

<u>(B.1) The Chesapeake and Atlantic Coastal Bays Critical Area</u>

Lisa Hoerger
Regulations Coordinator
Department of Natural Resources
Critical Area Commission for the Chesapeake & Atlantic Coastal Bays
1804 West Street
Suite 100
Annapolis, MD 21401
(410) 260-3478
E-mail: lhoerger@dnr.state.md.us

(B.2) Tidal Wetlands

Rick Ayella
Division Chief
Maryland Department of the Environment
Tidal Wetlands Division – Baltimore Office
1800 Washington Boulevard
Baltimore, MD 21230-1718
(410) 537-3835
Email: rayella@mde.state.md.us

(B.3) Non-Tidal Wetlands

Amanda Sigillito
Division Chief
Maryland Department of the Environment
Nontidal Wetlands and Waterways Division
1800 Washington Boulevard
Baltimore, MD 21230-1718
(410) 537-3766
Email: asigillito@mde.state.md.us

(B.4) Forests

Marian Honeczy
Supervisor of Urban Programs & FCA Coordinator
Department of Natural Resources
Forest Service
Tawes State Office Building E1
580 Taylor Avenue
Annapolis, MD 21401-2397
(410) 260-8511
E-mail: mhoneczy@dnr.state.md.us

(B.5) Historical and Archeological Sites

Elizabeth J. Cole
Administrator, Review & Compliance
Department of Planning
Maryland Historical Trust - Crownsville Office
100 Community Place
Crownsville, MD 21032-2023
(410) 514-7631
bcole@mdp.state.md.us

(B.6) Living Aquatic Resources

Catherine McCall
Assistant Director
Coastal and Marine Assessment
Maryland Department of Natural Resources
580 Taylor Avenue, E-2
Annapolis, MD 21401
(410) 260-8737
Email: cmccall@dnr.state.md.us

APPENDIX F

Army Compatible Use Buffer (Chesapeake Bay)
Program Proposal

DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

DAIM-ZA

DEC 19 2016

MEMORANDUM THRU U.S. Army Installation Management Command (IMCG), 2405 Gun Shed Road, Joint Base San Antonio Fort Sam Houston, Fort Sam Houston, Texas 78234-1223

FOR Commander U.S. Army Garrison Aberdeen Proving Ground (IMAP-PWE), 4510 Boothby Hill Avenue, Aberdeen Proving Ground, MD 21005-5001

SUBJECT: Revised Approval – U.S. Army Garrison Aberdeen Proving Ground (USAGAPG) Army Compatible Use Buffer (ACUB) Priority Area Changes

1. References:

a. Memorandum, HQ, DAIM-ISE, 22 Sep 16, subject: Approval – U.S. Army Garrison Aberdeen Proving Ground (USAGAPG) Army Compatible Use Buffer (ACUB) Priority Area Changes.

b. Memorandum, U.S. Army Installation Management Command, IMAP-PWE, 11 May 16, subject: U.S. Army Garrison Aberdeen Proving Ground (USAGAPG), MD, Army Compatible Use Buffer (ACUB) Priority Area Changes.

2. This memorandum supersedes the approval memorandum at reference a.

3. I approve the changes proposed to the USAGAPG ACUB priorities described at reference b.

4. USAGAPG is expected to coordinate with Headquarters IMCOM G4 for applicable execution guidance.

5. Within 120 days from the issuance of this memorandum, USAGAPG will update its original ACUB proposal including associated maps, tables, and cost estimates by incorporating the changes approved by this action and accomplishments to date. Please transmit copies of the updated proposal to the POC listed below, HQ U.S. Installation Management Command G-4, and the U.S. Army Environmental Command Cooperative Agreement Manager responsible for the USAGAPG ACUB.

6. The point of contact for this matter is Mr. John Housein (571) 256-9731 (DSN 260), email john.g.housein.civ@mail.mil.

GWEN BINGHAM
Lieutenant General, GS
Assistant Chief of Staff
for Installation Management

CF:
U.S. Army Environmental Command

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

DAIM-ISE

SEP 2 2 2016

MEMORANDUM THRU U.S. Army Installation Management Command (IMPW-SE), 2405 Gun Shed Road, Joint Base San Antonio Fort Sam Houston, Fort Sam Houston, Texas 78234-1223

MEMORANDUM FOR Commander U.S. Army Garrison Aberdeen Proving Ground (IMAP-PWE), 4510 Boothby Hill Avenue, Aberdeen Proving Ground, MD 21005-5001

SUBJECT: Approval – U.S. Army Garrison Aberdeen Proving Ground (USAGAPG) Army Compatible Use Buffer (ACUB) Priority Area Changes

1. References:

a. Memorandum, DAIM-ISE, 24 Feb 12, subject: Interim Army Implementation Guidance for Encroachment Authorities

b. Memorandum, IMAP-PWE, 11 May 16, U.S. Army Garrison Aberdeen Proving Ground (USAGAPG), MD, Army Compatible Use Buffer (ACUB) Priority Area Changes

c. Memorandum, IMPW-SE, 3 Jun 16, Description of proposed changes to the USAG-Aberdeen Proving Ground (APG) Army Compatible Use Buffer (ACUB) Priority Areas

2. In accordance with the procedures outlined in reference 1.a., and in response to reference 1.b., the changes proposed for the USAGAPG ACUB have been reviewed by Headquarters Department of the Army (HQDA) staff in coordination with stakeholder organizations. HQDA staff have found that USAGAPG proposed changes amount to a 23% reduction in Priority Areas targeted for ACUB action through encroachment partnership. The proposed changes do not substantially increase cost or geographic scope and therefore do not warrant higher level approval.

3. The Chief of Army Training Support Systems Division in the Office of the Deputy Chief of Staff G-3/5/7 and the Chief of the Army Environmental Division, in the Office of the Assistant Chief of Staff for Installation Management approve the proposed actions subject to the following conditions.

a. Funds appropriated to IMCOM for Base Operations Support and funds obtained through the Office of the Secretary of Defense Readiness and Environmental Protection Integration Program cannot be used to execute transactions in priority areas identified

as PA 1 NE Kent (6,423 acres), PA 1 S Kent (20,981 acres) and PA 1 N Cecil (966 acres).

b. Within 120 days from the issuance of this memorandum, USAGAPG will update its original ACUB proposal including associated maps, tables, and cost estimates by incorporating the changes approved by this action and accomplishments to date. Please transmit copies of the updated proposal to the POC listed below, HQ U.S. Installation Management Command G-4, and the U.S. Army Environmental Command Cooperative Agreement Manager responsible for the USAGAPG ACUB.

5. The point of contact for this matter is Mr. John Housein (571) 256-9731 (DSN 260), email john.g.housein.civ@mail.mil.

MARY WILLIAMS-LYNCH
Colonel, GS
Chief, Army Environmental Division

THOMAS E. MACIA
Chief, Training Support Systems Division

DEPARTMENT OF THE ARMY
U.S. ARMY INSTALLATION MANAGEMENT COMMAND
U.S. ARMY GARRISON ABERDEEN PROVING GROUND
4510 BOOTHBY HILL AVENUE
ABERDEEN PROVING GROUND MARYLAND 21005-5001

REPLY TO
ATTENTION OF

MAY 11 2016

IMAP-PWE

MEMORANDUM THRU U.S. Army Installation Management Command (IMPW-E), 2405 Gun Shed Road, JBSA Fort Sam Houston, TX 78234-1223

FOR Office of the Assistant Chief of Staff for Installation Management (DAIM-ISE), 600 Army Pentagon, Washington, DC 20310-0600

SUBJECT: U.S. Army Garrison Aberdeen Proving Ground (USAGAPG), MD, Army Compatible Use Buffer (ACUB) Priority Area Changes

1. References:

a. Memorandum, DAIM-ISE, 24 Feb 12, subject: Interim Army Implementation Guidance for Encroachment Authorities.

b. U.S. Army Garrison Aberdeen Proving Ground, MD, Army Compatible Use Buffer (ACUB), 18 Mar 11.

c. Memorandum, DAIM-ZA, 1 May 12, subject: Approval – U.S. Army Garrison Aberdeen Proving Ground, MD, Army Compatible Use Buffer (ACUB).

2. In accordance with procedures outlined in reference 1a, USAGAPG requests Installation Management Command and Headquarters, Department of the Army approval for changes to APG's approved ACUB Priority Areas (PA's) as referenced in 1b and 1c.

3. The proposed changes to APG's approved PA's will strategically reduce the acreage of the PA's and realign them with targeted areas of other land conservation programs. This revision will also allow the partner to secure more matching funds to further the support of APG's mission.

4. A memorandum for record detailing the proposed changes and copies of maps of the originally approved and the proposed adjusted PA's are enclosed.

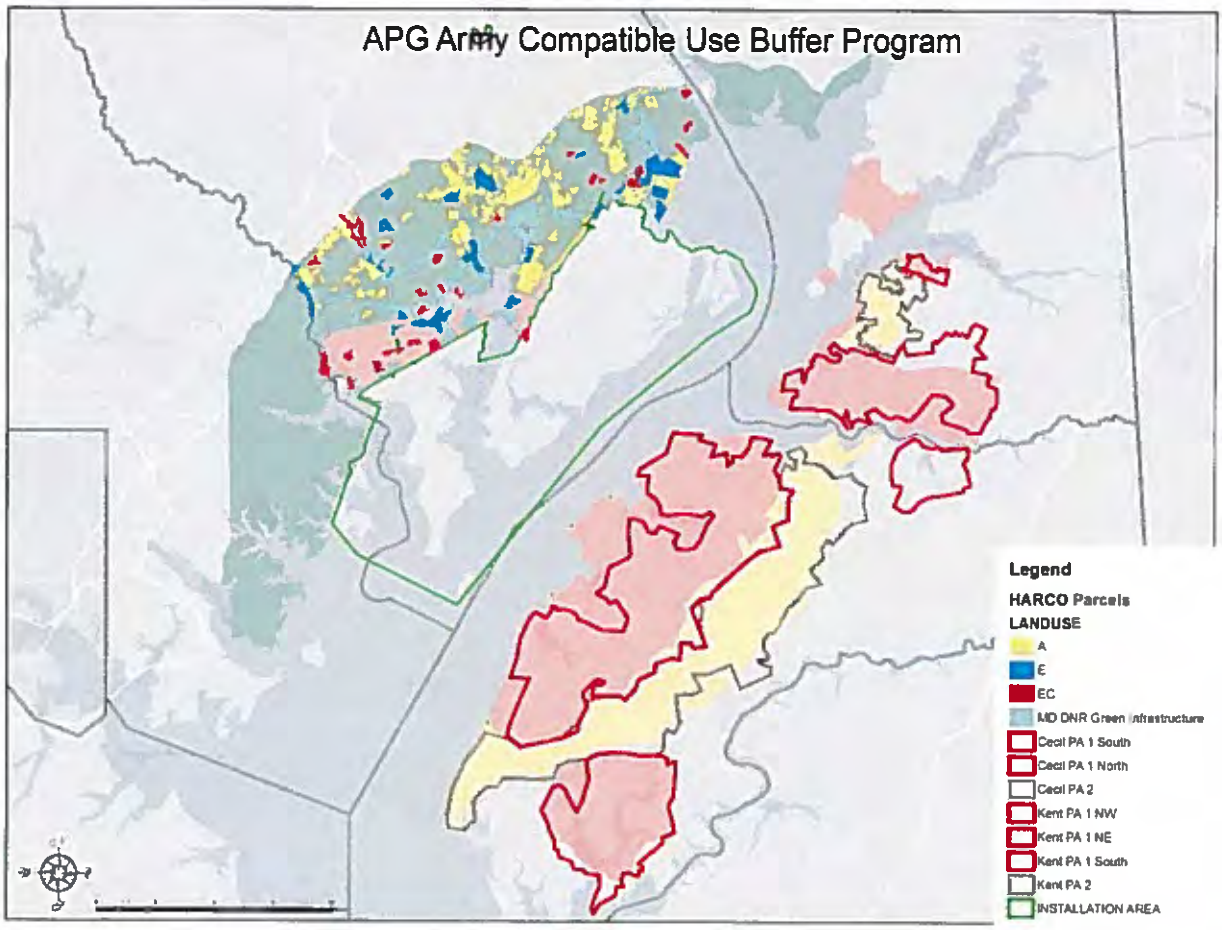
5. Once approved, reference 1b will be updated to reflect the updated PA's and end state.

6. The point of contact for this action is Mr. Todd Beser, at (410) 436-0721, or by email: todd.m.beser.civ@mail.mil.

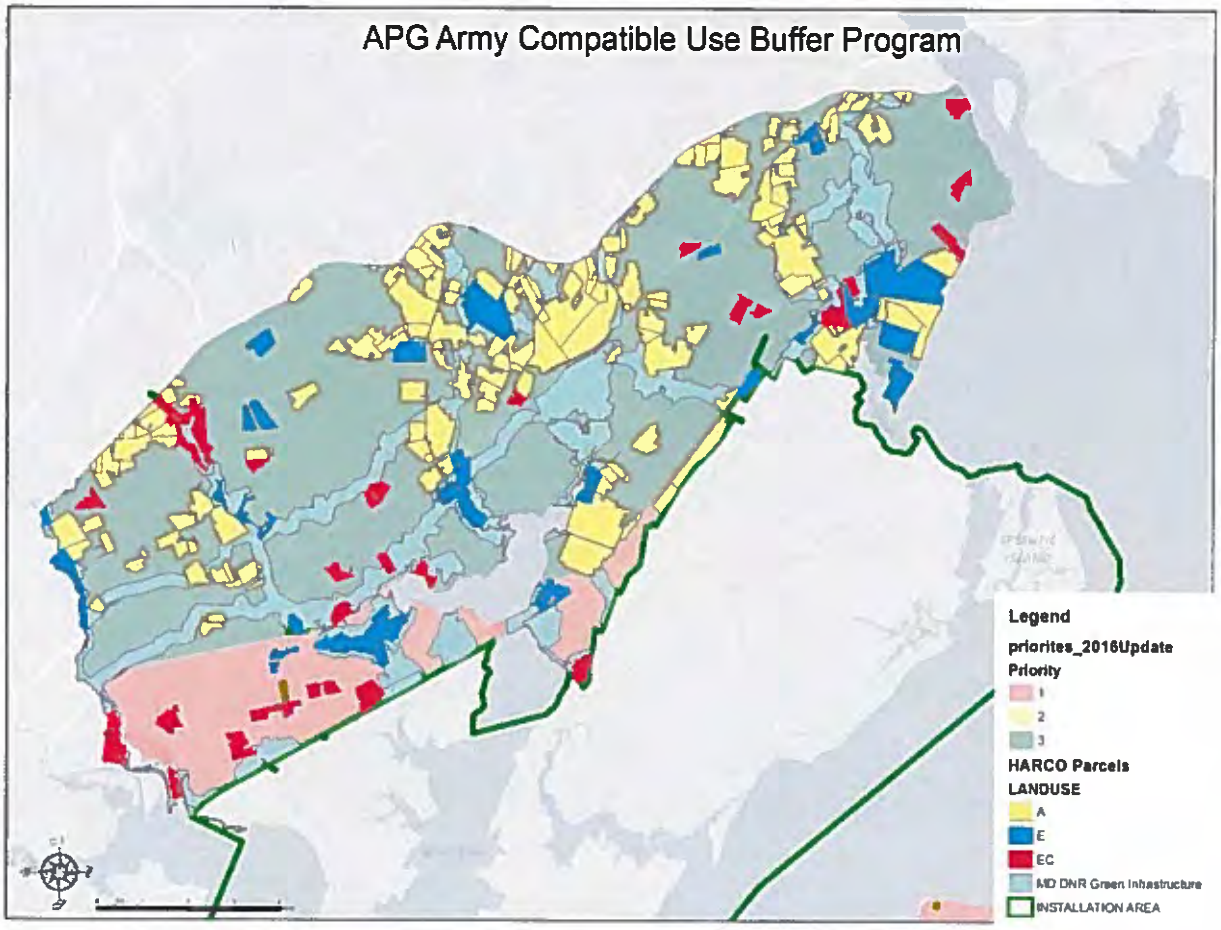
James E. Davis

5 Encls

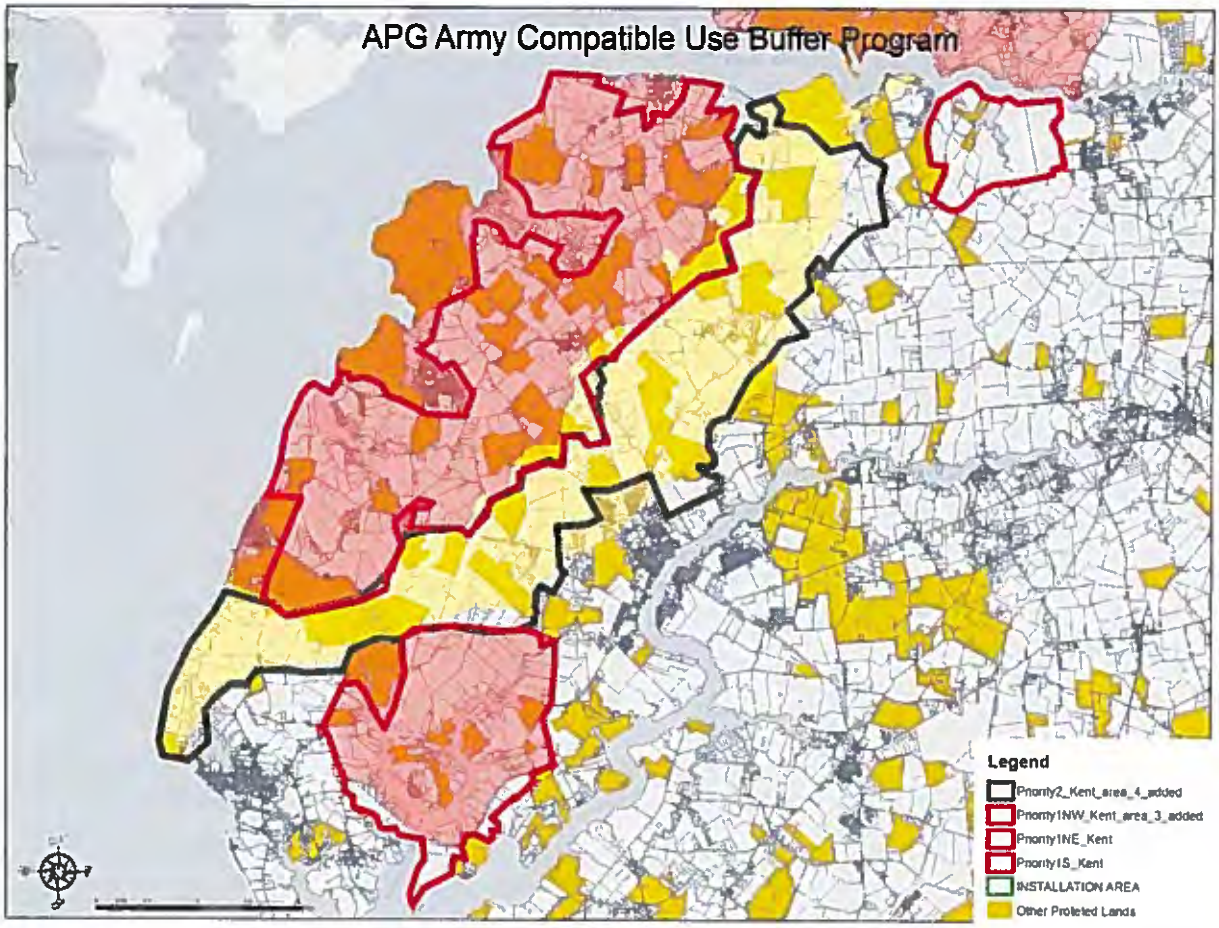
JAMES E. DAVIS
COL, FI
Commanding



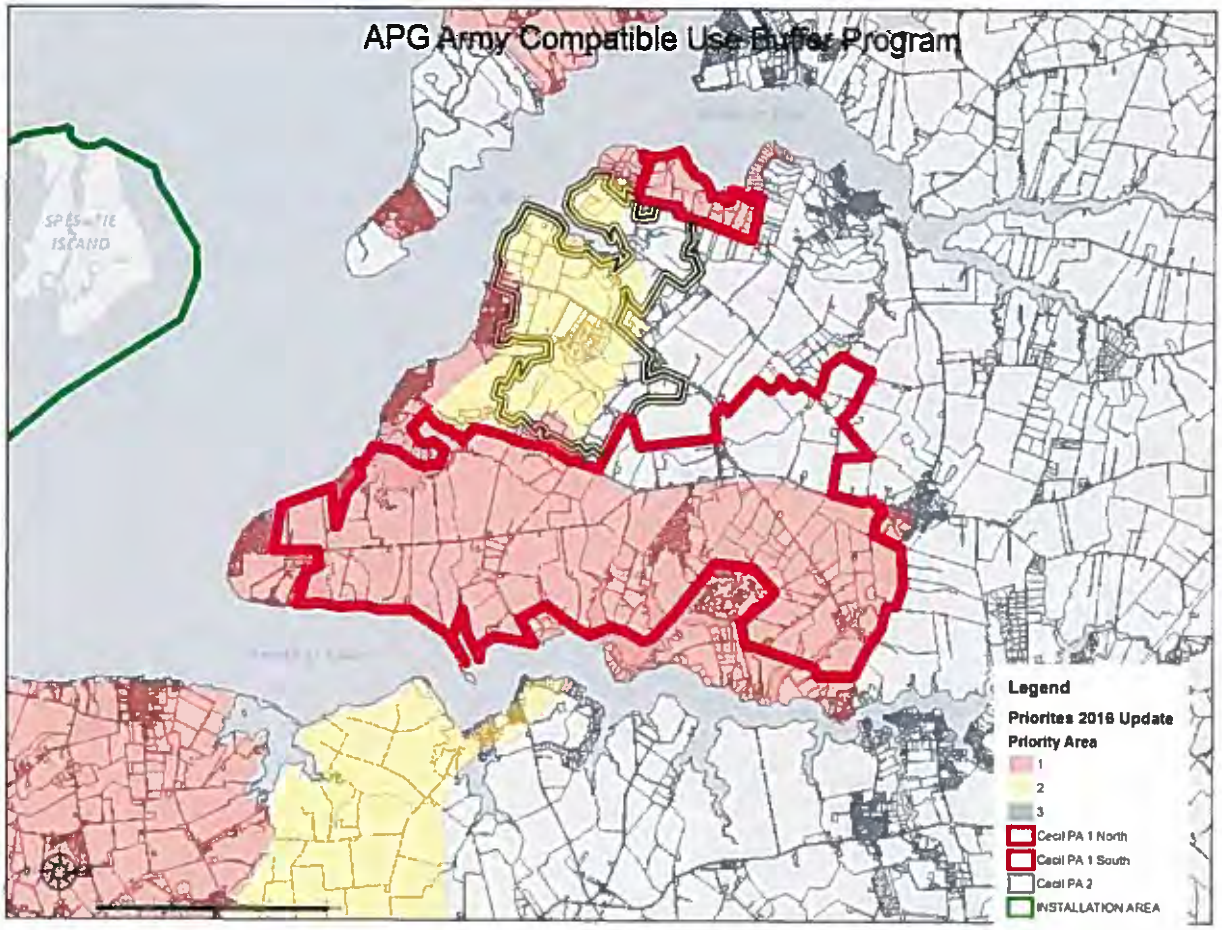
Enclosure 1: Map depicting overall proposed PA changes.



Enclosure 2: Map depicting the detailed analysis of parcels within Harford County, MD PAs



Enclosure 3: Map depicting proposed PA changes in Kent County (Eastern Shore, MD)



Enclosure 4: Map depicting proposed PA changes in Cecil County (Eastern Shore, MD)

IMAP-PWE

MAY 11 2016

MEMORANDUM FOR RECORD

SUBJECT: Description of Proposed Changes to the USAG-Aberdeen Proving Ground (APG) Army Compatible Use Buffer (ACUB) Priority Areas

1. This memo describes proposed changes to APGs ACUB approved priority areas (PAs). The PAs areas defined in the APG's original ACUB proposal dated 18 Mar 11 were based on the extent of operational noise contours (i.e., 130 and 115 dB), with emphasis on properties containing large tracts of forest, wetland, Chesapeake Bay critical area and bald eagle habitat. The proposed changes are based on further analyses including parcel size and established land use, and provide a better defined end-state.

2. On the Eastern Shore of Maryland, this revision will strategically reduce the acreage of the PAs and realign them with targeted areas of other land conservation programs. This revision will also allow the partner to secure more matching funds to further the support of APG's mission. Our desired end state remain the same as our FY16 REPI proposal of 90% of PA 1 and 80% of PA 2 including lands already protected and protected by other organizations.

3. On the Western Shore of Maryland, this revision targets larger parcels that have a more appropriate land use classification that may provide a greater opportunity for off post mitigation. It also realigns targets with other land conservation programs. We have selected parcels equal to or larger than 25 acres with the land use classification of Agricultural, Exempt and Exempt commercial. We have also included Maryland's Green Infrastructure targets. These changes give a total of 1,197 acres in PA 1 and 14,901 acres in PA 3 and 23,008 acres of targeted Green Infrastructure across the PAs. We will continue to target 60% on the Western Shore as an end state in order to develop off post mitigation locations that will aid in meeting various compliance requirements on APG.

4. Tables detailing changes to PA acreages:

Cecil County	**New**	**Old**
PA 1 North	966	1,505
PA 1 South	21,270	24,411
PA 2	6,369	5,751
Total	**28,605**	**31,667**

Encl 5

SUBJECT: Description of Proposed Changes to the USAG-Aberdeen Proving Ground (APG) Army Compatible Use Buffer (ACUB) Priority Areas

Kent County	**New**	**Old**
PA 1 NW	57,759	70,627
PA 1 NE	6,423	
PA 1 S	20,981	20,827
PA 2	47,990	53,655
Total	**133,153**	**145,109**

Harford, Baltimore, Cecil County	**New Selection w/in PA (Harford Co only)**	**New PA (Harford Co only)**	**Old**
PA 1	5993	14522	14522
PA 3	33113	82376	139294
Total	**39106**	**96898**	**153816**

5. The point of contact for this action is Mr. Todd Beser, at (410) 436-0721, or by email: todd.m.beser.civ@mail.mil.

JAMES E. DAVIS
COL, FI
Commanding

DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

DAIM-ZA

MAY 1 2012

MEMORANDUM FOR

COMMANDER, U.S. ARMY GARRISON ABERDEEN PROVING GROUND (IMAP-PWE) 305 ABERDEEN BOULEVARD, ABERDEEN PROVING GROUND, MD 21005-5001
COMMANDER, U.S. ARMY ENVIRONMENTAL COMMAND (IMAE-QP), 2450 CONNELL ROAD BLDG 2264, FORT SAM HOUSTON, TX 78234-7664

SUBJECT: Approval – U.S. Army Garrison Aberdeen Proving Ground, MD, Army Compatible Use Buffer (ACUB)

1. References:

a. Memorandum, OACSIM (DAIM-ISE), 24 Feb 12, subject: Interim Army Implementation Guidance for Encroachment Authorities.

b. U.S. Army Garrison Aberdeen Proving Ground, Army Compatible Use Buffer Proposal 02 Feb 12.

c. Memorandum, OACSIM (DAIM-ISE), 20 Apr 12, subject: Recommendation Army Compatible Use Buffer (ACUB) at U.S. Army Garrison Aberdeen Proving Ground, MD – ACTION MEMORANDUM.

2. In accordance with procedures outlined in reference 1a and in response to reference 1b, Headquarters, Department of the Army (HQDA) staff reviewed and recommended approval of the proposal to establish an ACUB at U.S. Army Garrison Aberdeen Proving Ground, MD.

3. The installation's proposal to enter into a cooperative agreement with the Harford Land Trust, The Conservation Fund, and Eastern Shore Land Conservancy meets the intent of Congress to sustain the training capabilities of our installations while maintaining sound environmental stewardship principles. The U.S. Army Garrison Aberdeen Proving Ground ACUB proposal meets all the requirements and is hereby approved with the following requirements.

a. ACUB easements shall be perpetual.

b. Variations from the approved plan shall be submitted to HQDA for consideration prior to the commitment of financial resources.

c. HQDA requires annual updates and biennial reviews of the ACUB.

4. Point of contact for this matter is Mr. John Housein, HQDA ACUB Program Coordinator, 571-256-9731, email: john.housein@us.army.mil.

MICHAEL FERRITER
Lieutenant General, GS
Assistant Chief of Staff
for Installation Management

CF:
IMCOM G-4
IMCOM G-7

Aberdeen Proving Ground Army Compatible Use Buffer Program

"CHESAPEAKE BAY-CUB"

3/18/2011
U.S. Army Aberdeen Proving Ground
U.S. Army Aberdeen Test Center

Prepared By	Prepared By
David Goad Environmental Division US Army Aberdeen Test Center	Todd Beser Environmental Division Directorate of Public Works US Army Garrison Aberdeen Proving Ground
Approved By	**Legally Sufficient**
Joseph Kaffl Installation OPSEC Officer U.S. Army Garrison Aberdeen Proving Ground	Joseph M. Masterson LTC, JA Staff Judge Advocate U.S. Army Garrison Aberdeen Proving Ground
Approved By	**Approved By**
Jeffrey P. Holt Colonel, IN Commanding U.S. Army Aberdeen Test Center 22 Sep 2011 Date	Orlando W. Ortiz Colonel, MI Deputy Installation Commander U.S. Army Garrison Aberdeen Proving Ground 22 Sep 11 Date

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EXECUTIVE SUMMARY

Aberdeen Proving Ground (APG) is seeking Headquarters, Department of the Army (HQDA) consideration for multi-year funding to develop Army Compatible Use Buffers (ACUBs) within the off-post noise envelope and bald eagle habitat range. ACUB will be an integral tool for APG to meet the demands of 2005 Base Realignment and Closure (BRAC) growth and a continuous increase in OPTEMPO testing due to the ongoing Overseas Contingency Operation (OCO).

APG currently has testing and training restrictions due to internal and external encroachment issues, including operational noise, protected species (bald eagle), protected lands (wetlands and critical area), and urban development. A comprehensive ACUB program will protect APG's vital military mission, and help conserve valuable habitat and protected lands in the Chesapeake Bay watershed - a national treasure. The APG ACUB program will also support the Department of Defense (DoD) in meeting the requirements of Executive Order 13508: Chesapeake Bay Protection and Restoration.

The APG ACUB program will support the military mission at APG by providing the following benefits.

1. Maintain the current compatible land uses on the Chesapeake Bay.
2. Meet future TMDL load allocations.
3. Conserve bald eagle habitat to supplement on-post bald eagle preservation.
4. Conserve wetlands or provide off-post mitigation options to alleviate on-post wetland mitigation.
5. Conserve Chesapeake Bay Critical Area or provide off-post mitigation options to alleviate on-post mitigation for consistency with Maryland's enforceable policies.

To achieve the goals of the ACUB program, APG will partner with the Eastern Shore Land Conservancy (ESLC), Harford Land Trust (HLT), and The Conservation Fund (TCF). All easements and fee-simple purchases within this program will require mutual benefit to APG, our land conservation partners, and willing property owners. Priority preservation areas along the northern Chesapeake Bay use the operational noise peak blast contours and bald eagle habitat range to delineate priority areas.

Priority 1: Priority 1 ACUB areas are properties within the 130db noise contour which extends on both the Eastern Shore and Western Shore. Priority 1 also encompasses the perimeter of the APG installation.
Priority 2: Priority 2 ACUB areas are properties between the 130db and 115db contours on the Eastern Shore, as well as areas along the Sassafrass and Elk Rivers that contain bald eagle nest and roost habitat.
Priority 3: Priority 3 ACUB areas are properties between the 130db contour and the perimeter of APG on the Western Shore. These areas are designated as Priority 3 because much of this land has already been developed or preserved.
Priority Caveat: Properties within any priority area that contain large tracts of forest, wetland, critical area, or bald eagle habitat, may be preferred for the potential regulatory relief that they provide.

The priority areas encompass 149,959 acres in Harford, Cecil, Kent, and Baltimore Counties of Maryland. APG and its partners are positioned to move on parcels within priority areas in Fiscal Year 2011; once the program is approved by HQDA. The installation is prepared to work with our partners in any public outreach capacity to increase the opportunity for a successful program. APG's partners have indicated a willingness of land owners within the program scope to enter into easements, and have already identified potential target parcels.

Figure 1 provides an overview of the ACUB program at APG. It summarizes priority areas, noise contours, TMDL segments, bald eagle hot spots, wetlands, and critical area locations.

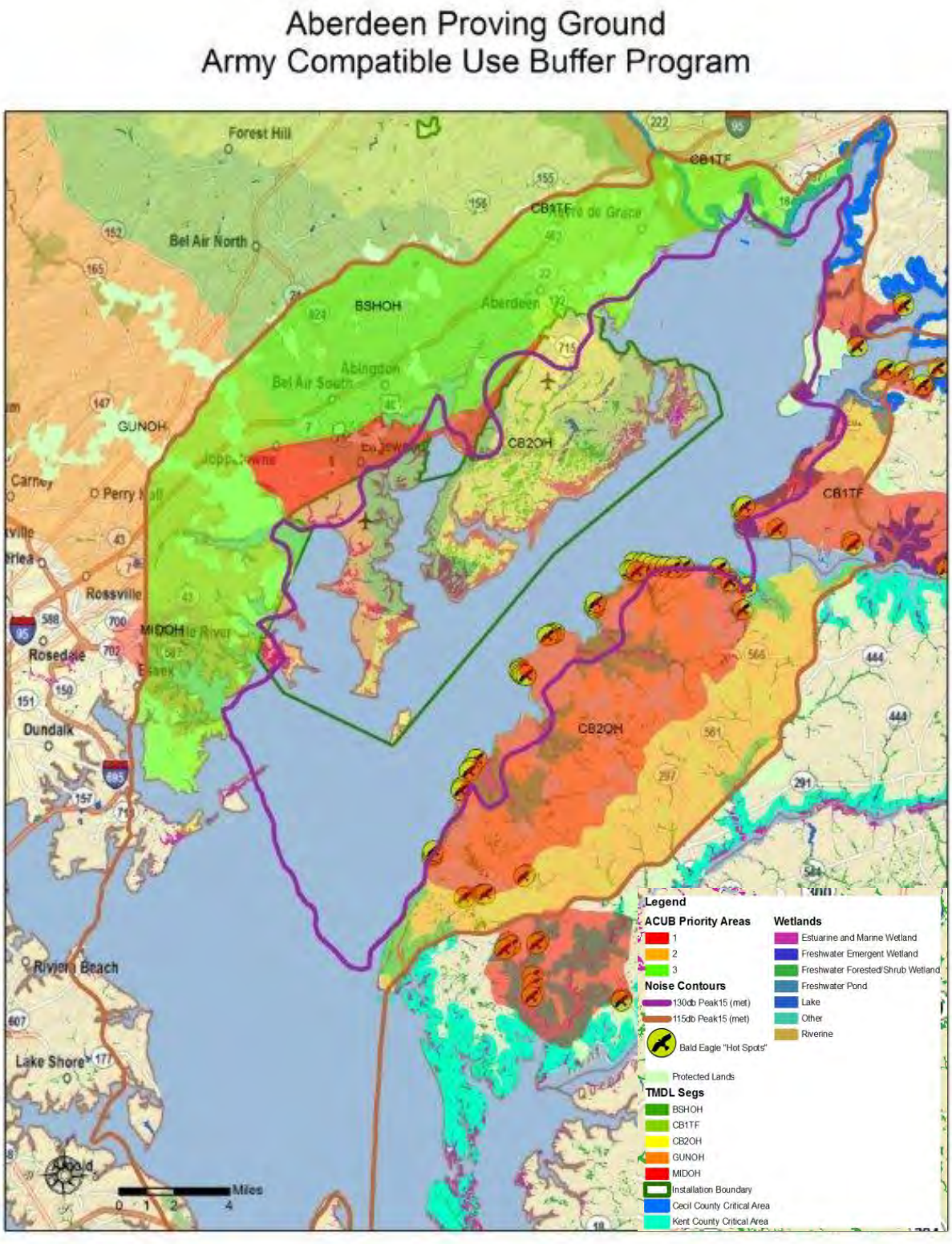

Figure 1. APG ACUB Program Overview

1.0 INTRODUCTION

Aberdeen Proving Ground (APG) faces tremendous growth as a result of Base Realignment and Closure (BRAC) 2005 and a continuous increase in OPTEMPO testing due to the ongoing Overseas Contingency Operation (OCO). To meet this increase in testing and training demands, APG is seeking Headquarters, Department of the Army (HQDA) consideration for multi-year funding to develop Army Compatible Use Buffers (ACUBs) within the off-post noise envelope and bald eagle habitat range.

Providing Soldiers, Sailors, Airmen and Marines with safe, effective, and superior equipment is extremely important, especially in the current OCO environment. Equipment testing and providing real time, high-quality, world-class data to decision makers is more important than ever. APG currently must comply with testing and training restrictions due to internal and external encroachment issues, including operational noise, protected species (bald eagle), protected lands (wetlands and critical area), and urban development. The allure of waterfront living threatens the installation's testing and training ranges. Left unchecked, this growth will ultimately result in the degradation of military capabilities.

A comprehensive ACUB program will protect APG's vital military mission. It will also help conserve the Chesapeake Bay - a national treasure and the largest estuary in the United States. The Chesapeake Bay is critical to the military's ability to test and train on a real, joint, land-water-airspace platform at APG. There is no other installation on the East Coast that provides the complete land-water-airspace profile adjacent to an active firing range. This capability provides an opportunity for joint Warfighters to "train as they fight" and is used by the Department of Army, Department of Navy, and the US Coast Guard.

Operational noise generated from the test and training mission at APG is often heard by residents on the Chesapeake Bay. An ACUB program at APG would limit development on the installation's boundary along the Chesapeake Bay, thereby limiting the number of future noise receptors. It will also protect fragile ecological systems, natural habitats, and agricultural land that are dependent on the bay for survival. The Chesapeake Bay is a critical resource for commercial and recreational activities; however it has been stressed in recent years by an increasing population; delegating APG one of the last bastions for natural resource protection on the bay landscape. APG plays a critical role in the protection of the bald eagle and habitats including wetlands, forest, and coastal zone buffers. Mission requirements often call for development on or near regulated land which may also result in impacts to bald eagle nest buffers or forest removal. Mitigating these impacts is critical to the health of the Chesapeake Bay; however, identifying land on the installation to protect for mitigation is becoming increasingly more difficult. The potential to utilize off-post lands for APG mitigation sites and bald eagle habitat would be a significant benefit to APG's mission to support the Warfighter.

Using ACUB land for environmental mitigation would allow APG to maintain the use of vital Research, Development, Test and Evaluation (RDT&E) areas while also providing greater protection and preservation throughout the Chesapeake Bay. Additionally, with Total Maximum Daily Load (TMDL) requirements in development, the ACUB program can be used to meet those pending requirements through land conservation in the TMDL segment sheds.

1.1 Test and Training Background

1.1.1 General Description of the Installation and Testing/Training Mission

The mission of Garrison Aberdeen Proving Ground is "to provide the highest quality installation management, operation and support services in a timely manner through the full involvement and commitment of our people."[1]

APG, the Army's oldest active Proving Ground, was established on October 20, 1917, six months after the United States entered World War I. The intent was to provide the military with a facility where design and testing of ordnance material could be carried out in close proximity to the nation's industrial and shipping centers. Since its inception countless Army systems have been tested at APG: from the French 75MM to the Atomic Cannon; the Christy, Sherman, Patton, Sheridan, and Abrams Tanks. These systems were proven at APG, serving our soldiers in WWI, WWII, Korea, Vietnam, Desert Storm, and most recently Operations Enduring Freedom and Iraqi Freedom.

APG occupies more than 72,500 acres of land and water in Harford and Baltimore Counties, Maryland (see Figure 2). The installation comprises two principal areas which are separated by the Bush River. The northern area is known as the Aberdeen Area and the southern area is known as the Edgewood Area. APG's northernmost point is marked by the confluence of the Susquehanna River and the Chesapeake Bay. To the south the principal area is bordered by the Gunpowder River. APG property not attached to the principal area of the installation includes the Churchville Test Area (CTA) and Pooles Island in Harford County and Carroll Island and Graces Quarters in Baltimore County. Approximately 144 miles of shoreline fall within the installation boundaries.

APG supports 79 Garrison Supported Organizations (GSOs)[2] and a host of satellite activities. Among the major tenants are the U.S. Army Research, Development and Engineering (RDECOM), US Army Research Laboratory (ARL), Edgewood Chemical Biological Center (ECBC), U.S. Army Developmental Test Command (DTC), U.S. Army Aberdeen Test Center (ATC), U.S. Army Public Health Command (PHC), Northeast Region Civilian Personnel Operations Center (NECPOC), U.S. Army Medical Research Institute of Chemical Defense (MRICD), Program Manager for Chemical Demilitarization and 20th Support Command. The BRAC 2005 decision has brought the US Army Communications Electronics Command (CECOM), US Army Test and Evaluation Command (ATEC), Communications-Electronics Research, Development and Engineering Command (CERDEC), Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD), and numerous other support organizations to APG.

[1] Garrison Aberdeen Proving Ground website, http://www.apg.army.mil/apghome/sites/local/index.cfm , 29 Jun 10.
[2] Garrison Aberdeen Proving Ground website, http://www.apg.army.mil/apghome/sites/tenants/tenants.cfm, 29 Jun 10.

Figure 2. Map of Aberdeen Proving Ground

BRAC 2005 has defined APG as a critical RDT&E center of excellence for the US Army. As a major hub for Army material testing and laboratory research, the post is a key element in the nation's defense. All tracked and wheeled vehicles which have served the U.S. Forces for the past 60 years have been tested for performance and durability at APG.

APG's Edgewood Area (APGEA) has served as a center for chemical warfare research and development since it was established. From the trenches of France and Belgium in World War I to the desert battlefields of Iraq nearly 80 years later, the research and testing done at APGEA has contributed to the defense and safety of American forces threatened by chemical weapons.

1.1.1.1 Aberdeen Test Center

As one of APG's largest GSOs and a Major Range and Test Facility Base (MRTFB), Aberdeen Test Center (ATC) operates under the guidance of the Department of Defense (DoD) Directive 3200.11 and is considered a national asset. The mission of ATC is "to provide test and test support services for authorized customers, within DoD and outside DoD, including government and non-government organizations, domestic and foreign. Provide comprehensive test and training both real and simulated; provide expert knowledge and technical services including instrumentation application, facility operations, manufacturing and fabrication; exploit emerging technologies; and develop leading edge instrumentation and test methodologies."[3] ATC is DoD's lead test center for manned and unmanned ground vehicles, direct fire, and live-fire vulnerability testing. Major missions at ATC include automotive testing of wheeled and tracked vehicles, firepower, survivability/lethality, Warfighter testing of soldier systems and support equipment, military environmental technologies and maritime systems.

ATC has developed into the most diverse, rigorous test center in DoD, testing a broad spectrum of military weapons systems and equipment including armored vehicles, guns, ammunition, trucks, bridges, generators, night vision devices, individual equipment (boots, uniforms, helmets, etc) and surface and underwater naval systems. As a multi-purpose proving ground, with a temperate climate, ATC's primary mission is to plan, conduct, analyze and report on projects supporting all phases of weapons development and acquisition including surveillance and operational tests for DoD and other government agencies, foreign governments, as well as the private sector.

In this single location, ATC can subject an item to a full range of tests from automotive endurance and full weapons performance with environmental extremes, to full-scale live fire vulnerability/survivability/ lethality testing utilizing an extensive array of test ranges/facilities, simulators and models. In addition to testing domestic systems, ATC exploits foreign systems. This one-stop testing capability effectively and efficiently meets the overarching need of the DoD acquisition community. Test Center professionals also develop state-of-the-art test procedures, methodologies and instrumentation to meet the test requirements of advancing military technologies. Structurally, ATC is aligned to facilitate integrated systems test and analysis. ATC's automotive test courses at Munson, Perryman and Churchville stress vehicle systems agility, mobility, and reliability at wartime levels; and nations throughout the world attempt to copy their capabilities.

[3] US Army Aberdeen Test Center website, http://www.atc.army.mil/mission.htm, 29 Jun 10.

ATC provides world-class, all-purpose testing, to Department of Defense and components, federal, state and local governments, academia, private industry, and allied foreign governments. ATC is the principal range operator at APG supporting numerous Program Managers (PMs) and Program Executive Offices (PEOs) that rely on the test center to provide test and evaluation services throughout the acquisition life cycle.

As a result of BRAC relocations, the mission at ATC is expanding to include more C4ISR missions. Further, ATC conducts the most rapid initiative tests of any developmental test center in the Army which continues to provide an increased workload with high priority and short turnaround times.

From FY05 through FY09, ATC supported almost 7000 (average 1384) tests; issued almost 28,000 (average 5523) firing clearances; averaged 515,925 miles driven; 388,400 miles simulated; 7608 large rounds fired; and 2,535,586 small rounds fired. All of these tests produced an average of 48,532 Test Incident Reports per year from FY05 through FY09 which resulted in safer, more effective items fielded to the nation's military. A Test Incident Report is a document noting shortcomings in a system to meet the Army's needs. Without ATC identifying these shortcomings, military equipment would go to theater and not function properly. The number of Warfighters' lives saved by the early identification of these issues may never be known, but is certainly countless and priceless.

Since the beginning of Rapid Initiative Projects in FY05, ATC has conducted 734 of the 1834 total Rapid Initiative projects for DTC, or 40% of the total number of projects. Rapid initiatives are critical needs identified in theater that must be tested for verification and rapid fielding to the Warfighter to improve the capability in real time. ATC's ability to execute these rapid initiative tests has been critical to the success of the military in all theaters of operation.

1.1.1.2 Army Research Laboratory

The U.S. Army Research Laboratory (ARL) of the U.S. Army Research Development and Engineering Command (RDECOM) is the Army's corporate, or central, laboratory. Its diverse assortment of unique facilities and dedicated workforce of government and private sector partners make up the largest source of world-class integrated research and analysis in the Army. The mission of ARL is to "Provide the underpinning science, technology, and analysis that enable full-spectrum operations." ARL accomplishes this mission through comprehensive experimentation that includes the exploitation of chemical energy munitions and ballistic firing of kinetic energy weapons at 13 outdoor range facilities and 8 indoor range facilities. With 11 of the 13 outdoor facilities located on Spesutie Island, and the proximity of Spesutie Island to the Chesapeake Bay and Eastern shore, the capabilities of these facilities continue to be reduced due to noise and land restrictions. ARL provides vital time sensitive research towards IED (Improvised Explosive Device) threat mitigation, insensitive munitions research, and vehicle survivability and lethality. The NEW (Net Explosives Weight) capabilities for our facilities have been reduced by 30% (average) in an effort to reduce noise and the subsequent number of noise complaints generated over the past several years.

The diversity of the challenges encountered in the OCO demand flexibility and timeliness with research and validation through range experimentation. The current process for approving new facilities, firing sites, and structures to meet this challenge and deliver life saving materials and equipment to the battlefield has become extremely cumbersome and time consuming. ARL has overburdened its two facilities that are located interior and not as affected by noise and land restrictions. These two interior

facilities are able to provide a greater NEW capability. As the experimentation schedules of those two facilities reaches its maximum and the noise restrictions increase on Spesutie Island, ARL will be forced to further postpone or delay critical experimentation.

1.1.2 General Description of the Testing and Training Infrastructure

APG operates on more than 72,500 acres which includes 66,000 acres of range areas. APG owns 144 miles of Chesapeake Bay and tributary shoreline, including 60 miles adjacent to live ranges with a Military Operations on Urban Terrain (MOUT) facility. Adjacent water bodies, including the Chesapeake Bay, Bush River, and Gunpowder River, contain water depths of 2 to 14 feet. APG is located in a temperate climate zone which replicates approximately 80% of the world's climate. APG holds unlimited restricted airspace as well as an airfield with landing capabilities for any military transport aircraft.

ATC maintains a real time meteorology capability; traditional laboratories with advanced tools; open air ranges with modular instrumentation suites; fabrication facilities and professional craftsman shops; domestic and foreign land/sea-based targets and threats; and isolated/secure/hardened surface and sub-surface opportunities.

1.2 Ecological Background

Realistic training and testing opportunities require quality natural resources. The framework of natural resources on APG provides the DoD with a variety of quality training and testing scenarios. Open, undeveloped shorelines are used for live fire training by all branches of the military and Coast Guard. Forest cover is used as a natural barrier to wind effects on test scenarios, while forest clearings are used as firing ranges. The diverse land coverage is vital for use in land navigation testing and training. The preservation of the natural environment is vital to the Army's ability to test and train as they fight – in real world environments. Since APG replicates approximately 80% of the world's environment protection of the mission at APG is inextricably linked to preservation of its natural environment.

There are numerous positive effects of the military mission on natural resources. First, the presence of APG continues to preserve native ecosystems by preventing widespread development and ensuring that land uses are conducted in a manner that protects the environment. Second, the presence of a dedicated staff of Army civilians ensures professional natural resources management and stewardship of these public lands.

APG is located on the Upper Western Shore, in the lower salinity region where the Susquehanna River empties into the Chesapeake Bay. APG supports ecologically diverse habitats and species, including:

- Prime bald eagle habitat supporting over 40 nesting pairs, 5 primary roosting areas, numerous secondary roosting areas, and foraging areas.
- Large populations of white tail deer and wild turkeys
- Miles of anadromous fish habitat and large populations of commercial and recreational fish
- Blue Crabs
- High quality estuarine/palustrine/shrub-scrub wetlands
- Dense diverse beds of Submerged Aquatic Vegetation (SAV)

- Rare plant species such as iris prismatica
- Large, high quality, contiguous forest tracts supporting forest interior dwelling species
- Miles of riparian buffers

Oftentimes State and Federal regulations concerning the protection of these natural resources overlap and sometimes contradict, causing confusion among range managers, test directors and project managers. Additionally, the population of the Bay's watershed is approaching 17 million people, increasing the pressures to develop shorefront properties. The open water of the Chesapeake Bay obviously prevents encroachment to APG's eastern boundary line, but it does not prevent noise, smoke, dust, and frequency interactions with the Eastern Shore of Maryland. Protecting land on the Eastern Shore from residential and commercial development would aid APG in minimizing restrictions on testing and training due to noise impacts. Further, APG's ability to use this ACUB for environmental mitigation would help streamline compliance with numerous regulatory agencies.

In addition to current environmental regulations, Total Maximum Daily Loads (TMDLs) for Nitrogen, Phosphorus and Sediment will soon be enforced on the Chesapeake Bay watershed. TMDLs are designed to reduce the amount of pollutants reaching the Bay by placing load allocations on all parties involved in different segments of the Bay watershed. APG falls into five of these segments and sits at the mouth of the Susquehanna River, which delivers 50% of the freshwater to the Chesapeake Bay. The need for a watershed-wide reduction in these three pollutants comes from the current degraded state of the Chesapeake Bay.

The eutrophication of the Chesapeake is directly related to the loss of forest cover and the increase in impervious surfaces in the watershed. The Chesapeake Bay currently experiences vast areas devoid of oxygen during the summer. Nitrogen, phosphorous, and sediment pollution are a main cause of the "Dead Zone". Excess nitrogen and phosphorous fuel algae blooms which block sunlight and consume available oxygen in the water column during the decomposition process. Sediments cover and kill submerged aquatic vegetation (SAV) and scatter sunlight before it reaches the plants. Lack of SAV reduces dissolved oxygen to the local water column increasing the anoxic area, thus compromising the entire ecosystem. Direct relationships exist between the amount of development in a watershed and the amount of pollution in the receiving waters. Conserving open, forested, and agricultural lands and preventing development in the watershed will prevent the pollutant load from increasing.

Each year "Ecocheck" produces a "Chesapeake Bay Report Card", in which the Upper Western Shore watershed was the highest rated from 2007-2009 with a "B" rating. 2010 saw the Upper Western Shore's grade slip to a "C". This report card encompasses a wide range of water quality and biotic factors in order to calculate an overall "Bay Health Index". The mostly undeveloped nature of APG is a significant factor in this repeated high rating. Continuing to address environmental concerns while limiting development will help keep our high grades. Furthermore, conserving land on the Eastern Shore will help protect the APG testing mission and aid in improving the health of the Eastern Shore watersheds.

1.2.1 Bald Eagles

Although no longer considered "endangered", the bald eagle remains federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The geographic location and environmental conditions of APG has made the installation a disproportionately important area for bald eagle population recovery and maintenance on the East Coast. APG's largely undeveloped forested shorelines along the Chesapeake Bay serve as optimal habitats for nesting, foraging, and roosting bald eagles. APG supports the highest density of bald eagles in the Chesapeake Bay region and one of the largest bald eagle nesting populations in the continental United States. Currently, over 60 nesting sites are tracked and monitored on APG. Though the nesting population is fluid, Figure 3 is an illustration of bald eagle nesting and roosting sites at APG. In addition to the large nesting population, APG is a convergence area for migratory bald eagles from the northeastern United States and Canada and the southeastern United States. The northern migrants arrive in the fall and stay through March, while the southern migrants arrive in the spring and stay through the summer.

APG is currently conducting an intensive 3-year study of the eagle population and its' movements, by placing satellite transmitters on 64 of the eagles. Transmitters on the birds have shown that APG supports not only the northern Bay resident eagle population but has an influence on populations as far north as Labrador, Canada and as far south as Florida.

1.2.2 Wetlands

Of APG's 72,500 acres, about half is comprised of open waters including the Chesapeake Bay, Bush River, Gunpowder River, and Romney Creek. The remaining 36,000 acres includes about 13,000 acres of wetlands. Therefore, roughly 68% of APG is a wetland or waterway. Of the 13,000 acres of wetlands throughout APG, there is vast diversity among emergent, forested, and shrub-scrub wetlands. Figure 4 is a depiction of wetlands at APG.

1.2.3 Chesapeake Bay Critical Area

The Maryland Department of Natural Resources Critical Area Commission defines the "Critical Area" as land area within 1000 feet of tidal waters or tidal wetlands. Maintaining this area adjacent to the streams, rivers, and bay, also known as the riparian zone, is essential to healthy water quality in the Chesapeake Bay. Of the roughly 36,000 land acres of APG, 21,402 acres (59%) are within areas that fit this definition of the Chesapeake Bay Critical Area. Figure 5 is an illustration of the lands that fit the definition of the Chesapeake Bay Critical Area at APG.

1.2.4 Total Maximum Daily Loads (TMDLs)

The Chesapeake Bay watershed, TMDL segment sheds have been delineated by the Environmental Protection Agency (EPA). APG is located within five different segment sheds of the bay: Bush River (BSHOH), Northern Chesapeake Bay (CB1TF), Upper Chesapeake Bay (CB2OH), Gunpowder River (GUNOH), and Middle River (MIDOH). Figure 6 shows the TMDL segment sheds for APG and the surrounding areas.

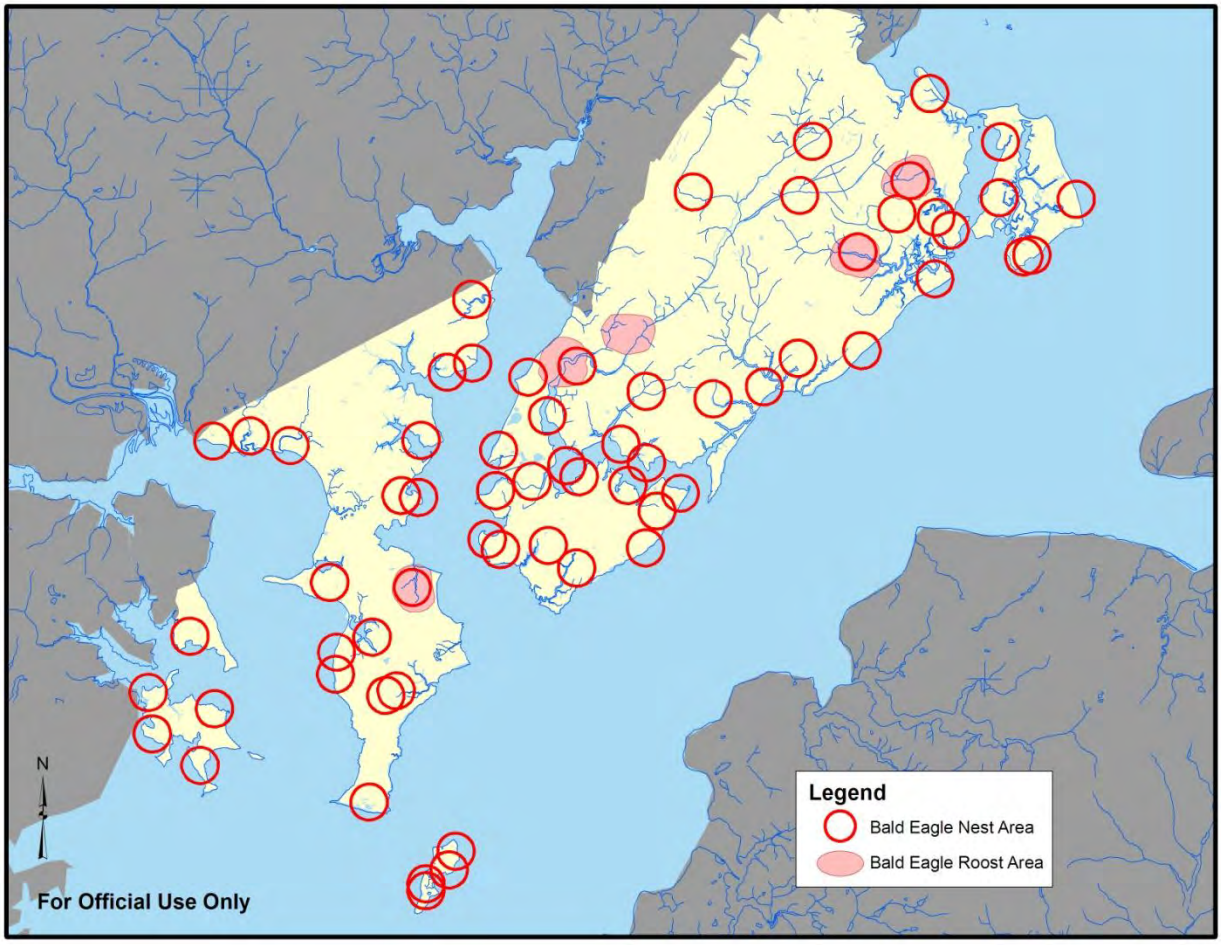

Figure 3. APG Bald Eagle Nests and Roosts

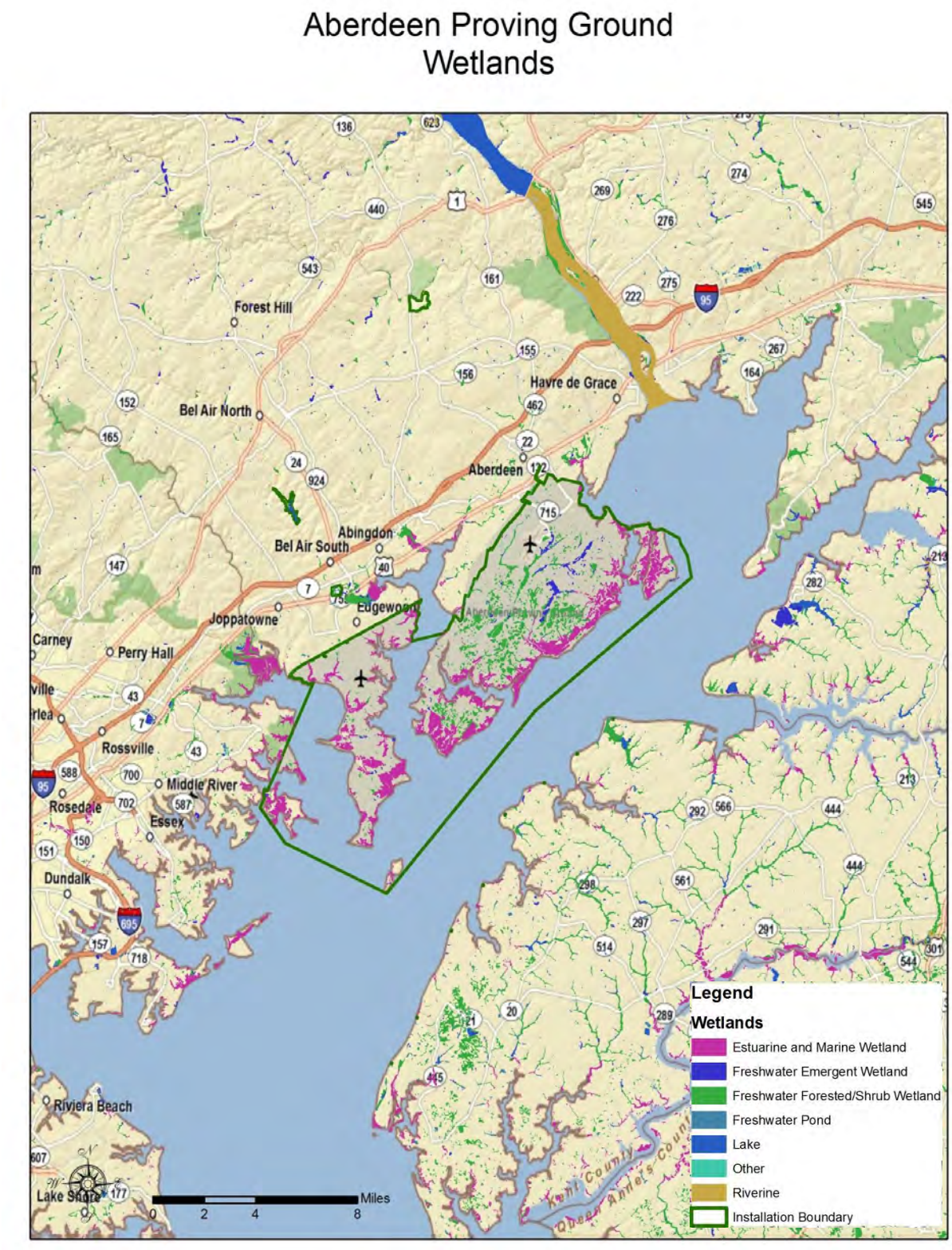

Figure 4. APG Wetlands

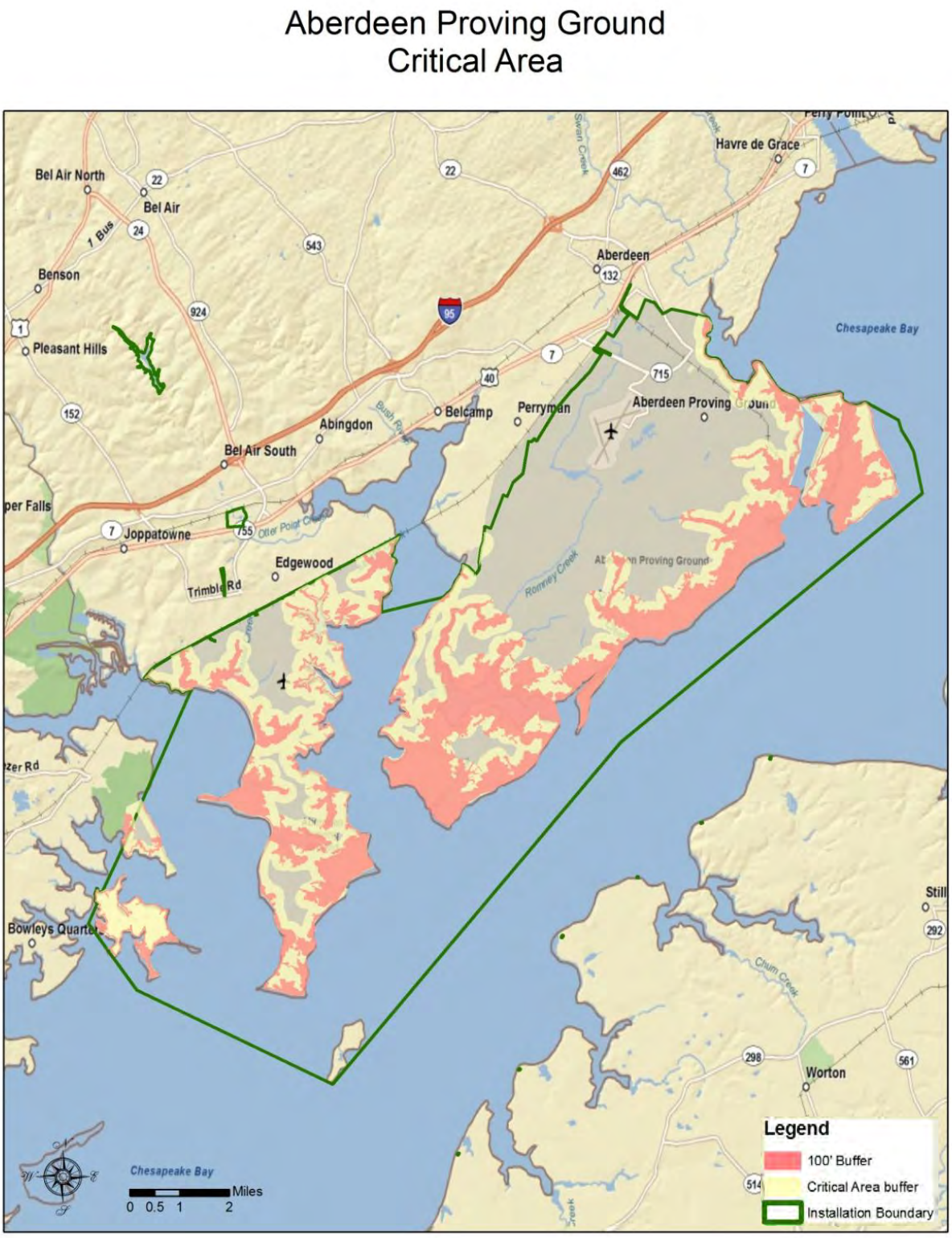

Figure 5. Chesapeake Bay Critical Area on Aberdeen Proving Ground

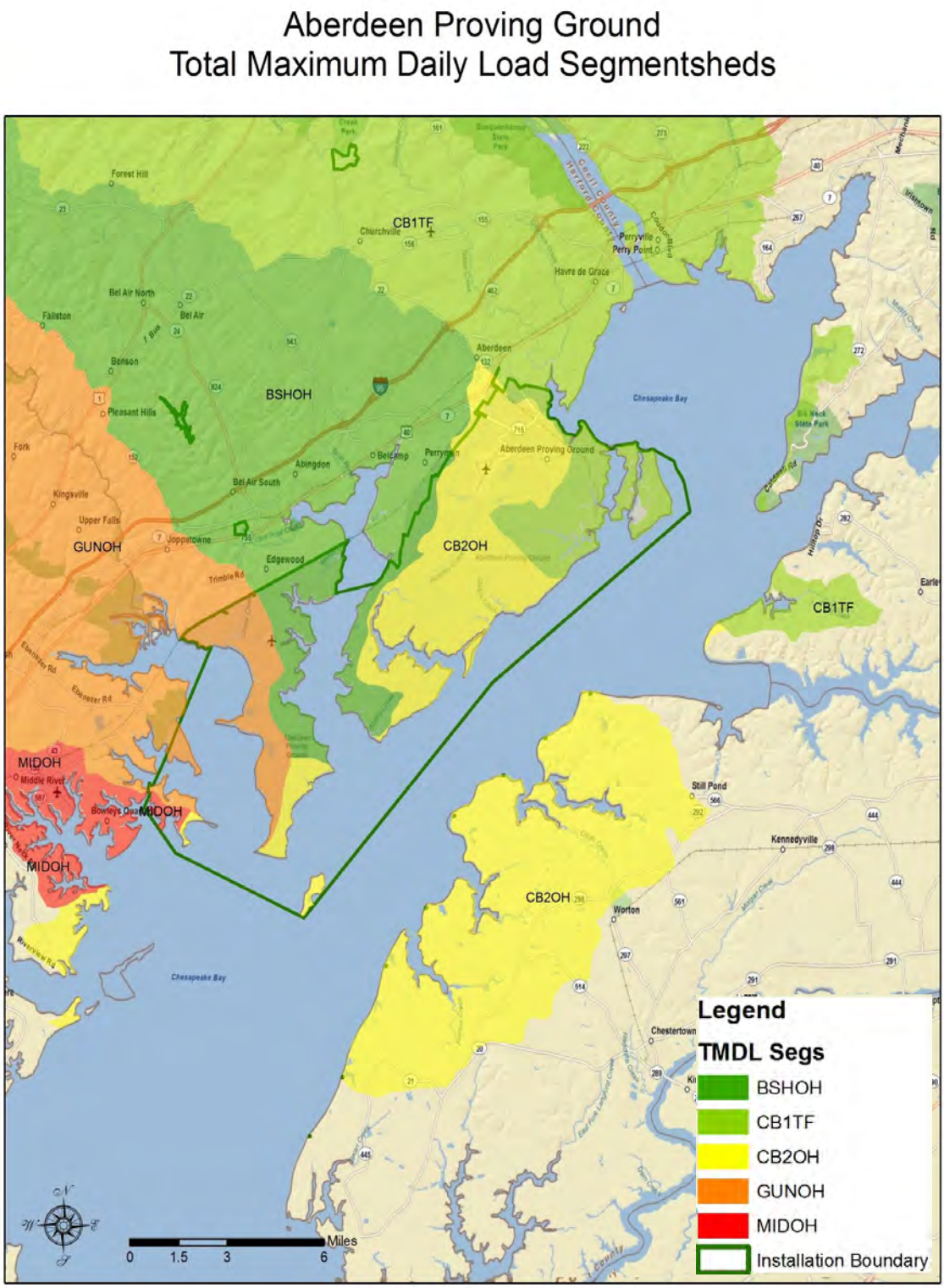

Figure 6. Total Maximum Daily Load (TMDL) Segment Sheds for APG and Surrounding Areas

2.0 DESCRIPTION OF THE PURPOSE AND NEED FOR ACTION

Base Realignment and Closure (BRAC) has transformed APG into the science and technology leader of the Department of the Army. Further, the OCO has increased the amount of items undergoing testing in the acquisition process, and created the Rapid Fielding Initiatives necessary to meet the needs of the Warfighter in real time. The purpose of this ACUB program is to protect the vital Research, Development, Test and Evaluation (RDTE) mission at APG from external encroachment through increased residential development and internal encroachment from regulatory mitigation. Preservation of the military mission at APG is served in multiple ways by this ACUB program:

1. Maintaining the current compatible land uses on the Eastern Shore which limits new noise receptors.
2. Meeting future TMDL load allocations.
3. Conserving bald eagle habitat to supplement on-post bald eagle preservation.
4. Conserving wetlands and/or providing off-post mitigation to alleviate on-post wetland mitigation.
5. Conserving Chesapeake Bay Critical Area and/or providing off-post mitigation to alleviate on-post mitigation for consistency with Maryland's enforceable policies.

Benefit #1: Reducing noise receptors

APG is located in the Boston-Washington megalopolis; a regional land mass that accounts for 22% of the country's metropolitan areas exceeding one million population in 1990; 17% of the entire US population in 1990; and in only 1.5% of the area of the country.[4] Clearly population density is very high in this corridor. Over the last 10 years, the Baltimore metropolitan area has expanded into Harford and Cecil counties. According to census statistics, the populations of Harford County and Cecil County each grew by 20% from 1990-2000. Using the interim census statistics for 2008, population growth in these two counties from 1990-2008 was 32% and 40%, respectively. In addition, the population continues to grow in Baltimore County and Kent County at just under 10% from 1990 to 2000 and about 13% from 1990-2008. The majority of citizens that are subjected to noise generated at APG are in one of these four counties.

According to the Army Alliance, the economic impact of APG after full BRAC implementation will be $2.8 billion in payroll, $15 billion in contracts, and a $6.5 billion total economic activity impact to the region. In addition, thousands of new BRAC employees will be working at APG thus increasing the local county populations.

[4] Birdsall, Stephen S. and John Florin, Megalopolis, http://www.america.gov/st/peopleplace-english/2008/May/20080614181129eaifas0.3639185.html, 01 Jul 2010.

The Eastern Shore has historically been dominated by agricultural lands and large private lots. A change to high density residential or commercial properties in this area would be detrimental to the mission of APG. An illustration of the noise contours associated with mission activities at APG is provided in Figure 7. A change in land use and increase in population would also bring about changes in residents' attitudes towards the mission of APG. New residents would not be accustomed to the impacts of the APG mission and the number of complaints due to operational noise will increase. The ACUB program could help in preventing an increase in the number of noise complaints received from the Eastern Shore by reducing high density developments and an influx of new residents.

With projected growth rates of 80% in Cecil County, 30% in Harford County, and 22% in Kent County from 2000 to 2030,[5] the number of noise complaints would rise significantly if no action is taken. The negative impact could be detrimental to the APG mission if the rate of development continues to increase and no conservation initiatives are undertaken. If the increased development is tailored to retired citizens whom are not working during the day, the number of complaints could increase dramatically, forcing major changes in testing and training schedules. If testing and training faces a large number of restrictions, the entire mission of APG could be jeopardized.

When evaluating the relative merits of investing in an ACUB program at APG, it is important to understand that while the encroachment threats are real and serious, there is still time to mitigate those threats. The next five to ten years have the potential to transform the landscape surrounding APG, but the ACUB program has the potential to ensure that change is compatible with APG's mission and operations. The need for action is imminent.

[5] U.S. Census Bureau, Population Projections, http://www.census.gov/population/www/projections/usinterimproj/

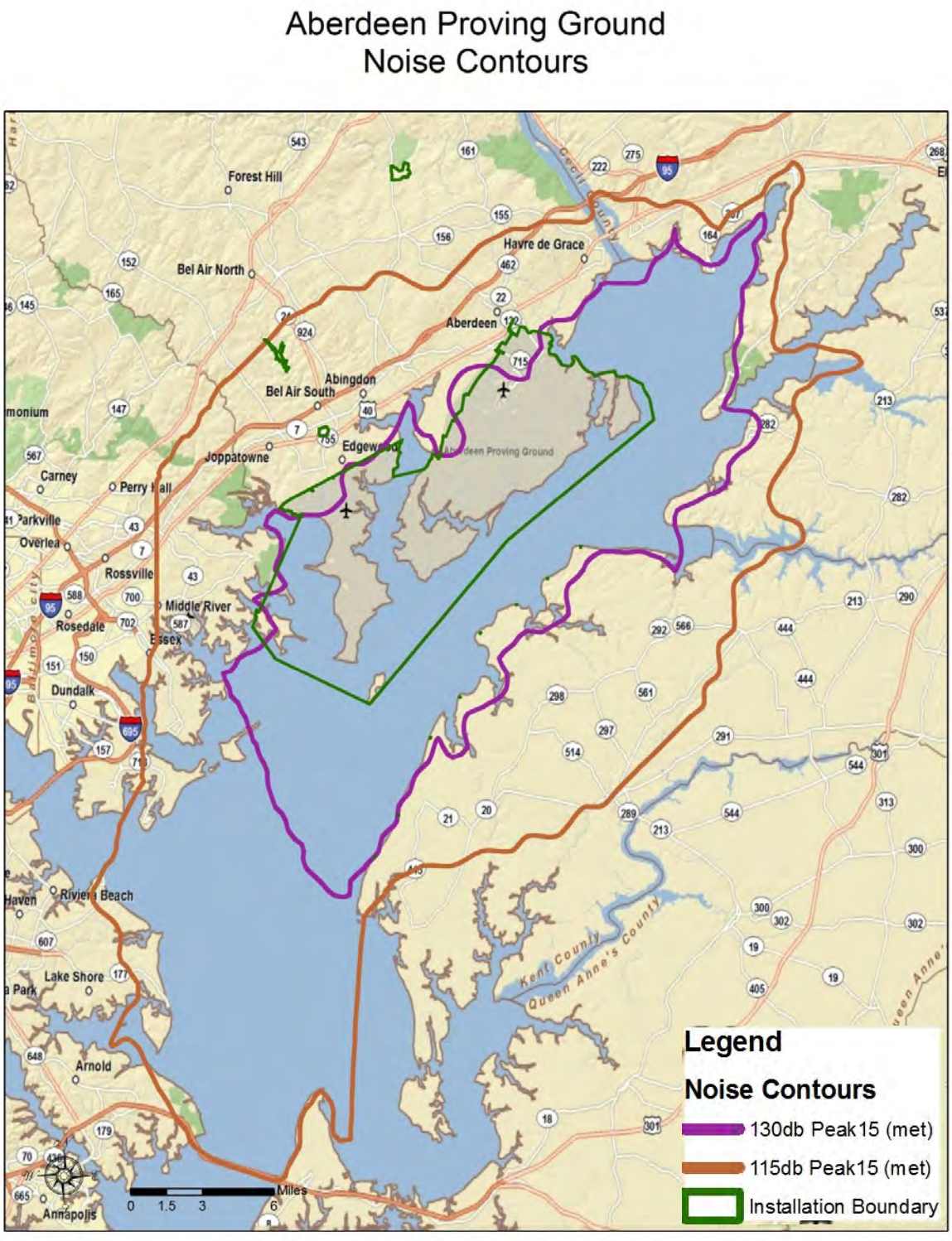

Figure 7. APG Peak Blast Noise Contours (REF. Aberdeen Proving Ground Operational Noise Management Plan, July 2006)

Benefit #2: Total Maximum Daily Load (TMDL)

The Environmental Protection Agency (EPA) is working with States in the Chesapeake Bay watershed to develop TMDLs for various segment sheds. TMDLs are being developed for nitrogen, phosphorous, and sediment. The approval and enforcement process for TMDLs has not yet been finalized.

One proposed method for meeting TMDL allocations is through the use of conservation easements on forested, agricultural, or open space. Since APG shares segment sheds with areas of both the Eastern and Western Shores of the Chesapeake Bay, this ACUB program will provide load allocation benefits through conservation of land in the segment sheds.

Benefit #3: Preserving bald eagle habitat

APG has a Biological Opinion (BO) and Bald Eagle Management Plan that govern protection of bald eagles on post. Since the BO was approved in 2006, eagle management at APG has improved. The BO provides a "take" statement permitting the take of six bald eagles per year and three nests per year incidental to the mission and caused by mid-line strike or electrocution from power lines.

A Conservation Recommendation of the BO states, "The Service recommends the Army to explore the possibility of future off site land preservation through conservation easements on non-federal lands to protect bald eagles on adjacent properties bordering the APG installation."[6] The APG ACUB program will provide a mechanism to achieve the conservation recommendation of the US Fish and Wildlife Service in the BO. The APG ACUB will also potentially provide preserved habitat for bald eagles to nest and roost throughout the northern Chesapeake Bay.

Currently there is a 500 meter buffer zone around all nest and roost sites. The number of nests and roosts at APG has increased from one nest in the 1960s to over 60 active nest sites and five main roost sites in 2010. Further, the College of William and Mary has been conducting a long term study of bald eagles at APG. The study indicates that APG is a premier location for bald eagles on the eastern seaboard. As the population increases, more land will be under nest buffer, meaning that development within nest buffers continues to be more constrained. Preserving bald eagle nest or roost habitat off-post was a recommendation of the BO and can serve to assist in future development and operations within the nest buffers.

APG has witnessed a dramatic increase in the bald eagle nesting population. The number of successful nests has increased from 13 in 2000 to 36 in 2010. Similarly, the number of chicks has increased from 18 in 2000 to 60 in 2010. The average number of chicks per successful nest has climbed from 1.4 in 2000 to 1.7 in 2010. In 2009, the nesting population produced an astounding 2.0 chicks per successful nest. The eagle population continues to thrive at APG.

A telemetry study conducted by the College of William and Mary at APG, as required by the BO, has yielded other bald eagle concentration areas along the northern Chesapeake Bay. These bald eagle "hot

[6] Biological Opinion, APG Bald Eagle Mortality, US Fish and Wildlife Service, Chesapeake Bay Field Office, December 27, 2006.

spots" are utilized by bald eagles that reside or migrate to APG. Figure 8 shows the locations of off-post bald eagle sites within the ACUB area for APG.

US Fish and Wildlife Service (USFWS) is currently considering programmatic permits that would determine a sustainable level of bald eagle nests, roosts, and/or population. Preservation of off-post sites may potentially assist APG when this permit program becomes effective. Preliminary discussions with USFWS representatives indicate a willingness to consider ACUB protected eagle habitat as available habitat for bald eagles utilizing APG. This agreement would need to be finalized, but the possibility exists for this benefit.

Benefit #4: Reducing on-post wetland mitigation

An agreement to use ACUB parcels for off-post mitigation sites needs to be negotiated with individual land owners, regulators, and APG's partners. This benefit is possible, and will be pursued on a case-by-case basis. Based on the assumed buy-in from the landowners and regulators, regulatory relief through off-post mitigation or conservation on ACUB parcels could be used to satisfy wetland requirements for on-post development.

Maryland Department of Environment (MDE) and the US Army Corps of Engineers (USACE) regulate wetland impacts with mitigation requirements. Depending on the type and location of the impacts, mitigation ratios can be as high as 2:1. Since APG is roughly 68% wetlands and waterways, development on the installation can have wetland permit requirements. Wetland mitigation usually includes creation of new wetlands due to the federal policy for "no net loss" of wetlands as started by President George H. Bush in 1988[7]. Requiring wetland creation on-post creates a snowball effect as limited land is developed in wetlands and then wetlands are created in upland areas. With 68% coverage by wetlands and waterways, mitigation creation on-post is extremely challenging. Further, wetland mitigation is required "in perpetuity". Though wetland regulators have agreed that "in perpetuity" is not feasible for APG, there is no precedent for the increased mitigation ratios required to impact previous mitigation areas.

Early discussions with wetlands regulators indicate a willingness to consider ACUB properties as off-post mitigation sites in the future. Preservation of wetlands under the ACUB program can greatly enhance the flexibility of the mission by reducing permit timelines and reducing the cost of mitigation for on-post activities. It will also preserve on-post property for the military mission rather than using it for regulatory mitigation requirements.

[7] National Wetlands Policy Forum. Recommendations. 1988.

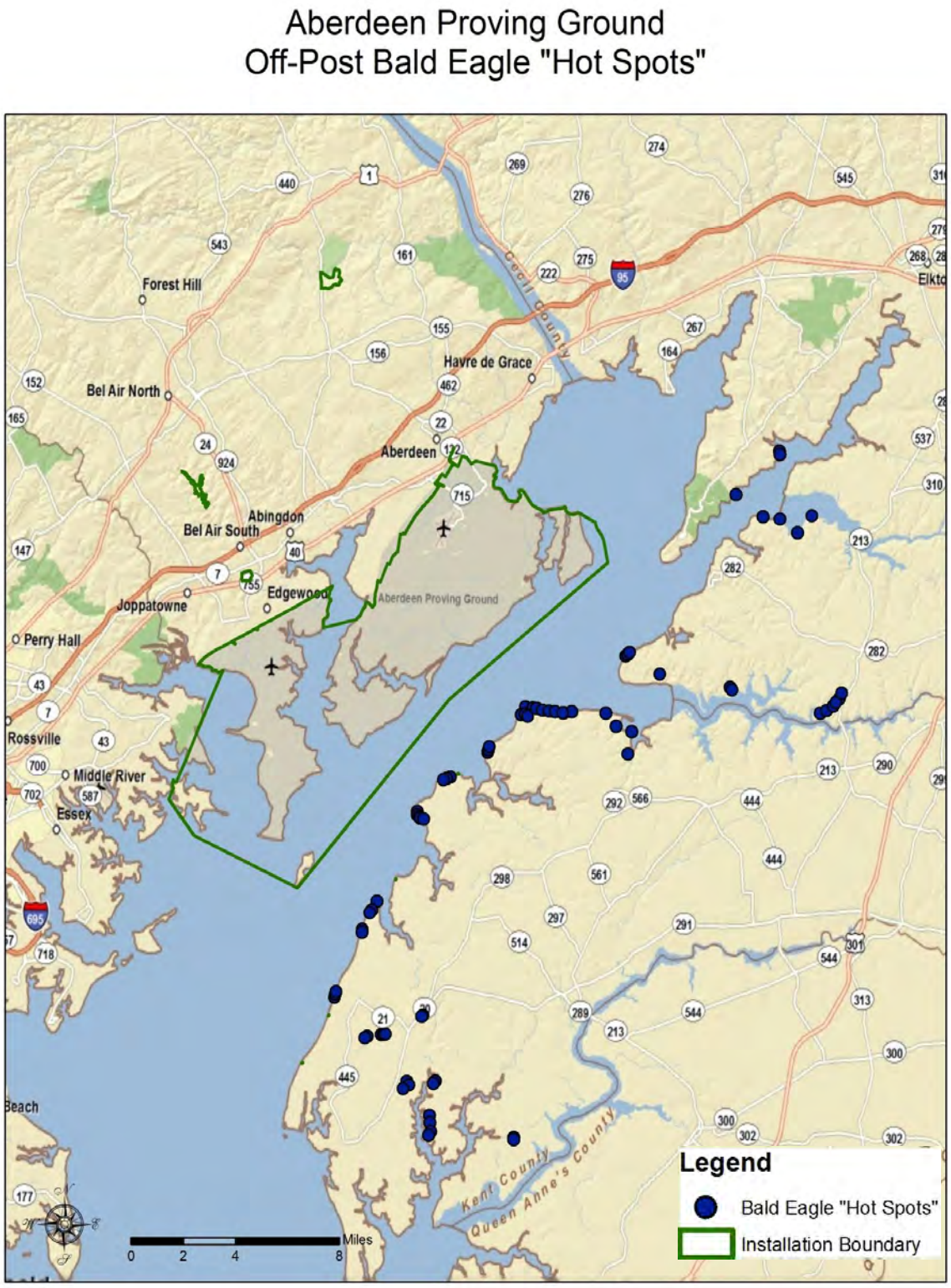

Figure 8. APG Off-Post Bald Eagle Hot Spots

Benefit #5: Reducing on-post mitigation for consistency with Maryland's enforceable policies.

An agreement to use ACUB parcels for off-post mitigation sites needs to be negotiated with individual land owners, regulators, and APG's partners. This benefit is possible, and will be pursued on a case-by-case basis. Based on the assumed buy-in from the landowners and regulators, regulatory relief through off-post mitigation or conservation on ACUB parcels could be used to satisfy coastal zone requirements for on-post development.

Maryland Department of Natural Resources Critical Area Commission (CAC) requires storm water treatment for all new or redevelopment activities as small as 250 square feet in areas within 1000 feet from mean high water., Depending on the type and location of development, if consistency is not achievable though stormwater management, mitigation is required and the ratio can be as high as 3:1. The low minimum requirement means that practically anything built to support the military mission at APG must be fully consistent with the state's enforceable policies including the Critical Area Act. Consistency usually entails stormwater management and/or mitigation for activities that have a reasonable and foreseeable affect on the state's coastal resources. The net result of this requirement is that simple mission requirements, such as small target pads or firing positions, are delayed until the determination is finalized and cost more due to the requirement for stormwater management and/or mitigation. Plus, land that could be used for mission requirements is now required for mitigation. Typically, mitigation requirements are "in perpetuity", and though the CAC is willing to negotiate on that requirement, the negotiated agreement will create a snowball effect for mission development in mitigation areas. Supporting a dynamic military testing environment within the current budget constraints means that this seemingly minor requirement can have major implications. With 59% of the land acreage for the installation categorized as meeting the definition of "Critical Area", finding locations outside these areas for development and inside these areas for mitigation are increasingly more difficult. Figure 9 illustrates Critical Area locations in Cecil and Kent Counties. Early discussions with Critical Area regulators indicate a willingness to consider ACUB properties as compensatory mitigation sites in the future. Preservation of critical area under ACUB can greatly enhance the flexibility of the mission by reducing consistency determination timelines and reducing the cost of treatment and/or mitigation for on-post activities. It will also preserve on post property for the military mission instead of using it for regulatory mitigation requirements.

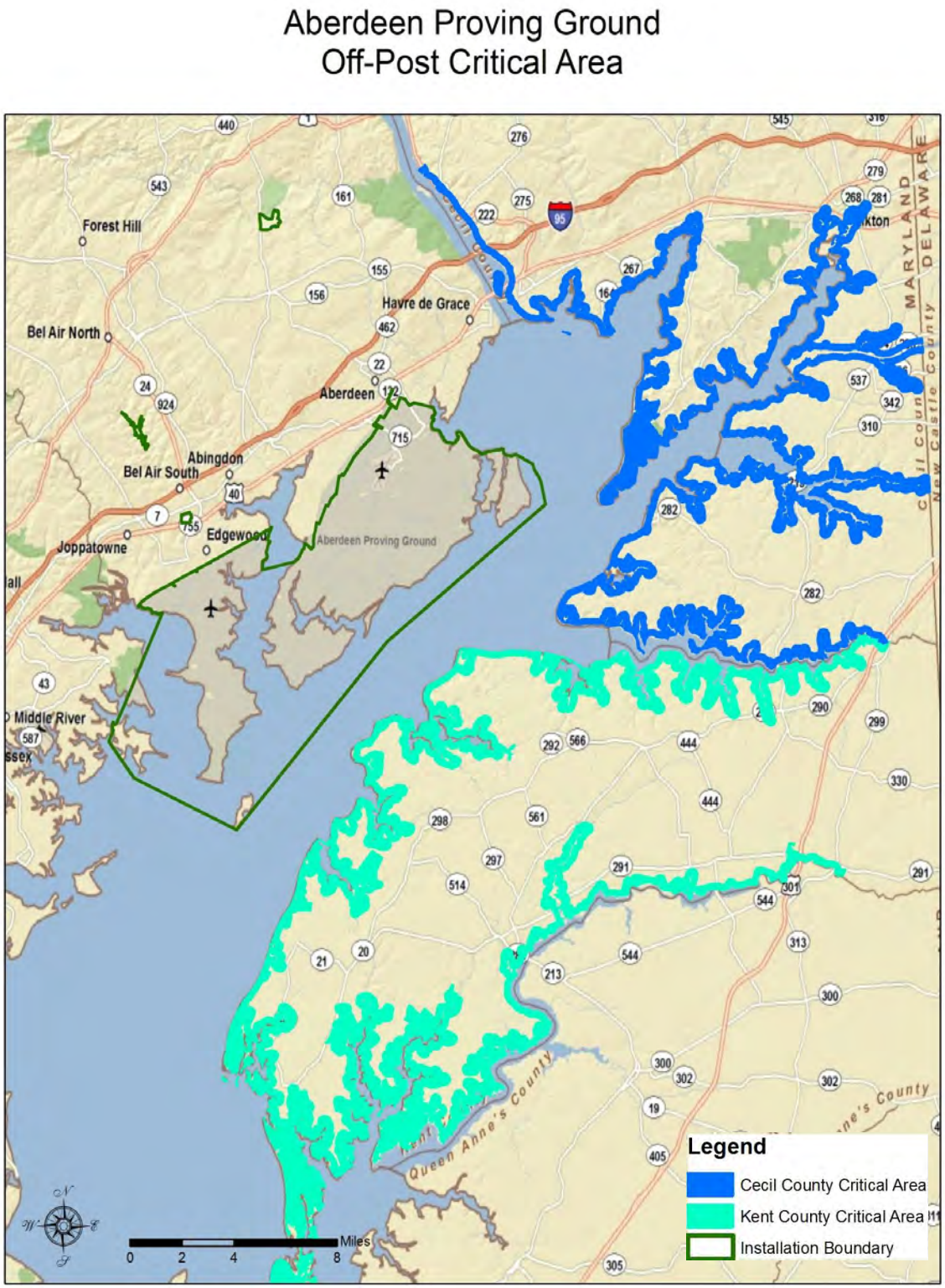

Figure 9. Off-Post Critical Area Locations

2.1 Current Testing and Training Restrictions

2.1.1 Safety and Human Welfare

Operational Noise

Operational noise presents the largest potential for restrictions due to human proximity to APG. Though noise is aggressively managed at APG and workarounds to noise impacts are routinely utilized, there are occasions when mission activities are canceled or delayed due to potential operational noise impacts to the surrounding community.

From 2002 through March 2010, 87 programs have been delayed less than 24 hours due to noise concerns; 25 programs have been delayed more than 24 hours; 5 missions have been modified; and 7 missions have been cancelled. Anecdotally, there have been numerous other programs that delayed for a few hours to accommodate noise concerns without being documented. These delays impact test schedules which ultimately impacts acquisition of critical items for the military.

Operational noise is receptor unique causing different people to receive sounds in different ways. Therefore, it is hard to gauge the reception of APG operational noise to the entire public. APG maintains an operational noise management plan and maintains staff to manage operational noise on a daily basis. Even with the guidelines, daily management, and layered approval authorities, APG still receives complaints from the surrounding communities. From 2002 through 2009, APG received 476 noise complaints.

This ACUB program will limit the development of land at locations where APG operational noise is heard. The benefit of limiting land development in the noise envelope is significant. As stated earlier, limiting the number of people on a parcel of land limits the number of noise receptors and potential noise complainants on that land. Further, conserving land on which a citizen resides that is not sensitive to APG Operational Noise ensures that parcel of land will remain compatible with the APG mission.

2.1.2 Natural Resources

Bald Eagles

APG has a formal Biological Opinion[8], dated 27 DEC 2006 and amended 31 MAY 2007, which outlines a number of reasonable and prudent measures; terms and conditions; and conservation recommendations. The reasonable and prudent measures are:

- APG will reduce mortalities due to mid-line strikes and electrocutions.
- APG will minimize disturbance of active bald eagle nests and roost sites.
- APG will conduct a three year telemetry study.

[8] United States Department of the Interior, US Fish and Wildlife Service, Chesapeake Bay Field Office, *Biological Opinion, APG bald eagle mortality*, December 27, 2006.

Terms and conditions applicable to this ACUB program include:

- Minimize direct impacts to bald eagles by maintaining a 500 meter protection buffer for known nests and communal roost areas.
- Initiate shoreline training exercises after the morning foraging period, 1000 hrs.
- Maintain a minimum altitude of 1000 feet for all rotary wing aircraft while in transit during shoreline training activities
- Conduct a telemetry study to evaluate the movement and behavioral response of roosting eagles at APG

Conservation recommendations pertinent to this ACUB include:

- The Service recommends the Army to explore the possibility of future off site land conservation to protect bald eagles.
- The Service recognizes the need to protect forested shoreline habitat like those found at APG for sustaining bald eagles within the Chesapeake Bay.
- The Service recommends the Army avoid Romney Creek for shoreline training.

The requirements of the BO have placed restrictions on mission opportunities at APG. Riverine units with the Navy are interested in using Romney Creek as an ideal location to train in a river or creek like setting where shorelines are close on both sides of the river. Romney Creek would provide restricted water and air adjacent to live fire ranges that would provide the most complete training scenario available to these units. ATC has had to turn away opportunities to train these warfighters prior to deployment in this skill as a result of the BO restrictions. These Riverine Units would typically train at ATC 2-3 times per year to meet their mission needs. Since the 2006 BO, ATC anticipates 8-12 total training opportunities have been lost.

Beginning shoreline training activities after 1000 hours has not had a detrimental impact on training activities at APG yet. However, if there is a change in training doctrine that necessitates sunrise settings for training; APG will not be able to accommodate that request under the current terms of the BO.

The requirement to maintain a 500 meter protection buffer around known nest and roost sites is about 25% more strict than other nest buffers throughout the region. In other cases, USFWS has instituted ¼ mile buffers (402 m) throughout the region. However, APG maintains a 500 meter buffer to protect the significant eagle population on post. Though USFWS has worked well with APG in the past, changes in USFWS personnel could result in stricter interpretations of this requirement which could limit the use of the test and training ranges.

At the beginning of the bald eagle nesting season, there can be as many as 60 nest sites that are protected. With a 500 meter buffer around each, that equates to 11,640 acres of APG land that is protected from development and other activities. In addition, there are five recognized roosts that account for an additional 1,250 acres of land. The combined acreage within bald eagle buffer zones equates to 18% of the total installation and about 30% of the land mass. Though workarounds for

mission activities are usually found, this protection adds time to obtaining approval for the military mission.

In addition to the Biological Opinion, APG maintains some other unique bald eagle requirements as a result of informal Section 7 consultations with USFWS from 02 October 2003. Requirement for operation at the Mulberry Point Soldier System Test Facilities Outdoor Range was further clarified in a meeting with USFWS on 29 June 2007. Those requirements include no firing activity between the hours of sunrise until 2 hours after sunrise; and no firing during the 90 minutes prior to and including sunset. During the winter months, this requirement reduces the effective time on this range to between 0930 and 1500 hours, providing only 5.5 hours of useful range time.

"Over the Beach" training opportunities have been limited at APG due to a bald eagle nest in proximity to the MOUT site along the shoreline. ATC anticipates at least two units have lost the ability to obtain this training 3-4 times per year because of the requirements to protect the eagles in the area.

Critical Area

All construction projects follow the same general path to obtain environmental approvals. First, National Environmental Policy Act (NEPA) compliance is obtained. Upon verification of NEPA compliance, environmental permitting and approval requirements are met, such as sediment and erosion control, wetlands, forest, eagles, and/or coastal zone consistency. Following permitting, construction can begin. At APG, construction activities are limited by weather with freezing conditions in the winter and rains in the spring and fall. Delays in environmental regulatory compliance can place significant delays on construction as the regulatory delays approach the weather-related deadlines. Since ATC supports the majority of Rapid Initiative test events, development delays can have a significant impact on fielding rapid initiative acquisition items.

Any new or redevelopment project impacting 250 or more square feet of land meeting the definition of "Critical Area" must be fully consistent with the Critical Area Act. Part of the approval process is providing stormwater management or mitigating any impacts to the land within 1000 feet of mean high water. Mitigation ratios can range as high as 3:1. 15 CFR 930 establishes a 60-day response time for state agencies to determine federal consistency. When a Rapid Initiative must be tested in 1-2 days, there is not 60 days to wait for a consistency determination. With so much of APG located within the area that meets the definition of "Critical Area", many small projects incur costly delays and mitigation.

The impacts of Critical Area Act requirements on the military mission are multi-fold. First, the delays in obtaining regulatory approval for the impacts delay the ability of the military to adequately test military equipment and train soldiers by impacting test schedules which impacts the time to get the item into theater. Second, stormwater management and/or mitigation for these impacts carry a cost. Although this is considered a cost to the business, it can be greatly reduced by proactively protecting critical area around the Chesapeake Bay so that mitigation requirements are mostly completed. This reduced cost will allow APG to better fund mission requirements. Third, mitigation encumbers testing and training lands. APG has about 36,000 acres of land available for the critical research, development, test and evaluation mission that takes place. Every acre of land that is encumbered by mitigation is an acre of

land that cannot be used to test and train our Warfighters. Through land management APG has been successful in locating compatible on post land for mitigation, the time will come when land becomes a scarce commodity. This ACUB effort will alleviate the internal encroachment from mitigation and allow the Warfighters the ability to train as they fight and test military equipment to the standards the DoD mission requires.

Wetlands

Wetlands cover approximately 13,000 acres of APG, or about 36% of the entire land mass. Any impact to wetlands requires a permit by either the Maryland Department of Environment (MDE) and/or the US Army Corps of Engineers (USACE). The permit application costs $7500 per acre of impact and can take up to one year to obtain. In addition, mitigation for wetland impacts is required at ratios ranging from 1:1 to 2:1, depending on wetland type.

The construction timeline discussed in the Critical Area section above also pertains to wetlands. The impacts of wetlands requirements on the military mission are multi-fold. First, the delays in obtaining regulatory approval for the impacts delay the ability of the military to adequately test military equipment and train soldiers. Delays can impact test schedules, which impacts the time it takes to get the item into theater. Second, mitigation for these impacts carries a cost. Although this is considered a cost to the business, it can be greatly reduced by protecting wetlands around the Chesapeake Bay so that mitigation requirements are mostly completed. This reduced cost will allow APG to better fund mission requirements. Third, mitigation takes up precious land mass. APG has about 36,000 acres of land available for the critical research, development, test and evaluation mission that takes place on the installation. Every acre of land that is dedicated to environmental mitigation is an acre of land that cannot be used to test and train our military. Though land managers at APG have been successful in locating compatible on post land for mitigation thus far, the time will come when land becomes a scarce commodity. This ACUB effort will alleviate further internal mitigation encroachment and thus free more space to conduct the critical DoD mission at APG.

2.2 Anticipated Training and Testing Restrictions

Since FY05, ATC has conducted 734 projects or 40% of the total Rapid Fielding Initiative (RFI)/Rapid Equipping Force (REF) testing in the Department of the Army. RFI and REF are programs designed to get crucial assets into theater as quickly as possible. ATC has deployed individuals into the theater of operations to interface with troops and accelerate the process of testing RFI/REF items to ensure a safe, reliable asset is returned to theater. This vital process saves lives every day in the theaters in which the US operates. In order to provide testing for the RFI and REF projects, APG must be postured to set up, execute, and report results of tests on a moment's notice. This capability requires maximum flexibility both in range scheduling and in environmental compliance. An ACUB program at APG would provide a proactive measure to allow those crucial test events to occur with minimal off post impacts and without the delay in meeting regulatory requirements.

Rapid acquisition initiatives will continue into the foreseeable future as a mechanism to get troops the equipment they need when they need it. Due to the unpredictable, dynamic environment of rapid

fielding projects, quantifying anticipated restrictions is difficult. However, the nature of these projects relies on flexibility to execute the project and in that sense, operational noise impacts and regulatory restrictions have the potential to negatively impact rapid initiatives.

The mission of the Phillips Army Airfield (PAAF) could significantly change, as the airfield is turned over from ATC to APG. An increase in use of the airfield for fixed and rotary wing aircraft could increase off post noise impacts. Aircraft noise impacts are a known issue throughout DoD and several installations have used compatible use buffer programs to address this issue. The specific areas of impact are unknown at this time but most likely will be captured by the current noise envelope. If significant impact zones are identified at a later date the ACUB priority areas will be modified.

2.2.1 Safety and Human Welfare

Neighbors directly bordering APG are mostly buffered from the range areas by the cantonment areas of the Aberdeen and Edgewood portions of the installation. Most of the adjacent land areas have already been developed around APG. However, land that is connected to APG through the operational noise envelope, bald eagle flyways, TMDL segment sheds and other means, is still largely undeveloped. Vast tracts of undeveloped land exist on Maryland's Eastern Shore within the noise contours of the APG mission. Future development of those tracts would introduce innumerably more receptors to operational noise from APG. The possibility for future development is high as this land is close to the Chesapeake Bay which can be an attractive lifestyle choice for baby boomers entering retirement. Likewise, the influx of personnel as a result of BRAC will continue to put development pressure on the surrounding communities to house and service the additional people working on post.

2.2.2 Natural Resources

Bald Eagles

APG has made great strides in managing the bald eagle population on post. The number of bald eagles using APG as either a residential or migratory location continues to increase. However, based on conversations with the College of William and Mary and US Fish and Wildlife Service, APG is probably still not at the carrying capacity for bald eagles. The eagles continue to show remarkable resilience to their surroundings in that they nest in closer proximity to each other and to human activities than ever before and on man-made structures which had previously never been done. Given that the number of eagles is likely to continue to increase, the amount of acreage that is managed for them also will increase thereby continuing to strain the development capabilities to meet future testing needs. In addition, development in the surrounding counties will continue to force eagles and other wildlife onto APG. Furthermore, USFWS is developing protection protocols for bald eagle roost sites which could expand the number of roosts protected at APG.

Critical Area

The Coastal Zone Management Act requires that activities undertaken on APG be consistent with Maryland's Coastal Management Program. Compliance with this program usually consists of storm

water best management practices and/or compensatory tree plantings to treat or mitigate development impacts associated with construction projects. Mitigation sites have been historically located on undevelopable plots in the cantonment area or in restricted zones in the range areas. These types of plots maintain compliance with Maryland's Coastal Management Program, but may not serve in the best interest of APG's natural resources. As these types of plots become scarcer and the pace of construction continues, mitigation locations will encroach on active testing and training ranges, thus reducing the amount of available land. Also, there is a fixed amount of acreage in areas meeting the definition of "Critical Area". As development is approved in the areas meeting the definition of "Critical Area" and on-post mitigation is undertaken, there will come a time when there is no more acreage in the areas meeting the definition of "Critical Area" to complete the military mission at APG.

One of the goals of APG's ACUB program is to work with local non-profit conservation partners to secure lands outside the installation that are suitable for the construction of compensatory Coastal Management Program mitigation sites. It is expected that this approach would not only alleviate the loss of testing and training land, but also lower the overall cost to the Army due to reduced construction costs. The cost savings could vary depending on the size and complexity of the mitigation project, but large fiscal savings are expected as well as ending the process of encumbering additional range lands with on-post mitigation. Another benefit of off-post mitigation sites is that they allow APG and our partners to improve the conditions of Critical Area throughout the northern Chesapeake Bay watersheds, thus improving the overall health of the Chesapeake Bay.

It is possible that the buffers will be extended in the future. There is also discussion among the regulators about increasing the mitigation ratios required for critical area impacts. Either of these actions would have an impact on mission activities at APG.

Wetlands

The Clean Water Act, Section 404, requires that a permit be obtained for any activity that may affect "waters of the United States, including wetlands." Permits are obtained based on individual projects on APG, with consideration of wetland types, areas and jurisdictional status. Typically the creation of compensatory wetlands to mitigate wetland impacts associated with the construction project is required. Considering the abundance of wetlands on APG it is nearly impossible to undertake a major construction project without causing an impact. Currently, compliance with the Clean Water Act is a significant cost and time factor.

Similar to Critical Area, one of the goals of APG's ACUB program is to work with partners to secure lands outside the installation that are suitable for the construction of compensatory wetland mitigation sites. It is expected that this approach will not only eliminate the loss of testing and training land, but also reduce the overall cost to the Army due to reduced construction and monitoring costs. The cost savings will vary depending on the size and complexity of the mitigation project though large, consistent fiscal savings are expected as well as ending the process of encumbering additional range lands with on-post mitigation. Another benefit of off-post mitigation sites is that they allow APG and ACUB partners to

improve the conditions of wetlands throughout the northern Chesapeake Bay watersheds thus improving the overall health of the Chesapeake Bay.

TMDLs

EPA and the States are also developing regulations for Total Maximum Daily Loads (TMDLs) for contaminants that impact the Chesapeake Bay. Currently the TMDLs are focused on Nitrogen, Phosphorous and sediment. The approval and enforcement processes for these requirements have not been finalized yet, but will have impacts on APG. As the TMDL program matures, the potential for additional impacts increases.

One proposed method for meeting TMDL allocations is through the use of conservation easements on forested, agricultural, and/or open space lands. Since APG shares segment sheds with areas of both the Eastern and Western Shores of the Chesapeake Bay, this ACUB program will provide load allocation benefit through conservation of land in the segment sheds.

Critical area, wetlands, TMDLs and storm water permits all aim to protect the Chesapeake Bay. Federal and State agencies are committed to the protection of the Chesapeake Bay, as reinforced by Executive Order (EO) 13508: Chesapeake Bay Protection and Restoration, signed 12 May 2009. The Federal Leadership Committee for the Chesapeake Bay FY11 Action Plan provides a number of actions to meet the EO13508. Specifically, the plan calls for conserving land and increasing public access. The APG ACUB will play a role in meeting the goals of the committee by conserving land on the Chesapeake Bay while also preserving the military mission.

Each one of these programs will likely become more stringent until the Chesapeake Bay regains health. The APG ACUB program can have multiple benefits, not only for the APG mission but also for the health of the Chesapeake Bay and the ability of federal agencies to meet the vision and requirements of EO13508.

3.0 DESCRIPTION OF PROPOSED ACTION AND PRELIMINARY LIST OF ALTERNATIVES

3.1 Proposed Action

The APG ACUB program is multifaceted and the benefits are far-reaching. APG proposes to work with local, non-profit conservation partners to purchase conservation easements and secure fee-simple purchases to limit non-compatible land development, provide off-post conservation credits for TMDLs and bald eagles, provide off-post mitigation potential for critical area and wetlands, and assist in protection and restoration of the health of the Chesapeake Bay.

In the preamble to EO 13508, President Obama declared the Chesapeake Bay "a national treasure"[9]. President Obama also stated that protection and restoration of the Chesapeake Bay will require the

[9] President Barack Obama, Executive Order 13508, Chesapeake Bay Protection and Restoration, 12 May 2009.

assistance of federal, state, and local governments; private enterprise; and citizens. In the FY11 Action Plan for EO 13508 the National Park Service is charged with leading different organizations in addressing how to ensure conservation planning approaches and priorities are shared and coordinated across jurisdictions and programs in the Chesapeake Bay watershed.

The goals of this ACUB program will serve to meet the goals of several of the groups involved in land conservation efforts on Maryland's Eastern Shore and will directly support CL.2 of the FY11 EO 13508 Action Plan. This ACUB program will be a keystone of EO 13508 by combining the efforts of all parties and achieving the vision provided by President Obama. The Federal Leadership Committee for the Chesapeake Bay, as established by EO 13508, visualizes a Chesapeake Bay watershed with seven main themes. Many of these themes are supported by this ACUB program, including[10]:

- Extensive areas of conserved lands that protect nature and the region's heritage
- Cities, towns and neighborhoods where citizens are stewards of nature
- Abundant forests and thriving farms that benefit both the economy and environment
- A broad network of land and water habitats that support life and are resilient to the impacts of development and climate change

This ACUB program will allow the Department of Defense, Department of Army, and Aberdeen Proving Ground to take a leadership position in the restoration of the Chesapeake Bay while simultaneously ensuring the protection of the critical military mission at APG.

Urban Sprawl & Operational Noise Protection

The 2000 census shows that Maryland had the sixth largest population per square mile of land. Census data projections show that Maryland is projected to grow by 26% between 2000 and 2030. Areas on the Eastern Shore of the Chesapeake Bay that were rural forty years ago have become exurban and suburban areas, and the trend continues. Population in Cecil County has grown 40% from 1990 through 2008. Similar population growth has greatly expanded in other Eastern Shore counties. With population growth slowing in the currently established Chesapeake Bay counties of Maryland, such as Baltimore, Harford, and Anne Arundel, the most available space for expansion is on the Eastern Shore (Cecil, Kent, Queen Anne's, Talbot, Dorchester) and the Lower Western Shore counties (Calvert and Saint Mary's). This is supported by projections that show a Cecil County projected growth of 80% from 2000-2030; Harford County with 30% growth; and Queen Anne's County at 53%. Kent County projections are slightly lower at 22%, which illustrates the opportunity that will remain available as a long term ACUB priority.

The projected growth throughout the region means that more potential noise receptors will be moving into the APG noise contours, thus increasing the risk to mission caused by increased noise complaints.

Regulatory Mitigation and Preservation

[10] Federal Leadership Committee for the Chesapeake Bay, Executive Order 13508, Strategy for Protecting and Restoring the Chesapeake Bay Watershed, 12 May 2010, p.1

As stated earlier, internal encroachment from regulatory requirements and mitigation will ultimately push APG to a point where no more land is available for mission requirements. For every acre of land used on post for regulatory mitigation, there is one less acre of land that can be used for the military mission. Furthermore, the waters of the Upper Western Shore are the healthiest of any on the Chesapeake Bay, so there is evidence that APG natural resource management and the military mission are compatible with the health of the Chesapeake Bay. This ACUB program seeks to find alternate, off-post land to be placed in preservation to protect eagle habitat, wetlands, and critical area; and willing partners that may allow mitigation on off-post land. Off-post preservation and mitigation will support the health of the Chesapeake Bay by providing many of the same natural environments that exist on APG lands.

3.1.1 Reduction of Restriction or Elimination of Work-around

The ACUB will reduce noise receptors on the Eastern Shore and reduce the amount of new "neighbors" who are not accustomed to the noise impacts from the testing and training conducted on APG. Conserving land on the Eastern Shore will also show our "neighbors" that APG and the Department of Army are concerned about their well being and the surrounding environment. The APG ACUB will provide off-post conservation and/or mitigation for critical area, wetlands, and bald eagle habitat, which will create the flexibility required to meet the ATC mission for testing Rapid Fielding Initiatives. This flexibility will ensure that these "moment's notice" turnaround requirements can be met by eliminating the time consuming permit and mitigation process associated with critical area and wetlands.

The ACUB will also provide off-post eagle habitat that can be used as other nesting and roosting locations for eagles under the upcoming programmatic permits undergoing consideration by USFWS. USFWS personnel have expressed a willingness to work with APG to fit off-post eagle habitat preservation into future agreements and considerations of potential on-post eagle interactions.

The APG ACUB will meet the 2006 Biological Opinion conservation recommendation to preserve off-post land for protection of the bald eagle.

The APG ACUB will streamline reviews of wetland permit applications by obtaining regulatory relief through establishing potential off-post mitigation sites.

The APG ACUB will assist APG in meeting the load allocations associated with the implementation of the Chesapeake Bay TMDL requirements.

The APG ACUB will also place the Department of Defense in a leadership position in meeting the Action Plan goals for protection of the Chesapeake Bay.

3.1.2 Prevention of Foreseeable Actions Causing Restrictions or Work-arounds

Limiting urban sprawl on the Eastern Shore of the Chesapeake Bay will limit the number of noise receptors in the APG noise contour envelope. Population trends along the Bay continue to mostly outpace the overall growth in the State of Maryland. Waterfront, water view, and near water properties will continue to increase in value as they become limited in supply on the Chesapeake Bay. If any of the larger properties on the Bay were to be sold to developers, the increase in population within the noise

envelope would be large. Gaining easements on properties within the noise envelope will reduce the opportunity for mass development on the Eastern Shore within the APG noise contour envelope.

3.1.3 Location and Description of Areas to be Protected

The unique element of the APG ACUB program is the Chesapeake Bay. With only open water between APG and Maryland's Eastern Shore, there is no land mass for natural attenuation of noise produced on APG. Compounding the issue is the relatively small economic benefit that Eastern Shore counties obtain from the presence of APG on the Western Shore.

The APG ACUB program uses the operational noise contours and data from the bald eagle telemetry study to outline priority areas for ACUB activities. All preservation easements or fee-simple purchases within this program will require mutual benefits to APG, our land conservation partners, and willing property owners.

Priority 1: Priority 1 ACUB areas will be properties within the 130 decibel (db) noise contour which extends on both the Eastern Shore and Western Shore. Priority 1 will also encompass the perimeter of the APG installation.

Priority 2: Priority 2 ACUB areas will be properties between the 130db and 115db contours on the Eastern Shore, as well as areas along the Sassafrass and Elk Rivers that contain bald eagle nest and roost habitat.

Priority 3: Priority 3 ACUB areas will be properties between the 130db contour and the perimeter of APG on the Western Shore. These areas are designated as Priority 3 because much of this land has already been developed or preserved.

Priority Caveat: Properties within any priority area that contain large tracts of forest, wetland, critical area, or bald eagle habitat, may be preferred for the potential regulatory relief that they provide.

Figure 10 illustrates the priority areas for the APG ACUB program. Figure 11 is an illustration of the APG ACUB priority areas aligned with lands currently under conservation through the work of various state, county, land conservation organization, or other program.

With the current housing market and economic climate, the stage is set for a valuable, effective, and mutually beneficial ACUB program to thrive at APG.

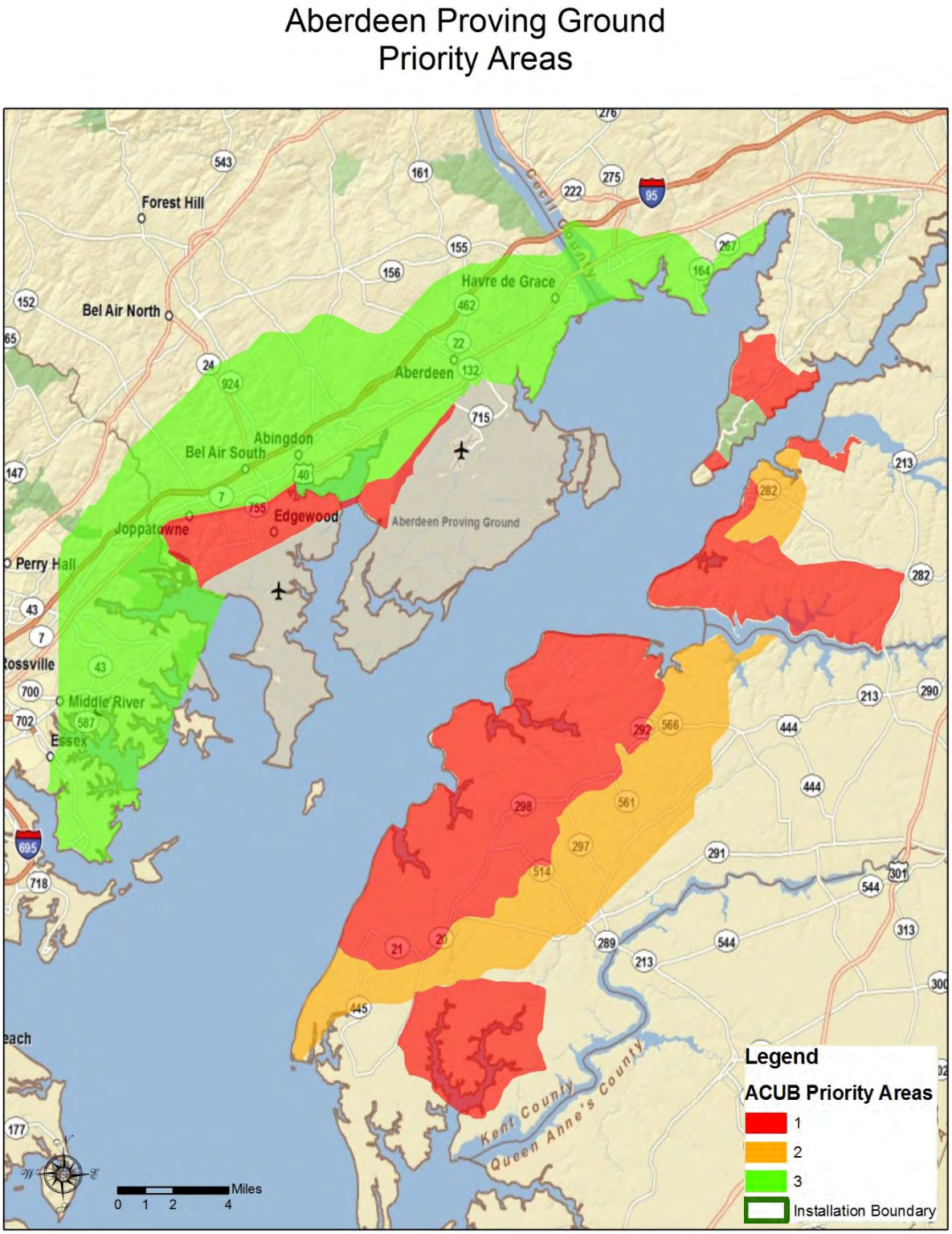

Figure 10. APG ACUB Priority Areas

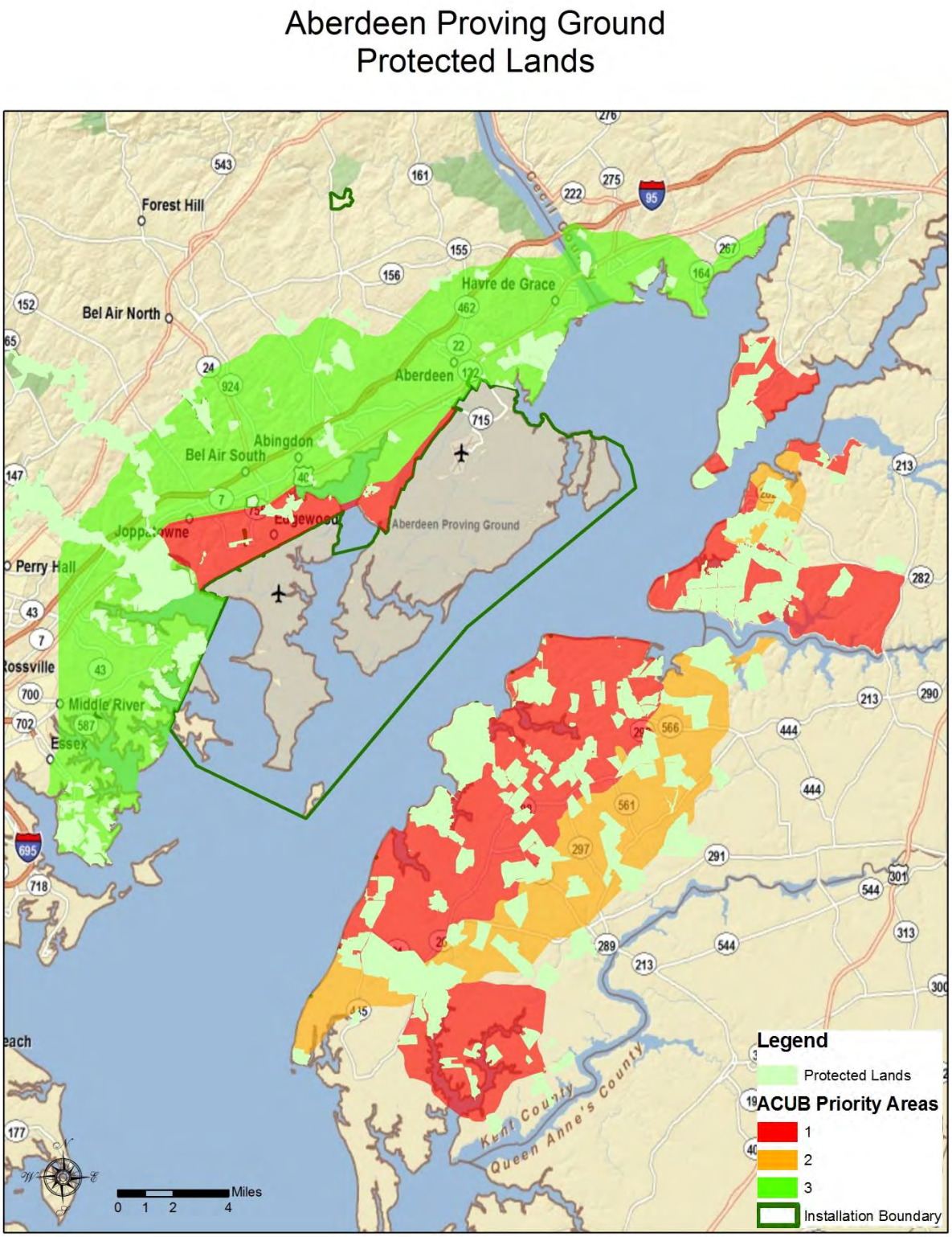

Figure 11. Currently Protected Lands within the APG ACUB Priority Areas

3.1.4 Potential Partners

Eastern Shore Land Conservancy

The mission of the Eastern Shore Land Conservancy (ESLC) is to preserve and sustain the vibrant communities of the Eastern Shore and the lands and waters that connect them. Their vision in 2050 is an Eastern Shore where towns are vibrant and well defined; farms, forests, and fisheries are thriving and scenic; historic, natural, and riverine landscapes are maintained.

ESLC would be APG's primary ACUB partner for properties on the Eastern Shore. The ESLC preserves property south of the Chesapeake & Delaware Canal in Cecil, Kent, and Queen Anne's Counties. ESLC has indicated a willingness of potential land owners on the Eastern Shore, and they are enthusiastic about developing the relationship with APG through the ACUB program.

Harford Land Trust

The mission of the Harford Land Trust (HLT) is to help landowners, private and public, conserve land and protect the natural resources, scenic beauty, rural character, and a healthy way of life in Harford County.

HLT would be APG's primary ACUB partner for properties on the Western Shore, mostly located in Harford County. APG has a relationship with Harford Land Trust dating back to 2006 when an ACUB program was approved to preserve the Hopkins property in Churchville, Maryland, and maintain compatible land use adjacent to the Churchville Test Area at APG. Both APG and Harford Land Trust are eager to expand this relationship to develop a more comprehensive ACUB program at APG.

The Conservation Fund

The Conservation Fund (TCF) forges partnerships to conserve America's legacy of land and water resources. Through land acquisition, community and economic development and training and education, the Fund and its partners demonstrate balanced conservation solutions that emphasize the integration of economic and environmental goals.

TCF offers expertise in large scale land conservation, and has partnered with other military installations on ACUB and REPI programs. TCF does not have a set agenda for conservation, rather they partner with community, government and corporate organization to fulfill their conservation priorities. TCF will be APG's primary ACUB partner for properties involving mitigation. TCF will also be APG's partner for parcels outside the scope of ESLC and HLT. TCF may also provide assistance to our other partners through their nationwide network of conservation regions, nationwide network of partners, and their revolving fund for conservation financing.

Confirmation letters from each ACUB partner are provided in Appendix B. Additional partners may be added as the APG ACUB program matures, depending on the needs of the program.

3.2 Alternative Actions

3.2.1 No Action Alternative

In this scenario, population would continue to grow within the APG operational noise and bald eagle habitat envelopes. Additional residential and commercial development will continue, especially along waterfronts that are particularly attractive to residents. Inevitably, this continued growth and development would encroach on the APG mission by introducing new noise receptors and additional complainants; by driving wildlife from their current locations to the more protected areas of APG; by eliminating the opportunity for off-post regulatory mitigation capabilities; and by driving up the value of the property making future ACUB opportunities less financially viable.

The "No Action" alternative is not a viable solution to the encroachment issues faced by APG now and in the future.

3.2.2 Participation in Local Planning and Land Use Policy Efforts

This scenario relies strictly on local land use controls such as planning and zoning; site plan review; and subdivision regulations to prevent encroachment. APG has limited influence on the planning and zoning activities of the surrounding communities. Pure economics makes it more attractive for localities to encourage development near APG because of the increase in APG mission brought by BRAC and the corresponding tax base that comes with development.

3.2.3 Land Acquisition

Under this alternative the Army would purchase additional land adjacent to APG's ranges in order to sustain the ability to meet the installation's testing, training and mission requirements. This alternative would be effective if it was viable to implement, however, the financial and political commitment required would be significant. There would be no partner contributions toward Army purchase of buffer lands and ongoing maintenance and operation of these lands would be a permanent annual expense to the Army. In addition, it is expected that there would be little political and public support for such a significant acquisition program which would most likely require eminent domain or condemnation in order to acquire key parcels. Acquisition of buffer lands by the Army is not considered a financially or politically viable alternative.

4.0 FUNDING REQUIREMENTS

As the goal of the APG ACUB program is to obtain both off-post noise buffering and on-post mitigation buffering, the prioritization of potential partners is multi-fold. Each parcel will be objectively judged to maximize the potential benefits to APG, using the scoring matrix provided in Appendix A. The parcels will be judged by the following criteria:

1. Limit development to reduce noise receptors in the operational noise envelope
2. Obtain TMDL conservation credit in the corresponding TMDL segment shed
3. Ability to protect bald eagle nest, roost or foraging sites for regulatory benefit
4. Ability to preserve wetlands and/or critical area for regulatory relief
5. Ability to construct or enhance wetlands and/or critical area for regulatory credit
6. Ability to satisfy another military mission requirement
7. Cost of the parcel and partner contributions

4.1 Cost Estimates

Total acreage in Priority Area 1 is 82,013 acres; in Priority Area 2 is 35,446 acres; and in Priority Area 3 is 82,889 acres. Of the 200,348 acres incorporated in this program, 50,389 acres are already protected through other programs. Priority Area 1 has 25,328 acres under current protection and Priority Area 2 has 11,358 acres under protection, while Priority Area 3 has 13,703 acres under current protection. Therefore, there is currently 149,959 acres unprotected throughout the priority areas in the APG ACUB program.

This program uses the fair market value per acre provided by the Maryland Agricultural Land Preservation Foundation, Easement Acquisition Program for Maryland Fiscal Year 2009/2010. For Priority Areas 1 (Eastern Shore) and 2, an average fair market value for Kent County and Cecil County was used in Table 1. For Priority Areas 1 (Western Boundary) and 3, an average fair market value for Harford County and Cecil County was used in Table 1. Properties cannot be above fair market value for ACUB funding.

The estimated values in Table 1 are approximations, and the actual cost to acquire easements on properties throughout this ACUB area will be driven by market factors and individual parcel attributes. Table 2 is reserved for tracking the annualized cost of the APG ACUB after the program is approved and the plan is executed.

LAND USE	EST. ACREAGE IN POTENTIAL ACUB AREAS	ESTIMATED COST/ACRE	ESTIMATED TOTAL COST	PARTNER CONTRIBUTION	ARMY CONTRIBUTION
Priority Area 1 Western Boundary	8,649	$11,512	$99,567,288	50%	$49,783,644
Priority Area 1 Eastern Shore	48,036	$8,800	$422,716,800	50%	$211,358,400
Priority Area 2	24,088	$8,800	$211,974,400	50%	$105,987,200
Priority Area 3	69,186	$11,512	$796,469,232	50%	$398,234,616
TOTAL	149,959		$1,530,727,720	50%	$765,363,860

Table 1. Estimated Total Cost for Army Compatible Use Buffer Program

Notes:

1. Estimates presented in Table 1 represent cost ceilings.
2. Successes can be achieved by conserving less than 100% of total target area.
3. Proposed area represents the entire footprint APG requests authorization to target. Actual execution will be less than the entire proposed target area.

	Personnel (Annual)	Management Cost (Annual)	Total Acres Acquired (Annual)	Estimated Buffer Cost per Acre	Total Estimated Cost for Land Purchase (Annual)	Estimated Total Army Cost (Annual)
Cost	TBD	TBD	TBD	TBD	TBD	TBD

Table 2. Annualized Cost for Army Compatible Use Buffer Program

4.2 Anticipated Partner Funding

Partners will be identified based on the location of the potential parcel and the needs of APG. Funding and services provided by the partners will be determined based on each parcel identified. Partners must contribute to each parcel, even if only in-kind services are provided. Each parcel submitted for ACUB funding will identify specific partners and their contributions. Potential partners have been identified below.

4.2.1 Eastern Shore Land Conservancy

APG met with Eastern Shore Land Conservancy (ESLC) personnel to explore a partnership for potential ACUB partners on the Eastern Shore of the Chesapeake Bay. The ESLC preserves property south of the C&D Canal in Cecil County, Kent County, and Queen Anne's County. ESLC has indicated a willingness of potential land owners on the Eastern Shore, and they are enthusiastic about developing a relationship with APG through the ACUB program. ESLC will be a primary partner on the Eastern Shore.

4.2.2 Harford Land Trust

APG partnered with Harford Land Trust (HLT) for the successful ACUB project to buffer Churchville Test Area in 2006. HLT is excited about the opportunity to continue their relationship with APG. During exploratory meetings to develop a larger ACUB program, HLT has already indicated a number of parcels within Priority 1 that they would like to preserve. They will be APG's primary partner for land preservation in Harford County.

4.2.3 The Conservation Fund

The Conservation Fund (TCF) has a long history of partnering with Army installations across the country to preserve land and protect the military mission. TCF is a national conservation organization with successes across the continent. The TCF revolving fund is a financing tool that can assist smaller land trusts achieve their goals. TCF has also completed numerous mitigation activities, which will fit with the APG ACUB benefit of wetland and critical area mitigation. TCF will be APG's primary partner for lands outside the purview of ESLC and HLT, as well as APG's primary partner for mitigation efforts on ACUB parcels.

4.2.4 Other Potential Partners

Other partners may be added as the APG ACUB program develops.

In addition, the various Garrison Supported Organizations throughout APG may contribute funds as they become available.

4.3 Other Anticipated Partner Contributions

The APG ACUB program will identify partners to be used in the event that on-parcel mitigation is permitted by regulatory agencies. These agreements will be worked out with the partner, the land owner, and the regulators prior to each parcel being identified for ACUB funding.

Further, as TMDL regulations develop, APG anticipates adding county government as a partner since the benefits of land preservation will benefit both APG and the individual county for TMDL purposes.

4.4 Metrics for Success

Priority Area 1 – Western Boundary

This portion of Priority Area 1 (PA 1) has a goal to buffer Perryman Test Area, ATEF Test Area, and a new unmanned ground vehicle test track for wheeled and tracked vehicles, as well as buffering noise impacts from firing programs. On the western shore of the Bush River the buffer would protect a training site for urban combat in addition to Nap of the Earth training, night vision training, drop zone training and Pinnacle Landing training for helicopter pilots. This PA exists to alleviate increasing noise and dust complaints originating off post as farmland and forested areas become developed residentially as well as keeping nighttime light encroachment to a minimum. The definition of success for PA 1 is:

- Green: Acquiring easements or fee-simple purchases on parcels adjacent to APG's boundary line on both sides of the Bush River or 500 acres.

- Amber: Acquiring easements or fee-simple purchases on parcels adjacent to APG's boundary line on both sides of the Bush River or 100 acres.
- Red: Not acquiring easements or fee-simple purchases on any parcels adjacent to APG's boundary line.

A timeline for this action is dependent upon funding levels. With good landowner interest and adequate funding this area could be fully buffered within three to five years since a capable partner, Harford Land Trust, has already shown interest in this area. Development in this portion of PA1 is imminent, so the three to five year timeframe may be too long to meet the needs of the test and training missions.

Priority Area 1 – Eastern Shore

This portion of PA 1 has a goal to buffer APG by reducing new noise receptors; acquiring TMDL credits for land conservation to meet the EPA/MDE pollution allocations; targeting parcels with known bald eagle nests to satisfy recommendations of APG's Biological Opinion; targeting parcels where compensatory critical area mitigation can occur; and targeting parcels where compensatory wetland mitigation can occur. The definition of success for this portion of PA 1 is:

- Green: 1000 acres within 5 years with potential for three bald eagle nests or roosts per year, 10 acres/year of potential wetland mitigation, and 10 acres/year of potential critical area mitigation.
- Amber: 500 acres within 5 years with potential for either three bald eagle nests or roosts per year, 10 acres/year of potential wetland mitigation, or 10 acres/year of potential critical area mitigation.
- Red: 100 acres within 5 years with no additional benefits.

A timeline for this action is dependent upon funding levels. A capable partner, Eastern Shore Land Conservancy, has already shown interest in this area and has indicated good landowner interest in land conservation programs. It would take several years to fully buffer this area. Development pressure will continue to increase in this portion of PA1, but there is a timeline of five to ten years is acceptable to the test and training mission.

Priority Area 2

Priority Area 2 (PA 2) has a goal to buffer APG by reducing new noise receptors; targeting parcels with known bald eagle nests to satisfy recommendations of APG's Biological Opinion; targeting parcels where compensatory critical area mitigation can occur; and targeting parcels where compensatory wetland mitigation can occur. The definition of success for PA 2 is:

- Green: 500 acres within 5 years with potential for 1 bald eagle nest or roost per year, 5 acres/year of critical area mitigation potential and 5 acres/year of wetland mitigation potential.
- Amber: 250 acres within 5 years with potential for either 1 bald eagle nest or roost per year, 5 acres/year of critical area mitigation potential or 5 acres/year of wetland mitigation potential.
- Red: 100 acres within 5 years with no additional benefit.

A timeline for this action is dependent upon funding levels. A capable partner, Eastern Shore Land Conservancy, has already shown interest in this area and has indicated good landowner interest in land conservation programs.

Priority Area 3

Priority Area 3 (PA 3) has a goal to buffer APG by reducing new noise receptors in APG's noise impact zones; acquiring TMDL credits for land conservation to meet the EPA/MDE pollution allocations; targeting parcels with known bald eagle nests; targeting parcels on which critical area mitigation can occur; and targeting parcels on which compensatory wetland mitigation can occur. The definition of success for PA 3 is:

- Green: 200 acres within 5 years with potential for either 1 bald eagle nest or roost per year, 1 acre/year of critical area mitigation potential, or 1 acre/year of wetland mitigation potential.
- Amber: 100 acres within 5 years with no additional benefit.
- Red: 50 acres within 5 years with no additional benefit.

A timeline for this action is dependent upon funding levels. A capable partner, Harford Land Trust, has already shown interest in and conducted work in this area.

5.0 POTENTIAL ISSUES OF CONCERN OR CONTROVERSY

In 1917, it took an Act of Congress and two Presidential Proclamations for the United States Government to take control of what is now Aberdeen Proving Ground. Great care will be taken to ensure the public understands that this is a voluntary program in which willing landowners may participate.

During this economic downturn, local governments will be concerned about the loss of the tax base due to the purchase of development rights through conservation easements. Additionally, many people feel that the government, both State and Federal, should not be spending money on land conservation during the poor economic condition. Several new regulations, including Total Maximum Daily Loads (TMDLs), will require jurisdictions to reduce their pollutant loads to the Chesapeake Bay. Participating in the ACUB partnership will allow them to reach these new requirements with the most minimal fiscal input. Additionally, there has been a large push for public access to the Chesapeake Bay in recent years for recreational activities. At this time it is not known if ACUB properties could be used to create public access points, but the possibility cannot be ruled out completely.

No major issues or potential controversy is anticipated by this ACUB program. Conversely, this program could be ground breaking in terms of regulatory benefit through ACUB preservation and in terms of joining multiple partners together to achieve one goal.

6.0 TIMELINE FOR PROPOSED ACTION

During discussions with Harford Land Trust and Eastern Shore Land Conservancy, there currently exists a list of willing landowners interested in conserving their properties. In fact, ESLC indicated that they

could have as many as five parcels in line for conservation as early as March 2011. Once the APG ACUB program is approved, APG will immediately move out with execution of the program. Assuming approval in FY12, APG could realistically execute FY12 funds in the program.

7.0 PLAN FOR SCOPING AND PUBLIC PARTICIPATION

7.1 Regulator Involvement

US Fish and Wildlife Service has indicated that the nest and roost sites preserved through the ACUB program may be considered as alternate nest and roost sites under the programmatic bald eagle permit that is being developed. Formalizing this agreement will be completed prior to including this benefit on any ACUB parcel.

7.2 Public Outreach

At this time, APG plans to allow its partners to conduct public outreach within the community to determine the willingness of land owners to conserve or sell their property through the program. In areas where there is considerable willingness by land owners, APG will participate in public outreach events with its partners.

7.3 Compliance with NEPA

This ACUB program complies with the requirements of the National Environmental Policy Act (NEPA). The NEPA categorical exclusion which applies to this program is (f)(1), grants or acquisition of leases, licenses, easements, and permits for use of real property or facilities in which there is no significant change in land or facility use. Examples of this categorical exclusion include, but are not limited to, Army controlled property and Army leases of civilian property to include leases of training, administrative, general use, special purpose, or warehouse space. A Record of Environmental Consideration (REC) will be completed for each parcel included in this ACUB program. The REC will be completed at the time the parcel is considered for funding under this program.

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APPENDIX A. PARCEL SCORING MATRIX

BENEFIT	POSSIBLE POINTS	SCORE
Reduce Noise Receptors	1000 ac or more = 7 750-1000 ac = 6 500-750 ac = 5 250-500 ac = 4 50-250 ac = 3 10-50 ac = 2 0-10 ac = 1	
Provide TMDL Benefit	Maximum benefit = 4 75% of max = 3 50% of max = 2 25% of max = 1 No benefit = 0	
Beneficial Eagle Habitat	More than 3 nests/roosts = 4 3 nests/roosts = 3 2 nests/roosts = 2 1 nest/roost = 1 No eagle benefit = 0	
Wetland Mitigation Potential	10 acres or more = 4 5-10 acres = 3 1-5 acres = 2 0-1 acres = 1 No wetland benefit = 0	
Critical Area Mitigation Potential	10 acres or more = 4 5-10 acres = 3 1-5 acres = 2 0-1 acres = 1 No critical area benefit = 0	
Priority Area	Along Border = 4 PA1 = 3 PA2 = 2 PA3 = 1	
Other Mission Support Benefit	Additional mission support benefit = 1	
Other Environmental or Cultural Benefit	Additional benefit = 1	
Cost	Partner Match Over 80% = 5 Partner Match 60.1% - 80% = 4 Partner Match 40.1% - 60% = 3 Partner Match 20.1% - 40% = 2 Partner Match 0.1% - 20% = 1	
TOTAL	**MAXIMUM POINTS = 34**	

Note: TMDL benefit scoring will be determined when regulations are finalized and conservation benefits within TMDL regulations are defined.

Note: Scoring may change as the program matures. Any change in scoring will be shared with all partners and incorporated into the program document.

APPENDIX B. PARTNER LETTERS

THE HARFORD LAND TRUST

Helping landowners, private and public, to conserve land and protect the natural resources, scenic beauty, rural character and a healthy way of life in Harford County.

March 9, 2011

Mr. David Goad
TEDT-AT-CSE
US Army Aberdeen Test Center
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

RE: Army Compatible Use Buffer Program

The Harford Land Trust, Inc. is pleased to be considered as a partner in Aberdeen Proving Ground Army Compatible Use Buffer Program.

We had a mutually beneficial project in 2007 with the ACUB program resulting in the preservation of the 162-acre Hopkins Farm bordering APG's Churchville Test Area. This rewarding experience gives us the confidence to again partner with APG and the ACUB partners.

I am hopeful that Army Headquarters will approve your proposed project and Harford Land Trust as a partner. I look forward to working with you and achieving the ACUB mission goals in the area of Aberdeen Proving Ground.

Sincerely,

Margaret L. Niland
Executive Director

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P.O. Box 169
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FAX 410-827-3763
www.eslc.org

EASTERN SHORE LAND CONSERVANCY

March 15, 2011

David Goad
US Army Aberdeen Test Center
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

Mr. Goad:

The Eastern Shore land Conservancy (ESLC) is interested in becoming a Primary Partner in Aberdeen Proving Ground's (APG) Army Compatible Use Program (ACUB).

Since 1990 ESLC has preserved farmland, forest, wildlife habitat, and riparian lands in the northern 6 counties on Maryland's Eastern Shore. ESLC has adopted a targeted approach to land conservation over its history and the APG ACUB program fits nicely with this approach. During our 20 year history, ESLC has partnered with many organizations and public entities in our work including; local governments, the State of Maryland, the Federal government through both the Farm and Ranchland Preservation Program and Section 6 Endangered Species grants, the Nature Conservancy, as well as many others. Land preservation efforts have focused on using donated and purchased conservation easements as the primary tools for conservation, though in fee purchases of properties have also been used. ESLC's familiarity with the Eastern Shore and our experience partnering with such a wide range of organizations and governmental entities makes us an ideal organization to work effectively and efficiently within the ACUB process.

ESLC supports the ACUB program for APG and we look forward to working with you to make this program a success. If you need anything else from ESLC, please contact me via email at jparks@eslc.org or by phone 443-988-8128.

Sincerely,

Jared Parks
Land Protection Specialist

THE CONSERVATION FUND

America's Partner in Conservation

410 Severn Avenue Suite 204
Annapolis, Maryland 21403
(443) 482-2826 fax: (443) 482-2806
www.conservationfund.org

March 17, 2011

Mr. David Goad
US Army Aberdeen Test Center
Attn: TEDT-AT-CSE (David Goad)
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

Re: Aberdeen Proving Ground Army Compatible Use Buffer Program

Dear David:

The Conservation Fund would be proud to participate as a "cooperating partner" in the Army Compatible Use Buffer Program being developed for Aberdeen Proving Ground.

We at The Conservation Fund (TCF) understand how critically important Aberdeen Proving Ground is to the economy of the State of Maryland. The Conservation Fund's dual charter balances the economic and environmental aspects of protecting America's land and water legacy. Protecting Aberdeen Proving Ground's mission in Hartford County by using land protection as a tool is squarely within the mission of TCF. We have partnered with the Army and other land trusts in a similar fashion at Fort A.P. Hill in Bowling Green, Virginia.

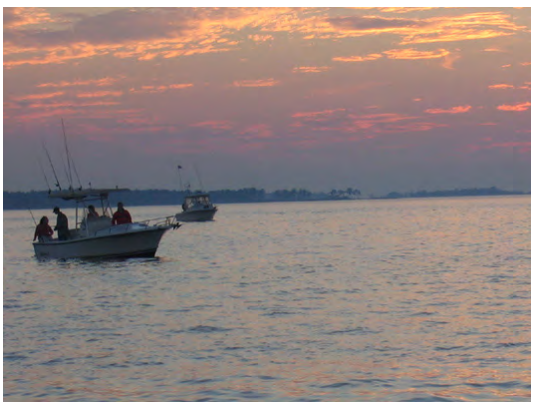
We look forward to forging a partnership with the Army that will make an Army Compatible Use Buffer Program a reality. Please let us know how we can best be of assistance in your efforts to obtain approval for the ACUB Program at Aberdeen Proving Ground. I can best be reached at (410) 274 8421.

Sincerely,

Bill Crouch
Maryland Director

APPENDIX G

Joint Land Use Study Report



APG JLUS

Aberdeen Proving Ground Joint Land Use Study

PUBLIC DRAFT

AUGUST 2015

Aberdeen Proving Ground
Joint Land Use Study

PUBLIC DRAFT

AUGUST 2015

This study was prepared under contract with the Chesapeake Science and Security Corridor (an arm of Harford County), with financial support from the Office of Economic Adjustment, Department of Defense. The content reflects the views of the key JLUS partners involved in the development of this study and does not necessarily reflect the views of the Office of Economic Adjustment.

Matrix DESIGN GROUP

ABERDEEN PROVING GROUND

JOINT LAND USE STUDY

Public Draft

Prepared for

Chesapeake Science and Security Corridor, Harford County

CHESAPEAKE SCIENCE & SECURITY CORRIDOR

Prepared by

Matrix DESIGN GROUP

August 2015

This study was prepared under contract with the Chesapeake Science and Security Corridor (an arm of Harford County), with financial support from the Office of Economic Adjustment, Department of Defense. The content reflects the views of the key JLUS partners involved in the development of this study and does not necessarily reflect the views of the Office of Economic Adjustment.

APG JLUS Acknowledgements

EXECUTIVE COMMITTEE

The Executive Committee served an active and important role in the development of the Aberdeen Proving Ground (APG) Joint Land Use Study (JLUS). The Chesapeake Science and Security Corridor would like to thank the following individuals for their review, guidance, and assistance:

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APG JLUS

Table of Contents

Figures and Tables

APG JLUS Acronyms

A

AA	Aberdeen Area
AB	Assembly Bill
ac	acres
ACEC	Areas of Critical Environmental Concern
ACUB	Army Compatible Use Buffer
AE	Alternative Energy Development
AE	Ammunition and Explosives
AEC	U.S. Army Evaluation Center
AGL	above ground level
ALUC	Advisory Land Use Committee
ALUC	Airport Land Use Commission
ALUCP	Airport Land Use Compatibility Plan
AMSAA	Army Material Systems Analysis Activity
APG	Aberdeen Proving Ground
APZ	Accident Potential Zone
AR	Army Regulation
AR	Attainment Report
ARL	Army Research Lab
ARWG	Adaptation and Response Working Group
AQ	Air Quality
AT	AT
AT / FP	AT / FP
ATC	ATC
ATCT	ATCT
ATEC	ATEC

B

BAH	Basic Allowance for Housing
BASH	Bird / Wildlife Aircraft Strike Hazard
BEH	Bachelor Enlisted Housing
BEMP	Bald Eagle Management Plan
BHWG	Bird Hazard Warning Group
BIO	Biological Resources
BLM	Bureau of Land Management
BOH	Bachelor Officer Housing
BOS	Board of Supervisors
BO	Biological Opinion
BOSS	Better Opportunities for Single Soldiers
BRAC	Base Realignment and Closure

C

CALA	Combat Aircraft Loading Ordnance Area
CAS	Close-Air Support
CB	Chemical and Biological
CBP	Chesapeake Bay Program
CDNL	Community Day-Night Average Noise Level
CECOM	U.S. Army Communications Electronics Command
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERDEC	U.S. Army Communications Electronics Research, Development and Engineering Command
CEWMP	Comprehensive Energy and Water Master Plan
CFR	Code of Federal Regulations
CIS	Capital Investment Strategy
CL	Community Legacy
CNEL	Community Noise Equivalent Level
CNRSW	Commander Naval Region Southwest
CO_2	Carbon Dioxide
COA	Critical Operations Area
CCOM	Interagency Coordination / Communication
CP	Comprehensive Plan
CR	Cultural / Historic Resources
CRP	Cultural Resources Program
CRPO	Cultural Resources Program Office

CSAR	Combat Search and Rescue
CSD	Customer Service Desk
CSSA	Chesapeake Science and Security Corridor
CSTA	Combat Systems Test Activity
CTP	Consolidated Transportation Program
CUP	Conditional Use Permit
CWA	Clean Water Act
CZ	Clear Zone
CZMS	Coastal Zone Management Act
C4ISR	Command, Control, Communications, Computers, Intelligence, Survivability and Reconnaissance

D

dB	decibel
DeCA	Defense Commissary Agency
DEIS	Draft Environmental Impact Statement
DNL	Day-Night Level
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DON	Department of Navy
DS	Dust, Smoke, and Steam

E

E-1	Enlisted Sailor
EA	Edgewood Area
EA	Environmental Assessment
EAP	Encroachment Action Plan
EAS	Essential Air Service
EB	Eastbound
ECBC	Edgewood Chemical Biological Center
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EMS	Emergency Management Services
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESLC	Eastern Shore Land Conservancy
EUL	Enhanced Use Lease

F

FAA	Federal Aviation Administration
FAD	Floodplain Accommodation District
FCC	Federal Communication Commission
FCD	Floodplain Accommodation District
FI	Frequency Spectrum Interference / Impedance
FISC	Fleet Industrial Supply Center
FL	flight level
FLPMA	Federal Land Management and Policy Act
FONSI	Finding of No Significant Impact
FRC	Fleet Readiness Center
ft	feet / foot
FYDP	Future Years Defense Plan
FY	fiscal year

G

GATE	Government and Technology Enterprise
GCA	Ground Control Approach
GIS	Geographic Information Systems

H

HA	Housing Availability
HUD	U.S. Department of Housing and Urban Development

I

I	Interstate
ICRMP	Integrated Cultural Resources Management Plan
ICUZ	Installation Compatible Use Zone
IDA	Intensely Developed Area
IE	Infrastructure Extensions
IFR	instrument flight rule
IGA	Intergovernmental Agreement
ILA	Industrial, Landscaping, and Agricultural
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
ITAM	Integrated Training Area Management

J

JLENS	Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System
JLUS	Joint Land Use Study
JPEO-CBD	Joint Program Executive Office for Chemical and Biological Defense
JSHS	Junior Science & Humanities Symposium

K

km	kilometers

L

Ldn	Day-Night Average Sound Level
LDA	Limited Development Area
LG	Light and Glare
LGTR	Laser-guided Training Round
LI	Legislative Initiatives
LRC	Long Range Component
LS	Competition for Land / Air Space
LSHG	Lower Susquehanna Heritage Greenway
LU	Land Use
LUO	Land Use Ordinance
LUPZ	Land Use Planning Zone
LZ	Landing Zone

M

MARC	Maryland Area Regional Commuter
MCA	Military and Civilian Aviation
MCA	Military Compatibility Area
MCCC	Maryland Commission on Climate Change
MDA	Maryland Department of Agriculture
MDARNG	Maryland Army National Guard
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MDOT	Maryland Department of Transportation
MEA	Maryland Energy Administration
MET	Maryland Environmental Trust
MGE	Municipal Growth Element
MHT	Maryland Historical Trust
MHEC	Maryland Higher Education Commission
MOA	Memorandum of Agreement
MOA	Military Operating Area
MOU	Memorandum of Understanding
MSL	mean sea level
MTP	Maryland Transportation Plan
MTR	Military Training Route

N

NAAQS	National Ambient Air Quality Standards
NACo	National Association of Counties
NATO	North Atlantic Treaty Organization
NBW	Neighborhood Business Works
NDAA	National Defense Authorization Act
NEIEN	National Environmental Information Exchange Network
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization(s)
NHPA	National Historic Preservation Act
NMP –	Nutrient Management Plan
NRHP	National Register of Historic Places
NLR	Noise Level Reduction
NM	nautical mile
NMFS	National Marine Fisheries Service
NO_x	nitrous oxides
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPIAS	National Plan of Integrated Airport Systems
NPS	National Park Service
NV	Noise and Vibration
NVG	night vision goggles

O

O_3	Ozone
OCRM	Office of Coastal Resource Management
OEA	Office of Economic Adjustment
OHV	Off-Highway Vehicle
ONMP	Operational Noise Management Program
OSD	Office of the Secretary of Defense

P

PAAF	Phillips Army Airfield
PEO C3T	Program Executive Office for Command, Control and Communications - Tactical
PEO IEW&S	Program Executive Office for Electronic Warfare & Sensors
PFA	Priority Funding Areas
PG	Policy Group
PL	Public Law
PM	Particulate Matter
PPE	Priority Preservation Element
PSD	Personnel Support Detachment
PT	Public Trespassing
PUC	Public Utilities Code

Q

QD	Quantity Distance Arcs

R

R	Restricted Airspace
RA	Restricted Airspace
RAB	Restoration Advisory Board
RC	Roadway Capacity
RCA	Resource Conservation Area
RCI	Residential Communities Initiative
RCZ	Range Compatibility Zone
RDECOM	U.S. Army Research, Development and Engineering Command
RDT&E	Research, Development Test and Evaluation
REAT	Renewable Energy Action Team
REPI	Readiness and Environmental Protection Initiative
RESI	Regional Economic Studies Institute
RGGI	Regional Greenhouse Gas Initiative

RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right-of-Way
RPMP	Real Property Master Plan
RPS	Renewables Portfolio Standard
RSZ	Range Safety Zone
RTLP	Range and Training Land Program
RV	Recreational Vehicle
R&D	Research and Development

S

SA	Safety
SAR	Search and Rescue
SB	Senate Bill
SEAP	Science and Engineering Apprentice Program
SF	square feet
SG	Smart Growth
SGSC	Smart Growth Subcabinet
SHA	State Highway Administration
SIP	State Implementation Plan
SLR	Sea Level Rise
SMART	Science, Mathematics & Research for Transformation
SNR	Scarce Natural Resources
SOI	Sphere of Influence
SOP	Standard Operating Procedures
SPA	Specific Plan Area
SR	Slow Route
SR	State Route
SRBC	Susquehanna River Basin Commission
SRP	Sustainable Range Program
SRT	State Report on Transportation
STA	State Transit Assistance
STC	sound transmission class
STEM	Science, Technology, Engineering, and Mathematics
SUA	Special Use Airspace
SWDA	Safe Water Drinking Act
SWPP	Source Water Protection Plan
S&E	Scientists and Engineers

T

TACTS	Tactical Aircrew Combat Training System
TACAN	Tactical Air Navigation
TOD	Transit Oriented Development
TDA	Transportation Development Act
TDML	Total Maximum Daily Loads
TR	Town-Residential Zoning
TWG	Technical Working Group

U

UAS	Unmanned Aerial System
UGB	Urban Growth Boundaries
US	United States
USAF	United States Air Force
USAPHC	United States Army Public Health Command
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	US Fish and Wildlife Service
USMC	United States Marine Corps
UXO	Unexploded Ordnance

V

VFR	visual flight rule
VO	Vertical Obstructions

W

WAH	Weide Army Heliport
WB	Westbound
WCM	Water Conservation Measure
WIP	Watershed Implementation Plan
WISS	Weapons Impact Scoring System
WRE	Water Resources Plan Element
WUI	Water Use Intensity

Z

ZO	Zoning Ordinance

APG JLUS

1 Introduction

Introduction

Military installations are critical to local, regional, and state economies, generating thousands of jobs and millions of dollars in annual economic activity and tax revenue. In the past, incompatible development has been a factor in the loss of training operations and restructuring of mission-critical components to other military installations. The loss of military missions and closure of military installations have been detrimental to their host communities. To protect the missions of military installations and health of local economies and industries that rely on them, encroachment must be addressed through collaboration and joint planning between installations and local communities. This Joint Land Use Study (JLUS) attempts to mitigate existing compatibility issues, facilitate the prevention of future issues, and improve coordination between the local communities and Aberdeen Proving Ground (APG).

The APG JLUS advocates a proactive approach to encourage increased communication about decisions relating to land use regulation, conservation and natural resource management issues affecting the Study Area communities and the military. This study seeks to avoid conflicts previously experienced between the United States (US) military and local communities in other areas of the US and throughout the world by engaging the military and local decision-makers in a collaborative planning process.

Gateway signage at Aberdeen Proving Ground entry

What Is A Joint Land Use Study?

A JLUS is a planning process accomplished through the collaborative efforts of a comprehensive list of stakeholders in a defined Study Area. These stakeholders include local community, state, and federal officials, residents, and the military who come together to identify compatible land uses and growth management recommendations within, and adjacent to, active military installations. The intent of the process is to establish and encourage a working relationship between the local communities, agencies and APG.

Joint Land Use Study Goal

The goal of the APG JLUS is to protect the viability of current and future military operations, while simultaneously guiding community growth, sustaining the environmental and economic health of the region, and protecting public health, safety, and welfare.

To help meet this goal, three primary guiding principles were identified:

- **Understanding.** Convene community and military representatives to identify, confirm, and understand the issues in an open forum, taking into consideration both community and APG perspectives and needs. This includes public awareness, education, and input organized in a cohesive outreach program.

- **Collaboration.** Encourage cooperative land use and resource planning among APG and surrounding communities so that future community growth and development are compatible with the operational missions at APG, while at the same time seeking ways to reduce operational impacts on adjacent lands within the Study Area.
- **Actions.** Provide a set of mutually supported tools, activities, and procedures from which local jurisdictions, agencies, and APG can select, prepare, and approve / adopt and then use to implement the recommendations developed during the JLUS process. The actions proposed include both operational measures to mitigate installation impacts on surrounding communities and local government and agency approaches to reduce community impacts on military operations. These tools will help decision makers resolve compatibility issues and prioritize projects within the annual budgeting process of their respective entity / jurisdiction.

Why Prepare A Joint Land Use Study?

Although military installations and nearby communities may be separated by a fenceline or geography including water bodies they often share natural and manmade resources such as land use, airspace, water, and infrastructure. Despite the many positive interactions among local jurisdictions, agencies, and the military, and because so many resources are shared, the activities or actions of one entity can produce unintended negative impacts on another, resulting in conflicts. As communities develop and expand in response to growth and market demands, land use approvals have the ability to locate potentially incompatible development closer to military installations and operational areas. The result can initiate new, or exacerbate existing, land use and other compatibility issues, often referred to as encroachment, which can have negative impacts on community safety, economic development, and sustainment of military activities and readiness. This threat to military readiness is currently one of the military's greatest challenges.

Collaboration and joint planning among military installations, local communities, and agencies should occur to protect the long-term viability of existing and future military missions. Working together also enhances the health of economies and industries of the communities before incompatibility becomes an issue. Recognizing the close relationship that should exist between installations and adjacent communities, the Department of Defense, Office of Economic Adjustment (OEA) implemented the JLUS program in an effort to mitigate existing and future conflicts and enhance communication and coordination among all affected stakeholders. This program aims to preserve the sustainability of local communities within the JLUS Study Area while protecting current and future operational and training missions at APG.

Public Outreach

The JLUS process is designed to create a locally relevant document that builds consensus and obtains support from the various stakeholders involved. To achieve the JLUS goals and objectives, the process included a public outreach program with a variety of participation opportunities for interested and affected parties.

Stakeholders

An early step in any planning process is the identification of stakeholders. Informing or involving them early in the project is instrumental to understanding, addressing, and resolving their most important issues through the development of integrated strategies and measures. Stakeholders include individuals, groups, organizations, and governmental entities interested in, affected by, or affecting the outcome of the JLUS document. Stakeholders identified for the APG JLUS included, but were not limited to, the following:

- Local jurisdictions (counties and cities)
- DOD officials (including OEA representatives)
- APG
- Local, regional, and state planning agencies
- Nongovernmental organizations
- The public (including residents and landowners)

Executive and Advisory Committees

The development of the APG JLUS was guided by two committees, comprising city, county, APG personnel, federal and state agencies, local governments, and other stakeholders.

Executive Committee. The Executive Committee (EC) consists of officials from participating jurisdictions, military installation leadership, and representatives from APG and federal and state agencies. The EC is responsible for the overall direction of the JLUS, preparation and approval of the study design, approval of policy recommendations, and approval of draft and final JLUS documents.

Advisory Committee. The Advisory Committee (AC) is responsible for identifying and studying technical issues. Membership includes county and municipal planners, military base planners and staff, and other subject matter experts as needed to help assist in the development and evaluation of implementation strategies and tools. Items discussed by the AC were brought before the EC for consideration and action.

The EC and AC served as liaisons to their respective stakeholder groups. The EC and AC members were charged with conveying committee activities and information to their organizations and constituencies and relaying their organization's comments and suggestions to both committees for consideration. The EC members were encouraged to conduct meetings with their organizations and / or constituencies to facilitate this input.

Public Workshops

In addition to the EC and AC meetings, a series of public workshops were held throughout the development of the JLUS. These workshops provided an opportunity for the exchange of information with the greater community, assisted in identifying the issues to be addressed in the JLUS, and provided an opportunity for input on the proposed strategies. Each workshop included an interactive presentation and facilitated exercise for the public to participate in the development of the plan.

Public Outreach Materials

Joint Land Use Study Overview / Compatibility Factors Fact Sheet. At the beginning of the JLUS process, a Fact Sheet was developed describing the JLUS program, objectives, public participation methods, and the APG JLUS proposed Study Area. This Fact Sheet was made available at the meetings for review by interested members of the public.

This Fact Sheet also served as an informational brochure describing each of the 24 compatibility factors used for JLUS analysis. While not every factor may apply to the APG JLUS, this list provides an effective tool to ensure a comprehensive evaluation of compatibility factors is conducted within the JLUS Study Area.

Strategy Tools Fact Sheet. JLUS strategies comprise a variety of actions that local governments, military installations, agencies, and other stakeholders can take to promote compatible land use planning. This Fact Sheet provided an overview of the strategy types that could be applied to address compatibility issues in the Study Area.

Website. A project website was developed to provide stakeholders, the public, and media representatives with access to project information. This website was maintained for the entire duration of the project to ensure information was easily accessible. Information contained on the website included program points of contact, documents, maps, public meeting information, and other JLUS resources. The project website is located at www.apgjlus.com.

JLUS Study Area

APG is situated on the northwestern shore of the Chesapeake Bay in Harford County, Maryland. The installation comprises approximately 72,165 acres, including nearly 40,425 acres of land at noncontiguous locations with the remaining area of 31,740 acres consisting of portions of the Chesapeake Bay and Bush and Gunpowder Rivers.

APG is approximately 35 miles northeast of the Maryland state capital of Annapolis, and strategically located between major cities - approximately 30 miles northeast of Baltimore, 60 miles northeast of

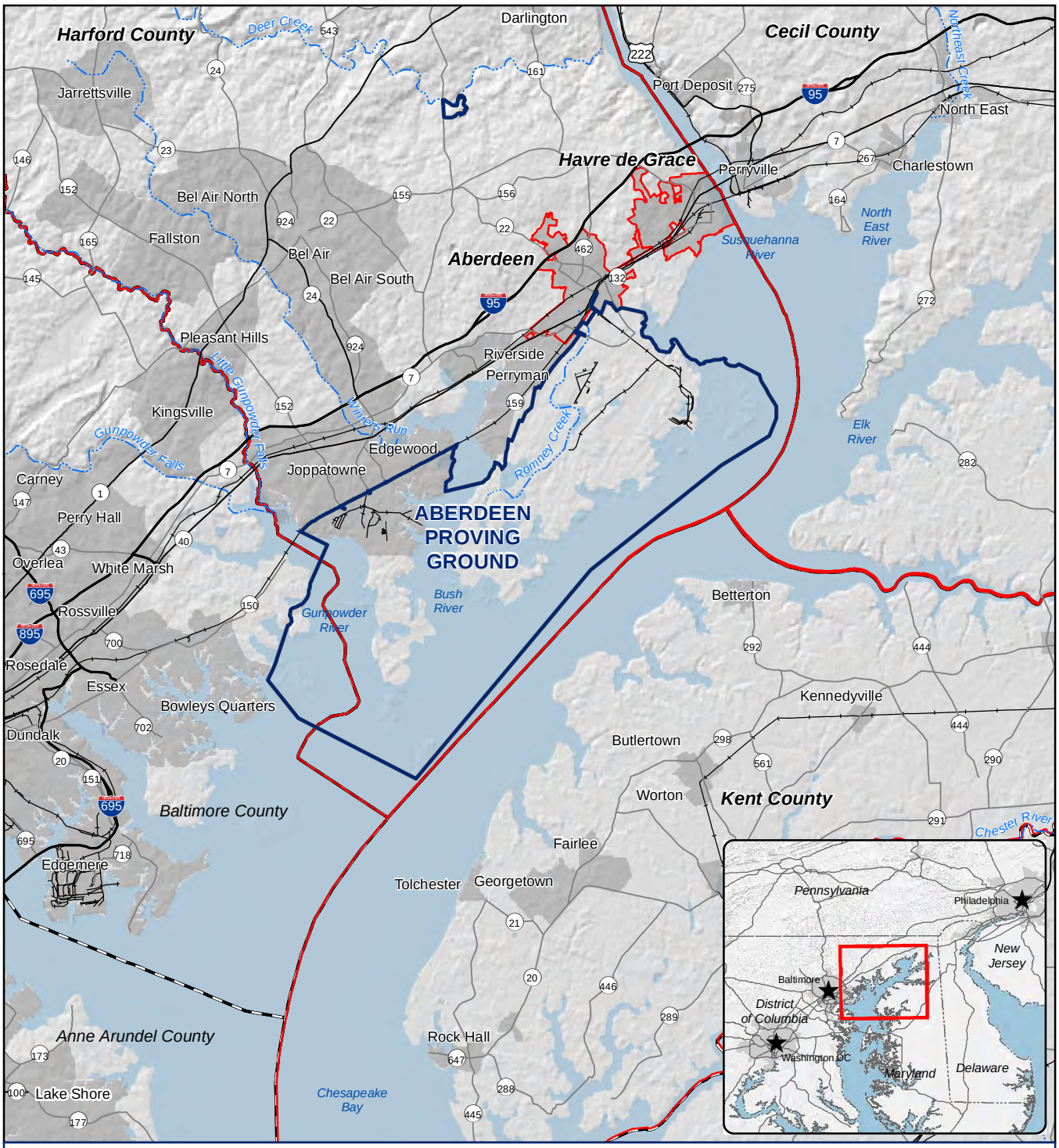
Washington DC, and 65 miles southwest of Philadelphia.

The APG JLUS Study Area encompasses all land near APG and areas that may impact current or future military operations or be impacted by operations. Due to its location and operational areas including the surrounding waters, the general JLUS Study Area was identified as the APG Aberdeen Area; Edgewood Area; Churchville Test Area; Spesutie Island; Graces Quarters; Carroll Island; range areas including portions of the Chesapeake Bay, Bush and Gunpowder Rivers; and the general area affected by operations including military airspace, range safety areas, and noise contours within the counties of Harford, Cecil, and Kent, and the cities of Aberdeen and Havre de Grace as illustrated in Figure 1.

JLUS Implementation

It is important to note that once the JLUS process is completed, the final document is not an adopted plan, but rather a set of strategies to be used by local jurisdictions, agencies, and organizations in the APG JLUS Study Area to guide their future compatibility efforts. Acceptance of the study by stakeholders (i.e. committees, jurisdictions, and the public) will be sought to confirm their collective support for identified implementation efforts. For instance, local jurisdictions and counties may use the strategies in this JLUS to guide future subdivision regulation, growth policy, and zoning updates, as well as formal coordinating procedures for the review of development proposals.

APG may use the JLUS process as a guide for interaction with local jurisdictions on future projects, and to manage internal planning processes with a compatibility-based approach.



Legend

- Installation Area
- Airfield
- Partnering JLUS Jurisdictions
- County Boundary
- City / Town / Unincorporated Community
- Interstate
- Highway
- Major Road
- Railroad
- Water Body
- River

Source: APG, 2014.

Matrix DESIGN GROUP

0 1 2 Miles

Figure 1
JLUS Study Area

Please see the next page.

APG JLUS

2 Community Profile

Introduction

This chapter provides an overview of the civilian communities within the Aberdeen Proving Ground (APG) Joint Land Use Study (JLUS) Area. Profiles of community growth and development trends are provided as is a description of the general setting of the JLUS Study Area.

Capturing and describing certain demographic characteristics of the communities in the JLUS Study Area provides a baseline context from which informed decisions can be made when developing compatibility strategies. The goal is to provide information that enables stakeholders to understand population and development trends that have the potential to affect the future of APG and its missions. This info is intended to be considered with other factors to help decision makers develop consistent, informed planning policies about future development and economic growth of the communities they represent before compatibility issues arise.

This section is intended to advise the military about the types of activities occurring "outside the fence" when considering future missions and operations at APG. This section will discuss Study Area growth trends including population projections and housing statistics; Economic drivers within each Study Area jurisdiction; projected growth; and transportation information for each Study Area jurisdiction.

APG Regional Overview

The APG JLUS Study Area encompasses the areas surrounding the military installation that are significantly influenced by military operations. The Study Area is situated at the headwaters of the Chesapeake Bay in northeast Maryland, northeast of Baltimore, near the borders of Pennsylvania and Delaware. The overall study area encompasses three counties (including several Census Designated Places or CDP's) and two cities.

Harford County

Harford County was established in 1773 and comprises a land area of approximately 437 square miles with an additional 86 square miles of water area. It is bordered by the Susquehanna River and Cecil County to the east, Baltimore County to the west, the State of Pennsylvania to the north, and the Chesapeake Bay and Kent County to the south. According to the 2010 Census, Harford County has a population of 244,826. The western portion of the Harford County Study Area comprises of largely developed areas east of Interstate 95 (I-95) from Baltimore to APG but largely rural woodlands and small farms west of I-95, with the exception of the Bel Air community and residential subdivisions. The largely developed areas east of I-95 include a mix of residential, commercial, and industrial areas encompassed by woodland areas.

Cecil County

Cecil County was first explored by Europeans in 1608 with the first European settlements occurring as early as 1633. However, it was not until 1674 that Cecil County was established separately from Baltimore County. Cecil County has a land area of approximately 350 square miles and a water area of 70 square miles. Cecil County is located in the northeastern corner of Maryland, and is bordered to the west by Harford County, the south by Kent County, the east by New Castle County Delaware, and the north by Lancaster and Chester Counties, Pennsylvania. According to the 2010 Census, Cecil County has a population of 101,108.

Cecil County has been a rural county for most of its history. However, as the metropolitan regions of Philadelphia, Wilmington, and Baltimore continue to grow, Cecil County is becoming a more favorable development area. Urban development is located along I-95/United States (US) Route 40 and along coastal areas. North and south of this corridor are more rural uses including agriculture and open space.

Source: Cecil County Comprehensive Plan, 2010

Kent County

Kent County was founded in 1642 and is the second oldest county in Maryland. Kent County has a land area of 277 square miles and a water area of 135 square miles. Kent County is bordered to the north by Cecil and Harford Counties, the east by New Castle and Kent County Delaware, the south by Queen Anne's County, and the west by Baltimore and Anne Arundel Counties. Kent County is considered primarily rural and agricultural in character, with smaller communities surrounded by farms, wetlands, and woodlands. Urban development is mostly located in small towns along coastal areas and the Chester River. According to 2010 Census, Kent County has a population of 20,197.

Economically, service and retail trade industries have experienced the largest growth in Kent County since 1985. However, Kent County takes pride in its agrarian character and takes steps towards conservation to prevent the loss of farmland to development. Measures include limiting the ability of landowners to create farmettes and promoting conservation easements.

City of Aberdeen

Aberdeen is located in Harford County along the I-95 / US Route 40 Corridor. The city is located in-between Havre de Grace and Edgewood approximately 25 miles northeast of Baltimore. The City is 6.47 square miles and shares the fenceline with APG. The 2010 Census population of Aberdeen was 14,959. The Village of Aberdeen was first settled in 1800. Aberdeen was incorporated as a town in 1892 and as a city in 1992. Aberdeen was originally an agrarian community located along the Pennsylvania and Baltimore and Ohio Railroads. When APG was established in 1917, overall availability of farmland decreased. APG also increased the need for civilian housing, which further drove Aberdeen's economy from agrarian to military support. Additionally, the City was incorporated into the Harford County Development Envelope in 1977.

The City of Aberdeen Comprehensive Plan anticipates buildout through 2030. Future growth is identified through 17 planning districts. Planning districts extend approximately one mile around the city limits. The City plans for future growth in 11 out of 17 Planning Districts. Of the 11 districts which anticipate growth, one is the existing City of Aberdeen and represents infill opportunities. Not including existing and infill opportunities, this equates to an area of 4,511 acres and roughly 8,770 equivalent dwelling units. The City of Aberdeen is also designated as a "Maryland Sustainable Community", as part of the Maryland Sustainable Communities Program.

The City of Aberdeen houses the only two entrance points to APG at the Maryland Boulevard and Harford gates. This gate placement impacts the city's roadways during the morning and evening rush hour.

City of Havre de Grace

The City of Havre de Grace is located in Harford County approximately 35 miles northeast of Baltimore. Havre de Grace is roughly six miles north of APG and situated at the mouth of the Susquehanna River in-between Aberdeen and Perryville. Havre de Grace lies along the I-95 and US Route 40 Corridors and is incorporated in the Harford County's Development Envelope. The city has a land area of approximately 6.9 square miles and as of the 2010 census, has a population of 12,952.

Havre de Grace was explored by Europeans as early as the 1620's, incorporated as a town in 1785, and incorporated as a city in 1878. Havre de Grace's history has been heavily influenced by its location at the mouth of the Susquehanna River. Havre de Grace was home to the first legally established ferry crossing on the Susquehanna River and has served as a midpoint on one of the most direct routes along the Atlantic Seaboard since colonial times. Establishment of APG in 1917 was also important for Havre de Grace, as the city provided entertainment and housing opportunities for military troops.

Havre de Grace has 7 revitalization areas, 5 new neighborhood developing areas, and 18 growth areas within the 2004 Comprehensive Plan Area. Revitalization areas focus mainly on the historic old town and properties while new neighborhoods and growth areas are located further away from the historic center; some areas within municipal limits and some outside municipal limits.

The City of Havre de Grace is also designated as a "Maryland Sustainable Community".

Source: Havre de Grace Comprehensive Plan, 2004

Land Preservation and Development Impacts

Land preservation regulations in the Study Area have the ability to help or hinder military compatibility. Land preservation regulations can prevent incompatible development from developing in military influence areas. The counties within the Study Area each have an agrarian history, which each look to protect while still allowing economic growth in other sectors.

Harford County

Harford County uses four major preservation programs to conserve agricultural and natural land. These include the Harford Agricultural Land Preservation Program (HALPP), Maryland Agricultural Land Preservation Foundation (MALPF), Rural Legacy Program, and the Maryland Environmental Trust (MET). These programs have collectively protected over 47,000 acres in the County.

Source: Harford County Land Preservation, Parks, and Recreation Plan, 2013

Cecil County

As of 2007, Cecil County land use is roughly 24 percent Development Lands (including Low Density Residential, Medium/High Density Residential, Commercial Industrial, and Rural Residential) and 76 percent Resource Lands (including Agriculture, Forest, and Wetlands). When regarding future land use, approximately 24 percent of the county is included in growth areas, 71 percent of the county is included in rural areas, and five percent of the county is included in mineral extraction and village uses. Of the 71 percent of land in rural areas, 95,819 acres (60 percent) is considered rural conservation and 63,469 acres (40 percent) is considered resource protection.

Source: Cecil County Comprehensive Plan, 2010

Kent County

Kent County has multiple tools available to help preserve agricultural land. These include: MALPF, Rural Legacy, Chesapeake Country National Scenic Byway, and donated conservation easements through the Eastern Shore Land Conservancy and/or MET. As of July 1, 2014, 17,488 acres have been preserved with MALPF easements, and 15,987 acres have been preserved through donated easements. Kent County has one Rural Legacy Area. The Sassafras Rural Legacy Focus Area has protected 2,204 acres of land and stretches from the Sassafras River near Betterton along the Chesapeake Shoreline just west of Worton. Finally, 986 acres have been protected along the Chesapeake Country National Scenic Byway.

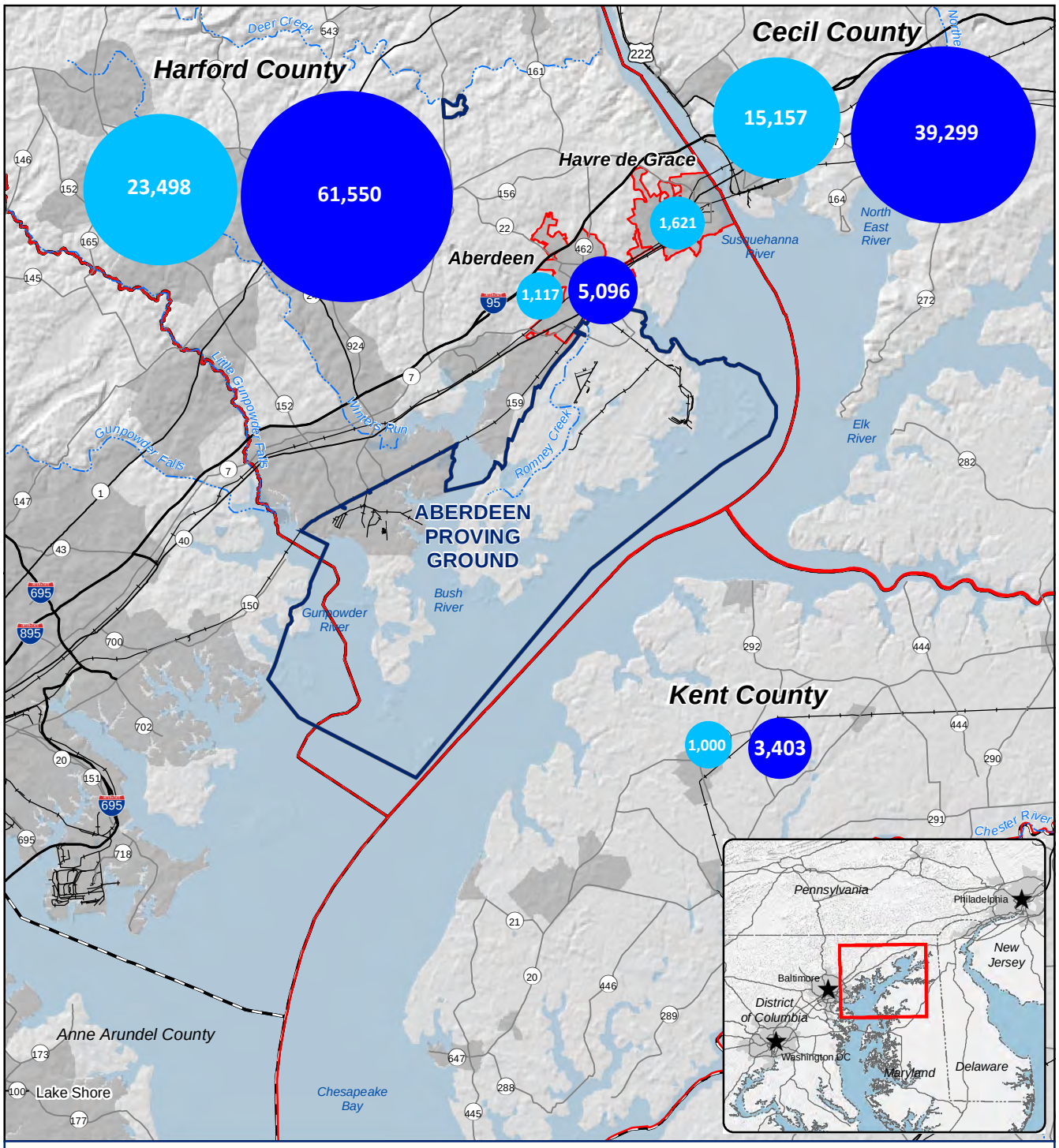
Source: Kent County Government, 2014

Study Area Growth Trends

The following section provides a summary of the study area's population growth, housing trends, and median home values. This information establishes a regional context for growth and development in the JLUS Area while providing a broad understanding of growth potential for compatibility analysis based planning.

Population

Population is based on the 2010 data provided by the US Census Bureau through the US Department of Commerce, Economics and Statistics Administration. The following section provides a comparison of the changes in population in the APG JLUS Study Area between 2000 and 2010 which is illustrated in Table 1 and the light blue circles on Figure 2.



Legend

- Installation Area
- Airfield
- Partnering JLUS Jurisdictions
- County Boundary

Source: APG, 2014.

- City / Town / Unincorporated Community
- Interstate
- Highway
- Major Road
- Railroad
- Water Body
- River

- Population growth between 2000 and 2010 (whole numbers)
- Projected population growth between 2000 and 2030 (whole numbers)
  * data unavailable for Havre de Grace

Matrix DESIGN GROUP

0 1 2 Miles

Figure 2
JLUS Study Area Growth 2000-2030

Table 1. Regional Population Growth by Study Area Jurisdiction, 2000 – 2010

Jurisdiction	2000	2010	Number Change	Percent Change
Maryland	**5,296,486**	**5,773,552**	**477,066**	**9%**
Harford County*	193,417	216,915	23,498	12%
Cecil County	85,951	101,108	15,157	18%
Kent County	19,197	20,197	1,000	5%
City of Aberdeen	13,842	14,959	1,117	8%
City of Havre de Grace	11,331	12,952	1,621	14%

Source: United States Census Bureau, profile of General Population and Housing Characteristics; 2000, 2010; Historical and Projected Total Population for Maryland's Jurisdictions, Maryland Department of Planning, 2014

**Harford County population includes the community of Bel Air but does not include City of Aberdeen or City of Havre de Grace*

The study area experienced an overall increase in population between 2000 and 2010. Harford County had the greatest population growth with the addition of 23,498 people, while Kent County experienced the least population growth at only 1,000. Similarly, Cecil County had the highest percentage of growth with an 18 percent increase during the 10-year period, while Kent County had the least percentage of growth with only a 5 percent increase within the same timeframe.

Cecil County's total population in 2010 was 101,108, which was an 18 Percent increase from the year 2000. Similar to Harford County, this growth can be partially attributed to BRAC activities but also the continued growth of both the Baltimore and Wilmington, Delaware Metropolitan areas. Kent County's population only grew by 5 Percent within the time span. Kent County's geographic setting in relation to APG means that growth due to BRAC is less likely. It can be assumed that Kent County's smaller population growth is due to a greater out-migration of youth in relation to a smaller in-migration of retirees as well as local desires to remain a rural, agrarian area.

The dark blue circles in Figure 2 graphically depict population growth for study area jurisdictions through 2030. Each county in the study area is expected to see population growth over the coming decades. Cecil County is expected to reach an approximate population of 125,250 by year 2030, a 24 percent increase from year 2010. Harford County is expected to reach an approximate population of 254,967 by year 2030, an 18 percent increase from the year 2010. Kent County is expected to reach an approximate population of 22,600 by year 2030, a 12 percent increase from the year 2010. The City of Aberdeen is expected to have a population of approximately 18,183 by year 2030, a 21 percent increase from year 2010. The City of Havre de Grace does not have readily available population projects.

Future growth will most likely be driven by the continued growth of major metropolitan areas in the region and the presence of APG.

Housing Value and Trends

Housing trends are an important indicator of economic activity and vitality, as they demonstrate the population growth or decline relative to new residential construction within an area. They also represent market decisions relative to home ownership versus rental properties. Ultimately, housing trends indicate potential future development locations and the types of residential and commercial development to come. A majority of the housing units in the Study Area jurisdictions are owner occupied. However, Aberdeen and Havre de Grace have owner occupied percentages lower than the state average and considerably lower than county averages. Since 2000, the median housing values and median monthly gross rents have increased significantly across the study area. Cecil County, Harford County, and Aberdeen have seen housing values almost double. Housing values in Kent County and Havre de Grace have more than doubled. Median monthly gross rental rates have risen by at least 50 percent in all jurisdictions. This increase can strain the affordability of the housing market close to APG, which, in turn, can lead to increased commuting distances by civilian and military personnel who work at APG and are priced out of the local housing market.

The availability of affordable multi-family dwellings is an important factor to consider for military compatibility, as some personnel with families stationed at APG may need to live off-base in the communities. It is also important for the communities within the JLUS study area to provide housing stock that meets the needs of the residents and the military personnel who are stationed at APG for indefinite periods of time.

Base Allowance for Housing

The Base Allowance for Housing (BAH) is a stipend given to military personnel who choose to live off base or cannot be accommodated in on-base housing. BAH is designed to augment the costs of living associated with private arrangements including home or apartment rent, utilities, and renter's insurance.

> The BAH is determined by pay grade, local area rental market, and dependent status.

While BAH rates for APG military personnel may vary by rank and dependent status, the rate for an E-1 stationed at APG ranges from $1170 (single) to $1563 (with dependents). Excluding the potential cost of utilities and renter's insurance, this figure is moderately above the median monthly rate in the study area jurisdictions. This means that an enlisted soldier should be able to locate affordable housing within the JLUS study area.

Source: Defense Travel Management Office, 2014

Economy

The Study Area is home to a diverse economy. While agriculture is still a major economic sector in the Study Area, the presence of APG has increased the amount of government and professional jobs in the Study Area. Unemployment is below the state average in Harford and Kent Counties and in the City of Havre de Grace. Unemployment is roughly equal to the State average in Cecil County. The unemployment rate in Aberdeen is above both the state average and national average (6.0 percent).

Harford County

BRAC brought numerous research and development firms to APG and thus Harford County. Since BRAC began implementation, approximately 99 new defense contractors and 8,000 contract employees relocated to Harford County. APG has approximately $13.6 billion dollars committed to future research and development projects. The Harford County Office of Economic Development hopes to capture some of this funding by supporting the Entrepreneurs Edge program, which pushes the innovation process for individuals to develop ideas into a business.

Harford County has also grown in non-defense related sectors. Major companies, including Clorox and Pier 1, have set up distribution centers that will add over 1.5 million square feet of commercial floor space to the county. Health care is also a growing industry, adding 130,000 square feet of health-care space through an expansion of the Upper Chesapeake Health System. Harford County is also home to two Enterprise Zones, Edgewood/Joppa and Aberdeen/Havre de Grace.

Source: Harford County Economic Development Department

Cecil County

Cecil County economic growth is due in part to the county's location midway between the Baltimore and Philadelphia/Wilmington Metropolitan areas. Between 2002 and 2008, Cecil County experienced 14 percent job growth. The largest increases in jobs occurred in the manufacturing, education and health services, retail trade, transportation and utilities, and local government sectors. The fastest growing sectors in terms of growth rate were education and health services, manufacturing, professional and business services, and local government. According to the 2010 Cecil County Comprehensive Plan, Cecil County has an average annual employment of 28,351. Despite the experienced economic growth, Cecil County still has a negative jobs/housing balance.

Cecil County offers real property and income tax credits to businesses that locate within the designated Cecil County Enterprise Zone. The availability of developable land, mounting growth pressure of surrounding jurisdictions, and the many transportation corridors which link Cecil County to the Northeast

Region are indicators of future economic growth in the county.

Source: Cecil County Comprehensive Plan, 2010

Kent County

Historically, Kent County has had an economy based on farming and commercial fishing. Today, Kent County's largest job sector is management, business, science, and arts.

Kent County's Economic Development Plan seeks to capitalize on growth in high quality service industries such as financial, health and elder care, recreational charter boat fishing, and outfitter hunting. Kent County also looks to travel and tourism industries and a continued focus on agriculture. Kent County hopes to increase availability of high capacity internet access to support new and existing business. Kent County also hopes to attract new business by marketing the lower business costs and attractive features of living within the county.

Source: Kent County Comprehensive Plan, 2006

City of Aberdeen

The City of Aberdeen is heavily influenced economically by APG. As part of the 2005 BRAC, APG brought 8,200 new positions to APG and Aberdeen looks to take advantage of the contractors and services that have followed. BRAC is seen as a way for Aberdeen to redevelop and expand commercial properties and shape the future for commercial districts in the City.

Aberdeen is also home to national companies such as C&S Wholesalers, Frito Lay, Home Depot, Pier I Imports, and Saks Fifth Avenue, which have warehouses within city limits.

Aberdeen has several business incentive programs to help attract new businesses, including: the Greater Aberdeen/Havre de Grace Enterprise Zone Program, Aberdeen BRAC Revitalization Zone, Historically Underutilized Business (HUB) Zone, Community Legacy Façade Program, and the Aberdeen Revolving Loan Fund Program. Future economic potential lies in Aberdeen's ability to expand the existing business base, attract high-tech businesses, and grow hospitality and food service sectors.

Source: Aberdeen Comprehensive Plan, 2011

City of Havre de Grace

Havre de Grace has a strong tourism, industrial, and health care base which provides approximately 2,500 employment opportunities. The historic downtown and waterfront are an important part of Havre de Grace's economic viability. Specialty stores and water activities help to increase the tourism market. Chesapeake Health Systems operates the Harford Memorial Hospital in Havre de Grace. The area surrounding the hospital has numerous health related businesses.

Havre de Grace has numerous resources to help foster business including the City Department of Economic Development, various business development programs, the Chamber of Commerce, and the Economic Development Commission. Harford County Government also provides business support through the Harford County Office of Economic Development. Both organizations work with the Maryland Department of Business and Economic Development to further local economic well-being. As stated earlier, Havre de Grace is located within the Greater Aberdeen/Havre de Grace Enterprise Zone. As of 2004, the Enterprise Zone had created $58 million in new capital investment in Havre de Grace alone. This equated to roughly 600 new jobs.

Havre de Grace's location within the I-95/US Route 40 Corridor and the Northeast Rail Corridor in proximity to APG creates an environment for sustained economic growth. Future economic opportunities include new development of corporate and technology office parks, availability of small flexible office space for start-up businesses, and attracting APG technology affiliates.

Source: Havre de Grace Comprehensive Plan, 2004.

Current Development Overview within the Study Area

The APG JLUS Study Area supports a myriad of land uses that range from agricultural and parklands to residential and urban population centers, with varying sizes of employment and population levels throughout. The cities of Aberdeen, Havre de Grace, and parts of Harford County lie north and west of APG. Cecil County lies northeast and east of APG and Kent County lies south and southeast of APG. Development adjacent to APG is characterized by the following:

North

The land north of APG is urban and agricultural. Immediately north of the Aberdeen Area is the Town of Aberdeen and farmland in unincorporated Harford County. Within close proximity of the northern boundary of APG is the City of Havre de Grace and associated urban areas. The Northeast Rail Corridor lies on the northern border of the Aberdeen Area.

Land north of the Edgewood Area consists of mostly suburban uses. Immediately north of Edgewood Area are the communities of Edgewood and Joppatowne. The Northeast Rail Corridor lies on the northern border of the Edgewood Area.

East

The Chesapeake Bay lies immediately to the east of APG. Across the Chesapeake Bay from APG are Elk Neck State Park, agricultural uses, and minor residential uses located in Cecil and Kent Counties.

South

The Chesapeake Bay lies immediately to the south of APG. Across the Chesapeake Bay is Kent County. Kent County is a rural county with many agricultural land uses. A small number of communities exist along the shoreline of Kent County including Betterton, Kinnard's Point, and Rock Hall.

West

Land west of APG is suburban, industrial, and agricultural. The community of Perryman lies west of the Aberdeen Area and consists of minor residential uses and large warehouse distribution centers. The distribution centers sit on the fenceline with the Aberdeen Area.

West of the Edgewood Area are residential and state lands in Baltimore County. Minor residential uses are located in Edgewood and Joppa. A part of the land is Gunpowder Falls State Park and Dundee Natural Environmental Area.

APG JLUS

3

Military Profile

Introduction

This chapter provides an overview of the military profile including the history and current operations at Aberdeen Proving Ground (APG) within the Joint Land Use Study (JLUS) Study Area.

Identifying and describing the various activities performed on the military installation provides valuable insight into the importance of APG as a national defense strategic asset. This information enables stakeholders to make informed decisions about the future development and economic growth of communities in proximity of APG, which could potentially impact the existence and future role of the facility.

Aberdeen Proving Ground Economic Impact

The APG JLUS Study Area spans the counties of Harford, Cecil, and Kent, and the cities of Aberdeen and Havre de Grace in the northeast region of Maryland. APG is the leading employer in the Study Area with more employees than the next 20 major employers combined, resulting in a significant footprint in the regional and local economy.

APG generates $4.3 billion in economic activity and supports approximately 29,000 jobs that result in $1.6 billion in employee compensation. Economic impact categories are divided into two categories, economic output, and employee compensation. These categories are further divided into direct, indirect, and induced. Direct impacts are those which occur as a direct result of the spending associated with APG. Indirect impacts are those which are created as a result of the in-state expenditures associated with APG. Induced impacts are estimates based on the increase in local incomes due to the operation of APG.

Installation Setting

APG is owned by the DOD, Department of the Army. APG is located on the shores of the Chesapeake Bay and occupies over 72,165 acres in Harford and Baltimore Counties. This area is further divided in 40,425 acres of land and 31,740 acres of water. APG is centrally located between Baltimore and Wilmington, Delaware as well as Washington, D.C. and Philadelphia, Pennsylvania.

APG is divided amongst several areas spread across Harford and neighboring Baltimore County. Individual settings are discussed below:

Aberdeen Area

The Aberdeen Area (AA) is approximately 28,708 acres of land and is located in the northern part of APG. There are three distinct sub areas: the security area (681 acres), the Cantonment (3,111 acres), and the Research, Development Test and Evaluation (RDT&E) range area (26,630 acres). The AA is mostly used for testing and research. The AA also includes Spesutie Island and the Phillips Army Airfield.

Edgewood Area

The Edgewood Area (EA), formerly Edgewood Arsenal, is made up of approximately 10,126 acres of land and is located to the south of the AA. There are three distinct sub-areas: the security area (220 acres), the Cantonment (5,156 acres), and the RDT&E range area (4,970 acres). The EA is the chemical research and engineering center for the United States (US) Army. Range testing occurs along the northeast fenceline and the southern portion of the EA. The EA is also the home of MDARNG Weide Army Heliport and the future home of the Northeast Maryland Additive Manufacturing Authority.

Churchville Test Area

The Churchville Test Area is located in northern Harford County, approximately 10 miles north of APG in the community of Churchville. Churchville Test Area is a location of the Aberdeen Test Center (ATC) vehicle

testing facility. The site is 221 acres and contains 11 miles of interconnecting roads and test courses. Roads and test courses contain mud, dirt, and gravel surfaces on varying grades, and are used to test the endurance and reliability of cross-country tracked and wheeled vehicles.

Carroll Island, Graces Quarters and Pooles Island

Carroll Island and Graces Quarters are a noncontiguous addition to APG located across the Gunpowder River in adjacent Baltimore County. Carroll Island and Graces Quarters add an additional 1,164 acres of land to APG but see minimal activity. Carroll Island is 799 acres and is located close to urban development in Baltimore County. Graces Quarters is 365 acres and the future home of the JLENS project that will help to monitor the Eastern Seaboard for airborne national security threats. The JLENS project has been briefed, and is only expected to be a three year mission.

Pooles Island is a 206 acre island and contains a lighthouse, which is the only permanent building located at any of these three areas. All three areas exhibit quantifiable amounts of unexploded ordinance (UXO) and environmental constraints.

Local Communities Working Together

APG is an integral part of the local community. APG has been located in Harford County since 1917 and has developed programs and partnerships with local organizations. Some of the organizations include Community Covenant, Baltimore Orioles Military Program, Small Business Programs, and Educational Outreach Programs.

Military Operations

APG's primary missions are to conduct research, development, testing and evaluation (RDT&E) of ordnance and military equipment and to train personnel. APG is home to 19 major commands and supports more than 80 tenants, 20 satellite, and 17 private activities.

Major operations at APG include: performance and durability testing of weapons, equipment, and supplies; testing of projectiles for accuracy, speed, reliability, and penetration; extensive research and development in the areas of chemical and biological weapons and materials; human factors; computational and information sciences; survivability and lethality analysis; and vehicle technology.

JLUS Observation

Aberdeen Proving Ground is an essential Army asset, home to world leaders in research, development, testing and evaluation of Army materiel, and profoundly impacting the way that wars are fought.

Military Strategic Importance

APG serves as a premier Army RDT&E center. The site is located along major transportation corridors that put APG within reach of some of the largest cities on the Eastern Seaboard. APG has experienced growth over the course of the BRAC. Several tenants relocations to APG have helped maintain the installation's importance for national defense.

Major Commands

APG has five core areas of operations or military support:

- Public Health and Medical Research
- Test and Evaluation
- Research and Development
- Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE)
- US Army Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance Team (C4ISR)

The base is home to 19 major commands. Major commands usually have subordinate units that conduct specific research in accordance with the Major Command primary objective. Some major commands may in fact be considered Major Subordinate Command units of higher major commands. Below is information related to some of the major commands at APG.

Army Research Lab (ARL)

The ARL is the Army's central laboratory. ARL's program consists of basic and applied research and survivability/lethality and human factors analysis that provide enabling technologies to many of the Army's most important weapons systems. ARL acts as a link between the scientific and military communities by bringing together internal and external science and technology assets to fulfill the requirements defined by or requested by the Soldier.

Source: http://www.arl.army.mil/www/default.cfm?page=20

Edgewood Chemical Biological Center (ECBC)

Edgewood Chemical Biological Center (ECBC) is a research and development resource for non-medical chemical and biological (CB) defense. ECBC supports all phases of the acquisition life-cycle including basic and applied research through technology development, engineering design, equipment evaluation, product support, sustainment, field operations and demilitarization.

Source: http://www.ecbc.army.mil/

Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD)

The mission of the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) is to provide research, development, acquisition, fielding and life-cycle support for chemical, biological, radiological and nuclear Defense equipment, medical countermeasures, and installation and force protected integrated capabilities supporting national strategies. The JPEO-CBD executes these responsibilities through seven Joint Project Managers.

Source: JPEO-CBD

Maryland Army National Guard (MDARNG)

The Maryland Military Department mans, equips, trains, and deploys National Guard units in support of missions directed by the President of the United States and to support state responses to any major emergency or disaster. The MDARNG 29th Combat Aviation Brigade is headquartered at the Edgewood Area and provides command and control to a variety of aviation and other units. It is the major aviation command within the Maryland Army National Guard containing units from across the nation.

Source: http://www.md.ngb.army.mil/absolutenm/templates/?a=754&z=41 http://www.globalsecurity.org/military/library/news/2009/11/mil-091117-arnews01.htm; Maryland Army National Guard PowerPoint Presentation 26 November 2013

Program Executive Office for Command, Control and Communications-Tactical (PEO C3T)

The Program Executive Office for Command, Control and Communications-Tactical (PEO C3T) provides soldiers with the computer systems, radios and communications networks required in the battlefield. PEO C3T develops, acquires, and fields this range of products to all Army units. PEO C3T ensures the integration of these systems so they function seamlessly; while providing on-site training and support for the systems deployed worldwide.

Source: http://peoc3t.army.mil/c3t/

US Army Communications-Electronics Command (CECOM)

CECOM ensures the global readiness of the C4ISR systems and the information and technology for troops to communicate on battlefield. CECOM ensures global readiness by providing training; field support for software modifications and software upgrades; logistics expertise; information assurance; joint network capabilities; and interoperability certification functions.

Source: US Army Communications-Electronics Command, the Critical Link Brochure, http://cecom.army.mil/about.html

US Army Communications-Electronics Research, Development and Engineering Center (CERDEC)

CERDEC is headquartered at APG and is charged with developing and integrating Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) technologies for networked soldiers. As the Army's main developer, supplier, and integrator of C4ISR onto Army platforms, CERDEC must balance the newest technology with on-the-ground needs of soldiers.

Source: http://www.army.mil/cerdec

US Army Medical Research Institute of Chemical Defense (MRICD)

US Army Medical Research Institute of Chemical Defense (USAMRICD) is a lead science and technology laboratory, with specific studies in medical chemical countermeasures research and development. The USAMRICD has numerous laboratories located at APG and is responsible for providing research and analysis on chemical defense research for DOD and Federal Agencies.

Source: http://chemdef.apgea.army.mil/

United States Army Public Health Command (PHC)

The United States Army Public Health Command (USAPHC) has a mission to promote health and prevent disease, injury, and disability of Soldiers and military retirees, their families, and Department of the Army civilian employees and assure effective execution of full spectrum veterinary service for Army and Department of Defense veterinary missions.

Source: http://phc.amedd.army.mil/organization/Pages/default.aspx; United States Army Public Health Command, May 2014

US Army Research, Development and Engineering Command (RDECOM)

RDECOM delivers technological capabilities that ensure the Army remains the dominant force on the battlefield now and in the future. The mission of RDECOM is to empower, unburden, protect and sustain the joint warfighter through integrated research, development, and engineering solutions. This includes providing technology solutions to meet current operational needs as well as developing new technologies to aid future Soldiers. RDECOM is the Army's largest technology developer and its leading technology integrator.

Additionally, ARL, CERDEC, and ECBC are all organizations apart of RDECOM.

Source: http://www.army.mil/article/39385/

Other Major Commands

Other major commands on APG include the 20th CBRNE Command, the Army Materiel Systems Analysis Activity (AMSAA), the Army Contracting Command (ACC), the US Army Evaluation Center (AEC), the US Army Civilian Human Resource Agency (CHRA) Northeast Region Office, the US Army Signal Network Enterprise Center APG (USANEC APG), the Kirk US Army Health Clinic (KUSAHC), and the Program Executive Office Intelligence Electronic Warfare & Sensors (PEO IEW&S).

Aberdeen Test Center (ATC)

ATC is a Major Range and Test Facility Base (MRTFB), one of only eight that are a part of the Army, and the only MRTFB located on the east coast. As a major national asset to the DOD, the ATC has become a lead test center for Land Vehicle Testing and Direct Fire Testing, as well as the Army's Center of Excellence for Live Fire Testing. The MRTFB designation is a driving force for the importance of the installation. In addition, ATC is the Range Officer in Charge at APG and operates on 66,000 of the over 72,000 acres.

Source: http://www.atc.army.mil/

Future Mission Operations

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

The Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) provides over the horizon surveillance and fire control quality data on Army and Joint networks enabling protection from enemy cruise missiles, aircraft, unmanned air vehicles, tactical ballistic missiles, large caliber rockets, and surface moving targets.

The JLENS consists of two systems: a fire control radar system and a wide-area surveillance radar system. Each radar system has a 74-meter balloon (known as an aerostat) that is moored at a fixed location. APG's JLENS system is planned to be placed on the Gunpowder River; one at Graces Quarters and one at the Edgewood Area. However, the mission is expected to only continue for three years.

Source: Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System, Selected Acquisition Report, 2012

APG Mission Footprint

Mission and training activities at APG generates a number of impacts that can affect the health, safety, and overall quality of life in the surrounding community. Examples of these mission impacts may include noise and vibration from ordnance testing or the risk of an aircraft accident.

Conversely, the military mission is susceptible to hazards created by nearby civilian activities, land use development, and environmental constraints that may obstruct air space, locate noise sensitive uses in high noise zones, or gather large numbers of people in safety zones. Understanding the overlapping spatial patterns of these impacts around the installation and ranges is essential for promoting compatible and fully coordinated land use decisions.

These overlapping spatial patterns comprise the mission footprint. The mission footprint serves as a compatibility tool for surrounding communities in making land use decisions. Several elements of mission profiles comprise the mission footprint that extends outside the APG installation. These elements are either tangible, meaning that they are either physically seen and / or heard, or intangible, meaning that they exist within space without being seen or heard.

The following outlines the different elements or mission profiles that comprise the APG Mission Footprint:

- Aircraft Safety Zones
- Noise Contours for Aircraft
- Imaginary Surfaces
- FAA Part 77 for Vertical Obstructions
- Bird / Wildlife Air Strike Hazard (BASH) Relevancy Area
- Range and Training Areas
- Noise Contours for Large Caliber Weapons and Detonations
- Quantity Distance Arcs (QD)
- Special Use Airspace
- Microwave Line-of-Sight

Aberdeen Proving Ground Airfields

Aberdeen is home to two airfields, Phillips Army Airfield and Weide Army Heliport.

Phillips Army Airfield (PAAF) is located in the Aberdeen Area south of the Maryland Blvd Gate. PAAF is owned by APG but operated by ATC. The Airfield includes one 8,000-foot by 200-foot hard-surfaced runway, four drop zones, one helipad, and three bomb ramps. PAAF also houses several air operations support facilities including: PAAF main hanger, control tower, taxiways, off-loading area, and aprons. Non-aviation activities also take place at PAAF. ATC uses certain runways for speed and braking tests on wheeled and tracked vehicles. The C-12U Huron and RQ-7B Shadow, as well as the UH-72A Lakota utilize PAAF.

Weide Army Heliport (WAH) is located on 98.5 acres of land in the Edgewood Area. WAH was closed to fixed wing aircraft in 1980 and is now utilized as a heliport and home to the Maryland Army National Guard. WAH includes a 1,600-foot, rotary-wing-only runway. Support facilities include: one flight operations building, one counterdrug observation building, two main hangers, and a warehouse. The types of aircraft that are used at WAH include UH-60 A/L Black Hawk, CH-47D Chinook, and UH-72A Lakota.

Aircraft Safety Zones

Aircraft safety zones for APG are based on historical data of aircraft collisions, geography, and runway information. The purpose of safety zones are to provide for the general safety of the public as it relates to the land uses under and near these zones. Safety zones help limit and guide development to enable the provision of safety of the public and pilots while simultaneously allowing for continued economic growth. The safety zones are referred to as Clear Zones (CZs) and Accident Potential Zones (APZ I and II). Clear Zones are the zones which begin at the end of a runway and extend to a predetermined distance. This is the area where an accident involving an aircraft operation is most likely to occur; therefore, development is completely restricted in this area. APZs are areas following the CZs where there is still potential for accidents, but development is less regulated.

These safety zones are illustrated in Figure 3. Within these zones, there are restrictions on types, densities, and heights of land uses. Clear Zones vary between PAAF and WAH. The PAAF Clear Zone begins at the end of each runway and extends 3,000 feet beyond the end of the runway with a width of 500 feet. The WAH Clear Zone begins at the end of each runway and extends 400 feet beyond the end of the runway with a width of 300 feet. The Clear Zones do not extend off of APG, although portions of APZ I and II for PAAF extend beyond the installation boundaries.

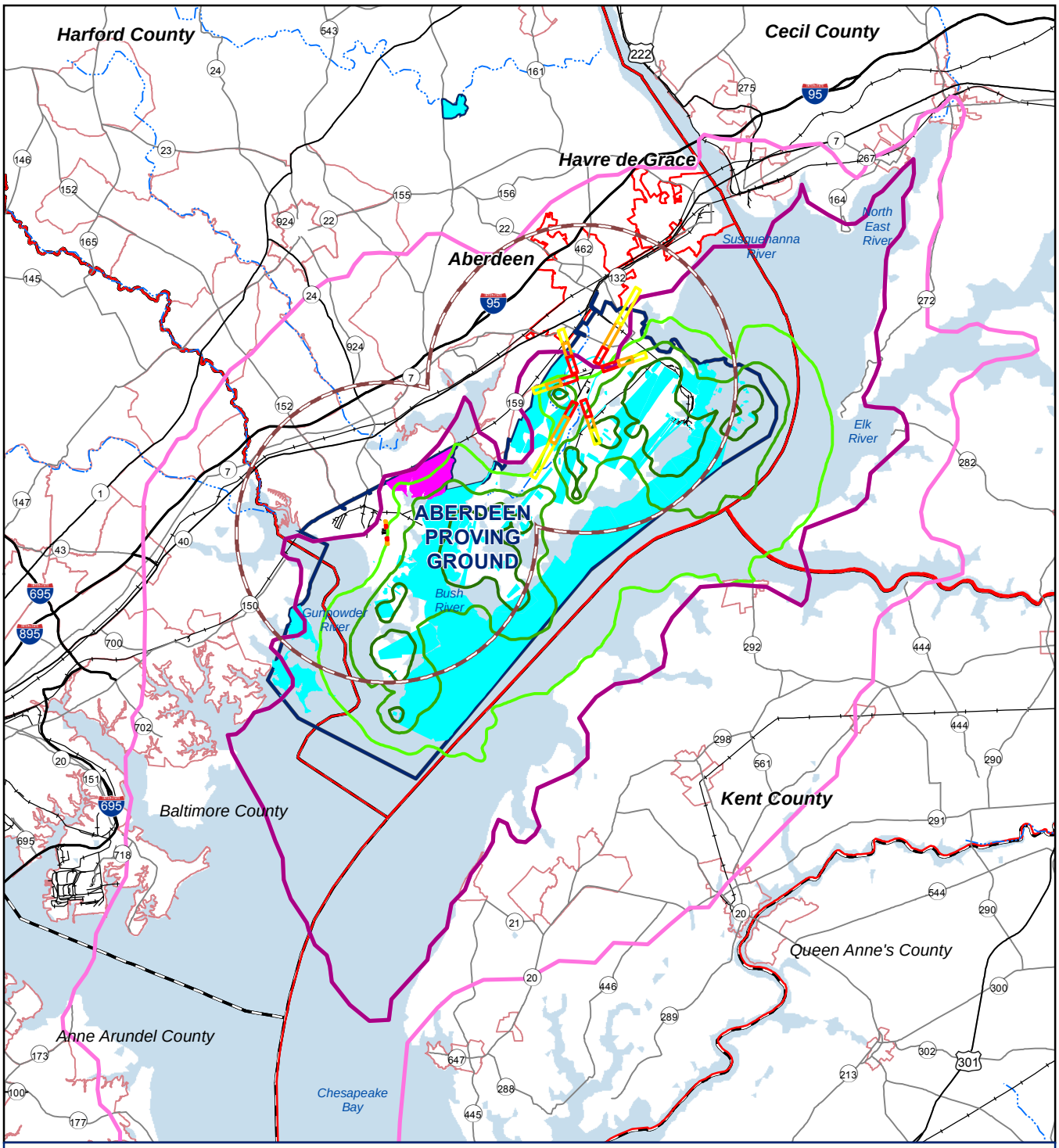


Figure 3
Military Footprint Composite –Range / Training Areas, Range Noise Contours, Safety Zones, BASH

PAAF has a total of three runways, but only one of them is active. Runway 04/22 is 8,000 feet long and 200 feet wide and can handle a wide variety of aircraft including a Lockheed C5 Galaxy. The other two runways are inactive but have the potential to be used in the future.

Source: Long Range Component, APG Master Plan; UFC 3-260-01, Airfield and Heliport Planning and Design, 2008.

Imaginary Surfaces

The imaginary surfaces of an active runway are used to determine where vertical obstructions could exist in the vicinity of aviation operations. The various imaginary surfaces build upon one another and are designed to eliminate natural or man-made obstructions to air navigation and operations. The extent or size of an imaginary surface depends on the type of runway. Thus, the key terms related to imaginary surfaces relative to APG runways are described below.

- The Primary Surface defines the limits of the obstruction clearance requirements in the immediate vicinity of the landing or take-off area. It comprises surfaces of the runway, runway shoulders, and lateral safety zones and extends 2,000 feet beyond the runway end. This surface is 2,000 feet wide, or 1,000 feet on each side of the runway centerline.
- The Clear Zone defines the limits of the obstruction clearance requirements in the vicinity contiguous to the end of the primary surface. It measures 2,000 feet wide (same width of the primary surface) by 1,000 feet long. This is the area where an accident involving an aircraft operation is most likely to occur.
- The Approach-Departure Clearance Surface is symmetrical about the runway centerline and begins as an inclined plane (glide angle) 200 feet beyond each end of the primary surface of the centerline elevation of the runway end, and extends for 50,000 feet for the APG runways. The slope of the approach-departure clearance surface is 50:1 outward and upward along the extended runway (glide angle) centerline until it reaches an elevation of 500 feet above the established airfield elevation. It then continues horizontally at this elevation to a point 50,000 feet from the start of the glide angle. The width of this surface at the runway end is 2,000 feet; it flares uniformly, and the width at 50,000 feet is 16,000 feet.
- Horizontal Clearance Surfaces include an inner surface at 150 feet above airfield elevation extending to 7,500 feet from the runway, and an outer surface at 500 feet above airfield elevation extending from 14,500 feet to 44,500 feet from the runway end.
- The Transitional Surfaces connect the primary surfaces, Clear Zone surfaces, and approach-departure clearance surfaces. The slope of the transitional surface is 7:1 outward and upward at right angles to the runway centerline.

Figure 4 illustrates the imaginary surfaces relevant at PAAF and WAH. These areas extend radially outwards a distance of 8.5 miles from runways, covering portions of all Study Area jurisdictions.

Associated with the imaginary surfaces of an active airfield and in relation to flight operations from an airport (military or civilian), vertical obstructions are assessed through compliance with Federal Regulation Title 14 Part 77, which establishes standards and notification requirements for objects affecting navigable airspace. Figure 4 illustrates the Part 77 footprint based on the elevation of the runway.

Bird / Aircraft Strike Hazard

Birds and wildlife can represent a significant hazard to military training and flight operations. Certain types of land uses, such as standing water or grasslands, attract birds and wildlife. While there have been an insignificant number of fatalities associated with bird air strike hazards (BASH) in the past 30 years, the concern associated with BASH is the significant amount of damage a BASH incident can cost the federal government. According to the DOD Partners in Flight Program, strikes involving military aircraft cost approximately $75 million in damage every year.

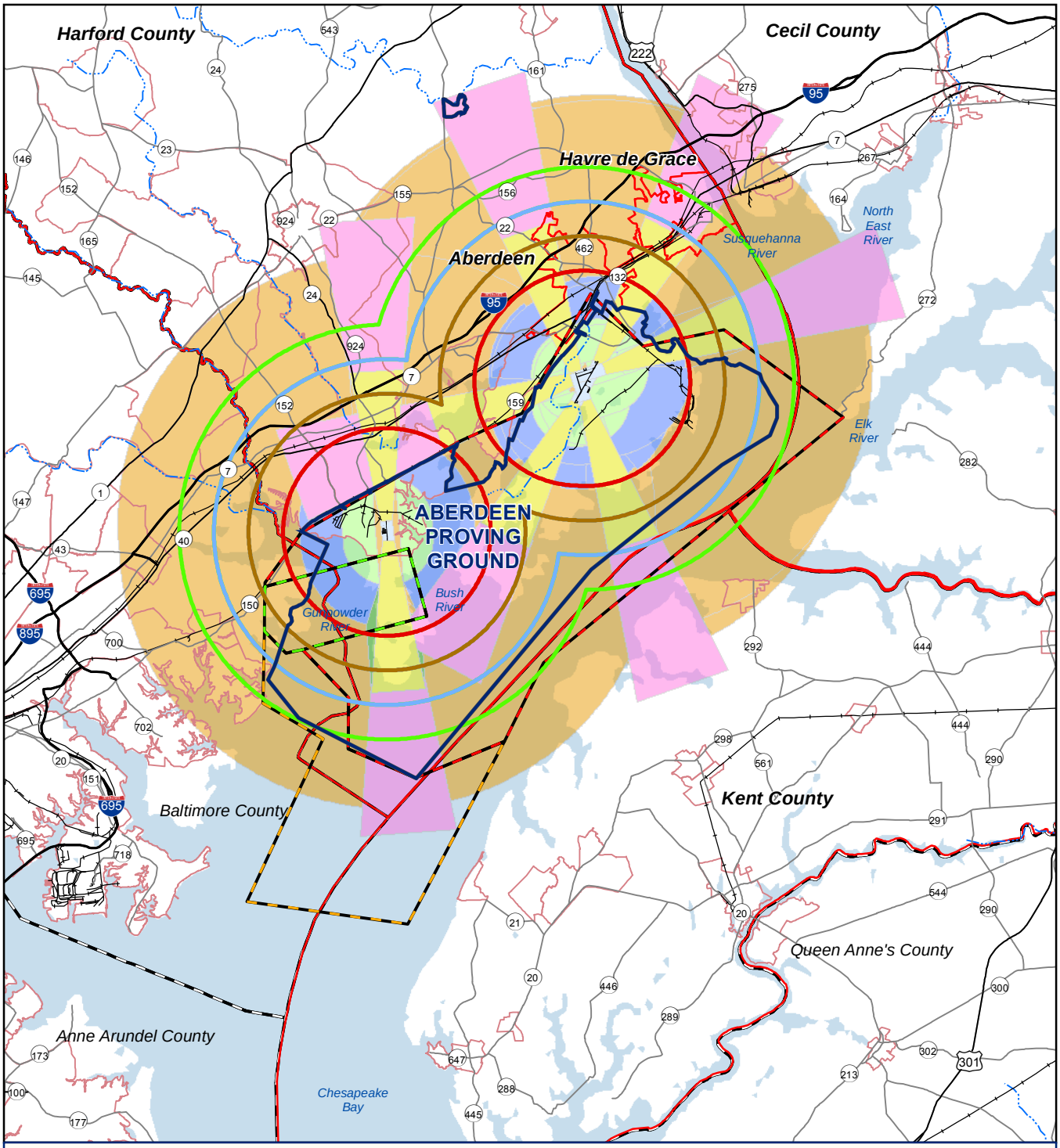


Figure 4
Military Footprint Composite – Imaginary Surfaces, FAA Part 77, Special Use Airspace

According to the APG Integrated Natural Resources Management Plan, BASH is not a significant issue at APG as bird / aircraft strikes occur very rarely. Figure 3 shows potential BASH relevancy areas.

Aberdeen Proving Ground Target Ranges and Training Areas

The RDT&E character of the APG mission means that a large part of the base is considered range area. The total range areas are approximately 66,000 acres including water (34,454 acres of land mass) and are located mainly within the AA and EA but are also located within other areas such as Graces Quarters and Carroll Island. Figure 3 illustrates the location of range and training areas.

Range areas also include water impact areas, which are located in parts of the Bush River, Gunpowder River, Romney Creek, Spesutie Narrows, and Chesapeake Bay. Currently, no munitions of any type are permitted to be fired into the waters within and surrounding APG.

All range areas are contained on installation; however, some operations and QD arcs extend over or into APG restricted area waters which are publicly accessible.

Range Management

ATC controls operations over the range complex and coordinates with Garrison on major activities that might impact the installation or community. Firing programs and operations are managed to ensure that adjacent firing programs are compatible and danger zones are established as to not affect other areas on base. All range use is scheduled to preclude conflict and adverse community impact.

Range Noise Contours

The main source of noise at APG is from ordnance testing. All operations, which will or can produce noise off-base, are conducted between certain hours.

- Weekdays between 8:30 AM and 10:00 PM
- Saturdays between 9:00 AM and 4:00 PM
- Sundays and holidays between 10:00 AM and 3:30 PM with command approval

All operations, which will or can produce noise off-base, are conducted at least 100 meters inside the installation boundary in an attempt to mitigate impacts to neighboring communities.

During normal workdays, a noise model calibration shot will be conducted between 7:30 AM and 8:00 AM. The type and extent of operations conducted during a normal work day will depend on this noise model calibration shot and if it shows adverse noise effects on surrounding communities.

The APG Noise Management Plan illustrates CDNL blast noise contours and peak blast noise contours. CDNL blast noise contours are classified as Zone III (70 CDNL), Zone II (62 CDNL), and LUP Z (57 CDNL). Though ordnance testing at APG can frequently be heard off-base, the CDNL contours extend off-base into the counties of Harford, Kent and Cecil as seen in Figure 3.

Peak blast noise contours are classified by 115 PK15(met) and 130 PK15(met). Moderate risks of noise complaints are associated with 115 PK15(met) and high risks of noise complaints are associated with 130 PK15(met). Blast noise from APG causes noise complaints in Cecil, Harford, and Kent Counties.

Depending on the amount and intensity of development that occurs over the fenceline, any source of noise may begin to conflict with local residents. This could put mission critical activities at APG at risk.

Source: Aberdeen Proving Ground Noise Management Plan, 2006.

Quantity Distance Arcs

Quantity distance (QD) arcs are the area where risk has been assessed based on the impacts of the types of munitions being stored. Quantity distance arcs extend off-base at two locations: into the Chesapeake Bay off Spesutie Island and on the Bush River. These arcs do not encroach on dry land. Additional impact areas are also clustered within the territorial waters of APG off the shore of the EA along the Bush River.

Conowingo and Harford Loops

The Conowingo and Harford Loops are meant to test fuel consumption on various in-service vehicles. Conowingo Loop is a paved, closed loop course that is made up of local and federal public highways. The course is designed to assess medium to heavy duty vehicles. The Harford Loop includes various terrain and grades where test vehicles operate at the posted speed limit. The loops are located north of the Churchville Test Area.

Aberdeen Proving Ground Special Use Airspace

Special Use Airspace (SUA) is airspace where military activity or unusual flight conditions may occur. The designation of SUA serves to alert nonparticipating aircraft (civilian or military) to the possible presence of these activities. There are six types of SUA: Alert Areas, Prohibited Areas, Controlled Firing Areas, Military Operating Areas (MOAs), Restricted Areas, and Warning Areas. Only Restricted Areas are designated within the APG.

A restricted area contains airspace that is subject to restrictions of use due to unusual, often invisible, hazards to aircraft. RDT&E uses at APG create restrictions on outside aircraft operations because of the potential to interfere with myriad testing that occurs at APG.

Restricted airspace encompasses 133 sq. nm in the immediate vicinity of the base which is divided into three areas, R-4001 A, B, and C. R-4001 A and B surround APG and R-4001C is a restricted airspace around the JLENS aerostats. Figure 4 displays APG SUAs.

Source: https://www.federalregister.gov/articles/2013/10/01/2013-23951/proposed-modification-and-establishment-of-restricted-areas-aberdeen-proving-ground-md#h-18

Microwave Line-of-Sight

The Microwave Line-of-Sight footprint is defined as the area in which electromagnetic waves or acoustic waves are transmitted or spread to various communication sites by simple unobstructed horizontal planes. This horizontal plane is at a certain height and allows for a clear, unobstructed pathway for the transmission of electromagnetic waves for electronic scoring of bombing and target practice.

Depending on a structure's height and distance from APG, obstructions built within the radio frequency line-of-sight may have a significant impact to RDT&E activities at APG.

Microwave Line of Site requirements at APG generally extend northwest of the installation to other properties within Harford County. No Line of Site extends to the Eastern Shore. A BRAC Spectrum Study comparing APG to Fort Monmouth, New Jersey showed that Line of Site conditions at APG did not reveal any unexplained or unexpected results. It was determined that no change would be needed for APG to accommodate Line-of-Site spectrum capacity.

However, as Harford County continues to grow, there may be the possibility for taller structures to be built within the APG line-of-sight areas.

APG JLUS

4 Existing Compatibility Tools

Introduction

This chapter provides an overview of compatibility tools currently used or applied in evaluating and addressing compatibility issues in the Aberdeen Proving Ground (APG) Joint Land Use Study (JLUS) study area. Relative to compatibility planning, there are a number of existing plans and programs that are either designed to address compatibility directly or indirectly through the topics they cover.

This summary provides an overview of key plans and programs that impact compatibility planning organized by level of government. There are three types of planning tools evaluated relative to their applicability: permanent, semi-permanent, and conditional. Permanent planning tools include acquisition programs, either fee simple purchase of property or the purchase of development rights. Semi-permanent tools include regulations such as zoning or adopted legislation. Examples of conditional tools would include memorandums of understanding (MOU), intergovernmental agreements (IGA), and other policy documents such as comprehensive plans (CP) that can be periodically modified.

The overview of key plans and programs is organized in the following order:

- Federal
- Aberdeen Proving Ground
- State of Maryland
- Harford County
- Cecil County
- Kent County
- City of Aberdeen
- City of Havre de Grace
- Other tools and references

Federal

Federal policy, laws and programs have evolved to influence almost every aspect of land use. This is especially true in coastal environments that host major military facilities, like APG. A broad range of federal plans, programs and actions apply to APG both directly and indirectly. In some cases federal authority may exercise exclusive control over state and local authorities, while in other cases (such as coastal zone management), federal agencies may delegate primary "operational" responsibility to state agencies, favoring to establish policy, certify state programs, and fund and monitor their activities.

The following is not an exhaustive accounting of all relevant federal laws or programs, but rather an identification of those considered to be most relevant for assessing compatibility issues and potential strategies stakeholders might employ to avoid or mitigate conflicts.

Clean Air Act

The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources in order to control air pollution. Under the CAA, the EPA establishes limits on six criteria pollutants through the National Ambient Air Quality Standards. Standards are set to protect public health and public welfare. The CAA also gives the EPA the authority to limit emissions of air pollutants generated from sources such as chemical plants, utilities, and steel mills. Individual states may have stronger air pollution laws, but they may not have weaker pollution limits than those set by the EPA. Under the law, states have to develop State Implementation Plans that outline how each state will control air pollution under the CAA.

Clean Water Act

The Clean Water Act (CWA) establishes the regulation of water resources and water pollution. The CWA establishes the goals of eliminating the release of toxic substances and other sources of water pollution to ensure that surface waters meet high quality standards. The CWA prevents the contamination of near shore, underground and surface water sources.

Federal Aviation Act

An important outcome of the Act is FAA Regulation Title 14 Part 77, commonly known as Part 77, which provides the basis for evaluation of vertical obstruction compatibility. This regulation determines compatibility based on the height of proposed structures or natural features in relation to their distance from the ends of a runway. Using a distance formula from this regulation, local jurisdictions can easily assess the height restrictions near airfields.

The FAA has identified certain imaginary surfaces around runways that are used to determine how structures and facilities are evaluated to identify if they pose a vertical obstruction in relation to the airspace around a runway. The levels of imaginary surfaces build upon one another and are designed to eliminate obstructions to air navigation and operations, either natural or man-made. The dimension or size of an imaginary surface depends on the runway classification.

Federal Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) was created in 1972 and is administered by NOAA's Office of Coastal Resource Management (OCRM). In 1978, to manage its extensive coastline (more than 7,000 miles), estuarine embayment's, tidal flats, tidal wetlands, creeks and other coastal assets, Maryland developed its Coastal Program.

In general, the program emphasizes protection of coastal resources, water dependent uses, and "facilities in the national interest" located in coastal areas (including military bases). Public access to the shore is also a primary CZMA objective. The CZMA is administered at the state level through Maryland's Coastal Program.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 is a federal regulation that established a United States (US) national policy promoting the protection and enhancement of the environment and requires federal agencies to analyze and consider the potential environmental impact of their actions. The purpose of NEPA is to promote informed decision-making by federal agencies by making detailed information concerning significant environmental impacts available to both agency leaders and the public.

All projects receiving federal funding require NEPA compliance and documentation. NEPA is applicable to all federal agencies, including the military. NEPA mandates that the military analyze the impact of its actions and operations on the environment, including surrounding civilian communities. Inherent in this analysis is an exploration of methods to reduce any adverse environmental impact.

Aberdeen Proving Ground (APG)

APG Base Realignment and Closure Impact Study

The 2007 Base Realignment and Closure (BRAC) Impact Study analysis estimates the economic, fiscal and public policy implications of BRAC–related growth at APG through 2017 for a seven–jurisdiction area, which includes Harford, Cecil, Baltimore, New Castle, Lancaster and York counties and the City of Baltimore.

The analysis makes heavy use of publicly–sourced data and uses standard econometric methodologies. The study team considers analysis under three separate scenarios: low-case, mid-case and high. By calculating employment, income, population and other impacts, the study team identified by jurisdiction the most problematic elements from the perspective of ongoing BRAC accommodation, including prospective shortfalls in housing, school capacity, water/sewer capacity and wastewater treatment capacity though 2017, the final year forecasted.

Source: Aberdeen Proving Ground BRAC Impact Study, 2007.

Aberdeen Proving Ground (APG) Master Plan

All US Army installations are required to maintain a Real Property Master Plan (RPMP), in accordance with Army Regulation 210-20 and UFC 2-100-01. The Aberdeen Proving Ground Master Plan comprises three major planning component documents all of which address specific planning concerns and strategies for the future of APG.

Long Range Component (LRC). The LRC outlines APG's long-term strategies for growth with consideration of regional, local, installation, and site-specific planning issues. It contains focused, detailed planning strategies

that guide the long-range use of land and facilities throughout APG. It is a broad-based area analysis of the entire installation projected over a period of 20 to 50 years. It describes the existing conditions and baseline data used to develop the plans contained in this component, as well as the remaining components of the RPMP.

Short Range Component (SRC). The SRC defines real property projects scheduled in the near term. It is tied to the long-term strategies of the Capital Investment Strategy and the Long Range Development Plans of the LRC. The SRC reflects installation facility actions and capital investments over the current Future Years Defense Plan window (2010-2017) and marks the transition from planning to programming.

Capital Improvement Strategy (CIS). The CIS contains the holistic set of actions needed to create the Real Property Vision and links long-term planning (general strategies) to plan implementation. The CIS supports the vision of the LRC and forms the basis of programming actions. It focuses on strategies to integrate current demands with long-term facility needs, based on assessments of excesses and deficits. It also leads to the prioritization of programming actions found in the SRC.

Other Planning Initiatives Noted in the Master Plan

APG Enhanced Use Leasing (EUL) Program. EUL legislation (10 USC 2667) provides additional tools for managing installation assets. The purpose of the EUL is to achieve business efficiencies and maximize returns on investment by using lease proceeds for a variety of operational needs. Currently, APG has a EUL under development on Maryland Boulevard with St. John Properties.

Community Development and Management Plan. Corvias Military Living was contracted to develop the Community Development and Management Plan for APG, as part of the Army's Residential Communities Initiative (RCI) Program.

The RCI program is intended to improve the quality of life for Soldiers and families assigned to APG. Over the anticipated 50-year term all family housing will be rehabilitated or replaced and additional new housing will be provided. In addition, RCI will bring new community centers, other ancillary facilities and amenities to meet family housing needs at APG.

Source: Aberdeen Proving Ground Real Property Master Plan Update, 2012.

Army Compatible Use Buffer Program

The most recent ACUB plan for APG was finalized in 2011 as the "Chesapeake BAY-CUB." The plan addresses growing encroachment concerns as they relate to realistic training opportunities and the continued viability of APG as a significant training and research center for the US Army and the Maryland Army National Guard.

The 2011 revisions address multiple levels of compatibility, including environmental and safety concerns. Environmental considerations include the bald eagle and wetlands, and other local and regional species and habitats of concern in the Chesapeake Bay Critical Area. The plan outlines other anticipated training and testing restrictions such as safety and human welfare. The BAY-CUB provides a proposed action and a preliminary list of alternatives to deal with compatibility issues. These programs seek to maximize the amount of land available for research and development and training and testing operations while responsibly addressing conservation and potential nuisance concerns. The implementation of these plans and policies assist in coordinating local and regional compatibility measures around APG and the Chesapeake Bay.

Source: Aberdeen Proving Ground Army Compatible Use Buffer Program, 2011.

Integrated Cultural Resources Management Plan

The ICRMP is a planning tool employed by APG to make informed decisions regarding the cultural resources under their control in compliance with public laws, in support of military mission, and consistent with sound principles of cultural resources management.

The ICRMP includes an overview of laws, statutes, regulations, and executive orders that relate to the management of cultural resources at APG. Internal and external coordination procedures are specified through standard operating procedures to ensure compliance with cultural resources laws during the execution of

APG mission activities. The document also sets goals for APG's Cultural Resources Program (CRP) over a five- year planning horizon.

APG has reviewed and updated their ICRMP to reflect the current status of the identification and evaluation of cultural resources at APG, as well as changes in its administrative structure. The APG ICRMP is based upon information assembled from historical, archeological, ethnographic, architectural, and planning documents prepared for APG since 1996.

Source: Aberdeen Proving Ground Integrated Cultural Resources Management Plan, 2008.

Integrated Natural Resources Management Plan

APG has prepared an INRMP to address the management of the natural resources at APG and the interrelationships of the natural resources with the military mission. The INRMP reflects the commitment set forth by the Army to conserve, protect, and enhance the natural resources. The primary purpose and objective of the INRMP is to present an implementable management plan that guides APG in achieving natural resource management goals, supporting the military mission, and complying with environmental policies and regulations. In addition, the INRMP ensures that natural resources conservation measures and Army activities on APG land are integrated and consistent with federal stewardship requirements

Source: Aberdeen Proving Ground Integrated Natural Resources Management Plan, 2009.

Operational Noise Management Plan

The ONMP serves as a primer on operational noise for installation personnel and the community. Prepared by the US Army Public Health Command at APG in 2005, the ONMP identifies the specific noise environment for APG, the impacts of the noise environment and provides recommendations to manage this environment as a responsible neighbor. The objectives of the ONMP are to:

- Provide a document which can educate both the military and the public about the noise generated from APG operations.
- Manage noise complaints to reduce the potential for conflict between APG and the surrounding communities.
- Assess the compatibility of the noise environment with the existing and proposed land uses.
- Mitigate the noise and vibration environments, where feasible, to increase land use compatibility.

Source: Aberdeen Proving Ground Operational Noise Management Plan, 2006.

Readiness and Environmental Protection Initiative Projects

Coordination between the Aberdeen Test Center staff and the Harford Land Trust/Harford County helped alleviate threats to the nearby Churchville Test Area through a Readiness and Environmental Protection Initiative (REPI) project. As of September 30, 2010, the one REPI conservation project that has taken place at APG has resulted in 163 acres of preserved land, partially alleviating the threat of nearby regional growth which was causing noise, dust and other issues.

Source: US DOD Readiness and Environmental Protection Initiative (REPI) Project Fact Sheet, Aberdeen Proving Ground.

State of Maryland

Chesapeake Bay & Atlantic Coastal Critical Areas Act & Protection Program

The Critical Area Act establishes the Chesapeake Bay Critical Area and Atlantic Coastal Bays Critical Area Protection Program and the Critical Area Commission to enable the State and local governments to jointly address the impacts of land development on habitat and aquatic resources.

The law governing the Program requires that development projects within 1,000 feet of the tidal influence of the Chesapeake Bay meet standards designed to mitigate adverse effects on water quality, and fish, plant and animal habitat. Local governments can also prohibit uses that they believe would adversely affect habitat or water quality within the Critical Area. Each jurisdiction within a critical area develops and implements a plan to achieve the

objectives of the Program, which is subject to review and approval by the Commission.

Sources: Harford County Chesapeake Bay Critical Area Management Program, 2011; http://www.dnr.state.md.us/criticalarea/reg_act.asp.

Coastal Zone Management Act & Program

The Coastal Zone Management Act (CZMA) of 1972 provides for the management of the nation's coastal resources and helps balance economic development with environmental conservation. Maryland's Coastal Zone Management Program was approved in 1978 in response to the CZMA. With Coastal Zone boundaries that include 17 of the state's 23 counties bordering the Atlantic Ocean and the Chesapeake Bay, the program coordinates multi-agency initiatives that provide a framework for statewide water quality, hazard mitigation, public access and habitat restoration.

Sources: Coastal Zone Management Act of 1972; http://dnr.maryland.gov/ccs/pdfs/MD309AS2001.pdf.

Maryland's Military Installation Council

The Maryland Military Installation Council (MMIC) identifies what public infrastructure and community support is needed for the development and expansion of Maryland military installations and studies potential impacts of tentative development and expansion on local communities. The Council also researches best management practices regarding how other jurisdictions cope with increased development around military installations, and reviews State policies in order to best support the mission of the military installations and maximize economic benefits to local communities.

Source:http://msa.maryland.gov/msa/mdmanual/26excom/html/23military.htm

"PlanMaryland"

Maryland has implemented comprehensive state level and statewide planning and growth management policies and practices to promote "Smart Growth" (SG) principles. Smart Growth protects natural resources and promotes community character by leveraging investments in existing developed areas and limiting low density, single use "sprawl" development patterns and their associated public costs. Since 2009 local government Comprehensive Planning requirements have been expanded to include sustainable growth. PlanMaryland resulted in a sustainable growth plan for the 21st century focusing on trends and land use, visioning, state coordination and implementation, management and best management practices.

Source: http://plan.maryland.gov/plan/plan.shtml.

Transportation Plan, 2035

The 2035 Maryland Transportation Plan (MTP) looks to the future and identifies the state's most critical transportation challenges and needs, and provides a structure for how to address them through statewide visions, strategies and goals. The MTP incorporates related state goals for the economy, sustainable growth and the environment. It furthermore incorporates other agency transportation plans and public input and serves as the states guiding policy on transit. The MTP also establishes priorities and principles for implementation to be used in decision making regarding Maryland's transportation investments.

Source: Maryland Transportation Plan, 2035.

Local Jurisdictions

In Maryland authority to regulate land use is delegated by the state to counties and municipalities. The nature of a jurisdiction's authority to regulate local land use depends on that jurisdiction's form of local government. For instance, the "Land Use Article" of the Annotated Code of Maryland provides the legal basis for planning at the municipality and county level throughout most of Maryland. In such cases, the Article grants the authority to prepare a comprehensive or master plan, a zoning ordinance, and subdivision regulations for many of the state's municipalities.

Two of the Maryland counties within the APG JLUS study area, Cecil and Kent Counties, are "non-charter" counties and therefore derive their authority to regulate land use from the Land Use Article. Harford County is a charter county granted planning and zoning authority under the "Express Powers Act" in lieu of the Land Use Article.

These distinctions have relevance to the particular scope of the delegated authority, to procedural requirements affecting land use planning and regulation. In addition to their comprehensive plans and zoning ordinances, counties and municipalities may also elect to use other tools to address specific compatibility issues. For example, Maryland state regulations require a general notification of potential noise from military installations, but local jurisdictions may further specify that this notification be accomplished through the land development process or supplementary noise abatement techniques.

There are five incorporated jurisdictions (three counties and two cities) within the APG Study Area that are acting as "partners" in the JLUS; Harford County, Cecil County, Kent County, and the Cities of Aberdeen and Havre de Grace, with numerous smaller census designated places (CDP's) within unincorporated county lands. This JLUS focuses on areas most affected by APG activities and conversely, the areas that have the most potential to pose compatibility and mission protection issues for APG.

Harford County

Harford County extends over 526 square miles (over 15percent is water), with a 2012 population of 248,257, the people represent a sizable population that have the potential to be affected by APG missions. The County has utilized a variety of planning tools to achieve its goals for organized development and a safe environment for its residents.

Harford County Master Plan & Land Use Element Plan

The Harford County Master Plan is a policy document that assists in guiding the long range development plans of the County. The Master Plan, along with the Land Use Element Plan, establish goals and guiding principles upon which city officials' base decisions regarding development and growth. The 2012 update of the Master Plan contains elements outlining the County profile, the public engagement process, inter-jurisdictional coordination, and strategic framework of the County. The strategic framework section within the Master Plan details all of the other 'Element Plans' that were created by the various departments of the county. The visions, goals and guiding principles outlined in the various elements of the Master Plan and the Land Use Element Plan are important because they direct the implementation of specific regulations which influence the area around APG, which is located within Harford County.

Harford County Zoning Code

The Harford County Code contains the codified zoning ordinance which was adopted in 2008 and has been amended through January 2014. The ordinance categorizes the land within the County into seventeen districts, with several overlay districts, and provides development regulations for each district. Lot size requirements, lot area, parking, and height regulations are detailed under supplementary regulations, and a permitted use matrix is provided for each district. The County of Harford does not include overlay districts for airport or military zoning, although it does contain an overlay district for the Chesapeake Bay Critical Area. Article VII: District Regulations details each of the seventeen districts, their density allocations, and their height maximums. The R4 Urban Residential district allows for mid-rise and high-rise apartments up to five or six stories in height, and the B3 General Business District allows for four story row duplexes, but only within the Chesapeake Science and Security Corridor. The remainder of the residential, commercial and industrial districts restrict heights to three stories (aside from Industrial Districts which allow for 40 feet for industrial buildings). The Mixed Use Office district (MO) allows for retail and trade service buildings up to 65 feet in height, while transient housing is allowed up to a maximum height of 85 feet.

Article XI of the ordinance details regulations for telecommunication facilities. Articles V, VII and IX of the ordinance details regulations for outdoor lighting.

Airport Land Use Compatibility

Harford County does not currently regulate zoning for airport purposes, such as employing an Airport Overlay Zone, nor does it use an Airport Land Use Compatibility Plan (ALUCP). Airport Land Use Compatibility Plans establish planning boundaries and land use compatibility standards for airports that do not employ their own Airport Plan. Harford County does have authority to implement airport zoning regulations that would contribute to military compatibility in

unincorporated areas proximate to APG. Article IX: Special Exceptions of the Harford County Code gives detail regarding transportation, communications and utilities exceptions in relation to air facilities, although it is in regards to public and private airports only and not military air facilities. The regulations, taken from the Code of Maryland Regulations (COMAR), state that the height of obstacles near each end of the runway must be compatible with takeoff and landing performance.

Other Harford County Tools

Real Estate Disclosure

Section 10-702 of the Real Property Article, Annotated Code of Maryland, requires the owner of certain residential real property to furnish to the purchaser either (a) a RESIDENTIAL PROPERTY DISCLAIMER STATEMENT stating that the owner is selling the property "as is" and makes no representations or warranties as to the condition of the property or any improvements on the real property, except as otherwise provided in the contract of sale, or in a listing of latent defects; or (b) a RESIDENTIAL PROPERTY DISCLOSURE STATEMENT disclosing defects or other information about the condition of the real property actually known by the owner. Certain transfers of residential property are excluded from this requirement.

Army Alliance

The Army Alliance, Inc. is a chartered nonprofit organization created to work with local, state and federal officials to promote continuous economic viability of APG. Army Alliance works with senior Army and DOD officials and local and State officials in making sure that APG remains a major component in the Army's long-term strategy.

Army Alliance periodically updates a strategic plan that outlines a number of proactive initiatives designed to attract additional Army activities as well as other federal research and development activities across the nation.

Source: http://armyalliance.org/

MOU between APG and Harford County

A Memorandum of Understanding (MOU) was adopted in 2009 titled 'Mutual Support for Emergency or Disaster Assistance between Aberdeen Proving Ground and Harford County, Maryland.' The MOU states that due to the common relationship between APG and Harford County, effective planning and support between the two entities is necessary. It mentions that mutual areas of interest as part of the MOU are comprehensive, including support and coordination of resources such as medical, police, fire, logistical, and technical or hazardous material (HAZMAT) assistance.

Cecil County

Cecil County comprises over 415 square miles (over 15 percent is water), with a 2010 population of 101,108 people. The County has utilized a variety of planning tools to achieve its goals for organized development and a safe environment for its residents.

Cecil County Comprehensive Plan

The Cecil County Comprehensive Plan, adopted in 2010, includes Elements for: land use, water resources (including potable water, wastewater, and stormwater), transportation, public facilities (including police, emergency services, schools, parks, and libraries), economic development, housing, environmentally sensitive areas, mineral resources, and other natural resources.

Cecil County Zoning Ordinance

The Cecil County Zoning Ordinance, originally adopted in 1993 and amended through 2010, categorizes the land within Cecil County into eighteen districts, providing development regulations for each. For each respective district the Code details maximum residential density provisions, building heights and outdoor lighting requirements. The majority of Cecil County lands proximate to APG military missions or located within APG noise contours include the Open Space (OS) district, the Northern and Southern Agricultural-Residential (NAR and SAR) districts, and the Rural Residential (RR) districts. Other Cecil County zoning districts encompassed by the APG 115 PK15 peak blast noise contour include the Manufactured Home (MH) district, the Maritime-Business (MB) district, the Development Residential (DR) district, both Light and Heavy Industrial (M1 and M2) districts, the

Village Residential (VR) district, the Multifamily Residential (RM) district, the Mineral Extraction A (MEA) district, the Suburban Residential (SR) district, and the Business General (BG) district.

Article V, Part VIII discusses utilities, specifically telecommunication structures and communication towers. Section 115 states that communication towers may be permitted in the BG, M1 and M2 zones, and as a special exception in the NAR, SAR, MH and RM districts providing they have setbacks three times the height of the tower from the nearest roadway. It furthermore states new towers shall be built at the lowest height possible, but pursuant to Section 168 communication towers are not subject to district height regulations.

Article VI Schedule of Zone regulations details yard requirements, as well as building height limitations per district. The OS district purpose is preservation, recreation and protection of resources, and therefore does not allow for residential land uses and most development. The RR, NAR, SAR, SR, VR, DR, RM, MH, MB and MEA districts all have maximum height limitations of 35 feet, while the BG district has a height maximum of 55 feet for commercial/ business oriented buildings, and the M1 and M2 industrial districts have height maximums of 75 feet. Additionally, Article V details several regulations for lighting, while Article VII details density by zoning district.

Airport Land Use Compatibility

Cecil County does not currently regulate zoning for airport purposes, nor does it use an Airport Land Use Compatibility Plan (ALUCP). The county does however employ an Airport Approach Zone, defined within Section 168 of Article VII. This Airport Approach Zone is defined by the FAA, but is aimed at civilian and commercial public airports. Given that the majority of the area surrounding APG and its two air fields is incorporated, Cecil County's authority to implement airport zoning regulations is limited, nor would it apply to APG, which resides in Harford County.

Special Area Plan- Urban Growth Boundary Plan

The purpose of this Urban Growth Boundary Study is to create areas around each of the Towns, whereby the provision of water and sewer infrastructure would be closely coordinated between the County and the respective Towns. The primary focus of this Study has been to seek input from the Towns on their existing ability to serve areas currently outside incorporated boundaries, and to evaluate ways to effectuate that service. In the US Route 40 corridor, the Urban Growth Boundaries (UGB's) are subareas of the larger Development and Suburban Districts. In the outlying areas, around the Towns of Rising Sun, Chesapeake City and Cecilton, the UGB's correspond to those areas designated as Town-Residential (TR) Zoning.

This plan also details future Annexation Areas of the Towns, which are derived from each town's comprehensive plan.

Other Cecil County Tools

Real Estate Disclosure

Property disclosure is mentioned in the Zoning Ordinance for Cecil County under the Right to Farm Ordinance, as well as under Section 293 Property Disclosure and Hold Harmless Statement, the latter of which details disclosure regarding property frontage on a publicly maintained road and access to public water and sewer lines.

Cecil County Strategic Plan

The Cecil County 2014-2019 Strategic Plan is the first comprehensive plan developed, approved, and adopted under the new system of charter government and specifically responds to the regulations described in Article 6, Section 601 (a). The process for developing the plan included the work of the Strategic Planning Advisory Network, public feedback, and a review by County employees and affiliate agencies.

Priorities of the plan including advancing lifelong educational opportunities for citizens of all ages, providing fiscal stability, implementing improvements in infrastructure, creating an environment that encourages economic growth through job creation, business development, and community revitalization, and improving the quality of life for citizens by enhancing safety and health in all communities.

Eastern Shore Land Conservancy

The Eastern Shore Land Conservancy (ESLC) is a non-profit corporation in good standing with the charitable division of the office of the Secretary of State of Maryland. They assist in the conservation of natural habitats and resources along the eastern shore of Maryland. To date, ESLC has:

- Protected nearly 47,000 acres of the Eastern Shore's important natural habitat areas and prime farmland through easements on 268 properties and the creation of three preserves;
- Assisted in the protection of another 7,400 on 16 properties.
- Established a record of preservation that far exceeds any other local land conservancy in Maryland and is one of the most successful in the country;
- Received conservation easement and other property interests on which more than $40 million worth of development rights have been extinguished;
- Rescued six highly threatened priority properties on 1,146 acres and worth more than $12 million using their Land Rescue Revolving Fund. In two cases, the properties are key links in trail systems and will allow public access and serve as permanent urban growth boundaries.

Source: http://www.eslc.org/

Kent County

Kent County is comprised of approximately 415 square miles (over 30 percent is water), with a 2010 population of 20,197 people and approximately 210 miles of shoreline. The County has utilized a variety of planning tools to achieve its goals for organized development and a safe environment for its residents.

Kent County Comprehensive Plan

The Kent County Comprehensive Plan presents a series of goals and strategies to guide the preparation of County regulations and the application of County programs. These goals and policies are organized in eight functional categories dealing with the economy, towns and villages, the countryside, the environment, housing, transportation, community facilities and public services, and historic and cultural preservation. Each section contains a summary of important issues and trends, a statement of goals which should guide the County's administrative programs, and a list of strategies that the County will take to reach these goals.

Kent County Zoning Code

Chapter 222 of the Kent County Code details the Land Use Ordinance, adopted in 2002 and amended through 2013. The Kent County Land Use Ordinance divides the land within the county into seventeen major districts in which the Code provides development regulations for these districts. Kent County does not include a stand-alone district provision or sub districts for military or Airport zoning, yet they do provide a unique section on Marine district regulations, although they do not apply to APG. Districts that fall within the APG 115 peak blast noise contour include the Agricultural Zoning (AZD) District, the Resource Conservation District (RCD), the Rural Character district (RC), the Rural Residential (RR) district, the Critical Area Residential (CAR) district, the Community Residential (CR) district, the Village (V) district, the Crossroads Commercial (CC) district, the Marine (M) district, the Employment Center (EC) district, and the Industrial (I) district.

Maximum height restrictions are delegated by district, in which many of them are specific (down to the heights per residential or commercial buildings use). The CC district allows for height maximums of 45 feet for commercial buildings and 38 feet for residential buildings, while the EC and I districts allow for height maximums of 45 feet for industrial buildings and 35 feet for residential buildings. All other districts within the noise contour boundaries (AZD, RCD, RC, RR, CAR, CR, V, and M districts) restrict building heights to 38 feet.

Collocation of personal wireless facilities on existing facilities is permitted in most zoning districts. Communication towers are permitted only as a special exception in the AZD, RCD, RC, CC, C, CCA, EC and I zoning districts. New communication towers are limited to 199 feet unless a variance is granted. Article V details regulations for outdoor lighting and maximum density by district.

Airport Land Use Compatibility

Kent County does not currently regulate zoning for airport purposes, nor does it have an Airport Land Use Compatibility Plan (ALUCP) although the Land Use code does establish an Airport Safety Zone within the Land Use Overlay for a proposed public airport. Because the area surrounding APG is within Harford County, airport-specific land use controls for Kent County would not be relevant to APG.

Other Kent County Tools

Real Estate Disclosure

Chapter 85: Farming, of the Kent County Code details a section on Real Estate transfer disclosure and a right to farm notice. The real estate transfer disclosure statement is written as follows:

> *"Upon any transfer of real property by any means, the transferor shall provide the purchaser or lessee a statement specifically advising the purchaser or lessee of the existence of this chapter that shall be substantially in the form approved by the Kent County Zoning Administrator and by resolution of the Board of County Commissioners. The transferor shall require that the purchaser or lessee sign the statement and have it recorded by the Kent County Clerk of Court."*

Kent County does not require additional disclosures specific to impacts from APG.

Eastern Shore Land Conservancy

The ESLC is a nonprofit charitable organization in Maryland that helps in conservation and easement acquisition of land. More information on ESLC is detailed in the previous section, under 'Other Cecil County Tools'.

City of Aberdeen

The City of Aberdeen encompasses roughly 6.8 square miles, had a 2010 population of 14,959 people, and has long supported mission protection for APG due to the location of the installation in the City of Aberdeen.

City of Aberdeen Comprehensive Plan

The City's Comprehensive plan was most recently updated in 2011, and includes the following elements: land use, municipal growth, transportation, community facilities, mineral resources, sensitive areas, housing, and water resources. The plan concludes with an Implementation chapter which details authority, smart growth measures, the development code and the capital improvement program. The guidelines outlined in the various elements of the Comprehensive Plan are important because of their potential impacts on operations at APG, which is located in Aberdeen.

City of Aberdeen Development Code

City of Aberdeen Municipal Code Chapter 235 contains the approved development code, or zoning ordinance, which was adopted in 1990 and has been amended through 2014. The code divides the land within the county into fifteen districts, and provides development regulations for these districts. Lot size requirements, lot area, parking, and height regulations are detailed under Article IV: Provisions Applicable to All Districts and a map is provided for each district. The City of Aberdeen does not include a stand-alone district provision or sub districts for airport or military zoning.

Section 235-24 of the Aberdeen Development Code details General Height requirements for residential, commercial and industrial districts, as well as exceptions and modifications.

While communication towers are allowed in the B-3, M-1, M-2, ORE, AG and TOD districts with special exception approval, no other height provisions that reference communication or transmission towers are specified within the Aberdeen Development Code. Additionally, several sections in the Code detail regulations for outdoor lighting.

Special Area Plans

The Aberdeen TOD Master Plan was completed in 2012 and details importance of the MARC commuter rail, the local and state highways, as well as possible future transportation amenities.

The TOD Master Plan helps give a tangible vision to a future that realized the potential growth at Aberdeen Proving Ground. Some strategies include better and/or additional shuttle bus service to connect APG with the train station and downtown Aberdeen, more frequent and mid-day shuttle service between downtown, the

station, and APG employment zones, and even car-sharing at and around the station area and at APG.

Other Tools

Flood Control Ordinance

The City of Aberdeen has the responsibility under the Flood Control and Watershed Management Act, §5-801 - 809 et seq., Environmental Article of the Annotated Code of Maryland, to control floodplain development in order to protect persons and property from danger and destruction and to preserve the biological values and the environmental quality of the watersheds or portions thereof under its jurisdiction.

Chapter 275 of the City of Aberdeen Code is titled Floodplain Management and it details the establishment of a Floodplain District, development regulations for that district, as well as administration and enforcement for those floodplain regulations.

Real Estate Disclosure

While the City of Aberdeen has several sections in their Ethics chapter of their Code that refer to financial disclosure, it is not clear whether the City does or does not impose further affirmative disclosure requirements on a real estate vendor.

City of Havre de Grace

The City of Havre de Grace, located approximately five miles to the northeast of Aberdeen, encompasses roughly 6.9 square miles, including small areas of water, with a 2010 population of 12,952 people.

City of Havre de Grace Comprehensive Plan

The City of Havre de Grace has a Comprehensive Plan that was written in 2004, with amendments made to the Municipal Growth and Water Resources Elements in 2010. The Comprehensive Plan includes the following elements: municipal growth, historic preservation, economic development, transportation, community facilities, mineral resources, sensitive areas, housing, and water resources. The Plan also includes an Implementation chapter which details authority, recommendations, the development code and the capital improvement program. The guidelines outlined in the various elements of the Comprehensive Plan are important because of their potential impacts on operations at APG, which is located near Havre de Grace.

City of Havre de Grace Zoning Code

City of Havre de Grace Municipal Code Chapter 205 contains the approved development code, or zoning ordinance, which was adopted in 2000 and amended through 2009. The code divides the land within the city into seven districts, which are Residential (R, R-1, and R-2), Residential Office (RO), Residential Business (RB), Mixed Office/ Employment Center (MOE), and Commercial (C). Lot size requirements, lot area, and height regulations are detailed by district, and a map is provided for the districts. The City of Havre de Grace does not include a stand-alone district provision or overlay district for airport or military zoning.

Height regulations are sporadically detailed in the zoning ordinance by district. Height regulations are detailed in Table 1 of the Zoning Code, and while heights are usually delegated by district, the code goes in depth, giving height maximums by use. Most residential uses in the R-1 and R-2 districts are limited to 40 feet, while conditional use residential uses, duplexes, townhouses and semi-detached residential buildings in the RO and RB districts are allowed up to 60 feet in height, as long as yard setbacks increase by one foot for every two feet in excess of the 40 foot building maximum. Multi-family residential buildings in the R-2, RO and RB districts, as well as hotels permitted in the C and RB districts are allowed up to 80 feet. Most Commercial uses such as community facilities, parking facilities, schools and clubs are allowed up to 60 feet in height, while churches (permitted in R, R-1, R-2, and RO, RB and C districts) and hospitals are allowed up to 100 feet in height.

Utility structures are allowed up to 60 feet in height, and are permitted in the C district and conditionally permitted in the R, R-1 and R-2 districts provided their height equals their setback from adjacent residential properties. Utility structures are also conditionally permitted in the RO and RB districts, and are a special exception in the MOE district. Telecommunication towers are allowed in the MOE district provided several terms are met. No other height provisions that reference communication or transmission towers are specified within the Havre de Grace zoning code.

The zoning code provides additional regulations for density, found in Table 1 of the code. Several district regulations, such as the MOE district regulations, including provisions for outdoor lighting. Additionally, Chapter 116 of the Havre de Grace Code details noise prohibitions and exemptions.

Other Tools

Flood Control Ordinance

Chapter 78 of the City of Havre de Grace Code is titled Floodplain Management and it details the establishment of a Floodplain Zones and boundaries, development regulations for these zones, as well as variances and permit enforcement for those floodplain regulations.

Real Estate Disclosure

While the City of Havre de Grace has several sections in their Ethics chapter of their code that refer to financial disclosure, it is not clear whether the city does or does not impose further affirmative disclosure requirements on a real estate vendor.

Other Tools and References

Office of Economic Adjustment and NACo

In the interest of land use compatibility between the military and the local community, the DOD Office of Economic Adjustment (OEA) and other public interest groups, such as the National Association of Counties (NACo), have prepared educational documents and videos that educate and inform the public about encroachment issues and methods that can be used to address existing or future compatibility concerns. The following five resources have been published to inform the public on land use compatibility.

Guides

The Practical Guide to Compatible Civilian Development near Military Installations (July 2007), OEA

This guide offers general information on community development and civilian encroachment issues. The guide can be found at: http://www.oea.gov/.

Joint Land Use Study Program Guidance Manual (November 2006)

This manual provides guidance on the JLUS program, process, and efforts to support compatible development. This manual can be obtained on the OEA website at the following address: http://www.oea.gov/.

Encouraging Compatible Land Use between Local Governments and Military Installations: A Best Practices Guide (April 2007), NACo

This guidebook presents case studies of best practices between the military and communities through communication, regulatory approaches, and Joint Land Use Studies. The guide can be accessed on the NACo website at the following address: http://www.naco.org/.

Videos

The Base Next Door: Community Planning and the Joint Land Use Study Program, OEA

This informative video discusses the issue of encroachment near military installations as urban development occurs within the vicinity. This video can be accessed on the official OEA YouTube channel at: http://www.youtube.com/watch?v=6UiyWDgLeJM

Managing Growth, Communities Respond, OEA

This video highlights the lessons learned from three communities (Kitsap Naval Base in Bangor, Washington; Fort Drum in Jefferson County, New York; and Fort Leonard Wood in Pulaski County, Missouri) that have successful programs for managing growth near their respective military installations. This video can be accessed on the official OEA YouTube channel at: http://www.youtube.com/watch?v=rea6d3bDp3c

Professional Associations Network

The Professional Associations Network is an informal group composed of the Presidents (or their designated representative) of the APG Professional Associations. The APG PAN originated to assist in the coordination of the growing number of professional associations supporting the APG community and to accommodate the needs of our brethren and their associations that may be transitioning from other locations due to BRAC.

Identification of Compatibility Issues

Compatibility, in relation to military readiness, can be defined as the balance or compromise between community needs and interests and military needs and interests. The goal of compatibility planning is to promote an environment where both community and military entities communicate, coordinate, and implement mutually supportive actions that allow both to achieve their respective objectives.

A number of factors assist in determining whether community and military plans, programs, and activities are compatible or in conflict. For this Joint Land Use Study (JLUS), 24 compatibility factors were reviewed to identify, determine, and establish a prioritized set of key study area issues. These compatibility factors are listed below.

Compatibility Factors	
1 Air Quality	13 Legislative Initiatives
2 Anti-Terrorism / Force Protection	14 Light and Glare
3 Coordination / Communication	15 Marine Environments / Climate Change
4 Cultural Resources	16 Noise
5 Dust / Smoke / Steam	17 Public Trespassing
6 Energy Development	18 Roadway Capacity
7 Frequency Spectrum Capacity	19 Safety Zones
8 Frequency Spectrum Impedance / Interference	20 Scarce Natural Resources
9 Housing Availability	21 Sensitive Biological Resources
10 Infrastructure Extensions	22 Vertical Obstructions
11 Land / Air / Sea Spaces	23 Vibration
12 Land Use	24 Water Quality / Quantity

Of the 24 compatibility factors considered, several were determined to be inapplicable to this JLUS: Air Quality, Anti-Terrorism / Force Protection, Cultural Resources, Energy Development, Light and Glare, and Public Trespassing.

Similar issues were consolidated into single compatibility factors. For example, the Marine Environments and Climate Adaption issues were consolidated into one factor since the impacts associated with each of these are very similar.

Issues

At the initial committee workshops and subsequent public forums, groups were asked to identify the location and type of compatibility issues they thought existed today, or could occur in the future, using the 24 factors as a guide. A number of individual issues were identified for each factor. Additional technical issues were analyzed and added based on available information and similarity with other community JLUS experiences around the country.

Setting Priorities

The public and committees provided input on establishing priorities for the compatibility factors and issues. Priorities were used to determine the type and timing of associated actions for each issue. Three criteria were utilized to prioritize the compatibility factors:

- Is it a Current Impact? Each issue was considered based on its current impact to the compatibility of either APG or the surrounding areas. Issues posing the most extensive operational constraints or community concerns constitute the highest priority.
- Location. This criterion assesses the proximity of each issue in relation to activities occurring on APG and surrounding areas. Issues occurring near the installation are often more critical than those occurring remotely.
- Potential Impact. Although an issue may not have a current impact on the installation or the community, it may possess the ability to become an issue in the future. Should conditions change, adjacent or proximate development increase, or other issues become apparent, new conflicts with existing or future missions and operational activities at APG could arise. Issues were considered based on their future potential using the same criteria that were established for current impact.

With a comprehensive list of issues to address in the JLUS, the public and Advisory Committee (AC) identified the relative priority of each compatibility factor. The Executive Committee finalized the prioritization of

issues based on public and AC input, categorizing the factors into four categories:

- High-Priority. Due to the nature of these issues, an immediate response is warranted. Issues identified as High Priority are to be initiated within 1-2 years following completion of the JLUS.
- Medium-Priority. To be initiated within 3-4 years following completion of the JLUS.
- Low Priority. To be initiated in 5 or more years following completion of the JLUS.
- Awareness Factors. Awareness factors are those issues that pose a minimal impact to APG and/or the surrounding jurisdictions and are documented in this JLUS for the purpose of maintaining operational awareness. These items do not require action at the current time, but should be monitored in the long term.

APG Compatibility Issues by Factor

Coordination / Communication refers to the programs and plans that promote interagency coordination. Interagency communication serves the general welfare by promoting a more comprehensive planning process inclusive of all affected stakeholders. Interagency coordination also seeks to develop and include mutually beneficial policies for both communities and the military in local planning documents such as general plans. The following Coordination / Communication issues were identified:

- Coordination between APG and Jurisdictions. Coordination between APG and local jurisdictions on area planning and land use issues is informal and inconsistent leading to a lack of information sharing and coordinated evaluation of development impacts. Jurisdictions do not understand APG requirements that affect long-range development plans.
- Communication of Remediation Activities. Installation's Water quality improvement efforts are not adequately conveyed to the public.
- Formal Coordination Process. No formal process to notify APG of development actions outside the fenceline.
- Base Community Relations Outreach. APG community relations outreach extends to Harford and Cecil County but does not include Kent County which is informed only through media alerts.
- Communication of APG Activities. Public's nominal mission understanding affects community support for APG.
- Communication from APG with Outside Community. Because communications are not formalized, the level of APG communication with outside jurisdictions is perceived as dependent on leadership interest which can fluctuate with changes in leadership.
- Coordination on Multi-Jurisdictional Infrastructure Improvements. Coordinate multijurisdictional infrastructure improvements to ensure all jurisdictions are notified and can plan appropriately for impacts in affected areas. This will help avoid previous scenarios where intersection improvements were not fully coordinated across jurisdictions and resulted in relocation of water lines and regulatory takings of homes in roadway widening areas.
- Engagement from APG on Area Planning Issues. Installation planners attend local jurisdiction planning meetings but lack of active participation is perceived as indifference.
- Security Issues Not Communicated. Harford County Sheriff is not regularly informed about events that happen on the installation that affect the outside community.
- Complaint Documentation Process. Notifying APG and documenting noise and vibration complaints, particularly when there is private property damage, is perceived as onerous to homeowners.
- Energy Conservation Efforts. Need for coordinated effort on regional energy conservation efforts to ensure that solutions from all parties are considered. Providing an inclusive process that considers solutions from multiple sources will ensure the best outcomes for all regional stakeholders. This will alleviate organizations potentially working at cross-purposes such as with the waste-to-energy plant

where the decision to potentially reuse or demolish the facility was made after significant investment and without the transparent exploration of alternatives.

- Coordination on Public-Private Partnerships. Need for coordination between APG and surrounding jurisdictions on Public-Private Partnerships, such as housing and Enhanced Use Leasing that may impact areas outside APG to balance the viability of communities while addressing the ongoing needs of APG.
- Wildlife Hazards. Communication and coordination between various agencies is required to manage bird populations and control the size of the deer herd in the Aberdeen Area and Edgewood Areas to reduce the potential for negatively affecting military activities including aircraft strikes.

Dust, Smoke, and Steam is a by-product generated by both military and civilian activities. The primary dust, smoke, and steam-related issues in this JLUS are associated with military vehicle testing. Dust, smoke, and steam are compatibility issues if sufficient in quantity to impact military and / or flight operations, such as reduced visibility or cause equipment damage, or if military activities cause dust, smoke, or steam to interfere with civilian uses or quality of life. The following Dust, Smoke, and Steam issues were identified:

- Dust Generation from Testing Activities at APG and Dust, Smoke, and Steam from Activities outside APG. Military activities at APG automotive test areas can create fugitive dust impacts outside APG and dust, smoke, and steam from activities outside APG can migrate onto APG.

Frequency Spectrum Impedance/Interference is the interruption of electronic signals due to the existence of a structure or object between the source of the signal and its destination (receptor). Such obstructions can include wind turbines, cell towers, and tall buildings depending on the ground-level elevation at the site and the numbers of structures within a confined area. The following Frequency Spectrum Interference / Impedance issues were identified:

- No Coordinated Assessment of Hazards Associated with Frequency. Though there is informal coordination between CERDEC, other tenants, and APG to deconflict frequency use during CERDEC ground-to-satellite tests, there is no plan to coordinate and assess near-zone and far-zone hazards associated with ground-to-satellite tests.
- Potential for Ground-Based Interference. Line-of-sight signal transmission between Aberdeen Area and Churchville Test Site can be impacted from potential signal interference.
- Potential to Disrupt Aircraft Navigational Systems. Coordination of signal transmission frequency testing and angle of transmission with area aircraft is required to ensure that potential disruption to aircraft navigational systems does not occur.
- Potential for Harford Metropolitan Area Network to Impact APG. Harford County is pursuing the Harford Metropolitan Area Network (HMAN) project for high speed fiber optic transmission for the County, the municipalities of Havre de Grace, Bel Air and Aberdeen, and businesses throughout the county. Though current phases include only hardwiring, any proposed Wi-Fi in the future may create a radiating signal bloom that could potentially impact APG frequency testing.
- Radio Frequency Interference Affects Emergency Services Communications. Jurisdictions on both sides of Chesapeake Bay have experienced EMS radio system outages from unknown sources speculated to come from APG.
- APG Electronic Warfare Footprint. Concern that electronic warfare footprint associated with APG research and testing activities can spill-over into adjacent jurisdictions. Land uses that occur outside of APG that rely on wireless signals could have the potential to impact activities at APG.
- Coordination with Broadband Providers. Lack of coordination between broadband providers and APG can result in signal interference from use of bi-directional amplifiers outside the fenceline.

- Marine Frequency on Range. Potential for signal interference with waterfront lanes / marine frequencies on range.

Frequency Spectrum Capacity is the entire range and capacity of electromagnetic frequencies used for communications and other transmissions, which includes communication channels used for radio, cellular phones, and television. In the performance of typical operations, the military relies on a range of frequencies with reliable capacities for communications and support systems. Similarly, public and private users rely on a range of frequencies in the use of cellular telephones and other wireless devices used on a daily basis. The following Frequency Spectrum issues were identified:

- Comprehensive Frequency Management Program. Need for a comprehensive Frequency Management Program to assess current and future frequency needs of all APG tenants inside and outside the fenceline to deconflict frequency requirements.

Housing Availability addresses the supply and demand for housing in the region, the competition for housing that may result from changes in the number of military personnel, and the supply of military family housing provided by the installation. The following Housing Availability issues were identified:

- Urban Environments. Urban city environments such as Baltimore City provide amenities and lifestyle attractive to young professionals. These urban environments are unavailable proximate to APG. APG personnel choosing to reside in an urban environment will have a longer commute adding to regional roadway congestion. The lack of urban environments proximate to APG may put the installation at a disadvantage for attracting younger job seekers.

Infrastructure Extensions covers the extension or provision of infrastructure (i.e., roads, sewer, water, etc.). The extension or expansion of community infrastructure to a military installation or areas proximate to an installation have the potential to induce growth, potentially leading to incompatible uses and conflicts between military missions and civilian communities. Through careful planning, the extension of infrastructure can serve as a mechanism to guide development into appropriate areas, protect sensitive land uses, and improve compatibility of land uses and military missions. The following Infrastructure Extensions issues were identified:

- Water provision to APG Edgewood Area. The current service agreement with Harford County for water provision to the Edgewood Area is a non-binding short-term temporary solution for Winters Run Creek production deficiencies. Long-term solutions for Edgewood water will require new infrastructure.
- Coordination of Easements on APG Property. There is utility infrastructure traversing APG property without a formal agreement with APG at the Churchville Test Site. Formal easements are necessary to know which agency requires maintenance access, to coordinate access when needed, and to prevent potential liability issues.

Land, Air and Sea Space Competition is the management or use of land and air space to accomplish testing, training, and operational missions. These resources must be available and of a sufficient size, cohesiveness, and quality to accommodate effective training and testing. Military and civilian air operations can compete for limited air space, especially when the airfields are in close proximity to each other. Use of this shared resource can impact future growth in operations for all users. The following Competition for Land and Air Spaces issues were identified:

- JLENS Program. Public perception that the JLENS program could impact rights to privacy.

Land Use planning and regulation relates to the government's role in protecting the public's health, safety, and welfare. Local jurisdictions' general plans and zoning ordinances can be the most effective tools for avoiding or resolving land use compatibility issues. These tools balance land use compatibility with safety and noise zones and imaginary surfaces to promote development patterns appropriate for the airfield vicinity while protecting public property rights. Land use separation also applies to properties where the use

of one property may adversely impact the use of another. For instance, industrial uses are often separated from residential uses to avoid impacts related to noise, odors, lighting, and so forth. The following Land Use issues were identified:

- Incompatible Land Development. More intense land development throughout the Study Area has the potential to inhibit mission-critical activities at APG.
- Real Estate Disclosures Inconsistent Across Jurisdictions. Inconsistent application of real estate disclosures results in patchwork of new home buyer knowledge of installation impacts on properties.
- Potential for New Mission Footprints Constrained by Environmental Constraints. Buffers for wetlands, wildlife, and eagle nesting potentially reduce developable land for additional missions at Aberdeen Area.
- Eastern Shore Properties Present Possible Encroachments. Real estate easement instruments for properties with noise monitoring equipment on Eastern Shore do not contain legal descriptions resulting in access that may be outside the easements.
- Identification of Encroachment Buffers. Encroachment buffers around APG are not identified on City and County planning documents.

Legislative Initiatives are proposed changes in relevant policies, laws, regulations or programs which could potentially have a significant impact on one or more substantive areas of concern to both the facility and to the stakeholder communities. The focus of this compatibility issue is on initiatives with general and broad implications. The following Legislative Initiative issues were identified:

- Environmental Regulatory Impacts. Federal and state environmental regulations reduce the APG buildable footprint and ability to accommodate new missions.

Marine Environments / Climate Adaptation is attempting to mitigate the potential impacts caused by climate change, which is the gradual shift of global weather patterns and temperature resulting from natural factors and human activities (e.g. burning of fossil fuels) that produce long-term impacts on atmospheric conditions. The effects of climate change vary and may include fluctuations in sea levels, alterations of ecosystems, variations in weather patterns, and natural resource availability issues. The results of climate change, i.e. ozone depletion and inefficiencies in land use, can present operational and planning challenges for the military and communities as resources are depleted and environments altered. The following Marine Environments / Climate Adaptation issues were identified:

- Dredging Requests to Aberdeen Proving Ground. The Port of Baltimore has engaged APG over the last couple of decades about receiving dredging spoils. Though APG is not currently a designated receiver site in the Army Corps of Engineers Dredged Material Management Plan, the upland placement of dredging spoils could be used to combat potential sea-level rise.
- Long-Term Plan for Environmental Impacts from Climate Change. Sea level rise studies indicate that portions of APG may be underwater as early as 2050 necessitating a long-term mitigation plan for APG.
- Conowingo Dam Impacts Aberdeen Proving Ground. When Conowingo Dam floodgates are open, debris, sediment, and flooding occur along Spesutie Island.
- Disposal of Dredged Material Destined for Cecil County and Associated Risk from Unexploded Ordnance. Concern that dredging spoil disposed of in Cecil County may carry risks of unexploded ordnance. Consideration that these spoils could be used for shoreline stabilization at APG to combat sea-level rise.

Noise is the result of both military mission exercises and construction and development activities. This factor can be incompatible with sensitive land uses. Noise that is loud and extending into night hours can disrupt

the lives of the public. The following Noise issues were identified:

- Noise from Installation Activity. Noise from activities at APG has the potential to affect sensitive noise receptors in surrounding communities.
- Regional Noise Sources. There are other sources of blasting than APG within the region which can be misattributed to APG testing.
- Overflight of the City of Havre de Grace. APG overflight of the City of Havre de Grace creates general noise nuisance.

Roadway Capacity relates to the ability of existing freeways, highways, arterials, and other local roads to provide adequate mobility and access between military installations and their surrounding communities. The following Roadway Capacity issues were identified:

- Peak Hour Traffic (Traffic Loads at Gates). Peak hour traffic including a mid-day peak causes congestion and traffic delays outside the installation which have a quality of life impact for those working at APG and those traveling the area.
- Public Transportation Connections. Amtrak and MARC commuter trains stop near the boundary of both APG and Edgewood, but there is no direct transit connection from the stations into the installation.
- Increased APG Commuter Traffic Affects Local Roads and Level of Service. APG commuter traffic affects local roads and contributes to level of service impacts:
    - Westbound commuter traffic to APG cuts through local subdivisions via I-95 to reach the installation
    - Traffic switching between Route 40 and I-95 to avoid higher I-95 eastbound toll creates failing LOS at US Route 40 and State Hwy. 222 interchange
    - Congestion on Harford County cross arteries such as MD 543 and 152
- Traffic congestion creates safety hazard at MD 543 at I-95 interchange.

Safety Zones are areas in which development should be more restrictive, in terms of use and concentrations of people, due to the higher risks to public safety. Issues to consider include aircraft accident potential zones, weapons firing range safety zones, and explosive safety zones. The following Safety issues were identified:

- Awareness of Range Fires. During dry months of the year, certain testing procedures can cause brush fires. These fires need to be maintained and proper communication needs to be provided outside of APG regarding their potential effects.
- Unexploded Ordnance. Areas at APG could still contain unexploded ordnance buried underground which potentially pose a safety risk for adjacent development outside the fenceline.
- Incompatible Uses in Accident Potential Zones. Incompatible uses in the Accident Potential Zones extend into Harford County and the City of Aberdeen creates a safety concern.

Sensitive Biological Resources include federal and state listed species (threatened and endangered species) and their habitats. These resources may also include areas such as wetlands and migratory corridors that are critical to the overall health and productivity of an ecosystem. The presence of sensitive biological resources may require special development considerations and should be included early in the planning process. The following Sensitive Biological Resources issues were identified:

- Eagle Nesting Sites. Eagle nesting site buffers impact ability to carry out mission-critical activity and contribute to reduced development areas.

Scarce Natural Resources involves pressure to gain access to valuable natural resources, such as oil, natural gas, and minerals, located on military installations, within military training areas, or on public lands historically used for military operations, can impact land utilization and military operations. The following Scarce Natural Resources issues were identified:

- Water Quantity / Quality at Edgewood. Harford County water supply to Edgewood is temporary because of Harford County's own service demand.

Vertical Obstructions are structures that impede navigable airspace for both military and civilian aircraft operations. Structures that pose a threat to the airspace for military and civilian aviation include tall wind turbines and wireless communication towers. It is important to ensure the communities adjacent to APG plan accordingly to safeguard against unintended safety concerns relative to structures that obstruct navigable airspace. The following Vertical Obstructions issues were identified:

- Vertical Obstructions Understanding. Lack of awareness of vertical obstruction requirements within jurisdictions surrounding APG can lead to incompatible development.

Vibration is an oscillation or motion that alternates in opposite directions and may occur as a result of an impact, explosion, noise, mechanical operation, or other change in the environment. Vibration may be caused by military and / or civilian activities. Some studies have shown that homeowners become concerned about the structural rattling and potential damage when the peak decibels exceed 120 dBP (peak sound level), but actual damage isn't likely to occur at decibels lower than 150 dBP. The following Vibration issues were identified:

- Vibration Damage in Study Area Communities. Vibration from APG ordnance testing has the ability to cause physical property damage in areas throughout the study area on both sides of the Chesapeake Bay.

Water Quality and Quantity is the factor that assesses the quantity and quality of water resources in the APG JLUS Study Area. This factor evaluates the amount of water that is utilized by the installation relative to the available supply of water and then compares that with the demand and supply that is utilized by the surrounding communities to provide for the necessary public services. In addition to evaluating the water supply, this factor also reviews the overall quality of public water use in the JLUS Study Area. Water quality can be affected by military operations, public recreation use and stormwater drainage. The following Water Quality and Quantity issue has been identified:

- Havre de Grace Marina Siltation. The Spesutie Island Causeway is a potential source of sediment buildup near the Havre de Grace Marina which is reported to affect local boating and the Chesapeake Bay ecosystem.
- Edgewood Area Lacks an Uninterruptable Water Supply. The Edgewood Area water source is subject to periodic production shortages. Supplemental water to the Edgewood Area from Harford County is temporary. A reliable source of water to serve the Edgewood Area is needed to meet current and future needs.
- Aberdeen Area Lacks an Uninterruptable Water Supply. The source of water for the Aberdeen Area suffers from periodic production shortages due to flows that cannot be maintained during moderate drought periods. Back-up water supplies are provided from Harford County by way of the City of Aberdeen through a collective MOU which expires in 2017.
- EUL Site On Top of Aquifer Recharge Infiltration Field. The EUL site is located within the Source Water Protection Area that encompasses the water wells for Harford County and the City of Aberdeen. There is a concern that future EUL development can impact the aquifer recharge associated with the wells.
- Stewardship of Chesapeake Bay Waters. Perception that counties are providing a disproportionate amount of funding versus APG to clean the Chesapeake Bay.

Please see the next page.

APG JLUS

6

Implementation Plan

Implementation Plan

This section identifies and organizes the recommended courses of action (strategies) that have been developed through a collaborative effort between representatives of Harford County and its JLUS partners: local jurisdictions, APG, state and federal agencies, local organizations, the general public, and other stakeholders that own or manage land or resources in the region. Because the APG JLUS is the result of a collaborative planning process, the strategies in this section represent a true consensus plan; a realistic and coordinated approach to compatibility planning developed with the support of stakeholders involved throughout the process.

The JLUS strategies incorporate a variety of actions that can be taken to promote compatible land use and resource planning. Existing and potential compatibility issues arising from the civilian / military interface can be removed or mitigated through implementation. The recommended strategies function as the heart of the JLUS document and are the culmination of the process.

The key to the implementation of strategies is the establishment of the JLUS Implementation Coordination Committee (see Strategy COM-1A) to oversee the execution of the JLUS. Through this committee, local jurisdictions, APG, and other selected partners can continue their collaboration to establish procedures, recommend, or refine specific actions, and adjust strategies over time to promote the resolution of key compatibility issues through realistic strategies and implementation.

Implementation Plan Guidelines

The key to a successful plan is balancing the different needs of all involved stakeholders. In working towards a balanced plan, several guidelines became the basis upon which the strategies were developed. These guidelines included:

- In concert with the Maryland state laws, the Implementation Plan was developed with the understanding that the recommended strategies must not result in a taking of property value. In some cases, it may be determined that recommended strategies can only be implemented with new enabling legislation.
- In order to minimize regulation, where appropriate, strategies were recommended only for specific geographic areas to resolve the compatibility issues identified.
- Similar to other planning processes that include numerous stakeholders, the challenge is to create a solution or strategy that meets the needs of all parties. In lieu of eliminating strategies that do not have 100% buy-in by all stakeholders, it was determined that the solution / strategy may result in the creation of multiple strategies that address the same issue but would be tailored to individual jurisdictions or agencies.

APG Military Compatibility Areas

In compatibility planning, the generic term "Military Compatibility Area" (MCA) is the term used to formally designate a geographic area where military operations may impact local communities, and conversely, where local activities may affect the military's ability to carry out its mission. The MCAs are geographic areas where the majority of the recommended strategies apply. The proposed APG Military Compatibility Area Overlay District (MCAOD) is an area that incorporates all of the MCAs.

The use of MCAs and the MCAOD ensures that strategies are applied to the appropriate areas, and that locations not affected by a specific compatibility issue are not impacted by regulations or policies that are not appropriate for their location or circumstance.

The MCAs are proposed to accomplish the following purposes:

- Promote an orderly transition between community and military land uses so that land uses remain compatible.
- Protect public health, safety, and welfare.
- Maintain operational capabilities of military installations and areas.
- Promote the awareness of the size and scope of military mission areas to protect areas separate from the actual military installation (i.e., critical air space) used for mission purposes.
- Establish compatibility requirements within the designated area, such as requirements for sound attenuation, real estate disclosure, and air navigation easements.

There are four proposed MCAs for the area around APG that comprise the MCAOD. These MCAs (described in the following paragraphs) are:

- Noise MCA
- Safety MCA
- Vertical Obstruction MCA
- BASH MCA

Figure 5 shows the combined MCAOD and Figures 6 through 9 provide maps of the respective MCAs.

Noise Military Compatibility Area

The Noise MCA includes all land located outside APG within the noise contours for 115 PK15 (met) peak blast or 57 decibels averaged C-weighted (CDNL) noise levels (Land Use Planning Zone) associated with ordnance testing and other military activities at APG. This MCA encompasses land areas which are identified by APG as posing the potential for noise complaints from ordnance testing. The APG Noise MCA is illustrated on Figure 6.

Noise is often a concern to the public surrounding military installations that have flying or ordnance testing missions. The siting of residential and other land uses such as schools and hospitals which are particularly sensitive to noise, are not recommended within areas identified in this MCA.

Coordination among local jurisdictions, developers, and organizations and agencies responsible for the siting of noise sensitive uses is recommended within the Noise MCA. Including the Noise MCA in local planning documents will provide public awareness, and where possible, land use controls may be used to reduce the potential for the proliferation of noise sensitive uses where they are most impacted by APG operations.

Additional information and technical background explaining the various noise measurement units [i.e. CDNL vs. PK15 (met)] and specific noise contours associated with ordnance testing is provided in the Military Profile found within the Chapter 3 of the Background Report.

Safety Military Compatibility Area

The Safety MCA comprises the existing Phillips Army Airfield Clear Zone (CZ), Accident Potential Zones I and II (APZ I and APZ II), and the Weide Army Heliport CZ and APZ I. The APG Safety MCA is illustrated on Figure 7.

The proposed Safety MCA identifies areas where measures would be applied to regulate compatible land use types and densities / intensities of development outside APG. Since the safety zones at Weide Army Heliport and the Phillips Army Airfield CZs do not extend off the installation, the MCA contains only portions of APZ I and APZ II associated with Phillips Army Airfield that extend into Harford County and the City of Aberdeen. The current location of the safety MCA is based on the Phillips Army Airfield layout and air operations identified in the APG Master Plan and dimensions identified in DOD's United Facilities Criteria (UFC) 3-260-01, Airfield and Heliport Planning and Design.

Each of the safety zones has recommended guidelines of the type of development that should not occur within them. These guidelines are found in the DID Instruction 4165.57. Compatibility guidelines preclude land uses that concentrate large numbers of people, such as residences, apartments, churches, and schools, from being sited within APZs. While the likelihood of an accident is remote, the DOD recommends low density

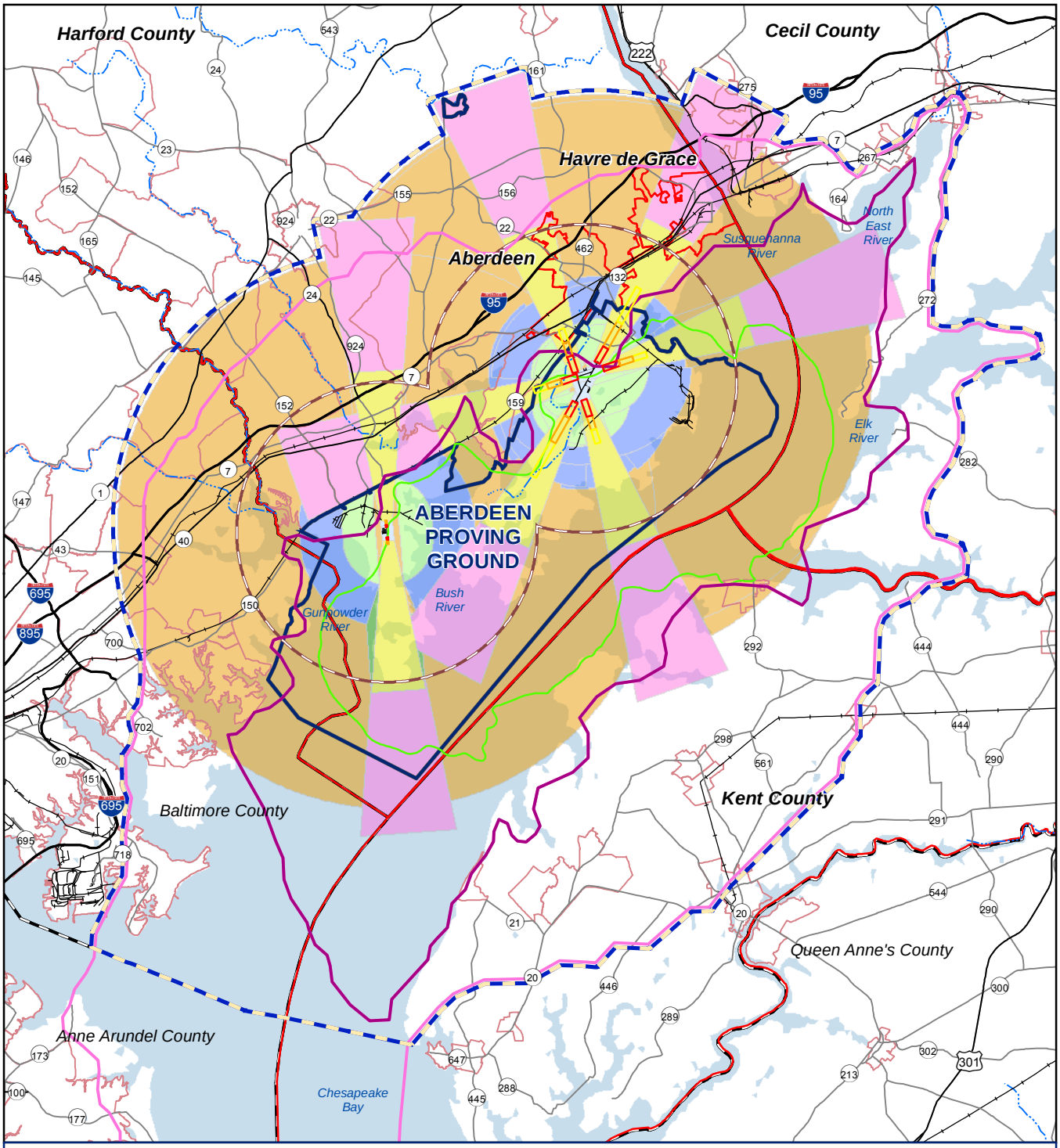


Figure 5
Military Compatibility Area Overlay District (MCAOD) and MCAs Composite

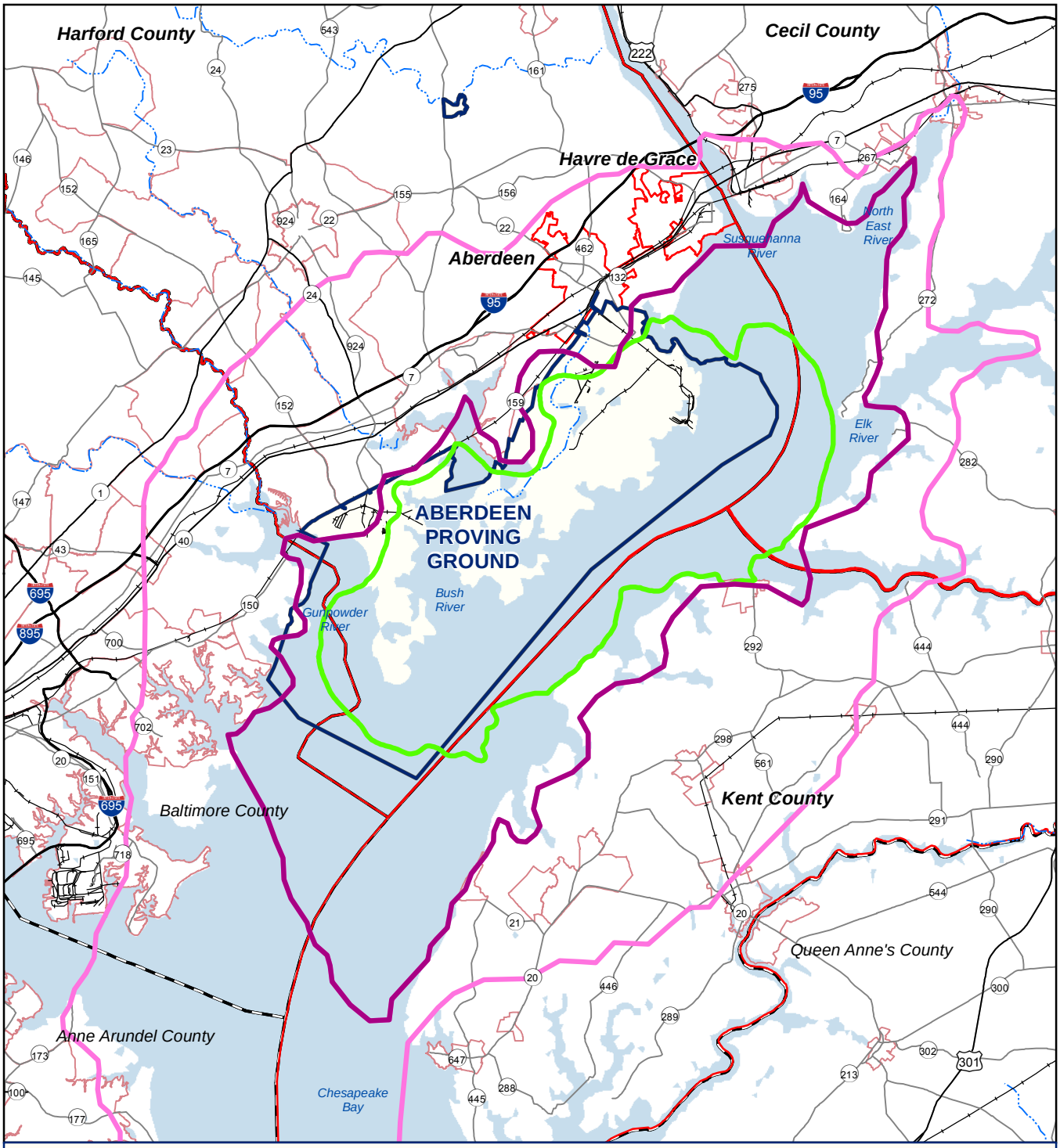


Figure 6
Noise MCA

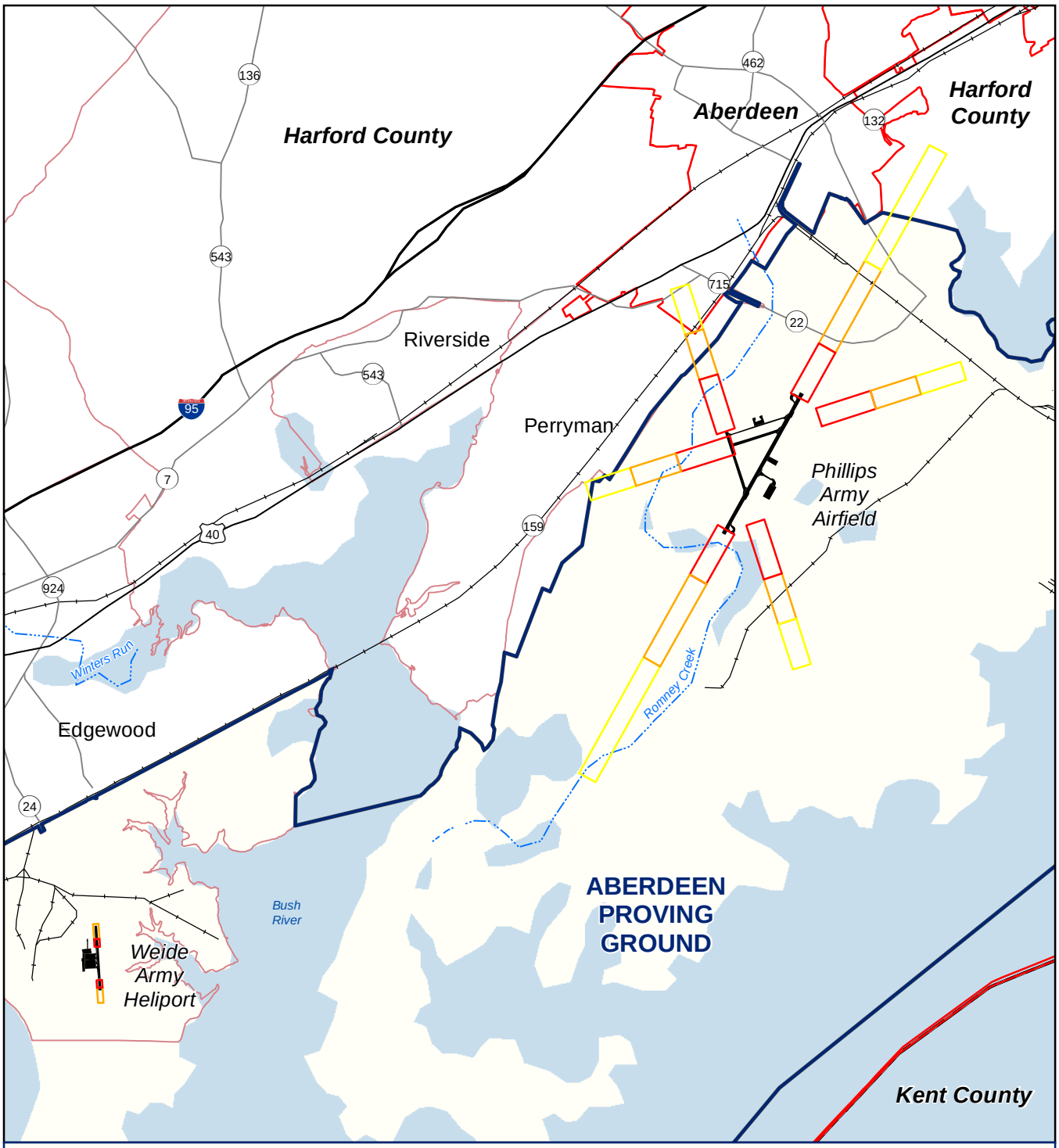


Figure 7
Safety MCA

land uses within the APZs to ensure the maximum protection of public health and property.

Within APZ I, residential uses are not recommended and only limited low intensity non-residential uses are recommended. Detached single family residential uses – up to 2 units per acre are recommended within APZ II. Other compatible uses in APZ II include agriculture, limited intensity office / retail, and light industrial. Development within the areas proximate to these safety zones should be reviewed for compatibility with both current military mission and future missions.

Vertical Obstruction Military Compatibility Area

The Vertical Safety MCA is based on the DOD Imaginary Surfaces – a set of surfaces in 3-dimensional space designated to prevent the risk of structures becoming vertical obstruction hazards to aircraft. These surfaces include both sloping surfaces radiating outward from the runway and surfaces with maximum heights that extend along the horizontal plane. Some of the more critical surfaces include the Inner Horizontal Surface, which restricts development of structures up to 150 feet above airfield elevation and the Approach-Departure Clearance Surface which includes a 500-foot slope from the end of the runway out to a distance of approximately 4.7 miles. The Vertical Obstruction MCA is intended to follow the DOD imaginary surfaces with regard to structure height and is not intended to reduce or change DOD guidance with regard to maximum height of structures.

A potential source for aircraft accidents to occur is related to the presence of vertical obstructions in areas that are frequently used by low flying aircraft. Vertical obstruction issues are a major concern to flight operations and training due to the potential for a building or structure to extend into navigable airspace and impede the safety of flight operations. Vertical obstructions can affect flight safety, line of sight, and even frequency. Examples of potential vertical obstructions include communications towers (radio, television, cellular, microwave, etc.), silos, electric transmission towers and lines, and similar manmade structures.

While the presence of vertical obstructions can sometimes be mitigated by altering flight tracks, increasing minimum allowable flight altitudes or similar risk reduction measures, the proliferation of vertical obstructions or their placement along key flight routes can cause long term changes in the viability of navigable airspace, ultimately affecting the sustainability of military missions. The APG Vertical Obstruction MCA is illustrated on Figure 8.

BASH Military Compatibility Area

The APG Bird and Wildlife Strike Hazard (BASH) MCA extends out from nearest air operations area of both the Phillips Army Airfield and the Weide Army Heliport a distance of five statute miles. This MCA is meant to include areas around the airfield with the highest safety concerns if concentrations of birds or bird-attracting uses were located there. Bird strikes with aircraft can have serious safety concerns, including the potential for loss of life and / or aircraft. Even minor bird strikes can cause costly repairs to aircraft and interfere with flight missions. However, helicopters are less likely than most fixed-wing aircraft to suffer major damage from BASH incidents.

The five-mile distance associated with the BASH MCA is an FAA recommended standard for managing bird attractants around runways. Developments like landfills, landfill transfer stations, developments with major water features are just some examples of uses that may attract birds within the approach and departure flight corridors in an around APG. The APG BASH relevancy area MCA is illustrated on Figure 9.

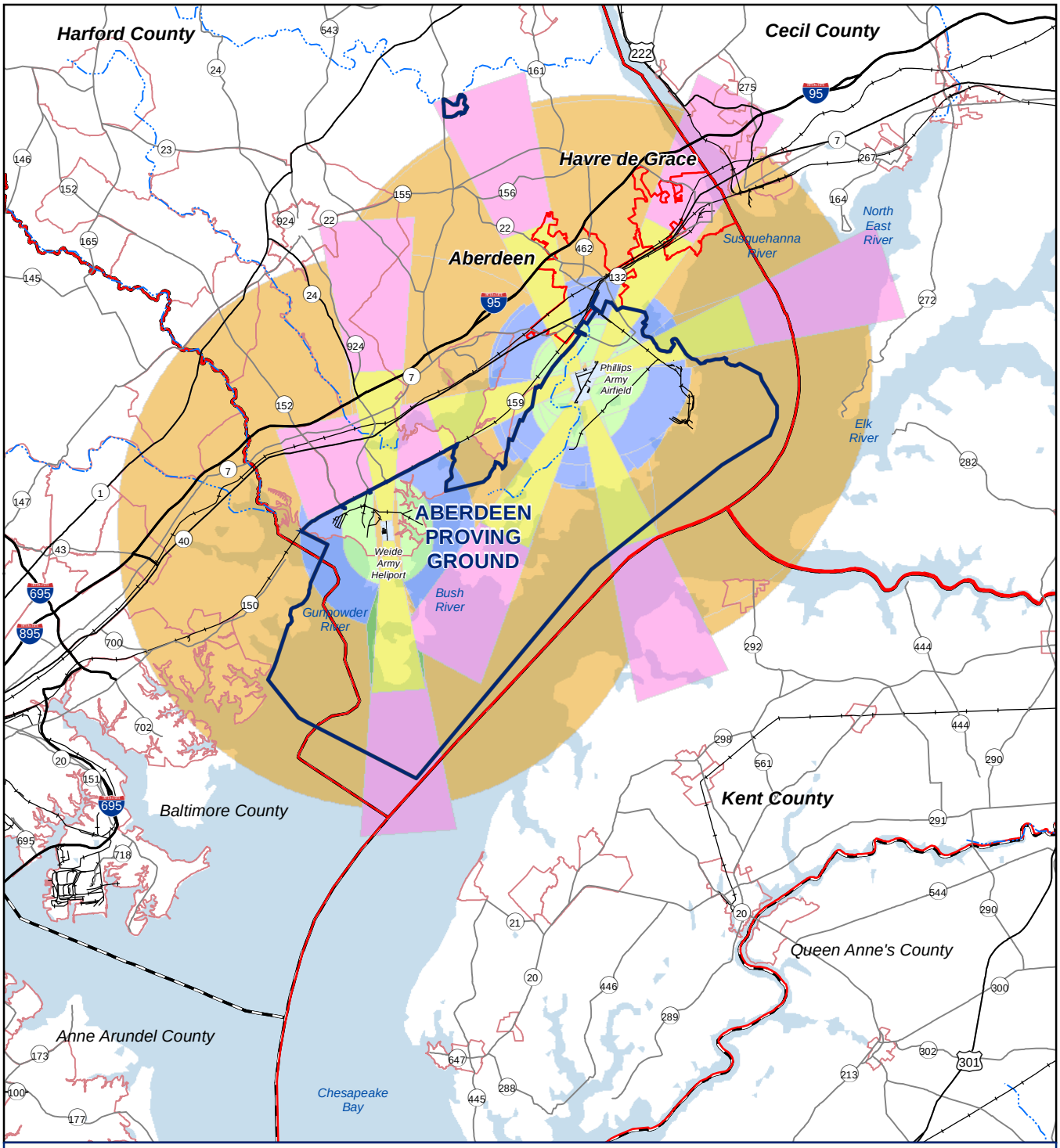
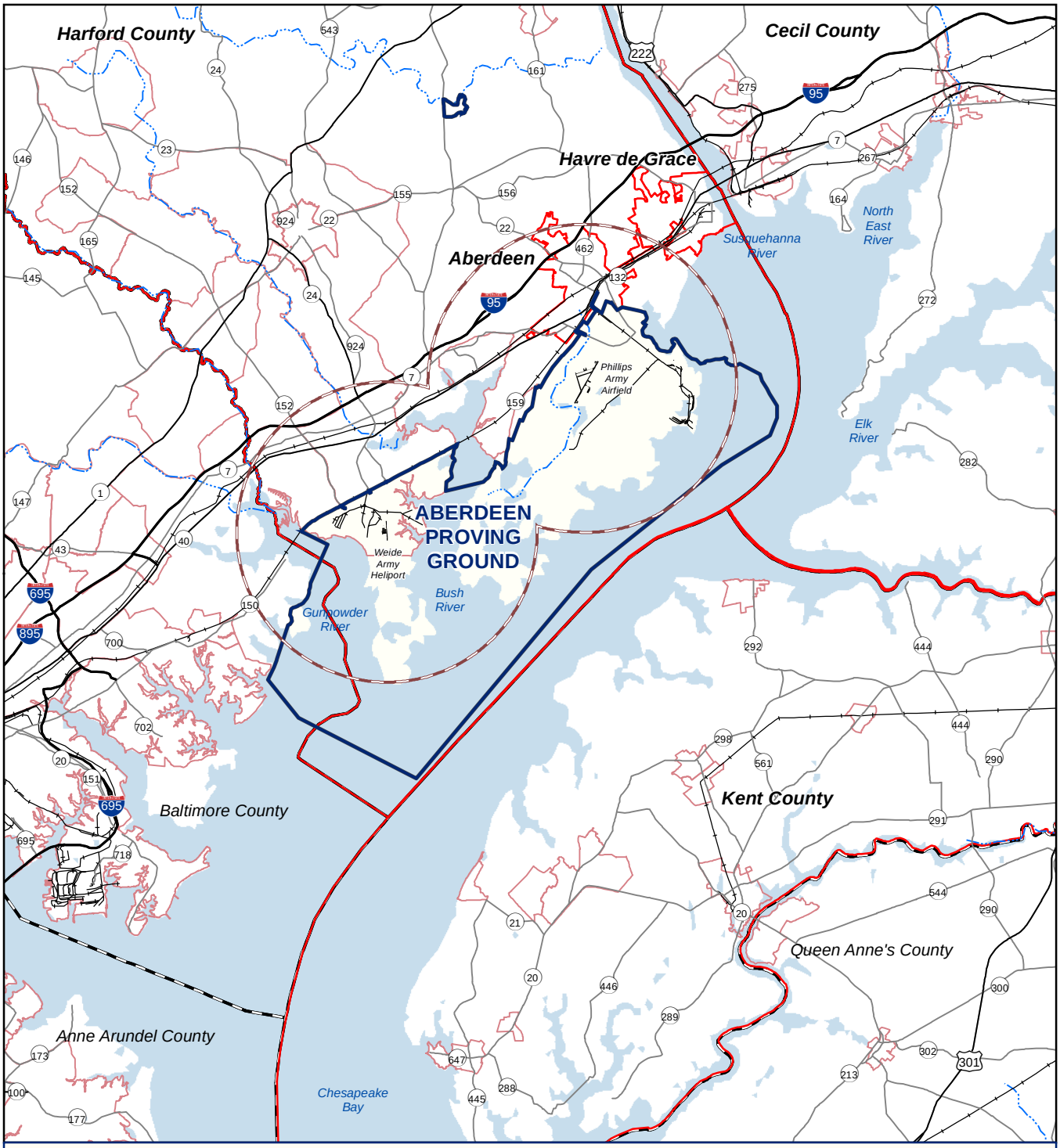


Figure 8
Vertical Obstruction MCA



Source: APG, 2014.

Matrix DESIGN GROUP

0 1 2 Miles

Figure 9
BASH MCA

How to Read the Implementation Plan

The strategies developed are designed to address the issues identified during preparation of the JLUS. The purpose of each strategy is to:

- avoid future actions, operations, or approvals that would cause a compatibility issue,
- eliminate an existing compatibility issue,
- reduce the adversity of an existing issue, and / or
- provide for on-going communications and collaboration.

In an effort to list and describe the strategies in an efficient manner, they have been arranged in a table to correspond with their compatibility factor. The issue within each factor topic is presented first to provide a linkage between the strategy and the condition it is to resolve or minimize. The following paragraphs provide an overview of how to read the information presented for each strategy in the JLUS.

Strategy ID Number. Each strategy is assigned a unique identifier (i.e., COM-1A, COM-1B, COM-1C, etc.) to provide an easy reference. A Strategy ID is composed of the Compatibility Issue to which it applies, i.e. "COM" for Communications / Coordination strategies and a sequential number.

Military Compatibility Area (MCA) / Location. The MCA / location identifies the geographic area applicable to the strategy (i.e., Safety MCA, Noise MCA, etc.). The MCA geographies for the APG strategies are described and illustrated on the previous pages of this JLUS. Some of the strategies are designated as "General" if they do not have a specific associated geography; some are designated as "MCAOD" if they apply to the entire MCAOD for the JLUS Study Area, while others may apply only to APG or a specific jurisdiction.

Strategy. In bold type is a title that describes the strategy. This is followed by the complete strategy description of a recommended action.

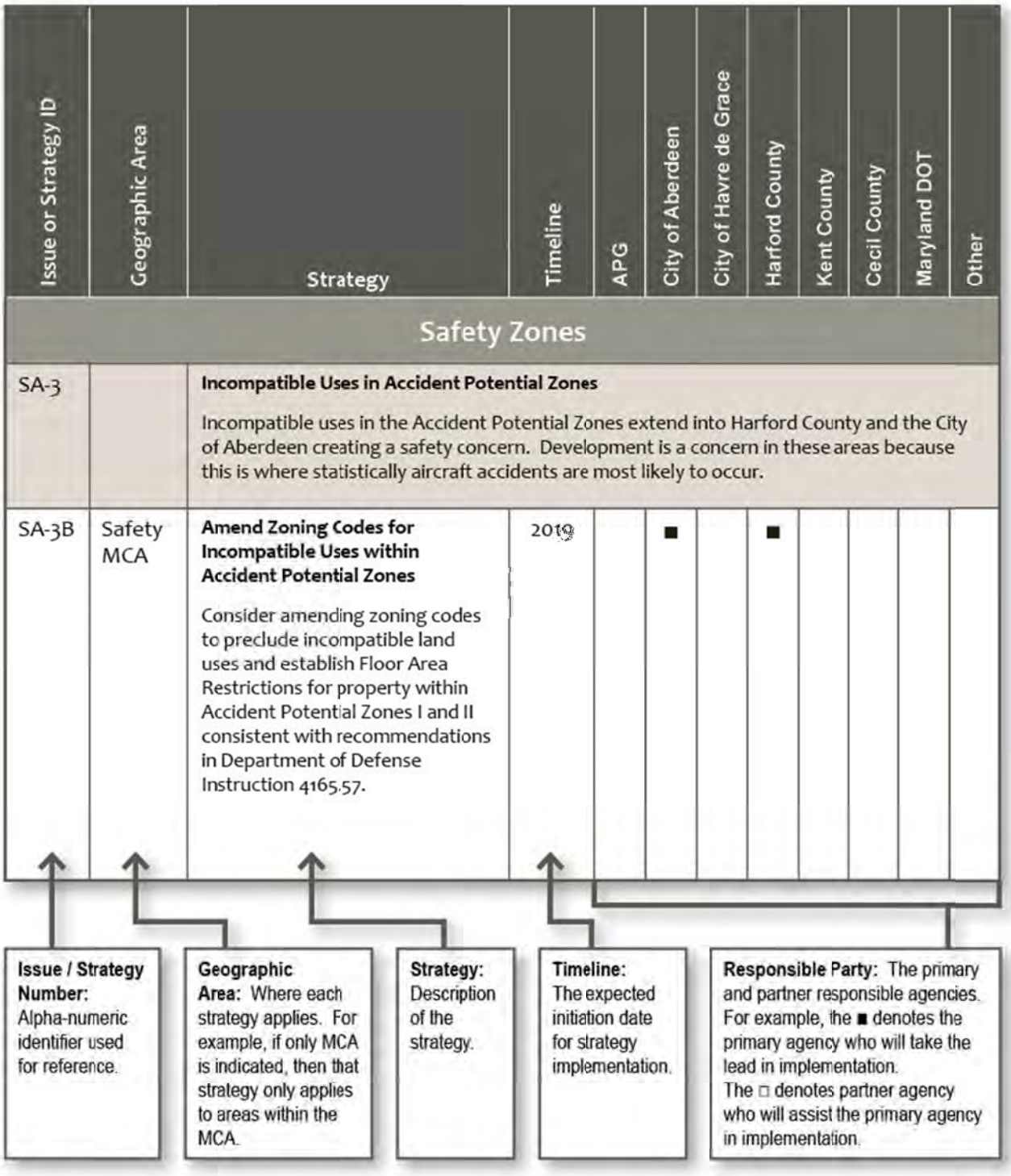
Timeframe / Priority. The timeframe or priority is an estimate of when a strategy is anticipated to be initiated – High [2016]; Medium [2017-2018] and Low [2019 and beyond]). Awareness refers to strategies that will be needed on a continuous, intermittent, or as-needed basis.

Responsible Partner. At the right end of the strategy table are a set of columns, one for each jurisdiction, military entity, agency, and organization with responsibilities relevant to implementation of the JLUS strategies. A column is also assigned as "Other" where parties are only required for select strategies. These parties are identified at the end of the strategy description if they apply.

If an entity has responsibility relative to implementing a strategy, a mark is shown under their name. This mark is one of two symbols that represent their role. A solid square (■) designates that the entity has a primary responsibility for implementing the strategy. A hollow square (□) designates that the entity plays a key supporting role, but is not directly responsible for implementation. The responsible parties are identified by their name or assigned acronym in the heading at the top of the page.

Figure 10 illustrates how to read the Implementation Strategies. The JLUS strategies are presented on the following pages organized alphabetically by compatibility factor.

Figure 10. Strategy Key



Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Coordination / Communication											
COM-1		**Coordination Between APG and Jurisdictions** Coordination between APG and local jurisdictions on area planning and land use issues is informal and inconsistent leading to a lack of information sharing and coordinated evaluation of development impacts. Jurisdictions do not understand APG requirements that affect long-range development plans.									
COM-1A	Study Area	**Establish a JLUS Coordination Committee** Establish a JLUS Coordination Committee to maintain efficient and effective coordination among the JLUS partners and to oversee the implementation of JLUS recommendations. The JLUS Coordination Committee should meet on a regular basis as agreed upon by the Committee and be responsible for establishing effective and timely means of communication for the purpose of coordinating and addressing compatibility concerns and issues. Consider committee membership from the JLUS Executive Committee as well as other community partners as deemed appropriate to maintain continuity and institutional project knowledge. Consider the formation of a technical subcommittee comprising Advisory Committee members to address technical aspects of the JLUS implementation. *Other Partners: Town of Perryville, other members as deemed required*	2016	■	■	■	■	■	■	■	■
COM-1B	Study Area	**Provide Mutual Briefings** To perpetually enhance support and cooperation, and reinforce the partnership between APG and local jurisdictions, APG should annually present a "state of the installation" briefing including strategic goals, operational changes, and proposed construction projects that may impact the greater community to the Study Area county commissions and city councils. The counties and cities should provide annual briefings to APG of changes within the communities that may impact the installation including comprehensive plans, master plans, transportation plans, zoning, development	2016	■	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		projects, and capital improvement plans. *Other Partner: Town of Perryville*									
COM-1C	Study Area	**Conduct Quarterly Planning Coordination Meetings** APG Department of Public Works Planning Division and the planning department heads from Study Area jurisdictions should conduct quarterly meetings to share short and long-term visions and goals including changes in federal agency, DOD and APG policy / guidelines as they apply to development outside the fenceline, real property development at APG, and changes to jurisdiction comprehensive plans, master plans, transportation plans, zoning, development projects, and capital improvement plans. *Other Partner: Town of Perryville*	2016	■	■	■	■	■	■		■
COM-1D	Study Area	**Develop and Maintain a Repository of Requirements Documentation to Inform the Community Planning Decision-Making Process** APG Department of Public Works Planning Division should develop and maintain a repository of non-classified requirements documentation relevant to planning and development outside the fenceline. Requirements documentation may include information related to vertical obstructions, frequency spectrum, energy development, bird and wildlife attractants, etc. The repository should be available to Study Area jurisdictions for consultation to ensure development is compatible with APG mission operations.	2016	■							
COM-2		**Communication of Remediation and Water Improvement Activities** Installation's remediation and water quality improvement efforts are not adequately conveyed to the public.									
COM-2A	General	**Reinstate the Restoration Advisory Board Website** Reinstate and maintain the APG Restoration Advisory Board (RAB) website. Include updates on restoration activities as part of	2016	■							

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		outreach activities to educate the community outside the fenceline and foster community support. Consider leveraging APG social media to disseminate information to the public. Consider leveraging APG social media to maximize communication to the public of RAB activities and remediation status.									
COM-2B	General	Public Communication of Water Quality Improvements Identify public outreach methods to convey status of water quality improvements at APG. Leverage existing APG resources and outreach methods. Consider incorporating water improvement activities as part of the outreach efforts recommended in Strategies COM-5A, COM-5B, and COM-5C.	2016	■							
COM-3		Formal coordination process for Development Notification No formal process to notify APG of development actions outside the fence line.									
COM-3A	Study Area	Include APG in an Advisory Capacity to Local Planning Commissions and Development Advisory Committees Establish a formal agreement between all Study Area jurisdictions and APG to formalize a process that provides copies of certain types of development proposals, rezoning, and other land use or regulation changes for lands located within the APG influence area for review and comment. The agreement should address an effective method that promotes a productive communication and coordination process that can be maintained and reproduced in the future. This supports a proactive approach for identifying potential conflicts early in the proposed development application. Review periods shall conform to existing community processes for providing comment. The process of formalizing Army review and comment should include: ▪ Definition of project types that require review ▪ Definition of project types that require military attendance at pre-application meetings, if applicable Identification of	2016	□	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		the points of contact for all coordination Formal procedures for requesting and receiving comments ▪ Standard timelines for responses consistent with State law and local/county procedures. The Army representative will provide technical information on items being considered, but shall not directly vote to approve, conditionally approve, or deny a project or development application. Procedures should be reviewed annually and updated as appropriate by the JLUS Coordination Committee. *Other Partner: Town of Perryville*									
COM-3B	Study Area	Formalize Development Review Coordination Consider formalizing coordination processes to ensure long-term consistency in information sharing and communication between local jurisdictions and agencies with APG that will also supplement existing coordination requirements in overlay district regulations. Establish a Memorandum of Agreement (MOA) to formalize processes for APG review and comment on development proposals, rezoning applications, other land use or regulation changes or master plans that may pose operational impacts on APG. The MOA should outline an effective process that promotes productive communication and coordination that can be maintained and replicated in the future. The MOA should provide a proactive approach for identifying potential conflicts with the military as early in the development review process as possible. The MOA with APG should include: ▪ Definition of project types that require review ▪ Definition of project types that warrant military participation at development review meetings ▪ Identification of points of contact for all coordination	2016	■	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		▪ Notification procedures for requesting and receiving comments ▪ Timeframes for responses consistent with state law and similar jurisdiction procedures. ▪ Provide notice to APG on all public hearings regarding projects identified for coordination. Procedures should be reviewed annually and updated as appropriate by the JLUS Coordination Committee. *Other Partner: Town of Perryville*									
COM-3C	Study Area	Consider Web-Based Tool for Coordinated Development Reviews Consider implementing a web-based tracking tool for coordinating development reviews with APG using automation through e-mail notifications. The tool could provide a clearinghouse to discuss various project types and a forum for discussion on broader long-term project review, such as comprehensive plan updates, zoning ordinance language, and capital improvement plans for public facilities. Ensure that project uploads include contact information, project location information, a project description, and a deadline for comments.	2016	■	■	■	■	■	■		
COM-4		Base Community Relations Outreach within Study Area APG community relations outreach extends to Harford and Cecil County but does not include Kent County which is informed only through media alerts.									
COM-4A	Cecil County / Kent County	Strengthen Outreach to Eastern Shore Communities APG should develop and implement a plan to strengthen outreach efforts and coordination with the Eastern Shore communities in Cecil and Kent counties to educate the public and garner support for APG. Outreach should include press releases, notification of events, education, and operational changes and anomalies outside of normal procedures that may impact the Eastern Shore communities. Outreach should employ community meetings, area newspapers, television, radio,	2019	■				□	□		

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		jurisdiction websites, social media, and other outreach methods as employed with Harford County.									
COM-5		**Communication of Aberdeen Proving Ground Activities with Outside Communities** Public's nominal mission understanding affects community support for APG.									
COM-5A	Study Area	**Develop an Outreach Campaign Plan** Develop an Outreach Campaign Plan to identify public outreach goals and action items, metrics and milestones for activities, and responsible parties for conducting outreach activities. Goals should support a range of activities including public appearances, speaking engagements, educational seminars, open houses, media engagements, exhibits, press and news release and publication development/distribution that reinforces the community understanding of APG, enhances its strategic value within the community, and strengthens the community support base. The Public Outreach Campaign Plan should address current issues, concerns, and potential changes at APG. Consideration should be given to a broad mix of outreach channels including in person, print, video, and digital tools such as websites, social media, and podcasts and support from area jurisdictions and organizations. *Other Partner: CSSC*	2019	■	☐	☐	☐	☐	☐		☐
COM-5B	Study Area	**Establish an APG Public Outreach Program** APG should create an outreach plan to share information with the community. The public outreach program should describe outreach activities to include possible installation tours / open houses, development of informational brochures to be mailed to neighbors and posted on the APG website, a single location identifying public relations points of contact for APG, and making contact information widely available. It should also include a military and community communication protocol directory that identifies the different	2019	■							

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		level of communication channels between the appointed and elected officials, to staff, to the general public and APG.									
COM-5C	Study Area	Conduct a Good Neighbor Program APG should conduct, on a bi-annual basis, a Good Neighbor Program where they send out letters to property owners within the region inviting them to an APG Open Forum. The purpose of the meeting will be to allow for an open exchange of information to maintain transparent communication and provide a platform for APG to inform neighbors and interested citizens of any upcoming mission changes or operations and maintenance events that may have an impact on the neighbors and whereby the adjacent property owners can provide input and pose questions to Army representatives. The open houses would be held in rotating locations on or near APG and within the region on a semi-annual basis and require participation by each local jurisdiction. *Other Partner: CSSC*	2019	■	☐	☐	☐	☐	☐		☐
COM-5D	Study Area	Make APG Points of Contact More Widely Known Advertise and increase awareness of APG Public Affairs Office and other contact numbers for all community complaints and inquiries. Communication procedures, including methods for providing input, posing inquiries, and expected response time should be made publicly available through the APG and local jurisdiction websites, social media sources, and posted in public facilities such as community centers, municipal buildings, and local newsletters. *Other Partner: CSSC*	2019	■	☐	☐	☐	☐	☐		☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
COM-6		Communication from APG with Outside Community Because communications are not formalized, the level of APG communication with outside jurisdictions is perceived as dependent on leadership interest which can fluctuate with changes in leadership.									
COM-6A	Study Area	Expand Communication Efforts with All Jurisdictions within the Study Area Update jurisdictions' and regional planning organizations websites to recognize APG, its mission, location, links to the APG webpage, contact information for key organizations, and relevant installation activities potentially affecting the communities. *Other Partner: CSSC*	2019	■	☐	☐	☐	☐	☐		☐
COM-6B	Study Area	Increase Awareness through APG News Publication Increase circulation of the APG News at public locations throughout the Study Area and publish distribution locations on the APG website.	2019	■							
		For other strategies that address this issue see Strategies COM-1B, COM-1C, and COM-3A.									
COM-7		Coordination on Multi-Jurisdictional Infrastructure Improvements Coordinate multijurisdictional infrastructure improvements to ensure all jurisdictions are notified and can plan appropriately for impacts in affected areas. This will help avoid previous scenarios where intersection improvements were not fully coordinated across jurisdictions and resulted in relocation of water lines and regulatory takings of homes in roadway widening areas.									
COM-7A	Study Area	Regional Infrastructure Technical Working Group Consider the formation of a regional Infrastructure Technical Working Group comprising subject matter experts to collaborate, share information, and coordinate during the planning, programming, design, and construction of multi-jurisdictional infrastructure projects. *Other Partners: Town of Perryville, Maryland DOT, CSSC, BMC, WILMAPCO*	2019	■	■	■	■		■	■	■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
COM-7B	Cities of Aberdeen and Havre de Grace	**Participation on Baltimore Regional Transportation Board** Request participation on the Baltimore Regional Transportation Board, which functions as the Metropolitan Planning Organization serving Harford County, to ensure that MPO mission of providing comprehensive, coordinated and continuous ("3C") transportation planning is inclusive of the cities of Aberdeen, Havre de Grace during all project phases to provide the cities with a shared awareness of planned and programmed improvements surrounding APG and to appropriately coordinate and budget for impacts. *Other Partner: Baltimore Regional Transportation Board (BRTB)*	2019		■	■			■		□
COM-8		**Engagement from Aberdeen Proving Ground on Area Planning Issues** Installation planners attend local jurisdiction planning meetings but lack of active participation is perceived as indifference.									
		For strategies that address this issue see Strategies COM-1C and COM-3A.									
COM-9		**Security Issues Not Communicated to Outside Law Enforcement** Harford County Sherriff is not regularly informed about events that happen on the installation that affect the outside community.									
COM-9A	Study Area	**Establish and Formalize Coordination Procedures and Protocols** Establish an MOA to formalize procedures, protocols, and points of contact for the coordinated and timely dissemination of security and safety information reciprocally between APG and Study Area law enforcement offices and departments that affect areas outside and inside the fenceline. Ensure that all MOA's are current and updated. *Other Partner: CSSC*	2019	■	■	■	■	■	■		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
COM-10		**Complaint Documentation Process to Aberdeen Proving Ground** Notifying APG and documenting noise and vibration complaints, particularly when there is private property damage, is perceived as onerous to homeowners.									
COM-10A	Study Area	**Consolidate Information on Damage Claims Process** Preparation and development of a fact sheet on the damage claims process can be provided upon request to homeowners if they believe damage from vibration caused by mission activities has occurred. The fact sheet should include where to locate and submit claim forms, points of contact for the process, and what to expect during the claims review process.	2019	■							
COM-11		**Coordination on Regional Energy Conservation Efforts** Need for coordinated effort on regional energy conservation efforts to ensure that solutions from all parties are considered. Providing an inclusive process that considers solutions from multiple sources will ensure the best outcomes for all regional stakeholders. This will alleviate organizations potentially working at cross-purposes such as with the waste-to-energy plant where the decision to potentially reuse or demolish the facility was made after significant investment and without the transparent exploration of alternatives.									
		For a strategy that addresses this issue see Strategy COM-7A.									
COM-12		**Coordination on Public-Private Partnerships** Need for coordination between APG and surrounding jurisdictions on Public-Private Partnerships, such as housing and Enhanced Use Leasing that may impact areas outside APG to balance the viability of communities while addressing the ongoing needs of APG.									
		For a strategy that addresses this issue see Strategy COM-1C.									
COM-13		**Communication and Coordination to reduce Wildlife Hazards** Communication and coordination between various agencies is required to manage bird populations and control the size of the deer herd in the Aberdeen Area and Edgewood Areas to reduce the potential for negatively affecting military activities including aircraft strikes.									
COM-13A	Study Area	**Educate the Public Surrounding APG about Wildlife Hazards** Provide enhanced public awareness and educational programs and brochures to improve the public awareness and understanding of the hazards of bird attractants and wildlife habitats on the activities at APG including aviation operations to enhance interagency management. Coordinate the education process with area	2021	□	□	□	□	□	□		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		agencies to incorporate as part of their outreach. Include this information on agency, jurisdiction and APG websites, and include as part of the Public Outreach Program in COM-5B. *Other Partners: Maryland Department of Planning and Maryland Department of Natural Resources*									
Dust / Smoke / Steam											
DSS-1		Dust Generation from Testing Activities Military activities at the Automotive Test Areas and Churchville Test Area can create fugitive dust impacts outside the test sites.									
DSS-1A	Harford County / City of Aberdeen	Pursue Acquisition and Easements through ACUB Program Identify priority property outside APG subject to the potential for fugitive dust impacts from test facilities and incorporate in ACUB program for either fee simple acquisition or the acquisition of easements. *Other Partners: Harford Land Trust*	2021	■	■		■				☐
DSS-1B	City of Aberdeen / Harford County	Ensure Community Activities such as Construction, Prescribed Burns and Industrial Processes Employ Best Management Practices Ensure regulations require best management practices and enforcement mechanisms to control fugitive dust, smoke, and steam impacts that may migrate onto APG and impact operations.	2021		■		■				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Frequency Spectrum Capacity											
FSC-1		**Comprehensive Frequency Management Program** Need for a comprehensive Frequency Management Program to assess current and future frequency needs of all APG tenants inside and outside the fence line to deconflict frequency requirements.									
FSC-1A	APG	**Develop a Comprehensive Frequency Management Program** Develop and implement a Comprehensive Frequency Management Program for all tenants at APG to establish a spectrum planning process that ensures the current and future availability of spectrum and procedures for deconflicting future spectrum needs.	2019	■							
Frequency Spectrum Impedance / Interference											
FSI-1		**No Coordinated Assessment of Hazards Associated with Frequency Use** Though there is informal coordination between CERDEC, other tenants, and APG to deconflict frequency use during CERDEC ground-to-satellite tests, there is no plan to coordinate and assess near-zone and far-zone hazards associated with ground-to-satellite tests.									
FSI-1A	APG	**Develop a Plan to Formalize Assessment and Mitigation of Frequency Hazards** Develop and implement a Frequency Hazard Mitigation Plan to coordinate, assess, and establish mitigation procedures for potential near-zone and far-zone hazards associated with ground-to-satellite tests that may impact other APG tenant operations, APG personnel, and activities outside the fenceline.	2019	■							
FSI-2		**Potential for Ground-Based Interference** Line-of-sight signal transmission between Aberdeen Area and Churchville Test Area can be impacted from potential signal interference.									
FSI-2A	City of Aberdeen / Harford County	**Establish Procedures to Avoid Frequency Conflicts** The City of Aberdeen and Harford County should coordinate with APG on review of projects with frequency requirements that could impact communications off-installation. The criteria that triggers coordination includes: ▪ proximity to APG ▪ tower height	2019	■	□		□				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		▪ power emission from tower sources ▪ high output transmission devices									
FSI-2B	City of Aberdeen / Harford County	Pursue Acquisition and Easements through ACUB Program Identify priority property outside APG within the line-of-sight requirement and incorporate in ACUB program for either fee simple acquisition or the acquisition of easements. *Other Partners: Harford Land Trust*	2019	■	■		■				☐
FSI-3		Potential to Disrupt Aircraft Navigational Systems Coordination of signal transmission frequency testing and angle of transmission with area aircraft is required to ensure that potential disruption to aircraft navigational systems does not occur.									
		For a strategy that addresses this issue see Strategy FSI-1A.									
FSI-4		Potential for Harford Metropolitan Area Network to Impact APG Harford County is pursuing the Harford Metropolitan Area Network (HMAN) project for high speed fiber optic transmission for the County, the municipalities of Havre de Grace, Bel Air and Aberdeen, and businesses throughout the county. Though current phases include only hardwiring, any proposed Wi-Fi in the future may create a radiating signal bloom that could potentially impact APG frequency testing.									
FSI-4A	City of Aberdeen / City of Havre de Grace / Harford County	Coordinate on Harford County Long-Term IT Infrastructure Planning Include the ongoing coordination for the HMAN long-term IT infrastructure project including any pre-planning for future wireless requirements throughout the service area as part of the coordination in Strategies COM-1B, COM-1C, and COM-3A.	2019	■	☐	☐	■				
FSI-5		Radio Frequency Interference Affects Emergency Services Communications Jurisdictions on both sides of Chesapeake Bay have experienced EMS radio system outages from unknown sources speculated to come from APG.									
FSI-5A	Study Area	Formalize Communication Procedures Identify and convene a coalition of spectrum stakeholders to discuss use of frequencies and notification procedures for mitigating and troubleshooting possible service interruptions. *Other Partner: CSSC*	2019	■	☐	☐	☐	☐	☐		☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
FSI-6		**APG Electronic Warfare Footprint** Concern that electronic warfare footprint associated with APG research and testing activities can spill-over into adjacent jurisdictions. Land uses that occur outside of APG that rely on wireless signals could have the potential to impact activities at APG.									
FSI-6A	Study Area	**Ensure Compatible Frequencies** The Federal Communications Commission is the government entity responsible for managing frequency usage. The military is assigned certain frequencies to use that generally do not interfere with civilian uses. The continued usage of only assigned frequencies should ensure no interference between military and civilian uses. *Other Partner: Federal Communications Commission*	2019	■	☐	☐	☐	☐	☐		☐
FSI-6B	City of Aberdeen / City of Havre de Grace / Harford County	**Employ RF Spectrum Analysis Technology** Employ "RF spectrum analyzer" technologies used to detect interference between frequency bands. Identify interference from on- and off-installation sources including military and public/commercial users.	2019	■							
FSI-7		**Coordination with Broadband Providers** Lack of coordination between broadband providers and APG can result in signal interference from use of bi-directional amplifiers outside the fenceline.									
FSI-7A	City of Aberdeen / City of Havre de Grace / Harford County	**Develop an Educational Outreach Program with Broadband Providers to Ensure They are Aware of APG Frequency Requirements** APG should work with broadband providers to ensure that providers are aware of the installation frequency requirements when planning wireless broadband transmission facilities to deconflict and prevent future interference with required installation frequencies. *Other Partner: Local Broadband providers*	2019	■							☐
FSI-7B	General	**Develop Outreach Materials** Work with affected jurisdictions to develop public outreach materials including website updates and public service announcements to	2019	■	☐	☐	☐	☐	☐		☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		inform the public about the potential for interruption of cellular service and GPS devices within areas associated with APG testing. *Other Partner: CSSC*									
FSI-7C	City of Aberdeen / City of Havre de Grace / Harford County	Establish Procedures to Avoid Frequency Conflicts / Issues Identify telecommunications projects that should be referred to the military for review and communicate this information to jurisdictions. The criteria that triggers coordination includes tower height, proximity to APG, power emission from tower sources, and high output transmission devices. Coordinate with jurisdictions on RF projects that could impact off-installation communications. *Other Partners: Federal Communications Commission*	2019	☐	■	■	■				☐
FSI-7D	APG	Adjust Frequency Usage Evaluate the feasibility of adjusting frequency usage to utilize different frequencies that would not interfere with, or be impacted by, bi-directional amplifiers.	2019	■							
FSI-8		Marine Frequency on Range Potential for signal interference with waterfront lanes / marine frequencies on range.									
		For strategies that addresses this issue see Strategies FSI-5A and FSI-6A.									
Housing Availability											
HA-1		Urban Environments Urban city environments such as Baltimore City provide amenities and lifestyle attractive to young professionals. These urban environments are unavailable proximate to APG. APG personnel choosing to reside in an urban environment will have a longer commute adding to regional roadway congestion. The lack of urban environments proximate to APG may put the installation at a disadvantage for attracting younger job seekers.									
HA-1A	City of Aberdeen	Implement Transit Oriented Development Master Plan Continue implementation of Master Plan for the Transit Oriented (TOD) development in downtown Aberdeen including strategies and coordinated funding.	2016/On-going		■						

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
HA-1B	City of Aberdeen	Coordinate Aberdeen TOD Development with APG Coordinate the development of the TOD with APG to leverage opportunities and synergies to support the APG workforce.	2016	☐	■						
HA-1C	Harford County	Master Plan for Transit Oriented Development in Edgewood Develop a Master Plan for Edgewood that creates a pedestrian-oriented live / work / play community leveraging local and regional transportation connections incorporating the MARC Station. Conduct a market analysis to determine the optimum mix of housing types, commercial opportunities and amenities to attract a diverse workforce and support area growth into the future. *Other Partner: Harford County Office of Economic Development*	2016	■			■				☐
HA-1D	Harford County	Edgewood Community Area Plan Amend the Harford County Land Use Element Plan and Edgewood Community Area Plan to recognize the development of TOD for Edgewood. Develop specific regulations that support and incentivize its development. Identify and evaluate partnership opportunities with APG for (P4) Private-Public Public-Public development to catalyze investment and buildout.	2019	☐			■				
HA-1E	Harford County	Incorporate Infrastructure Improvements in Harford County Capital Improvements Plan to facilitate Edgewood Transit Oriented Development Identify and program necessary infrastructure projects in the Harford County Capital Improvements Plan to facilitate the creation and development of Edgewood TOD.	2019				■				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Infrastructure Extensions											
IE-1		**Water provision to APG Edgewood Area** The current service agreement with Harford County for water provision to the Edgewood Area is a non-binding short-term temporary solution for Winters Run Creek production deficiencies. Long-term solutions for Edgewood water will require new infrastructure.									
IE-1A	APG	**Master Plan for Long-Term Infrastructure Improvements for Potable Water Provision to Edgewood Area** Develop a Master Plan including assessment of existing conditions; quantified supply and future demand based on anticipated need; defined courses of action for supply including a reliable source of water and any conservation and reuse measures; and funding for infrastructure improvements to achieve the safe and reliable provision of water to the Edgewood Area without relying on temporary sources. Consider as options: ▪ A long-term service agreement with Harford County ▪ Provision from the Aberdeen Area by way of Harford County infrastructure (connection fees which support capital construction of the County system to provide the water and capital construction by the Army to enhance the connection to the county system would be required) ▪ Provision form the Aberdeen Area entirely within the jurisdiction of APG to reduce all reliance on external infrastructure and safeguard the potable water supply. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland Department of the Environment, Maryland Department of Natural Resources, Harford County*	2016	■			☐				☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
IE-1B	APG	**Plan and Coordinate for the Implementation of Infrastructure Improvements to Achieve a Safe and Reliable Potable Water Supply to the Edgewood Area** Develop a coordinated Implementation Plan to execute the Water Provision Master Plan in Strategy IE-1A. Include measurable milestones, Capital Improvement Plan projects, dedicated funding sources, and multijurisdictional / multiagency coordination. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland Department of the Environment, Maryland Department of Natural Resources*	2017	■							☐
IE-1C	APG	**Implement Water Reduction Projects** Implement programmed projects to reduce potable water usage in the Edgewood Area through the beneficial reuse of treated groundwater for non-potable uses.	2016	■							
IE-2		**Coordination of Easements on APG Property** There is utility infrastructure traversing APG property without a formal agreement with APG at the Churchville Test Area. Formal easements are necessary to know which agency requires maintenance access, to coordinate access when needed, and to prevent potential liability issues.									
IE-2A	Churchville Test Area	**Research Undocumented Utilities and Execute any Necessary Access Easements with Respective Utility Companies** Confirm with APG DPW Master Planning Real Estate Branch whether active easement instruments are located at the Churchville Test Area. Research historical real property instruments to identify whether utilities are present. Consider employing Miss Utility to identify subsurface utilities onsite. Execute easement instruments with any utility than runs through the property not having an easement agreement with APG. *Other Partners: Miss Utility, utility providers*	2019	■							☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Land / Air / Sea Space											
LAS-1		**JLENS Program** Public perception that the JLENS program could impact rights to privacy.									
LAS-1A	Study Area	**Develop a JLENS Educational Program** Create an informational brochure and/ or packet to distribute to the public in surrounding communities about the nature of the JLENS program, reinforcing the public safety benefit. Incorporate the brochure into public outreach efforts in Strategies COM-5B and COM-6A.	Aware-ness	■							
Land Use											
LU-1		**Incompatible Land Development** More intense land development throughout the Study Area has the potential to inhibit mission-critical activities at APG.									
LU-1A	MCAOD	**Define and Establish Military Compatibility Areas (MCAs)** Create a Military Compatibility Area Overlay District (MCAOD) containing Military Compatibility Areas (MCAs) that reflect the types and intensity of compatible uses. The MCAOD is the collective geographic area of all of the MCAs combined. The MCAs established should be used by local jurisdictions to identify areas where specific compatibility issues are more likely to occur and address ways to avoid compatibility issues. The MCA's should include: **Safety MCA** - Includes the Accident Potential Zones (APZs) I and II. **Noise MCA** - Includes areas within the averaged 57 dB CDNL noise zone and 115 dB PK15 (met) and 130 dB PK15 (met) impulse noise zones. **Vertical Obstruction MCA** – Based on the DOD imaginary surfaces map, horizontal area which limits development of buildings and structures. **BASH MCA** – 5-mile radius from the center of the airfield at Phillips Army Airfield and the	2017	□	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Weide Army Heliport. Where appropriate, the jurisdictions should incorporate the MCAOD and MCA boundaries on their zoning map and future land use maps and include the zones on their websites for easy access and understanding by the public. *Other Partner: Town of Perryville*									
LU-1B	Noise MCA	Continue to Pursue Properties for ACUB Program and Seek Partnership Opportunities Continue to pursue property in Priority Areas identified in the ACUB Program for fee simple acquisition and conservation easements to meet multipurpose goals including noise compatibility and environmental stewardship. *Other Partners: Harford Land Trust, Cecil Land Trust, The Eastern Shore Land Conservancy, Maryland Agricultural Land Preservation Foundation*	2016	■							■
LU-1C	MCAOD	Incorporate Compatibility Planning Concepts into CIPs / Infrastructure Master Plans. Incorporate compatibility planning concepts into CIPs / Infrastructure Master Plans for infrastructure extensions and improvements. Avoid extension of infrastructure service within APG area of influence for rezoning applications, except to serve approved community / area plans or commercial and industrial development which provides a compatible land use pattern.	2019		■	■	■	■	■	□	
LU-2		Real Estate Disclosures Inconsistent Across Jurisdictions Inconsistent application of real estate disclosures results in patchwork of new home buyer knowledge of installation impacts on properties.									
		For strategies that address this issue see Strategies NOI-1F and NOI-1G.									
LU-3		Potential for New Mission Footprints Constrained by Environmental Conditions Buffers for wetlands, wildlife, eagle nesting and other natural resources potentially reduce developable land for additional missions at Aberdeen Area.									
LU-3A	APG	Developable Areas Plan Produce a Developable Areas Plan that provides an overview of all constraints - bird /	2021	■							

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		wildlife habitat areas, environmental, wetlands and shoreline buffers, an assessment of changes / trends in those areas, and mitigation measures to manage birds / wildlife including ongoing adaptive management. The Plan should identify remaining developable areas unencumbered by all constraints at APG and include facility demolitions to provide a comprehensive examination of areas to support additional future missions and mission growth. Enhance the existing "Red, Yellow, Green" Map for areas suitable for development, suitable for development with mitigation (on- or off-site), and areas where development is inappropriate. Actively seek input from APG tenants in the Plan development to incorporate programmed facilities, future mission changes, and geographic areas where tenant synergies can be leveraged towards future facilities.									
LU-4		**Properties Present Possible Encroachments** Real estate easement instruments for properties with noise monitoring equipment on the Western and Eastern Shore do not contain legal descriptions resulting in access that may be outside the easements.									
LU-4A	Study Area	**Review and Revise Easements for Noise Monitoring Equipment** Review and revise access easements for private properties with noise monitoring equipment where metes and bounds legal descriptions are not delineated on the real estate instruments. Consider conducting field surveys to identify locations of access easements to prevent potential encroachments.	2021	■							
LU-5		**Identification of Encroachment Buffers** Encroachment buffers around APG are not identified on City and County planning documents									
		For a strategy that address this issue see Strategy LU-1A.									

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
LU-6		**Environmental Regulatory Impacts** Federal and state environmental regulations reduce the APG buildable footprint and ability to accommodate new missions.									
LU-6A	Study Area	**Comprehensive Planning for Development** Develop a comprehensive plan that assesses the impacts of federal and state environmental regulations on the operations at APG and considers mitigation alternatives to address ongoing mission needs. Identify potential on- and off-site mitigation strategies and techniques. *Other Partners: Maryland Department of the Environment, US Environmental Protection Agency, US Army Corps of Engineers*	2019	■			■	■			☐
		For another strategy that address this issue see Strategy LU-3A.									
Marine Environments / Climate Change											
MEC-1		**Dredging Requests to Aberdeen Proving Ground** The Port of Baltimore has engaged APG over the last couple of decades about receiving dredging spoils. Though APG is not currently a designated receiver site in the Army Corps of Engineers Dredged Material Management Plan, the placement of clean dredge spoils along the shoreline could be used to combat potential sea-level rise.									
MEC-1A	APG	**Assess the Viability of Receiving Dredging Spoils** Evaluate the viability of receiving clean dredging spoils at APG shoreline areas as part of a long-term strategy for mitigating sea-level rise. If determined favorable, coordinate with state and federal agencies to include APG as a receiver site for clean dredging spoils from the Port of Baltimore as part of the Dredged Material Management Plan, from areas along the Susquehanna River upstream of the Conowingo Dam, and from the Chesapeake and Delaware Canal. *Other Partners: Maryland Department of the Environment, US Environmental Protection Agency, US Army Corps of Engineers*	2021	■							☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
MEC-2		**Long-Term Plan for Environmental Impacts from Climate Change** Sea level rise studies indicate that portions of APG may be underwater as early as 2050 necessitating a long-term mitigation plan for APG.									
MEC-2A	APG	**Develop Long-Range Plan for Sea-Level Rise** Develop a long-range strategic plan for mitigating upland impacts of sea-level rise and shoreline erosion at APG. Incorporate updated analysis and quantifiable impacts of projected real property loss by APG area on mission capability and capacity, and identify strategies to mitigate impacts.	2021	■							
MEC-2B	City of Aberdeen / City of Havre de Grace / Harford County	**Quantify Regional Sea-Level Rise and Consider Adoption of Sea-Level Rise Ordinance** Conduct a study to quantify the regional impacts of development on sea-level rise and consider adoption of a sea-level rise ordinance to address any cumulative regional impacts including those experienced at APG. The ordinance may contain revisions to existing floodplain ordinances to allow tailored regulations for high-risk areas including more resilient development within high-risk areas and directing development away from vulnerable areas to preserve valuable coastal resources and strategic assets. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland Department of the Environment, Maryland Department of Natural Resources, Clean Chesapeake Coalition*	2021	□	■	■	■				□
		For another strategy that addresses this issue see Strategy MEC-1A.									
MEC-3		**Conowingo Dam Impacts Aberdeen Proving Ground** When Conowingo Dam floodgates are open, debris, sediment, and flooding occur along Spesutie Island.									
MEC-3A	Harford County / Cecil County	**Reduce Upstream Sediment Load Flowing Into the Susquehanna River** Consider land use regulations that reduce the sediment load from discharging into the Susquehanna River. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland*	2019				■		■		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Department of the Environment, Maryland Department of Natural Resources, Clean Chesapeake Coalition									
MEC-3B	APG / Havre de Grace	**Work with the Army Corps of Engineers** Educate the Army Corps of Engineers on the downstream impacts of opening the Conowingo Dam floodgates on APG operations to ensure that solutions being considered by the Army Corps of Engineers in their ongoing study of sedimentation control minimize impacts on APG operations and shoreline / basin areas near Havre de Grace. *Other Partner: Army Corps of Engineers Baltimore District, Town of Perryville*	2016	■		☐					☐
		For another strategy that addresses this issue see Strategy MEC-1A.									
MEC-4		**Disposal of Dredged Material Destined for Cecil County and Associated Risk from Unexploded Ordnance** Concern that dredging spoil disposed of in Cecil County may carry risks of unexploded ordnance. Consideration that these spoils could be used for shoreline stabilization at APG to combat sea-level rise.									
		For a strategy that addresses this issue see Strategy MEC-1A.									
Noise											
NOI-1		**Noise from Installation Activity** Noise from activities at APG has the potential to affect sensitive noise receptors in surrounding communities.									
NOI-1A	Noise MCA	**Increase Public Understanding of Noise Sources** Increase community awareness of flight schedules and military testing and evaluation operations throughout the entire APG area of influence through the use of local media sources, newsletters, brochures, and annual outreach functions hosted by APG in cooperation with each Study Area jurisdiction. Include information that there are other noise generating uses such as quarries within the Study Area.	2021	■	☐	☐	☐	☐	☐		

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
NOI-1B	Noise MCA	**Seek Assistance from APG to Incorporate Maps and Updates to Planning Documents to Minimize Noise Concerns Among Residents** Based on additional noise data and input from APG, consider revisions to communities' comprehensive plans to define areas that may be suitable for future real estate disclosure, sound attenuation or other measures to mitigate impacts from military operations. *Other Partners: Town of Perryville*	2019	☐	■	■	■	■	■		■
NOI-1C	Noise MCA	**Educational Materials on Sound Attenuation Methods** Use DOD or FAA sound attenuation educational materials as a supplemental educational document, describing techniques to reduce indoor vibration associated with impulse noise. Local jurisdictions should make use of already available technical support materials from the Federal Aviation Administration and Department of Defense.	2021		■	■	■	■	■		
NOI-1D	Noise MCA	**Require Noise Easements** Require noise easements for properties within the Noise MCA that notify property owners of the nearby noise and vibration associated with APG operations. These easements allow for these impacts with no liability on the jurisdictions where the noise impacts occur or on the organization generating the noise impacts.	2021		■	■	■	■	■		
NOI-1E	Noise MCA	**Adopt Real Estate Disclosure Amendment that Notifies Potential Buyers of Property within Noise Zones that Property is Located in a Host Community of APG and Subject to Operational Impacts including Noise from Overflight and Range Activities** Develop a Military Compatibility Real Estate Disclosure to provide appropriate information about missions and operations at APG. The disclosure should be provided at the earliest possible point in the interaction between realtor / real estate agent and / or owner and	2019	■	☐	☐	☐	☐	☐		☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		buyer or renter and required during title transfers. The disclosure should specify that a property is located near an active military installation and may be subject to aircraft overflight and range activities generating noise, vibration and other related impacts associated with military testing, training and readiness. ▪ Work with Maryland Association of Realtors and local real estate representatives to develop and implement adequate language for inclusion in disclosure notices ▪ Include language in the real estate disclosure that property located in Accident Potential Zone (APZ) I are not eligible for government-backed loans ▪ Introduce legislation requiring military compatibility real estate disclosures for jurisdictions. ▪ Work with the Maryland Real Estate Commission, Maryland Association of Realtors, and local realtors to ensure compliance with notification requirements. *Other Partners: Town of Perryville, Maryland Real Estate Commission, Maryland Association of Realtors*									
NOI-1F	Noise MCA	Develop Information to Facilitate Accurate Disclosures Provide current and adequate information to facilitate informed decisions by jurisdictions, developers and interested citizens relative to a property's location proximate to the APG area of influence. Include an information packet that provides information on applicable regulations that govern development within the APG area of influence. *Other Partners: Town of Perryville, Maryland Real Estate Commission, Maryland Association of Realtors*	2019	☐	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
NOI-1G	Noise MCA	**Develop a Memorandum of Understanding (MOU) with School Districts** APG should develop a MOU with the surrounding school districts to coordinate on all future school master plans to prevent schools from being planned in noise sensitive areas. *Other Partners: School Districts*	2019	■	☐	☐	☐	☐	☐		■
		For other strategies that address this issue see Strategies LU-1B, LU-2A, LU-2B, and LU-5A.									
NOI-2		**Regional Noise Sources** There are other sources of blasting than APG within the region which can be misattributed to APG testing.									
		For other strategies that addresses this issue see Strategies NOI-1A.									
NOI-3		**Overflight of the City of Havre de Grace** APG overflight of the City of Havre de Grace creates general noise nuisance.									
NOI-3A	City of Aberdeen / City of Havre de Grace / Harford County	**Consider Developing an Airfield Awareness Program** Consider developing an Airfield Awareness Program targeted to the landowners and homeowners to educate and increase awareness of the effects of aircraft operations at Phillips Army Airfield and Weide Army Heliport. Distribute as part of public outreach efforts in Strategies COM-5B and COM-5C, and post on the APG website.	2017	■	☐	☐	☐				
		For other strategies that addresses this issue see Strategies NOI-1A, NOI-1B, NOI-1C, and NOI-1D.									
Roadway Capacity											
RC-1		**Peak Hour Traffic (Traffic Loads at Gates)** Peak hour traffic including a mid-day peak causes congestion and traffic delays outside the installation which have a quality of life impact for those working at APG and those traveling the area.									
RC-1A	City of Aberdeen / City of Havre de Grace / Harford County	**Monitor Capital Improvements for Roadway Capacity** Monitor capital improvement projects to ensure roadway capacity is sufficient and increases traffic flow and mobility without causing unintentional pressures on the	2019	☐	■	■	■			■	■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		military or communities to provide for more services. *Other Partners: BRTB*									
RC-1B	City of Aberdeen / Harford County	**Conduct a Traffic Study to Assess Community Impacts on APG and Vice Versa** Conduct a traffic study to quantify demand cycles and address alternatives such as repositioning or improvements to gate access to allow for alternative routes to APG. *Other Partners: BRTB*	2019	■	□	□	□			■	■
RC-1C	APG / City of Aberdeen	**Coordinate and Budget for Gate Improvements that Affect Off-Installation Roadway Capacity and Level of Service** Identify, coordinate and budget for, necessary improvements to achieve more efficient functionality of installation egress / ingress points and improve localized congestion outside entry gates. This strategy should be implemented in conjunction with Strategies RC-1D and RC-2C.	2019	■	■					□	
RC-1D	City of Aberdeen / Harford County	**Consider Implementing Transportation Demand Management** Assess, develop, and implement Transportation Demand Management strategies and policies to reduce travel demand (specifically single-occupancy private vehicles), or to redistribute the trip generation across space (additional entry gates) or time (staggered work hours / telecommuting). *Other Partner: BRTB*	2019	■	■		■				■
RC-2		**Public Transportation Connections** Amtrak and MARC commuter trains stop near the boundary of both APG and Edgewood, but there is no direct transit connection from the stations into the installation.									
RC-2A	City of Aberdeen / Harford County	**Conduct a Feasibility Study to Assess Viability of Public Transit on to APG** Conduct a transportation feasibility study to quantify the possibility of public transit to reduce overall trip generation to APG. The study should evaluate trip generation including origin and destination pairs; driver	2019	■	□	□	□			■	■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		behavior and preference; peak trip periods; and cost, management, funding of a suitable public transit system, and access on to APG. *Other Partners: Baltimore Regional Transportation Board, Maryland Transit Administration*									
RC-2B	City of Aberdeen / Harford County	**Bike Share Programs and BikeLids at MARC Train Stations** Coordinate with the Maryland Transit Administration and Maryland DOT to establish a bike share program at the Edgewood and Aberdeen MARC stations. This strategy should be implemented in conjunction with Strategy RC-2C. *Other Partners: Maryland Transit Administration*	2019		■		■			■	■
RC-2C	City of Aberdeen / Harford County	**Bike Lanes along State Routes 22 and 24** Request that Maryland DOT plan, program, and install bike lanes along Routes 22 and 24. Identify appropriate roadway segments but ensure lanes are provided to the APG entry gates. It should also address bicycle access at the interchange between 24, 924 and I-95. This strategy should be coordinated and implemented in conjunction with Strategy RC-2B. *Other Partners: Baltimore Regional Transportation Board*	2019	■	■		■			□	■
RC-3		**Increased APG Commuter Traffic Affects Local Roads and Level of Service** APG commuter traffic affects local roads and contributes to level of service impacts: ▪ Westbound commuter traffic to APG cuts through local subdivisions via I-95 to reach the installation ▪ Traffic switching between Route 40 and I-95 to avoid higher I-95 eastbound toll creates failing LOS at US Route 40 and State Hwy. 222 interchange ▪ Congestion on Harford County cross arteries such as MD 543 and 152 ▪ Traffic congestion creates safety hazard at MD 543 at I-95 interchange									
RC-3A	City of Havre de Grace	**Consider Traffic Calming Devices to Discourage Cut-Through Traffic in Subdivisions** Consider installing traffic calming devices in subdivisions to discourage cut-through traffic in residential subdivisions. Consider traffic calming devices such as roundabouts,	2019			■					

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		medians, and speed humps to limit excessive through-traffic on local roads within neighborhoods.									
RC-3B	City of Havre de Grace / Harford County / Cecil County	Transportation Projects to Reduce Congestion Identify regional transportation projects that address overall roadway congestion and capacity, regional transportation goals, improvements to current and projected conflict points, and promote a multi-modal transportation system to promote an environment that supports APG mission growth and workforce needs. *Other Partners: Baltimore Regional Transportation Board, Wilmington Area Planning Council, Town of Perryville*	2019		■	■	■		■	☐	☐
RC-3C	City of Aberdeen / City of Havre de Grace / Harford County / Cecil County	Seek Alternative Funding Sources for Transportation Improvements Seek additional and alternative sources of funding for transportation improvements at the federal and state level such as the federal Transportation Alternatives Program administered through Maryland MPOs (including the Baltimore Regional Transportation Board and Wilmington Area Planning Council) and (P3) Public-Private Partnerships enacted through House Bill 560 to leverage expertise and efficiencies of the private sector. *Other Partners: Baltimore Regional Transportation Board, Wilmington Area Planning Council*	2019	■	■	■	■		■	☐	☐
Safety Zones											
SA-1		Awareness of Range Fires During dry months of the year, certain missions can cause brush fires. These fires need to be maintained and proper communication needs to be provided outside of APG regarding their potential effects.									
		For strategies that address this issue see Strategies COM-6A and COM-9A.									

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
SA-2		**Unexploded Ordnance** Areas at APG could still contain unexploded ordnance buried underground which potentially pose a safety risk for adjacent development outside the fence line.									
SA-2A	APG	**Efforts to Identify and Clear Unexploded Ordnance from APG** Establish a program and plan to identify and clear unexploded ordnance at APG. Consider expanding the UXO Technology Demonstration Site Program to clear areas near the greatest concentrations of personnel inside the fenceline and within a quarter-mile of the installation perimeter at the Aberdeen Area to provide a buffer outside the fenceline.	2021	■							
SA-3		**Incompatible Uses in Accident Potential Zones** Incompatible uses in the Accident Potential Zones extend into Harford County and the City of Aberdeen creating a safety concern. Development is a concern in these areas because this is where statistically aircraft accidents are most likely to occur.									
SA-3A	Safety MCA	**Incorporate Safety Military Compatibility Areas into Local Planning Documents** Incorporate the Safety Military Compatibility Area and associated compatible development guidelines from Department of Defense Instruction 4165.57 into local zoning codes and comprehensive plans for the safety of their citizens. Examples of regulations in this area should include conditions associated with types of uses such as restricting new development that attracts large congregations of people and uses that attract concentrations of birds that create a hazard to aircraft.	2019		■		■				
SA-3B	Safety MCA	**Amend Zoning Codes for Incompatible Uses within Accident Potential Zones** Consider amending zoning codes to preclude incompatible land uses and establish Floor Area Restrictions for property within Accident Potential Zones I and II consistent with recommendations in Department of Defense Instruction 4165.57.	2019		■		■				
SA-3C	Safety MCA	**Amend Zoning Codes to Address Accident Potential Zones** Amend zoning codes to require all allowable uses within Accident Potential Zones I and II to undergo a conditional use approval	2019		■		■				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		process that requires APG review. Uses that would require additional review include, but are not limited to residential uses and those that encourage the congregation of people such as places of worship, daycares, and group care facilities.									
SA-3D	Safety MCA	**Provide Safety zone Maps to Local Realtors and Title Companies** Harford County and the City of Aberdeen should provide maps of the Safety Zones to local realtors and title companies. Maps should include a delineation of areas that are, and may be in the future, subject to safety risks associated with APG flight operations.	2019		■		■				
SA-3E	Safety MCA	**Voluntary Conservation Easements for Property in Accident Potential Zones** Develop a conservation easement program to reduce development potential within the Accident Potential Zones. *Other Partners: Harford Land Trust, The Eastern Shore Land Conservancy*	2019	■	■		■				■
SA-3F	Safety MCA	**Pursue Properties for ACUB Program in Accident Potential Zones and Seek Partnership Opportunities** Pursue property in Priority Areas identified in the ACUB Program within Accident Potential Zones for fee simple acquisition and conservation easements to meet multipurpose goals including safety and environmental stewardship. *Other Partners: Harford Land Trust*	2016	■							■
SA-3G	BASH MCA	**Amend Zoning Ordinances to Include Bird / Wildlife Air Strike Hazard Regulations** Amend zoning ordinances to regulate land uses and guide building standards that will not attract birds and other wildlife in the BASH MCA, specifically within the Approach / Departure Clearance Surface. Such controls should prohibit certain trees and foliage that attract birds in this area.	2019		■	■	■		■		

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Scarce Natural Resources											
SNR-1		**Water Quantity / Quality at Edgewood** Harford County water supply to Edgewood is temporary because of Harford County's own service demand.									
		For strategies that address this issue see Strategies IE-1A and IE-1B.									
Sensitive Biological Resources											
SBR-1		**Eagle Nesting Sites** Eagle nesting site buffers impact ability to carry out mission-critical activity and contribute to reduced development areas.									
SBR-1A	APG	**Continue Monitoring Bald Eagle Nests** Continue to coordinate with US Fish and Wildlife Service to maintain records of Bald Eagle nesting sites and monitor any change in nesting sites to maintain coordinated management strategies that allow continuation of operational activities while providing necessary habitat and species protections. *Other Partner: US Fish and Wildlife Service*	2017	■							☐
SBR-1B	APG	**Coordination Among Management Agencies** Work with all management agencies to develop approaches to protect the Bald Eagle and its associated ecosystem and avoid disruption of nesting sites and habitat by providing management strategies that provide adequate habitat protection. *Other partners: US Fish and Wildlife, Maryland Department of Game and Inland Fisheries, Maryland Department of Natural Resources, The Nature Conservancy, The Trust for Public Land*	2017	■							☐
		For another strategy that addresses this issue see Strategy LU-1B.									

IN PROCESS

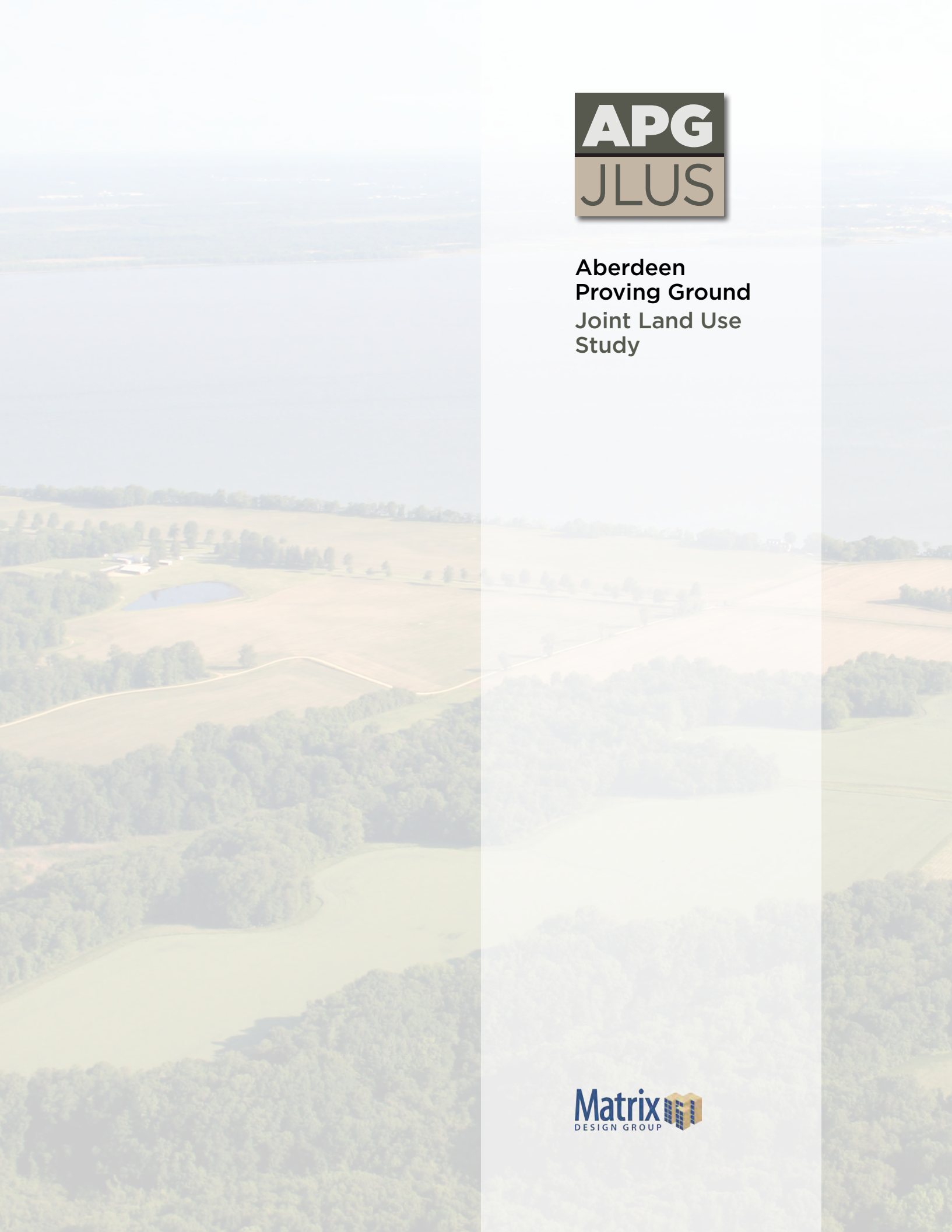
Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Vertical Obstructions											
VO-1		**Vertical Obstructions Understanding** Lack of awareness of vertical obstruction requirements within jurisdictions surrounding APG can lead to incompatible development.									
VO-1A	Vertical Obstruction MCA	**Identify and Map Specific Areas of Concern Related to Tall Structures** Develop a "Red, Yellow, Green" (RYG) Map, in consultation with APG, that identifies locations throughout the Vertical Obstruction MCA where tall structures (with defined heights) are permissible, permissible with height restrictions, and prohibited to protect public safety and ensure compatibility. *Other Partner: Town of Perryville*	2017	☐	■	■	■		■		■
VO-1B	Vertical Obstruction MCA	**Incorporate Vertical Obstruction MCA into Local Planning Documents** Adopt height regulations, incorporating mapping from Strategy VO-1A, for all proposed structures within the Vertical Obstruction MCA to ensure they do not pose a safety hazard to air operations in the region. *Other Partner: Town of Perryville*	2017		■	■	■	■	■		■
VO-1C	Vertical Obstruction MCA	**Optimize Use of Communication Towers** In order to reduce the number of communication towers needed in the future, providers should be encouraged to design new towers, structurally and electrically, to accommodate the applicant / licensee's antennas and comparable antennas for at least two additional users (minimum of three users for each tower structure), unless this design would require the addition of lights or guy wires to an otherwise unlighted and / or unmanned tower.	2017		■	■	■	■	■		
VO-1D	Vertical Obstruction MCA	**Ensure Part 77 Compliance** For all new, redeveloped, or rehabilitated structures (including electrical transmission towers/lines, cellular and radio transmission towers, etc.), ensure compliance with the Federal Aviation Administration (FAA) Part 77 height limit requirements to minimize vertical	2017		■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		obstructions. *Other Partner: Town of Perryville*									
VO-1E	Vertical Obstruction MCA	**Develop a 3-Dimensional Imaginary Surfaces Model** The cities of Havre de Grace and Aberdeen and Harford County should collaborate, with the assistance of APG and the FAA, to develop a digital and printed 3D model of existing height regulations compared to allowable heights for the imaginary surfaces. This tool will assist the jurisdictions in considering amendments to their zoning regulations to further enhance military compatibility and for determining whether heights of proposed structures obstruct the navigable airspace during the review of development applications. *Other Partner: FAA*	2017	☐	■	■	■	■	■		☐
VO-1F	Vertical Obstruction MCA	**APG Review of Proposed Structures** Establish partnerships between each jurisdiction and APG to allow for APG review and comment on any proposed new, redeveloped, or rehabilitated structures (including electrical transmission towers/lines, cellular and radio transmission towers, etc.) within the imaginary surfaces.	2017	☐	■	■	■	■	■		
VO-1G	Vertical Obstruction MCA	**Pursue Properties for ACUB Program in Vertical Obstruction Military Compatibility Area and Seek Partnership Opportunities** Pursue property in ACUB Program Priority Areas within the "Red Zone" on Map in Strategy VO-1A for fee simple acquisition and conservation easements to meet multipurpose goals including vertical obstruction safety and environmental stewardship. *Other Partners: Harford Land Trust, The Eastern Shore Land Conservancy*	2016	■							■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Vibration											
VIB-1		**Vibration Damage in Study Area Communities** Vibration from APG ordnance testing has the ability to cause physical property damage in areas throughout the Study Area on both sides of the Chesapeake Bay.									
		For strategies that address this issue see Strategies COM-10A and LU-1B.									
Water Quality											
WQQ-1		**Havre de Grace Marina Siltation** The Spesutie Island Causeway is a potential source of sediment buildup near the Havre de Grace Marina which is reported to affect local boating and the Chesapeake Bay ecosystem.									
		For strategies that address this issue see Strategies MEC-3A and MEC-3B.									
WQQ-2		**Edgewood Area Lacks an Uninterruptable Water Supply** The Edgewood Area water source is subject to periodic production shortages. Supplemental water to the Edgewood Area from Harford County is temporary. A reliable source of water to serve the Edgewood Area is needed to meet current and future needs.									
		For strategies that address this issue see Strategies IE-1A, IE-1B, and IE-1C.									
WQQ-3		**Aberdeen Area Lacks an Uninterruptable Water Supply** The source of water for the Aberdeen Area suffers from periodic production shortages due to flows that cannot be maintained during moderate drought periods. Back-up water supplies are provided from Harford County by way of the City of Aberdeen through a collective MOU which expires in 2017.									
WQQ-3A		**Continue to Plan for Onsite Potable Water** Continue to plan for onsite potable water to reduce reliance on Deer Creek and the Chapel Hill Treatment Plant and to provide a secure and reliable source of water. Develop a Master Plan including quantified supply and future demand based on anticipated need, determination of onsite well capacity at APG, modernization plan for onsite facilities, identification of additional / new infrastructure, funding sources, and commitment from the Maryland Department of the Environment of a water permit to draw the necessary quantity to support long-term APG demand. *Other Partner: Maryland Department of the Environment*	2016	■	☐						☐

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
WQQ-3B	APG	**Plan and Coordinate for the Implementation of Infrastructure Improvements to Achieve a Secure and Reliable Potable Water Supply to the Aberdeen Area** Develop a coordinated Implementation Plan to execute the Water Provision Master Plan in Strategy WQQ-3A. Include measurable milestones, Capital Improvement Plan projects, dedicated funding sources, and multijurisdictional / multiagency coordination. *Other Partners: Maryland Department of the Environment*	2017	■	☐						☐
WQQ-4		**EUL Site On Top of Aquifer Recharge Infiltration Field** The EUL site is located within the Source Water Protection Area that encompasses the water wells for Harford County and the City of Aberdeen. There is a concern that future EUL development can impact the aquifer recharge associated with the wells.									
WQQ-4A	APG	**Plan for Cumulative Impacts** Develop a plan to ensure that cumulative development impacts of The G.A.T.E. development do not have a detrimental impact on the aquifer recharge for the Source Water Protection Area that would affect the viability of water wells at APG. *Other Partner: St. John Properties*	2019	■	☐		☐				☐
WQQ-5		**Stewardship of Chesapeake Bay Waters** Perception that counties are providing a disproportionate amount of funding versus APG to clean the Chesapeake Bay.									
WQQ-5A	Study Area	**Quantify APG Funding and Include in APG Education Efforts** To demonstrate good stewardship of the Chesapeake Bay, quantify the value of, and document ongoing conservation efforts of the Chesapeake Bay ecosystem by APG. Incorporate as part of the public outreach in conjunction with Strategies COM-5B, COM-5C, and COM-6B.	2019	■							

Please see the next page.



Aberdeen Proving Ground
Joint Land Use Study

Matrix DESIGN GROUP

For Additional Information Contact:

CHESAPEAKE SCIENCE & SECURITY CORRIDOR

APG-CSSC Regional BRAC Office
2021 Pulaski Highway
Havre de Grace, MD 21078
(410) 273-5708

Or visit the website at:
www.apgjlus.com

APPENDIX H

Memorandum of Agreement for
Forest Mitigation

STATE OF MARYLAND
CRITICAL AREA COMMISSION
CHESAPEAKE AND ATLANTIC COASTAL BAYS
1804 West Street, Suite 100, Annapolis, Maryland 21401
(410) 260-3460 Fax: (410) 974-5338
www.dnr.state.md.us/criticalarea/

December 12, 2011

Mr. Scott English
Forester
Aberdeen Proving Ground
IMNE-APG-PWE, Bldg. E4630
Aberdeen Proving Ground, MD 21010

Re: Memorandum of Agreement Between APG, CAC, and MD DNR Forest Service

Dear Mr. English:

Thank you for continuing to work cooperatively with the Commission staff on this very important endeavor. Today the Commission signed the Memorandum of Agreement (MOA) and have enclosed a copy for your files and will forward another signed copy to the DNR Forest Service for their files.

As discussed, we will continue to coordinate with your office on the implementation of the MOA.

Sincerely,

Lisa A. Hoerger

Lisa A. Hoerger
Regulations Coordinator

cc: Mr. Steve Koehn, MD DNR Forest Service
Mr. Todd Beser, APG

DEPARTMENT OF THE ARMY
US ARMY ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND MARYLAND 21005-5001

REPLY TO
ATTENTION OF

MEMORANDUM OF AGREEMENT BETWEEN ABERDEEN PROVING GROUND, THE MARYLAND CRITICAL AREA COMMISSION AND THE MARYLAND DEPARTMENT OF NATURAL RESOURCES FOREST SERVICE

1. This Memorandum of Agreement (MOA) is entered into by and between the United States Army, Aberdeen Proving Ground (APG), the Maryland Department of Natural Resources Forest Service (DNR Forest Service), the Maryland Critical Area Commission (MD CAC) regarding the establishment and implementation of a comprehensive forest mitigation strategy under APG's Forest Management Plan (FMP) component of the APG Integrated Natural Resources Management Plan (INRMP). The provisions in this MOA compliment principles contained in Executive Order 13508, the Chesapeake Bay Protection and Restoration, the APG Regulation 200-40, the Army Chesapeake Bay Strategy, the Maryland Forest Conservation Act, the Maryland Critical Area Act, the Forest Strategy for Maryland for 2010-2015, the Maryland Statewide Forest Resource Assessment, and the Maryland Wildlife Diversity Conservation Plan.

2. This MOA does not define or determine mitigation requirements under any applicable federal or state laws or regulations, including the Coastal Zone Management Act, the Maryland Critical Area Act, or the Maryland Forest Conservation Act. This MOA's provisions only apply after any necessary forest mitigation requirement has been determined pursuant to any applicable federal or state laws or regulations governing a particular project or action.

3. PURPOSE.

a. The purpose of this MOA is to establish an agreement between all parties regarding forest mitigation strategy at APG as a component of APG's overall forest management program. This MOA addresses not only the mitigation efforts of reforestation/afforestation, but also recognizes forest enhancement and forest restoration efforts where silvicultural actions will be undertaken as specified in the FMP component of the APG INRMP. It establishes a tool to calculate, track and sustain forest mitigation when it is required at APG. Prescriptions will address actions such as forest composition, forest density, forest health, and invasive species removal in ways that improve, enhance and sustain the forest ecosystem on a landscape level at APG. This comprehensive approach will allow APG to focus on re-establishing wildlife corridors, greenways, habitat protection areas and enhancing the shoreline area. This MOA also establishes a single point of contact on the APG Garrison staff (IMNE-APG-PWE) for forest mitigation coordination, within the options established below.

b. This MOA specifies how APG will credit mitigation through acts of: 1) selective removal of trees that are identified as invasive or non-historical species and re-establishing in historically climactic species; 2) executing silvicultural actions to enhance and restore existing forests to ensure long-term health and sustainability. Capturing this comprehensive, sustainable, landscape level forest management approach will be quantified in the four categories outlined and prioritized below.

4. BACKGROUND.

a. APG is located on the northwestern shore of the Chesapeake Bay and consists of 40,178 acres of land and 39,106 acres of water. APG is divided into two areas, APG North and APG South. Graces Quarters, Carroll Island, and Poole's Island are considered part of the APG South, but are separated from the southern peninsula by the Gunpowder and Bush Rivers. The Churchville Test Site is considered part of the APG North, but is noncontiguous. Both APG North and APG South consist of a cantonment area and various test ranges. The cantonment areas include housing, industrial activities, airfields, supply and storage, medical, offices, research and development. Test ranges make up approximately 90 percent of APG and include firing ranges, impact areas, vehicle test courses and munitions storage bunkers and magazines.

b. A little more than 46 percent of APG's area is forest with 3,276 acres of wetland forests and another 14,775 acres of upland forests. Applying criteria used by the State of Maryland in the APG Master Plan, approximately 25 percent of APG is considered an area of intense development with the remaining 75 percent listed as not intensely developed. Home to more than 40 species of mammals, 55 neo-tropical bird species, 58 threatened and endangered vascular plants and more than 40 species of reptiles and amphibians, APG is an ecological treasure. In addition to other endangered species at the proving ground, APG has a healthy and thriving bald eagle population; one that APG has made a concentrated effort to restore and sustain. As of 2009, there were 36 active bald eagle nests and 6 active roosts.

c. APG leadership is committed to preserving and enhancing its natural resources while ensuring its military missions are successfully accomplished. An ongoing problem that threatens APG's coastal and riparian forests is shoreline erosion. Since monitoring began in 1846, as much as 750 feet of shoreline has been lost along the ranges, causing a constant threat to the sustainability of APG's designated mission. Approximately 8.68 miles of shoreline has been restored. Future plantings through forest mitigation within a 100 foot buffer would increase shoreline stabilization and preserve wildlife and fish habitat.

5. STATEMENT OF MUTUAL BENEFIT AND INTERESTS. As undeveloped forested lands in the Chesapeake Bay watershed have been reduced significantly, the importance of management efforts to ensure the long-term sustainability of existing forested lands is highlighted. The forests, wetlands, and riparian areas on APG serve a crucial role in reducing Total Maximum Daily Load, protecting water quality and sequestering carbon. The premise of this MOA is to achieve an agreement as to APG's strategy to address its forest mitigation as a comprehensive plan primarily focused on managing existing forested lands, thereby eliminating the approach of mitigating in parcels and fragments. Through these management efforts, APG will not only maintain and sustain the integrity of all of its forest ecosystems but also help to restore and improve the health and water quality of the Chesapeake Bay.

6. FOREST MITIGATION MECHANISMS AND CREDITS. This MOA quantifies four forest mitigation mechanisms:

a. **Reforestation/Afforestation.** Through its mitigation efforts, APG will continue to concentrate on planting native trees and shrubs that will promote and maintain a healthy forest community. APG will focus on mitigating areas that will reconnect interrupted wildlife corridors, improve upon or develop living shorelines and increase habitat protection areas and forest communities. Reforestation/afforestation of targeted areas will also continue initiating the establishment of native oak communities that provide several crucial ecological advantages. Oak forests contribute to better water quality, improve the nitrogen cycle and reduce runoff and erosion. Oak provide habitat and food for birds, insects, mammals, amphibians and bald eagles. Mitigation credit for reforestation/afforestation will be granted consistent with the Maryland Forest Conservation Act and the Maryland Critical Area Act. Planting areas will be prioritized for mitigation in the APG FMP. DNR Forest Service and MD CAC coordination will occur prior to mitigation execution. These actions will be accredited as forest mitigation to APG on a 1:1 basis.

b. **Successional Sweetgum Stand Conversion.** Aerial photos from 1932, which included the majority of the Aberdeen Area, but only a small portion of the Edgewood Area, show that 15,459 acres were utilized as cropland and pastures. As former agricultural lands within APG were no longer maintained or mowed they returned to early successional forest communities. These areas have returned as sweetgum monocultures. Heavy deer pressure has prevented oak and other native species such as tulip poplar and hickory from surviving and thriving, while it has created a favorable environment for pure sweetgum stands. Historically however, most of the old growth was forested wetlands and predominantly oak. Sweetgum stands that are 18 years or younger (averaging 1" to 6" in diameter) will be targeted for removal and enhancement with stand conversion replaced to oak, hickory and tulip poplar. Stands will be prioritized for mitigation in the APG FMP. DNR Forest Service and MD CAC coordination will occur prior to mitigation execution. These actions will be accredited as forest mitigation to APG on a 2:1 basis.

c. **Forest Enhancement and Restoration.** APG will implement silvicultural actions as specified in the FMP to restore the forests' ecological integrity. Prescriptions will reduce environmental stress influenced by exotic invasive plants, restore the natural distribution of native trees and shrubs and reduce overstocking to allow for natural regeneration. Numerous APG stands can be characterized as old growth, early successional grassland areas, stands having dense vines in tree crowns, and dense shrub layers dominated by alien woody plants and/or exotic ground cover community. Five invasive plant species, Japanese stiltgrass (*Microstegium vimineum*), autumn olive (*Elaeganus umbellate)*, Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), and garlic mustard (*Alliaria petiolata*), have become very prevalent at APG to the extent that it impacts the overall forest health. By actively managing early successional stands, old growth stands, invasive plant species and implementing

appropriate silvicultural prescriptions; APG will restore the natural distribution of native trees and shrubs, thereby, increasing the acreage of healthy forests on the landscape. Stands will be prioritized for mitigation in the APG FMP. DNR Forest Service and MD CAC coordination will occur prior to mitigation execution. These actions will be accredited as forest mitigation to APG on a 2:1 basis.

d. **Urban Forestry / Tree Canopy Enhancement.** APG will work towards improving its urban forest management and street tree sustainability. Mitigation credit would be provided for the improvement of urban forests and urban tree canopy enhancement. This would include the planting of shade and flowering trees along streets, roads and around buildings on APG. This would also include proper tree management and care along rights-of-way and fencing corridors on APG. DNR Forest Service and MD CAC coordination will occur prior to mitigation execution. APG will receive one acre of forest mitigation credit for every 100, 1.5 to 2.0 inch diameter trees planted.

7. PRIORITIZATION OF FOREST MITIGATION MECHANISMS. Individual mitigation efforts will be coordinated between the APG Forester, DNR Forest Service and MD CAC with the guiding principle of prioritization of the above forest mitigation mechanisms being in the following order:

a. Reforestation/Afforestation;

b. Forest Enhancement;

c. Successional Sweetgum Stand Conversion;

d. Urban Forestry / Tree Canopy Enhancement.

8. ANNUAL REPORTING. APG will provide a copy of APG's annual report (including Forest Stand specifics and accompanying GIS maps) to the MD DNR Forest Service and MD CAC that specifies completed mitigation type, quantity, and location in December of each calendar year.

9. QUALIFICATIONS.

a. Forest mitigation in this MOA is applicable to ALL forested areas of APG.

b. This MOA shall be implemented consistent with applicable federal and state laws. It does not establish any requirement by APG, the Army, the DoD, or the State of Maryland for the payment or obligation of funds, as execution is subject to the availability of funds and no provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act (31 U.S.C. 1341).

c. No penalties will be accrued by the Army for not implementing APG's Forest Management Plan.

d. Future military missions may require that completed forest mitigation sites be used for purposes other than forest mitigation. In such cases, the completed mitigation may be relocated and replaced on a 2:1 basis while mitigation for the new site activity(s) will also be addressed.

e. Any signing party has the ability to request to modify the mitigation ratios in the future pending all parties' approval.

f. Any federal property owner within the Chesapeake Bay watershed may request to use this MOA to meet their forest mitigation requirements through off-site forest mitigation on APG.

g. This MOA may be terminated at any time by any of the signing parties.

10. EFFECTIVE DATE. This agreement becomes effective upon the date of the last approving signature and will remain in effect indefinitely until superseded, rescinded, or modified by written, mutual agreement of both parties.

11. ACCEPTANCE OF AGREEMENT:

Orlando W. Ortiz
Colonel, US Army
Deputy Installation Commander

6 Dec. 2011
DATE

Steve W. Koehn
Chief, Maryland Department of Natural Resources Forest Service

9/28/11
DATE

Director

Ren Serey
Executive Director, Maryland Critical Area Commission

12/12/11
DATE

APPENDIX I

Forest Management Plan

Cumulative Forest Management Plan

August 2020

Prepared for:

US Army Garrison Directorate of Public Works
Environmental Division
Aberdeen Proving Ground, Maryland

Contract W56ZTN-16-D0003

TO: 01478

Prepared by:

Mar-Len Environmental, Inc.
RPF #192 Leonard Wrabel
275 Barnhart Road
Westminster, MD 21158

Table of Contents

EXECUTIVE SUMMARY

Aberdeen Proving Ground (APG) is located in Harford County and eastern Baltimore County, Maryland. It sits near the head of the Chesapeake Bay, the largest, most biologically productive estuary in the world and a national treasure and resource. APG controls 33,486 acres of the bay and consists of 72,406 acres with a land mass of 38,920 acres. Forest comprises of almost 50 percent of the acreage. APG controls 32,060.88 acres of the bay and consists of 72,474 acres with a land mass of 40,287 acres. Forest comprises 45.5 percent of the acreage. Upland forest comprises 15,063 acres while the wetland forest is 3,276 acres. Of the 18,339 acres of forest 17,827.06 acres are stand mapped for a total of 576 stands. This ecologically important land, under DOD stewardship, is home to 58 rare threatened and endangered vascular plants, 55 neo- tropical bird species, more than 40 species of reptiles and amphibians, nearly 250 species of birds, and more than 40 species of mammals.

Army Regulation (AR) 200-1, *Environmental Protection and Enhancement,* provides objectives for the conservation of natural resources on Army installations. Army leadership is committed to conserving and preserving natural resources so they will be available for present and future use. Several federal laws, regulations, and guidelines also apply to Army installations in protecting these resources. The Under Secretary of Defense has directed that ecosystem management will be the tool used by military installations to achieve the goal of effective natural resources management.

APG has one of the largest concentrations of bald eagles in the Chesapeake Bay region. APG attracts a disproportional number of eagles, because the installation has largely undeveloped shorelines close to abundant food resources in the surrounding rivers and Bay. In addition, many of these shoreline areas have restricted access with little human activity. APG's mature forested areas in close proximity to open water provides habitat for roosting, foraging, and nesting eagles. Residential and commercial development of surrounding shorelines in the northern Chesapeake Bay continues to drive an increasing number of eagles to APG.

APG implements a number of conservation measures to avoid, minimize, and/or mitigate impacts to the bald eagle population. One of these conservation measures provides for habitat enhancement in eagle nesting and roosting areas. This effort improves eagle habitat while sustaining the testing and training landscape required by the military mission. It is important to the long-term sustainment of the breeding eagle population that large canopy trees be replaced, either through natural re-generation or plantings. The forest stand improvements enhance native species diversity with plantings of oak, hickory, beech, and tulip poplar; decrease invasive species with spraying and removal; and provide for long-term forest and mission sustainability.

In accordance with these federal laws, regulations, and policies, the Installation Management Command (IMCOM) determined the need to conduct a forest inventory at Aberdeen Proving Ground (APG), Maryland. Prior inventories of a portion of the installation's forests were completed in 2001, 2003, 2009, 2012, 2014, 2016, 2017 and 2019 consisting of 237 stands.

The natural resources managers at APG require this information to implement appropriate conservation measures as required. The GPS data information provides the geographical location that is sufficient for APG natural resource managers to plan forestry and wildlife activities and conduct vegetative community classification, per AR 200-1 requirements.

The forest inventory serves the goals of providing a foundation from which APG can plan and execute its military mission requirements; meeting natural resources management goals; complying with the requirements of AR 200-1 and other Federal, State, and Army regulations applicable to natural resources management. As well as establishing baseline data required for preparation of subsequent revisions of Integrated Natural Resources Management Plans (INRMPs), and meeting legal and policy requirements consistent with current national natural resources management philosophies.

Current Land Use and Consequences to Natural Resources

APG is split into Aberdeen and Edgewood areas, each house a main cantonment area composed of headquarters, training, research, and support areas. These areas are improved, maintained grounds with numerous buildings and roads. Facilities in the cantonment areas include those for administration, housing, airfields, community activities, education, industrial activities, maintenance, medical uses, research and development, and supply and storage. Approximately 90 percent of the total installation is designated as test range, including the APG waters of the Chesapeake Bay and its tributaries. Firing ranges, impact areas, bombing fields, vehicle test courses, warehouses, and munitions storage are located within this area.

The diversity of natural resources at APG, including its size, climate, and location at the edge of the Chesapeake Bay, allows for realistic completion of the installation's mission. Development within the restricted area remains limited to scattered testing facilities and ranges. Natural features such as shorelines, creeks, wetlands, ponds used by waterfowl, and forests are in a relatively natural condition. The nature of the military mission at APG has offered a measure of protection to the natural resources within the installation's boundaries. The presence of the installation has prevented development for residences, industrial use, shipping or boating facilities, or urban use. The natural character of the installation continues to make it a vital habitat for waterfowl, fish, bald eagles, deer, and many other animals and plants.

However, use and development of the land at APG has had some adverse effects on its natural resources. Some fragmentation of forests has occurred when clearing areas for test facilities or building construction has required tree removal. The quantity and quality of interior forest habitat has declined, while disturbance has permitted the proliferation of opportunistic species. Autumn olive *(Elaeagnus umbellata),* an exotic species, was planted long ago at APG to revegetate areas cleared for development, and multiflora rose *(Rosa multiflora),* another invasive species, has invaded many habitats at the installation. Exotic invasive Japanese stilt grass *(Microstegium vimineum)* has become a ground vegetation dominant in many forest stands. Exotic plant species are now so common on the installation that they have become an established part of its ecology. The presence of a security fence around the restricted area and the reintroduction of deer in 1930's led to a population well beyond the caring capacity where deer and the forest can co-exist. During the 1930s, deer from a game farm near Harrisburg, Pennsylvania, were released at APG. During World War II, the deer population grew to numbers which created a hazard to military operations. Between then through 1960 state wildlife personnel trapped over 2,000 deer on APG and released them in various counties across Maryland. Since the 60's the deer presence has increased dramatically. Deer are a major threat to the APG Forest Eco System.

Eagle Sensitivity within APG

APG has one of the largest concentrations of bald eagles in the Chesapeake Bay region. APG attracts a disproportional number of eagles, because the installation has largely undeveloped shorelines close to abundant food resources in the surrounding rivers and Bay. In addition, many of these shoreline areas have restricted access with little human activity. APG's mature forested areas in close proximity to open water provides habitat for roosting, foraging, and nesting eagles. Residential and commercial development of surrounding shorelines in the northern Chesapeake Bay continues to drive an increasing number of eagles to APG.

APG implements a number of conservation measures to avoid, minimize, and/or mitigate impacts to the bald eagle population. One of these conservation measures provides for habitat enhancement in eagle nesting and roosting areas. This effort improves eagle habitat while sustaining the testing and training landscape required by the military mission. In 2012, APG lost over 10% of its eagle nest trees due to storms and natural degradation. It is important to the long-term sustainment of the breeding eagle population that these large canopy trees be replaced, either through natural re-generation or plantings. The forest stand improvements enhance native species diversity with plantings of oak, hickory, beech, and tulip poplar; decrease invasive species with spraying and removal; and provide for long-term forest and mission sustainability. As of 2020 APG supports a large population of bald eagles, tracking over 100 nest locations, averaging 60 successful nests each year. The improved eagle habitat fledged an all-time high of 93 chicks last season.

IMPORTANCE OF FORESTS FOR WATERSHED FUNCTION

GAPG is held by the Government as a valuable military installation and an environmentally sensitive ecosystem that offers a variety of forest cover types, a multitude of herbaceous plants, shrubs, and tree species. Forest stands play a major role in the streams and wetlands water quality. Trees provide soil stabilization and thermal protection. Wooded buffers provide a unique habitat for wildlife and probably are the most important areas within the forest. Riparian ecosystems support a greater diversity of wildlife than adjacent upland forest. Many species are restricted or prefer the stream zone. The increased humidity of these areas is important for herpetofauna, such as lizards, frogs and turtles. Root systems of woody vegetation supply cover for fish and aquatic invertebrates. More than eighty varieties of birds utilize stream side vegetation for summer feeding and nesting.

Forests are important to the Chesapeake Bay, as trees protect and improve water quality by reducing run-off and erosion in streams. Trees and shrubs reduce air pollution, by filtering and removing pollutants from the air. They also provide habitat and food for a variety of fish, birds, mammals, insects and amphibians. Large and connected areas of forest offer the most valuable wildlife habitat.

Forests and Watershed Protection

Numerous studies of watersheds have provided evidence that forest ecosystems provide the best protection for water quality (Carlton 1990; Dunne and Leopold 1978). The health of streams, rivers, and bays is tied to the dynamic well being of the forest. The forest system, including the plants, animals, non-living elements, and their structures are intimately associated with ground and surface water quality and flow patterns. The maintenance of a diverse, multi-layer forest capable of resistance to major disturbances, such as ice and windstorms, and resilient to minor disturbances provides an efficient and effective means of protecting water quality.

Through the continuous maintenance of a forest cover, soils are protected from erosion by:

1. Absence of overland flow;
2. Protection of erodible mineral soil by a thick layer of organic material;
3. High water holding capacity of the organic matter mixed with the upper soil horizon;
4. Dissipation of the energy of rain drops through the interception of canopy and mid-story trees and shrubs;
5. Reduction of the amount of rainwater reaching the ground due to interception by trees and shrubs (2-6% of flood-producing rainfall and 5% of the 40-45 inches of annual precipitation common in the eastern United States);
6. Increased water storage of the forest soil due to reduced transpiration rates during the growing season (18 inches of the 40-45 inches of annual precipitation common in the eastern U.S.); reduced flood damage due to structural protection afforded by riparian forests; and
7. Capturing sediment moving onto the reservoir lands from off site.

Forests also capture a variety of elements and materials that would be otherwise deposited into the streams and reservoirs. These forest systems provide a line of defense against atmospheric deposition of heavy metals and acids and intercept groundwater pollutants entering the reservoir lands from off site and physically and chemically transforming these pollutants to render them harmless.

Forest cover reduces stream and soil temperatures that slow down chemical processes that can lead to an increased release of nutrients associated with water quality degradation and the production of by-products that degrade water and habitat values.

The APG forest is especially valuable due to its oak dominance. Two broad areas of ecological function are supported to a high degree by oak forests:

1. Nitrogen Cycling
2. Stream Water Quality

Nitrogen Cycling and Stream Water Quality

Although the efficiency of nitrogen cycling in forests is dependent upon many factors including geography, climate, soil types, and forest stand ages (Goodale and others 2002), oak-dominated forests throughout the eastern U.S. typically have tighter control on nitrogen cycling than do beech/maple forests, releasing lower levels of nitrates from organic forest floor litter to adjacent streams (Lovett, et.al. 2004). Oak forests also maintain a higher ratio of carbon to nitrogen in forest floor litter than other deciduous forest types because of high lignin content, which slows the decomposition rate of downed debris, and the movement of soluble nitrogen compounds through the landscape (Finzi et.al. 1998). Lignins also boost forest soils' capacity for storing and releasing water and cycling nutrients by adding very long-lived (hundreds to thousands of years), degradable-resistant biomass to the humus component, which supports myriad microorganisms and chemical processes that bring resource cycling efficiency and stability to the forest ecosystem (Fisher and Binkley 2000). In these ways, oak forests are critical for the maintenance of high stream water quality and productive aquatic habitats at GAPG.

Wildlife Habitat and Biodiversity

Thousands of years of dominance by oak forest types in the eastern United States has produced myriad interdependent relationships between oak forests and wildlife. At every spatial level, from the tallest trees in the canopy to the smallest plants on the forest floor, mammals, birds, amphibians, reptiles and countless insects and microorganisms feed on and are fed upon by other forest inhabitants in a complex food web that is driven by the presence of oaks (Johnson and others 2002). Native streamside trees and other plants in oak associations add annual pulses of food resources in the form of leaves and woody debris to macro invertebrate communities that support high water quality stream system habitats for aquatic plants, invertebrates, and fish species (Sweeney 1992). Oaks are considered keystone species because of their significant contribution to the structural and biological diversity of the eastern forests and the critical processes that sustain the forest ecosystem (Fralish 2004). As an example, oak forests play a crucial role in the survival of hatchlings of most eastern forest bird species. In the spring, loopers, inchworms, and spanworms, the caterpillar stages of almost 200 species of forest moths, feed on the young leaves of oaks and other plant species in oak forest communities at a time when forest birds are foraging for hatchling food (Wagner 2005). Bird foraging reduces the insect pressure on the forest plants, allowing them to grow to their potential. The forest plants provide sufficient habitat for sustaining generations of birds that will consume other insects throughout the year. Oaks are primary hosts for gall wasps, whose larvae extend the food reserves into the summer and fall (Cornell 1983). From the fall to the winter, oaks continue to provide food in the form of acorn mast, which not only offers food for mammals and game birds, but also over-winters the larvae of acorn weevils that will provide additional food for birds and mammals the following year. In these ways, oak communities anchor a food web that supports a diverse range of higher feeding levels in the forest ecosystem. Historically GAPG was an Oak dominated forest community. *The Maryland Weather Service* reported in 1910 that, "On the necks of land stretching southeast from Baltimore and Harford counties occur tree assemblages to which the above name is given. These "necks" resemble in a general way the peninsulas stretching in a similar direction from Charles and St. Mary's counties, but the difference in vegetation of the two regions seems sufficiently striking to necessitate separating them. To begin with, this association shows a greater number of oaks than any other. White Oak is dominant, though Sweet Gum is almost equally abundant; Chestnut Oak, Willow Oak, Black Oak and Swamp Oak are more numerous here then they are in any other situation. In marked distinction to the "Meadow", Chestnut is frequent, even on low ground, while Hickories, Maple and Black Gum also occur plentifully. On the other hand there is little Pine, Cedar or Holly" (The Plant Life of Maryland, The Maryland Weather Service. 1910)

PURPOSE OF THE FOREST MANAGEMENT PLAN

The purpose of this plan is to assess the present condition of the forest; to identify major stressors that could threaten the forest's long-term sustainability; to address management questions, based upon assessment data and observations; to prepare a stand level Forest Management Plan that has as its major objectives the conservation of forest health and regeneration, structural and biological diversity, and economic value for silvicultural operations without diminishing the functional value of the forest for water quality, wildlife habitat, passive recreation, or forest health.
The four major characteristics assessed in this study include; forest cover types by delineated stands, overstory biological and structural characteristics and health, understory biotic and a biotic characteristic, and habitat characteristics and forest products potential.

The management recommendations will prioritize actions for improving forest health and ecological conditions. Management recommendations contain silvicultural recommendations to improve forest health with an emphasis on natural regeneration. The eradication of invasive plants and the reduction of deer population are also prioritized.

FOREST INVENTORY METHODS

Planning for future harvesting was not considered a primary objective of the inventory. The data collected during the inventories provides valuable information to natural resources managers concerning forest health for present and future management activities.
Point sampling with a 10-factor prism was used to identify trees to be sampled in sampling plots. Data sheets developed by the U.S. Forest Service (USFS) were used to collect most of the informational data for years 2001, 2003 and 2009. Data sheets developed by Maryland D.N.R. were used to collect data in 2012, 2013, 2014, 2016, 2017 and 2019. At each sampling plot, trees that fell within the prism's range were tallied for species, diameter, count, quality, product, product height, and crown classification. Some additional data at each plot included a subplot equaling 1/1000th of an acre for a natural regeneration count. In each study year, stands were sampled using line-transect and plot sampling methods. Transects were laid out in the office against topographic gradients, to capture the greatest degree of diversity. Sampling units were spaced equidistant from each other in an alternating pattern.

DOMINANT SOILS PRESENT

Soil Types/Categories

Beltsville Series (BeA, BeB, BeC, BU)-This soil type consists of very deep, slowly permeable, moderately well drained soils. These soils formed in loamy alluvial and marine sediments; slopes range from 0 to 10 percent. The thickness of the solum ranges from 40-60 inches. A fragipan is at a depth of 12-34 inches.

Codorous Series (Cd) - This soil type consists of very deep, moderately permeable, moderately well drained and somewhat poor drained soils. These soils formed in recently deposited alluvial sediments weathered from mostly metamorphic and crystalline rocks. They have clay content in the subsoil that increases as depth increases. They are organic soils and have thick, dark organic deposits. The thickness of the solum ranges from 30-60inches.

Elkton series (Ek) - This series consists of very deep, slowly permeable, poorly drained soils. These soils formed in silty Aeolian sediments and the underlying loamy alluvial and marine sediments. Slopes range from 0 to 2 percent. The thickness of the solum ranges from 40 to 60 inches.

Fallsington series (Fa) - This series consists of very deep, moderately permeable, poorly drained soils. These soils formed in loamy alluvial and marine sediments. Slopes are smooth and nearly level and range from 0 to 2 percent. The thickness of the solum ranges from 24 to 40 inches. The content of coarse fragments, mostly round to sub grounded gravel, ranges from 0 to 10 percent in individual horizons.

Hambrook series (HbA, HbB, HbC, HbE, HU) - This series consists of very deep, moderately permeable, well drained soils. They formed in loamy alluvial and marine sediments. Slopes range from 0 to 60 percent.

Lenape series (Le) - consists of deep, moderately permeable, very poorly drained soils. These soils formed in organic deposits overlying loamy estuarine or marine deposits having a high n value. The thickness of the organic deposit's ranges from 16 to 51 inches.

Lomgmarsh series (Lo) – consists of very deep, moderately permeable, very poor drained soils. These soils formed in loamy fluvial sediments overlying sandy alluvial marine sediments. Slopes are 0 to 1 percent.

Mattapex series (MpA MpB, MpC, MU, MwA) - consists of deep, moderately well drained soils. These soils are moderately permeable in the subsoil and moderately rapidly permeable and rapidly permeable in the substratum. They formed in silty aeolian sediment and the underlying loamy alluvial and marine sediments. Slopes range from 0 to 10 percent. The thickness of the solum ranges from 24 to 42 inches.

Nassawango series (NnA, NnB, NnC) - consists of very deep, well drained soils. These soils are moderately permeable in the subsoil and moderately rapidly permeable and rapidly permeable in the substratum. They formed in silty sediments overlying loamy alluvial and marine sediments. Slope ranges from 0 to 10 percent. The thickness of the soil ranges from 30 to 50 inches.

Othello series (Ot) -consists of very deep moderately slowly permeable, poorly drained soils. These soils formed in loess (silty) sediments overlying sandy alluvial and marine sediments. Slopes are smooth and nearly level, ranging from 0 to 2 percent. The thickness of the solum ranges from 24 to 40 percent.

Pone series (Po) - consists of very deep, moderately rapidly permeable, very poorly drained soils. These soils formed in loamy alluvial sediments overlying stratified alluvial and marine sediments. Slopes are smooth and nearly level and range from 0 to 3 percent. The thickness of the solum ranges from 26 to 40.

Romney (RE, RoA, Ud, Ur) - consists of very deep, moderately slowly permeable, somewhat poorly drained soils. These soils formed in silty sediments overlying loamy marine and fluvial sediments. Slopes are nearly level and range from 0 to 2 percent.

Woodstown series (WdA, WdB, WdC) - series consists of very deep, moderately permeable, moderately well drained soils. These soils formed in loamy marine and alluvial sediments. Slopes range from 0 to 10 percent. The thickness of the solum ranges from 24 to 45 inches.

Zekiah series (Ze) - consists of very deep permeable, poorly drained soils. These soils formed in loamy fluvial sediments overlying alluvial and marine sediments. Slopes are smooth and nearly level and are 0 to 1 percent.

Species commonly found throughout APG

** denotes invasive/non-native species*

Species	**Overstory**	**Understory**	**Ground**
grape (*Vitis*)			X
black oak (*Quercus velutina*)	X		X
swamp white oak (*Quercus* bicolor)	X		X
chestnut oak (*Quercus prinus*)	X		
Swamp chestnut oak (Quercus michauxii)			
northern red oak (*Quercus rubra*)	X		
pin oak (*Quercus palustris*)	X		
scarlet oak (*Quercus coccinea*)	X		
southern red oak (*Quercus falcata*)	X		
white oak (*Quercus alba*)	X		X
willow oak (*Quercus phellos*)	X		X
red maple (*Acer rubrum*)	X	X	X

Norway maple (*Acer platanoides*) *	X		
tulip tree (*Liriodendron tulipifera*)	X		
hickory (*Carya*)	X		X
black gum (*Nyssa sylvatica*)	X	X	X
sweetgum (*Liquidambar styraciflua*)	X	X	X
American chestnut (*Castanea dentata*)	X		
flowering dogwood (*Cornus florida*)	X		X
American beech (*Fagus grandifolia*)	X		X
ash (*Fraxinus*)	X		
black cherry (*Prunus serotina*)	X		X
American holly (*Ilex opaca*)	X	X	X
sweet pepperbush (*Clethra*)			X
black highbush blueberry (*Vaccinium fuscatum*)		X	X
Canadian serviceberry (*Amelanchier canadensis*)	X		X
Japanese honeysuckle (*Lonicera japonica*) *		X	X
honeysuckle (*Lonicera*)*			X
multiflora rose (*Rosa multiflora*) *		X	X
barberry (*Berberis*) *		X	X
greenbrier (*Smilax*)		X	X
sassafras (*Sassafras albidum*)	X		X
black walnut (*Juglans nigra*)	X		
black locust (*Robinia pseudoacacia*)	X		

Virginia pine (*Pinus virginiana*)	X		
eastern poison ivy (*Toxicodendron radicans*)			X
cottonwood (*Populus*)	X		
blackberry (*Rubus*)			X
wine raspberry (*Rubus phoenicolasius*) *			X
sweet bay (*Magnolia virginiana*)	X		
elderberry (*Sambucus*)			X
viburnum (*Viburnum*)			X
bayberry (*Morella*)			X
common persimmon (*Diospyros virginiana*)	X		X
autumn olive (*Elaeagnus umbellate*) *			X
privet (*Ligustrum*) *			X
osage orange (*Maclura pomifera*)	X		
sycamore (*Platanus*)	X		
Princess tree (*Paulownia tomentosa*) *	X		

INDIVIDUAL STAND NARRATIVES

Forest Map 1, Stand 1-5, 10.80 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Willow oak with associate species being; Sweet gum, Black cherry, Red maple, Swamp white oak, Southern red oak, Locust and Black gum. Grass and Blueberry were found in the understory. Phragmites are on the forest edge.

This stand is a mixture of sawtimber 12" – 23.9" and pole timber 6" – 11.9".

This stand is adequately stocked with 80% canopy closure.

This stand has 180 trees per acre.

Recommendations

-Heavy deer pressure.
-Many trees are unacceptable. Restocking is recommended as the stand is in poor condition.

STAND	ACTIVITY	ACRES
1-5	commercial TSI	10.80
	control invasives	
	examine stand for commercial harvest	

Forest Map 1, Stand 1-6, 11.65 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Willow oak and Sweet gum with associate species being; Holly, Sweet gum, Black gum and Red maple. Holly, Blueberry and Greenbrier were found in the understory.

This is a mature stand with most trees averaging 24" d.b.h. and some Willow oaks 30" – 36" d.b.h.

This stand is adequately stocked with 70 - 75% canopy closure.

This stand has 140 trees per acre.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.
-Extremely heavy deer pressure.

STAND	ACTIVITY	ACRES
1-6	commercial TSI	11.65
	control invasives	
	examine stand for commercial harvest	

Carroll Island: Forest Map 2, Stand 2-4, 54.16 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum, Red maple, Yellow poplar, Willow oak and Southern red oak with associate species being; Black oak, Hickory, Black gum, Chestnut oak, White oak and Persimmon. Sweet bay, Blueberry, Holly, Huckleberry and Greenbrier were found in the understory. Invasive plants include Microstegium.

This is a large sawtimber stand.

This stand is over stocked with 80% canopy closure.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.
-Favor oak in the understory, thin stand.

STAND	ACTIVITY	ACRES
2-4	commercial TSI	54.16
	control invasives	
	examine stand for commercial harvest	

Forest Map 2, Stand 2-5, 18.49 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Willow oak and Chestnut oak with associate species being; Holly, Black gum, White oak, Red maple, Black oak, Hickory, Sweet gum and Southern red oak. Black gum and Holly were found in the understory.

This stand is a mixture of sawtimber 12" – 23.9" and pole timber 6" – 11.9".

This stand is adequately stocked with 70 - 80% canopy closure.

This stand has 120 trees per acre.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.
-Extremely heavy deer pressure with noticeable browse lines and no tree regeneration.

STAND	ACTIVITY	ACRES
2-5	commercial TSI	18.49
	control invasives	
	examine stand for commercial harvest	

Forest Map 2, Stand 2-6, 24.31 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Willow oak and Sweet gum with associate species being; Cherry, Red maple, Holly, Pin oak, Southern red oak and declining Locust along with Black gum in very poor condition (possible military damage). Greenbrier, Holly and Blueberry were found in the understory.

This stand is a mixture of sawtimber 12" – 23.9" and pole timber 6" – 11.9". A few 24" trees throughout stand.

This stand is over stocked with 90 - 100% canopy closure.

Recommendations

-Stand is generally over stocked, mortality in co-dominant species and heavy suppression.
-Recommend reducing stock to favor oaks.

STAND	ACTIVITY	ACRES
2-6	commercial TSI	24.31
	control invasives	
	examine stand for commercial harvest	

Edgewood Area: Forest Map 3, Stand 3-2, 27.7 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Sweetgum and Red maple. Associate species include Willow oak, Walnut, Cherry Hickory, Virginia pine, White oak, Tulip poplar and Southern red oak. The understory is comprised of Barberry, Holly and Viburnum. None of the plots have regeneration, microstegium is dense. The current Canopy closure is 68 %, open gaps are present and areas of 95% closure. The high stocking is causing the bleeding canker in the Sweetgum dominating the stand.

This young saw timber stand has the following diameter distribution:

Mature	26"+	4%
Saw timber	11-23.9"	82%
Pole	6-10.9"	15%
Small tree	2-5.9"	1%

Currently the stand contains 157 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 188 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 58% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring high quality crop trees
-Cut vines in crop trees

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 188 B.A. and should be reduced to a B.A. of 90 sq.ft. which is all acceptable trees. The initial thinning will involve removing 98 sq.ft. of unacceptable saw timber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 28 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	DATE
3-2	TSI- single tree selection	27.7	2020
	Collect Data/Prepare new plan		2035

Edgewood Area: Forest Map 3, Stand 3-3, 16.5 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand borders the bay along the eastern boundary and was a homestead at one time. Mature trees and structures are still present. The stand is dominated by numerous pioneer species such as, Boxelder maple, Sweetgum, Walnut, Locust, Red maple, Cherry and Ash. The mature trees mostly oaks are in decline with a Willow Oak being 65" D.B.H. The understory is comprised of Barberry, Ailanthus and dense microstegium, highly invasive understory. None of the plots have regeneration, microstegium is dense. The current Canopy closure is 85%. The site is highly disturbed.

This saw timber stand has the following diameter distribution:

Mature	26"+	19%
Saw timber	11-23.9"	42%
Pole	6-10.9"	22%
Small tree	2-5.9"	7%

Currently the stand contains 110 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 100 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 80% stocking level. From a tree form and vigor stand point, 12% of the trees are acceptable.

Recommendations

-**Restoration /Mitigation** potential, for Critical Area

-Control the invasive understory and remove all unacceptable over story stock. Plant Oak species on a 20' x 20' spacing with a five-foot tree shelter. Maintain a 6' diameter circle around each planted tree to control ground completion.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	DATE
3-3	Restoration mitigation	16.5	as needed
	Collect data/prepare new plan		2031

Note: The entire site will not be available to plant.

Graces Quarters Area: Forest Map 3, Stand 3-5, 15.57 Acres

Overstory Summary Narrative

Data collected in 2003 states this stand is dominated by Sweet gum with associate species being; Yellow poplar, Red maple, White oak, Black cherry and Loblolly pine. No information was collected on the understory.

This small sawtimber stand has an average diameter of 8.8

Currently the stand contains 273.49 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 135 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 89.2% stocking level. From a tree form and vigor stand point, 55% of the trees are acceptable.

The acceptable sawtimber volume currently is 6,523 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Timber Stand Improvement

The thinning will involve reducing crown competition by lowering the basal area and the number of trees per acre. A thinning will increase the growth rate to the higher quality trees. Reduce Basal area to 70 sq.ft. per acre of acceptable growing stock. Favor oak and poplar as crop trees when viable.

STAND	ACTIVITY	ACRES
3-5	commercial TSI	15.57
	collect data/prepare plan	

Graces Quarters Area: Forest Map 3, Stand 3-6, 14.51 Acres

Overstory Summary Narrative

Data collected in 2003 states this stand is dominated by Sweet gum with associate species being; Red maple, Yellow poplar, Virginia pine and White oak. No information was collected on the understory.

This pole stand has an average diameter of 8.5".

Currently the stand contains 299.2 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 89.7% stocking level. From a tree form and vigor stand point, 56% of the trees are acceptable.

The sawtimber volume currently is 1,383 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Commercial TSI
-Reduce Basal area to 70 sq.ft. per acre of acceptable growing stock.
-Favor oak and poplar as crop trees when viable
-Collect data on forest health and regeneration.

STAND	ACTIVITY	ACRES
3-6	commercial TSI	14.51
	collect data/prepare plan	

Graces Quarters Area: Forest Map 3, Stand 3-7, 24.32 Acres

Overstory Summary Narrative

Data collected in 2003 states this stand is dominated by Sweet gum with associate species being; Chestnut oak, Yellow poplar, Red maple, White oak, Holly, Black cherry, Black oak and Black gum. No information was collected on the understory.

This large sawtimber stand has an average diameter of 12.3

Currently the stand contains 99.87 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 108.3 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 64.6% stocking level. From a tree form and vigor stand point, 51.7% of the trees are acceptable.

The acceptable sawtimber volume currently is 11,702 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Let stand go through natural succession as it is narrow and provides a long linear buffer to the bay.
-Manage towards Old growth, stand is approximately 180 years old.
-Collect data on forest health and regeneration.

STAND	ACTIVITY	ACRES
3-7	collect data/ prepare plan	24.32

Gracie's Quarters Area: Forest Map 3, Stand 3-8 35.54 Acres

Overstory Summary Narrative

Data was collected in 2019. The stand is dominated by Sweetgum, Tulip poplar with high quality oaks such as Willow, Southern red and White oaks with in the stand. The understory is comprised of Blueberry, Viburnum and Holly. None of the plots have regeneration, the current Canopy closure is 90 %. The stand is grossly over stocked with a BA of 167.

This large saw timber stand has the following diameter distribution:

Mature	26"+	13%
Saw timber	11-23.9"	59%
Pole	6-10.9"	17%
Small tree	2-5.9"	11%

Currently the stand contains 198 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 167 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a100+% stocking level. From a tree form and vigor stand point, 62% of the trees are acceptable.

The stand contains some very mature willow oaks 48 inch with quality 30-40-inch oaks also present making up 11 percent of the composition.

Recommendations

-Single Tree Selection/restoration favoring high quality crop trees of Poplar and Oak.
-Stand in Critical area

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 167 B.A. and should be reduced to a B.A. of 90 sq. ft. which is all acceptable trees. The initial thinning will involve removing 77 sq. ft. of unacceptable, matures, saw timber, pole timber, small trees as well as some acceptable quality trees.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
3-8	Restoration / TSI	35.54
	Collect data/prepare new plan	

Gracie's Quarters Area: Forest Map 3, Stand 3-9 56.86 Acres

Overstory Summary Narrative

Data was collected in 2019. The stand is dominated by Sweetgum, Tulip poplar with high quality oaks such as Willow, Southern red, Chestnut oak, Pin oak and White oaks with in the stand. Mid story trees consist
Of Hickory, Holly, Cherry and Black gum. The understory is comprised of Blueberry, Serviceberry and a sparse population of Green briar. None of the plots have regeneration, the current Canopy closure is 82%. The stand is grossly over stocked with a BA of 180.

This large saw timber stand has the following diameter distribution:

Mature	26"+	12%
Saw timber	11-23.9"	64%
Pole	6-10.9"	14%
Small tree	2-5.9"	10%

Currently the stand contains 214 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 80 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a100+% stocking level. From a tree form and vigor stand point, 64% of the trees are acceptable.
The stand contains some very mature old trees making up 12 percent of the composition.

Recommendations

-Single Tree Selection/restoration favoring high quality crop trees of Poplar and Oak
-Bleeding canker in some Sweetgum
-Wetland present
-Stand in Critical area
-Stand has an Eagle nest and buffer

From a management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 180 B.A. and should be reduced to a B.A. of 90 sq. ft. which is all acceptable trees. The initial thinning will involve removing 90sq.ft. of unacceptable, matures, saw timber, pole timber, small trees as well as some acceptable quality trees.
If permitted girdling would help create dead snags.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
3-9	Restoration / TSI	56.86
	Collect data/prepare new plan	

Gracie's Quarters Area: Forest Map 4, Stand 4-1, 23.58 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Tulip Poplar and Sweetgum with associate species being; Black cherry, Sycamore, Black gum, Red oak, Ash, Hickory and Red maple. The understory is sparse and comprised of Red maple, Black gum, Hickory, Cherry, Multiflora rose, and Microstegium.

This small sawtimber stand has an average stand diameter of 24 inches with the following diameter distribution breakdown:

Mature	26"+	5%
Sawtimber	11-23.9"	75%
Pole	6-10.9"	18%
Small tree	2-5.9"	2 %

Currently the stand contains 164 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 179 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 52% of the trees are acceptable.

The acceptable sawtimber volume currently is 10,000 – 12,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume, as more crop tree space is available.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer.
-This site is in the Critical Area and the harvest plan should be completed.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

From a timber management point of view this stand is in need of a commercial selective harvest. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 179 B.A. and should be reduced to a B.A. of 80 Sq.ft. The initial thinning will involve removing 99 sq.ft. of unacceptable sawtimber and pole timber. The undesirables can be utilized for pulpwood with the thinning producing approximately **220 cords** within the 20 acres of harvestable acreage. Following the commercial pulp or fuel wood sale the alien and invasive plants should be controlled or Poplar regeneration will not germinate a readily.

STAND	ACTIVITY	ACRES
4-1	Commercial TSI	20.00
	Control invasives	23.58
	Prepare new Plan	23.58

Edgewood Area: Forest Map 5, Stand 5-8, 31.84 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by mature Tulip poplar and mixed Oak species. Oak species include Willow oak, Southern red oak, Pin oak and White oak. Associate species include Sweetgum and Red maple. The understory is comprised of Barberry, Blueberry and Holly. The largest tree measured was a 49-inch Tulip poplar. This stand borders the bay and is very important for water quality. The regeneration plot survey found advanced regeneration in 0% of the plots. Currently, shade (Canopy closure) is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	13%
Sawtimber	11-23.9"	71%
Pole	6-10.9"	12%
Small tree	2-5.9"	4%

Currently the stand contains 100 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 150 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% plus stocking level. From a tree form and vigor stand point, 57% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-Manage for Old Growth

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursuing Old Growth in this mature stand by designating legacy trees, increasing growth to the larger trees, creating standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes; favoring all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth, instead it's found more valuable to increase the number of characteristics associated with these types of forest communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include:

Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type.

Create snags and down woody debris: Girdle trees of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.

Accelerate growth in legacy trees: Full or partial crown release. A total of 64 square feet of unacceptable growth is spread out among all size classes.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
5-8	Single Tree Selection Manage for Old Growth	31.84

Edgewood Area: Forest Map 5, Stand 5-9, 32 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum, White oak, Southern red oak and Tulip poplar with scattered Black cherry. Associate species include Black gum, Persimmon, Sassafras, Holly and Red maple. The understory is comprised of Barberry, Blueberry, Greenbrier, Pepperbush and Bayberry. Mature Poplar and Oaks are scattered through and account for 12% of the stocking as shown below. This stand borders the bay and is very important for water quality and has numerous man-made drainage patterns. The regeneration plot survey found advanced regeneration in 10% of the plots. Currently, shade (Canopy closure) is 95%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	12%
Sawtimber	11-23.9"	63%
Pole	6-10.9"	19%
Small tree	2-5.9"	6%

Currently the stand contains 124 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 133 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 37% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-This site is Eagle sensitive; either in buffer or nesting zone
-Shelterwood harvest

Currently the stand has a BA of 133 with only 40 sq. ft. of acceptable growing stock with regeneration being almost none existent. In order to remove the undesirable stock and open the canopy and ground layer for regeneration, the shelterwood should involve removing 3 sq. ft. of UGS matures, 52 sq. ft. UGS sawtimber, 21 sq. ft. pole UGS and 8 sq. ft. of small UGS.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
5-9	Shelterwood harvest	32
	Control invasives	
	Monitor natural regeneration	

Edgewood Area: Forest Map 5, Stand 5-10, 37.31 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum, White oak, Southern red oak, Tulip poplar and Willow oak. Associate species include Black gum, Black cherry and Red maple. The understory is comprised of Barberry, Blueberry, Greenbrier, Holly and Grapevine. Grapevine is hindering crown development; a canker is present in numerous Sweetgum. Mature Oaks are scattered throughout, a large 60-inch White oak recently blown down. These mature trees account for 8% of the stocking as shown below. This stand borders the bay, a large wetland marsh and is very important for water quality. The regeneration plot survey found advanced regeneration in 0% of the plots. Currently, shade (Canopy closure) is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	8%
Sawtimber	11-23.9"	75%
Pole	6-10.9"	14%
Small tree	2-5.9"	3%

Currently the stand contains 112 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 161 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 49% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-This site is Eagle sensitive; either in buffer or nesting zone
-Shelterwood harvest

Currently the stand has a BA of 161 with only 79 sq. ft. of acceptable growing stock with regeneration being almost none existent. In order to remove the undesirable stock and open the canopy and ground layer for regeneration, the shelterwood should involve removing 2 sq. ft. of UGS matures, 57 sq. ft. UGS sawtimber, 21 sq. ft. pole UGS and 2 sq. ft. of small UGS.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
5-10	Shelterwood harvest	37.31
	Control invasives	
	Monitor natural regeneration	

Edgewood Area: Forest Map 6, Stand 6-4, 35.07 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Tulip Poplar and Sweetgum with associate species being; Black cherry, Sycamore, Red oak, Ash, Hickory, Sassafras and Red maple. The understory is comprised of Spicebush, Holly, Pawpaw, Tree of Heaven, Wine berry, Multiflora rose, and Microstegium. No regeneration noted in the large canopy gaps after blow down. Highly invasive and alien understory is hindering regeneration along with the intense deer browse.

This large sawtimber stand has the following diameter distribution breakdown:

Mature	26"+	29%
Sawtimber	11-23.9"	52%
Pole	6-10.9"	16%
Small tree	2-5.9"	3 %

*Majority of Mature trees are unacceptable

Currently the stand contains 108 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 122 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, only 37% of the trees are acceptable.

The acceptable sawtimber volume currently is 7,000 ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer.
-This site is in the Critical Area and the harvest plan should be completed.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

From a timber management point of view this stand is in need of regeneration harvest. Yellow-poplar is a prolific seeder, and large crops are produced almost annually, a combination single tree selection and small less than ½ group selections will aid in regeneration. The Stand is marked in the same manner as with single-tree selection cut, the only difference being that small openings are created in the stand. Single-tree selection cutting occurs between the openings. The majority of the trees are unacceptable, leaving all acceptable sawtimber and pole timber as well as the higher quality matures trees will leave a residual basal area in the single tree selection areas of 60 sq.ft. per acre.

Controlling invasives and alien plants directly after the harvest is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
6-4	Single tree/small group harvest	35.07
	Control invasives	
	Prepare new plan	

Edgewood Area: Forest Map 6, Stand 6-7, 31.59 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Southern Red Oak *55", White Oak * 45", Tulip Poplar * 47" and Sweetgum * 36" with associate species being; Black cherry, Black Oak, Willow oak * 43", Sassafras, Hickory and Red maple. This stand has trees over 200 years old. The understory is comprised of Blueberry and dense Microstegium. Little to no regeneration noted in the large canopy gaps after blow down. Oak regeneration was very sparse and mostly under one foot in height. Highly invasive and alien understory is hindering regeneration along with the intense deer browse.
* Largest diameter in the stand by species.

This very mature stand has the following diameter distribution breakdown:

*Mature	26"+	42%
Sawtimber	11-23.9"	32%
Pole	6-10.9"	23%
Small tree	2-5.9"	3 %

Currently the stand contains 108 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 132 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 95% stocking level. From a tree form and vigor stand point, only 29% of the trees outside of the mature class are acceptable.

Recommendations

Manage towards Old Growth:

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursuing Old Growth in this mature stand by, designating legacy trees, increase growth to the larger, create standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes, favoring all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth, instead find it more valuable to increase the number of characteristics associated with these types of forest communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include;

Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type

Create snags and down woody debris: Girdle trees of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.

Accelerate growth in legacy trees: Full or partial crown release

Once canopy gaps are created by girdling poorly formed trees, plant 200 trees per acre (with a 6-foot shelter height) of Oak and Poplar to aid in regeneration of this stand that plays a major role in protecting the bay.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
6-7	Active manage for Old Growth	31.59
	Plant bare root seedlings/ shelter	
	Control invasives	
	Prepare new Plan	

Edgewood Area: Forest Map 6, Stand 6-10, 26.15 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Southern red oak *48", White oak 56", Swamp white oak, Tulip poplar and Sweetgum with associate species being; Black cherry, Black oak, Willow oak, Chestnut oak, Black gum, Hickory and Red maple. This stand has trees over 200 years old. The understory is comprised of Blueberry, Wine berry, Barberry and dense Microstegium. Oak regeneration averaged approximately 5,000 small seedlings per acre but consistent coverage is not present and most trees are under one foot in height. Highly invasive and alien understory is hindering regeneration along with the intense deer browse.
* Largest diameter in the stand by species.

This very mature stand has the following diameter distribution breakdown:

Mature	26"+	42%
Sawtimber	11-23.9"	44%
Pole	6-10.9"	13%
Small tree	2-5.9"	1 %

Currently the stand contains 80 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 111 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 85% stocking level. From a tree form and vigor stand point, only 34% of the trees outside of the mature class are acceptable.

Recommendations

-Manage towards Old Growth:
Actively pursue Old Growth in this mature stand by, designating legacy trees, increase growth to the larger, create standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes, favoring all species and create down woody debris often found in Old growth forest. Structural objectives and silvicultural techniques used to achieve structural enhancement may include;

-Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type

-Create snags and down woody debris: Girdle trees of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.

-Accelerate growth in legacy trees: Full or partial crown release

Once canopy gaps are created by girdling poorly formed trees, shelter 200 existing high-quality seedlings per acre (with a 6-foot shelter) so the regeneration can become established without the deer pressure. Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES

6-10	actively manage for Old Growth Shelter existing seedlings Control invasives Prepare new Plan	26.15

Forest Map 6, Stand 6-11, 24.65 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow Poplar and Sweet gum with associate species being; Cherry and Locust. Very few Holly and blueberry were found in the understory. Invasive plants include Microstegium, Multiflora rose, Barberry and Grapevine.

This is a small sawtimber stand 12" – 23.9" with scattered mature trees.

This stand is adequately stocked with 90% canopy closure.

This stand has 180 trees per acre. Basal area 150.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.

STAND	ACTIVITY	ACRES
6-11	commercial TSI	24.65
	control invasives	
	examine stand for commercial harvest	

Forest Map 6, Stand 6-12, 23.55 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow Poplar and Sweet gum with associate species being; Red maple, Southern red oak, Hickory, Black gum, Locust and Black oak. Holly, Ash, Blueberry and Sassafras were found in the understory. Invasive plants include Microstegium, Honeysuckle, Multiflora rose and Grapevine.

This is a mature sawtimber stand 12" – 23.9"

This stand is over stocked with 90% canopy closure.
This stand has 140 trees per acre.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.

STAND	ACTIVITY	ACRES
6-12	commercial TSI	23.55
	control invasives	
	examine stand for commercial harvest	

Forest Map 6, Stand 6-13, 12.43 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow Poplar, White oak and Sweet gum with associate species being; Holly, Hickory, Black oak and Black gum. Holly, Hickory, Dogwood, Greenbrier and blueberry were found in the understory. Invasive plants include Microstegium, Honeysuckle and Grapevine.

This is a mature sawtimber stand 12" – 23.9"

This stand is over stocked with 20 - 80% canopy closure with large gaps.

This stand has 180 trees per acre. The basal area is 150.

Recommendations

-Potential to be managed as an old growth forest. (50" + diameter White oak, 250 years old.)

STAND	ACTIVITY	ACRES
6-13	commercial TSI	12.43
	control invasives	
	examine stand for commercial harvest	

In 2016 MLE performed restoration activities. This 12.43-acre forest enhancement site is in the Critical Area. This stand also contains a 6-acre planting which spans between stands 6-13 and 6-14 for a total of 1200 trees.

The stand is dominated by Tulip poplar, and mature Oaks; with associate species being Red maple and Sweetgum. The understory contains dense areas of Holly, shading the forest floor and Greenbrier, which was treated due to its dense population.

Mar-Len Environmental, Inc. (MLE) removed unacceptable growing stock; allowing sunlight to filter to the forest floor. Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Red maple and Sweetgum were targeted for removal to help restore the natural forest ecosystem.

Forest Map 6, Stand 6-14, 37.36 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow Poplar and Sweet gum with associate species being; Cherry, Southern Red Oak, Holly, Pin oak, Red maple, Sassafras and Willow oak. Holly, Serviceberry, Greenbrier and blueberry were found in the understory. Invasive plants include Microstegium, Honeysuckle, Multiflora rose and Grapevine.

This is a mature sawtimber stand 12" – 23.9"

This stand is over stocked with 80-85% canopy closure.
This stand has 170 trees per acre. The basal area is 170.

Recommendations

Release the grapevine from the canopy.

STAND	ACTIVITY	ACRES
6-14	commercial TSI	37.36
	control invasives	
	examine stand for commercial harvest	

In 2016 MLE performed restoration work. This forest enhancement site is in the Critical Area. This stand also contains a 6-acre planting which spans between stands 6-13 and 6-14 for a total of 1200 trees.

The stand is dominated by Tulip poplar, and mature Oaks; with associate species being Red maple and Sweetgum. The understory contains dense areas of Holly, shading the forest floor.

Mar-Len Environmental, Inc. (MLE) removed unacceptable growing stock; allowing sunlight to filter to the forest floor. Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Red maple and Sweetgum were targeted for removal to help restore the natural forest ecosystem

Edgewood Area: Forest Map 7, Stand 7-1, 30.80 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Southern red oak, White oak, Chestnut oak, Pin oak, Tulip poplar, and Northern red oak. The understory is comprised of Sassafras, Serviceberry, Blackgum, Red maple, Paw paw, Blackberry, and Holly. This stand borders the bay to the North and currently has 1900 seedlings per acre. The regeneration plot survey found advance regeneration in only 50% of the plots; shade (Canopy closure) 85%, deer and invasives are major factors.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	33%
Sawtimber	11-23.9"	43%
Pole	6-10.9"	17%
Small tree	2-5.9"	3%

Currently the stand contains 184 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 111 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 95% plus stocking level. From a tree form and vigor stand point, 71% of the trees are acceptable. The sawtimber volume currently is 11,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available. Portions of the stand are forested wetlands that should be avoided.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer along Bay.
-This site is in the Critical Area and the harvest plan should be completed.
-Eagle buffer / FID AREA

Stand is overstocked at 95% stocking and a BA of 116. Ideal stocking in this Oak dominated stand is to have a BA of 80 sq. ft. per acre; this will involve removing 15 ft. per acre of mature trees, 15 sq. ft. per acre of unacceptable sawtimber, and 16 sq. ft. of unacceptable pole timber. The residual stand/stocking, after the harvest, will allow the current Oak regeneration to become established.

STAND	ACTIVITY	ACRES
7-1	Control invasives	30.80
	Selective Harvest	
	Prepare new Plan	

Edgewood Area: Forest Map 7, Stand 7-2, 54.82 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Swamp chestnut oak, White oak, Willow oak, Sweetgum, Tulip poplar, Walnut, and Paulownia. The understory is comprised of Blackgum, Red maple, Paw paw, Blackberry, Spicebush, Blueberry, Paulownia, and Holly. This stand borders the bay for 2400 feet. The regeneration plot survey found advance regeneration in 0% of the plots; shade (Canopy closure) 80%, deer and invasives are major factors. Microstegium, Tear thumb, Barberry, and Honeysuckle are common in open gaps throughout the stand.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	40%
Sawtimber	11-23.9"	44%
Pole	6-10.9"	14%
Small tree	2-5.9"	2%

Currently the stand contains 90 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 117sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 80% plus stocking level. From a tree form and vigor stand point, 41% of the trees outside of the mature class are acceptable. Mature trees exist in the stand; a 54-inch Paulownia, 56-inch Northern red oak, and a 54-inch White oak were located.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer along Bay.
-This site is in the Critical Area and the harvest plan should be completed.
-Eagle buffer

The stand is under stocked in quality trees, and most matures are in decline. Within the gaps, invasive plants exist, preventing regeneration. The stand is in need of restoration to improve water quality, and to support Eagle habitat. The vines and invasive plants should be eradicated and the openings planted in Oak and Poplar species. Once the invasive plants are controlled in the understory the native seed should become established. This is a priority restoration site, due to its location to the bay and Eagle nest.

STAND	ACTIVITY	ACRES
7-2	Forest restoration	54.82
	Prepare new Plan	

Edgewood Area: Forest Map 7, Stand 7-3, 20.76 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Sweetgum and Tulip poplar. The associate species include White oak, Pin oak, Willow oak, Southern red oak, Hickory, and Loblolly pine. The understory is comprised of Blackhaw, Winterberry, Greenbrier, Paw paw, Blueberry, Paulownia, and Holly. This stand borders the bay for 1200 feet. The regeneration plot survey found advanced regeneration in 0% of the plots; shade (Canopy closure) 80%, deer and invasives are major factors. Japanese honeysuckle vine dominates the understory.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	12%
Sawtimber	11-23.9"	72%
Pole	6-10.9"	13%
Small tree	2-5.9"	3%

Currently the stand contains 85 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 137sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 33% of the trees outside of the mature class are acceptable. The acceptable sawtimber volume is 8,000 bd. ft. per acre.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer along Bay.
-This site is in the Critical Area and the harvest plan should be completed.
-Eagle buffer

From a timber management point of view this stand is in need of a commercial thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 137 B.A. and should be reduced to a B.A. of 55 Sq.ft. which is all acceptable trees and matures. The initial thinning will involve removing 82 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 24 cords per acre. The invasives should be controlled prior to harvest.

STAND	ACTIVITY	ACRES
7-3	Control invasives	20.76
	TSI	
	Prepare new Plan	

Edgewood Area: Forest Map 8, Stand 8-2, 53.23 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by mixed Oak species which include; White oak, Southern red oak, Willow oak and Chestnut oak. Associate species include Sweetgum, Tulip poplar and Red maple. The understory is comprised of Sweet pepperbush, Blueberry, Greenbrier, Azalea and Aralia. Mature Oaks account for 15% of the stocking as shown below. The entire length of the stand borders the bay. The regeneration plot survey found advanced regeneration in the seedling group to equal 140 per acre and of the sapling group 38 per acre. Currently, shade (Canopy closure) is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	15%
Sawtimber	11-23.9"	50%
Pole	6-10.9"	27%
Small tree	2-5.9"	8%

Currently the stand contains 180 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 109 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% stocking level. From a tree form and vigor stand point, 49% of the trees are acceptable.

Access to the site is difficult due to the number of wetlands in and around the stand.

Recommendations

-This site is in the MD defined Critical Area
-Shelterwood harvest

In order to release and increase Oak and Poplar regeneration the UGS should be removed. Currently the stand has a BA of 109 with only 54 sq. ft. of acceptable growing stock with regeneration being almost none existent. In order to remove the undesirable stock and open the canopy and ground layer for regeneration, the shelterwood should involve removing 2 sq. ft. of UGS matures, 27 sq. ft. UGS sawtimber, 23 sq. ft. pole UGS and 8 sq. ft. of small UGS.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
8-2	Shelterwood harvest	53.23
	Control invasives	
	Monitor natural regeneration	

Edgewood Area: Forest Map 8, Stand 8-8, 66.25 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand borders the bay along its entire eastern boundary; 3,612 ft. along the Maryland defined Critical Area. The stand shows signs of severe anthropogenic activity. Sweetgum is the most prevalent species with associate species being Red maple, Locust, Sycamore, Holly, and Persimmon, Black cherry, Willow oak and Paulownia. The native understory is comprised of Blueberry and Bayberry. None of the field plots had native regeneration. The invasive plant community, such as Japanese honeysuckle, Multiflora rose, Mile a minute vine, Wineberry and Oriental bittersweet along with numerous dead and down trees makes the site almost impassible. Crowns of the trees are often covered in vines including native Grapevine. The current canopy closure is sparse at 15 percent closure; which has allowed the invasive plants to take over.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	5%
Sawtimber	11-23.9"	70%
Pole	6-10.9"	24%
Small tree	2-5.9"	1%

Currently the stand contains 148 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 94 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 70% stocking level. From a tree form and vigor stand point only 20% of the trees are acceptable. This stand is considered degraded and should be restored as it provides valuable water shed protection.

Recommendations

-In the MD defined Critical Area
-Site restoration as need to for mitigation, control invasives and replant.
-Site needs UXO scan prior to any restoration.

STAND	ACTIVITY	ACRES
8-8	Restore Forest	5 acres increments.

** Time table cannot be established

Edgewood Area: Forest Map 8, Stand 8-9, 31.2 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Sweetgum, Willow oak and Pin oak. Associate species include Persimmon and Red maple. The understory is comprised of Blueberry, Barberry, Wine berry and Microstegium. Only one plot had an Oak seedling, the remaining plots had no regeneration. The current Canopy closure is 85 %. The high stocking is causing stress on the Sweetgum dominating the stand. This stand is the critical area and borders a marsh and plays a major role in protecting water quality.

This timber stand has the following diameter distribution:

Mature	26"+	1%
Saw timber	11-23.9"	83%
Pole	6-10.9"	15%
Small tree	2-5.9"	1%

Currently the stand contains 200 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 156 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a115 stocking level. From a tree form and vigor stand point, 62% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring high quality Oak crop trees and Sweetgum.
-Cut vines in crop trees

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 156 B.A. and should be reduced to a B.A. of 90 sq.ft. which is all acceptable trees. The initial thinning will involve removing 66 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre. This stand has good access and can be easily managed.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	DATE
8-9	TSI-single tree selection	31.2	2020
	Collect data/prepare new plan		2035

Edgewood Area: Forest Map 8, Stand 8-10, 9.97 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by mixed Oak and Sweetgum. Oaks include White oak, Pin oak, Willow oak, Southern red oak, Swamp chestnut oak with Red maple and Paulownia. The understory is comprised of Greenbrier, Blueberry, Blackgum, and Holly. This stand borders the bay along its northern boundary. The regeneration plot survey found advanced regeneration in 0% of the plots; shade (Canopy closure) 70%, and deer are major factors.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	18%
Sawtimber	11-23.9"	54%
Pole	6-10.9"	28%
Small tree	2-5.9"	0%

Currently the stand contains 80 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 110sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 85% plus stocking level. From a tree form and vigor stand point, 41% of the trees outside of the mature class are acceptable. The acceptable sawtimber volume is 4,000 bd. ft. per acre.

Recommendations

-This site is in the Critical Area.

This site is too sensitive for management, hydric soils and forested wetlands are common throughout.

STAND	ACTIVITY	ACRES
8-10	Inspect for health	9.97
	Prepare new Plan	

Edgewood Area: Forest Map 8, Stand 8-11, 16.34 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by mature timber with Tulip poplar and mixed Oak species. Associate species include Sweetgum, Hickory, and Red maple. The understory is comprised of Greenbrier, Blueberry, Blackgum, and Holly. This stand is directly adjacent to the H Field range. The regeneration plot survey found advanced regeneration in 0% of the plots; however, 8-10 ft. tall Oak saplings are common in the stand and will be released during a thinning. Currently, shade (Canopy closure) is 80%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	29%
Sawtimber	11-23.9"	53%
Pole	6-10.9"	15%
Small tree	2-5.9"	3%

Currently the stand contains 110 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 143sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% plus stocking level. From a tree form and vigor stand point, 35% of the trees outside of the mature class are acceptable. The acceptable sawtimber and mature volume is 11,550 bd. ft. per acre.

Recommendations

-This site is in the Critical Area
-TSI & old Growth
-Eagle buffer

From a timber management point of view this stand is in need of a commercial thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 143 B.A. and should be reduced to a B.A. of 77 Sq. ft which is all acceptable trees. The initial thinning will involve removing 66 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre.

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursuing Old Growth in this mature stand by, designating legacy trees, increase growth to the larger, create standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes, favoring all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth, instead find it more valuable to increase the number of characteristics associated with these types of forest

communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include;
-Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type
-Create snags and down woody debris: Girdle trees of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.
-Accelerate growth in legacy trees: Full or partial crown release

Once canopy gaps are created by girdling poorly formed trees or removing by TSI, the existing regeneration should flourish. Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
8-11	TSI	16.34
	Manage for Old Growth	
	Prepare new plan	

Edgewood Area: Forest Map 9, Stand 9-6, 16.46 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Willow oak, White oak, Southern red oak, Tulip poplar, Sweetgum, and Red maple. The midstory contains big leaf magnolia, Persimmon, Sassafras, and Black gum, with an understory comprised of Blueberry, Blackberry and Pepperbush. This stand borders a large marsh to the South and shows signs of damage from Hurricane Sandy. The regeneration plot survey found advanced regeneration in 0% of the plots; due to shade (Canopy closure) is 80% and invasive plants such as Barberry and Microstegium. Wetland pockets are common in the stand.

This large sawtimber stand has the following diameter distribution:

Mature	26"+ 15%
Sawtimber	11-23.9" 57%
Pole	6-10.9" 14%
Small tree	2-5.9" 14%

Currently the stand contains 110 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 131sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% plus stocking level. From a tree form and vigor stand point, 48% of the trees outside of the mature class are acceptable. The acceptable sawtimber is 8,000 bd. ft. per acre. Once the undesirables are removed the stand should increase in volume as space is available.

Recommendations

-Logging roads should be maintained for access and fire control
-Flag off 100 ft buffer
-This site is in the Critical Area and a harvest plan should be completed
-TSI
-Eagle buffer

From a timber management point of view this stand is in need of a commercial thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 131 B.A. and should be reduced to a B.A. of 70 Sq.ft. which is all acceptable trees and matures. The initial thinning will involve removing 61 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre.

STAND	ACTIVITY	ACRES
9-6	Control invasives	16.46
	TSI	
	Prepare new plan	

Forest Map 9, Stand 9-12, 29.13 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow poplar, White oak, Red oak, Black cherry and Red maple with associate species being; Yellow poplar, White oak, Red oak, Black cherry and Red maple. Holly, Dogwood, Blueberry and Greenbrier were found in the understory. Invasive plants include Microstegium and Barberry.

This is a sawtimber stand 12" – 23.9"

This stand is over stocked with 80% canopy closure.

This stand has 120 trees per acre.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft^2/ac average with at least 70 percent canopy closure at all times.

STAND	ACTIVITY	ACRES
9-12	commercial TSI	29.13
	control invasives	
	examine stand for commercial harvest	

Edgewood Area: Forest Map 10, Stand 10-1, 41.18 Acres

Overstory Summary Narrative

Data was collected in 2011. This stand is dominated by Tulip Poplar with associate species being; Sweetgum, Black cherry, Black gum, Red oak, Ash, Hickory and Red maple. The understory is comprised of Holly, Spicebush, Honeysuckle and dense Microstegium. Down wood is common, as is uprooted trees. This stand borders the bay, but is deteriorating and not sustainable in its current state. The regeneration plot survey found advance regeneration in only 7 % of the plots; shade, deer and invasives are major factors.

This large saw timber stand has the following diameter distribution:

Mature	26"+	31%
Sawtimber	11-23.9"	60%
Pole	6-10.9"	6%
Small tree	2-5.9"	3 %

Currently the stand contains 95 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% plus stocking level. From a tree form and vigor stand point, 28% of the trees outside of the mature class are acceptable. The majority of the mature trees are in poor condition, however; high quality seed trees are present.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer.
-This site is in the Critical Area and the harvest plan should be completed.

From a sustainable management point of view this stand is in need of regeneration. The establishment of a new forest stand from the partial removal of the overstory is needed. Each harvest if done in a series is a shelterwood treatment. The essential characteristic is that the new forest stand is being established naturally before the complete overstory trees from the original forest stand are removed. Remove 80 sq.ft. of Basal area in the first cut leaving 50 square feet comprised of the acceptable saw timber and the highest quality mature trees as seed trees. The site will need to be treated to remove the invasive plant community to allow the seed to germinate. Twenty years after the new stand is establish the residual large sawtimber and matures can be removed or left to create a two aged forest system.

Following the harvest, the alien and invasive plants should be controlled or Poplar will not germinate as readily.

STAND	ACTIVITY	ACRES
10-1	Shelterwood	41.18
	Control invasives	
	Prepare new Plan	

Edgewood Area: Forest Map 10, Stand 10-4, 32.2 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Sweetgum and Tulip poplar. Associate species include Persimmon, Sassafras, Black gum, Cherry, Paulownia, Willow oak and Red maple. The understory is comprised of Bayberry, Barberry, Multiflora rose and Microstegium. No regeneration within the plots. The current Canopy closure is 85 %. This stand is the critical area and borders a marsh along the entire western boundary and plays a major role in protecting water quality. This stand shows signs of anthropogenic activity and has large abundance of downed wood.

This timber stand has the following diameter distribution:

Mature	26"+	15%
Saw timber	11-23.9"	74%
Pole	6-10.9"	7%
Small tree	2-5.9"	4%

Currently the stand contains 103 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 133 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100 stocking level. From a tree form and vigor stand point, 58% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring high quality Oak crop trees and Sweetgum.
-Cut vines in crop trees
-Restoration/Mitigation

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 133 B.A. and should be reduced to a B.A. of 77 sq. ft. which is all acceptable trees. The initial thinning will involve removing 56 sq.ft. of unacceptable saw timber, pole timber and small trees. The trees can be utilized for pulpwood and low-grade logs, the thinning producing approximately 18 cords per acre. This stand has good access and can be easily managed, however; due to past use the site may be sensitive to large scale activity. Restoration/Mitigation along the bay is also an option for future silvicultural activity. Control the invasive understory and remove all unacceptable over story stock. Plant Oak species on a 20’ x 20’ spacing with a five-foot tree shelter. Maintain a 6’ diameter circle around each planted tree to control ground completion.
Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	DATE
10-4	TSI single tree selection	32.2	2020
	Collect data/prepare new plan		2035

Edgewood Area: Forest Map 10, Stand 10-9, 110.49 Acres

Overstory Summary Narrative

Data was collected in 2012. An important buffer and FIDS habitat area; there is over 6300 feet of forest along the wetlands, marshes, and Bay. This stand is dominated by Tulip poplar and mixed Oak. Oaks include Southern red oak, Pin oak, Northern red oak, Chestnut oak, White oak, and Willow oak. The understory is sparse, and consists of Blackhaw, Hornbeam, Serviceberry, and Blackgum. The 30 regeneration plots show advanced regeneration in only 16% of the plots; due to shade (canopy closure) is 80% and deer pressure.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	19%
Sawtimber	11-23.9"	70%
Pole	6-10.9"	9%
Small tree	2-5.9"	2%

Currently the stand contains 95 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 131sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand 100% plus stocking level. From a tree form and vigor stand point, 58% of the trees outside of the mature class are acceptable. The acceptable sawtimber is 12,000 bd. ft. per acre.

Recommendations

-Logging roads should be maintained for access and fire control
-Flag off 100 ft buffer
-This site is in the Critical Area and a harvest plan should be completed
-TSI & Old Growth
-Eagle buffer& FIDS

From a timber management point of view this stand is in need of a commercial thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 131 B.A. and should be reduced to a B.A. of 80 Sq.ft. which is all acceptable trees and matures. The initial thinning will involve removing 51 sq.ft. of unacceptable sawtimber, pole timber, small trees, and poor quality matures.

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursuing Old Growth in this mature stand by designating legacy trees, increase growth to the larger, create standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes, favoring all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth, instead find it more valuable to increase the number of characteristics associated with these types of forest

communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include;

-Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type
-Create snags and down woody debris: Girdle trees of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.
-Accelerate growth in legacy trees: Full or partial crown release

Once canopy gaps are created by TSI and poorly formed trees are removed, Oak and Poplar regeneration should have a better chance to become established, however deer management is needed.

STAND	ACTIVITY	ACRES
10-9	TSI	110.49
	Manage toward Old Growth	
	Prepare new plan	

Edgewood Area: Forest Map 10, Stand 10-11, 50.53 Acres

Overstory Summary Narrative

Data was collected in 2012. An important Eagle buffer and roost area Cooper's Creek is the largest roost in the Edgewood area. Two major storms have caused massive tree damage, and this stand is in need of restoration. Due to this damage; our data reflects only the forested areas. This stand is dominated by Tulip poplar, with associated species being Willow oak and Southern red oak. The understory consists of Blackhaw, Blueberry, and Blackberry. The 17 regeneration plots show no advanced regeneration; due to shade (canopy closure) 90% in the forested areas, and dense invasive plant cover, such as Microstegium, and Mile a Minute weed prohibit regeneration in the openings where storm damage has occurred.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	34%
Sawtimber	11-23.9"	53%
Pole	6-10.9"	11%
Small tree	2-5.9"	2%

Currently the stand contains 61 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 109 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 80% plus stocking level. From a tree form and vigor stand point, 32% of the trees outside of the mature class are acceptable. The acceptable sawtimber is 10,000 bd. ft. per acre.

Recommendations

-Logging roads should be maintained for access and fire control
-Flag off 100 ft buffer
-This site is in the Critical Area and a harvest plan should be completed
-TSI & Salvage Harvest
-Restoration*
-Eagle buffer & FIDS

All downed timber was removed that is still viable. From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 109 B.A. and should be reduced to a B.A. of 70 Sq.ft. which is all acceptable trees and matures. The initial thinning will involve removing 36sq.ft. of unacceptable sawtimber, pole timber, small trees, and all viable down wood.

Following the salvage harvest, the invasive plant community needs to be controlled so the sight can be replanted. The oldest blow down area along the Eastern shore, near the Eagle nest approximately 6 acres, needs to be planted with 300 trees per acre, predominately Poplar and Oak. The remaining blow down area (14 +/- acres) should be planted with 70 to 100 trees per acre, in large gaps areas.

Poplar regeneration should have a better chance to become established, however deer management is needed.

STAND	ACTIVITY	ACRES
10-11	TSI & Salvage	43
	Prepare new plan	50.53

In December, 2013 APG restored part of the Forest Community in Coopers Creek Eagle Nest site at N-Field. The area was dramatically impacted by storm damage. The majority of the trees on site were blown down and covered with a dense layer of invasive plants. Approximately 710 +- trees were planted and sheltered on approximately 6.7 acres.

This Tulip Poplar dominated site was planted with mixed oaks suited for moist to wet soils.
These oaks will have a longer life span, than poplar and will withstand high winds and storms with in the critical area, along the bay.

Activities:

-Re-opened 1,600 ft of existing access road that was closed due to storm debris.
-Flagged site outer boundaries.
-Laid out a trail system within the planting for future maintenance.
-Staked each individual planting location.
-Performed UXO at each plating location and road access location.
-Removed Downed trees and invasive plants.
-Scarified soil to allow Tulip Poplar and other native seeds to come in contact with the soil.
(This will promote native plant regeneration).
-Removed downed trees to create road access
-Secured dig permit
-Planted and sheltered each tree

Note: The project benefited Eagle Habitat, Water Quality, and Mission Sustainability; the site is in the Critical Area.

Forest Map 10, Stand 10-16, 5.15 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Ash, Locust, Persimmon, Black cherry, Red maple, Sycamore, Yellow poplar and Pin oak. Honeysuckle, Grapevine, Holly and Blueberry were found in the understory. Invasive plants include Microstegium, Honeysuckle and Grapevine.

This is a pole timber stand 6" – 11.9"

This stand is adequately stocked with 75% canopy closure.

This stand has 140 trees per acre.

Recommendations

-May need to replant after reevaluating fire damage.

STAND	ACTIVITY	ACRES
10-16	commercial TSI	5.15
	control invasives	
	examine stand for commercial harvest	

Forest Map 10, Stand 10-17, 57.80 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum and Red maple with associate species being; Yellow poplar, Pin oak and Black cherry. Blueberry, Greenbrier and Holly were found in the understory. Invasive plants include Honeysuckle, Barberry and Multiflora rose.

This is a mixed stand, sawtimber 12" – 23.9", pole timber 6" – 11.9" (average 8" – 20")

This stand is adequately stocked with 90% canopy closure.

This stand has 140 - 160 trees per acre.

Recommendations

-Heavy deer browse, even Greenbrier browsed.

STAND	ACTIVITY	ACRES
10-17	commercial TSI	57.80
	control invasives	
	examine stand for commercial harvest	

Edgewood Area: Forest Map 11, Stand 11-1, 13.1 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Sweetgum, Red maple and Tulip poplar. Associate species include Holly, Hickory, Cherry, Walnut, Oaks and Black gum. The understory is comprised of Barberry, Multiflora rose, Greenbrier, Bittersweet and Microstegium. No regeneration within plots. The current Canopy closure is 90 %.
This stand is the critical area and borders a marsh and plays a major role in protecting water quality, with a large portion of the acreage in the 100-foot buffer.

This timber stand has the following diameter distribution:

Mature	26"+	26%
Saw timber	11-23.9"	61%
Pole	6-10.9"	13%
Small tree	2-5.9"	0%

Currently the stand contains 127 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 126 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 98% stocking level. From a tree form and vigor stand point, 73% of the trees are acceptable, which include 43 % matures. This stand has numerous blowdowns and areas of construction rubble. Since regeneration is so poor restoring the site by planting within natural or created gaps would benefit the stand long term.

Recommendations

-Manage towards old growth
-Establish regeneration by planting and controlling the understory.

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursuing Old Growth in this mature stand by designating legacy trees, increasing growth to the larger trees, creating standing dead, create canopy gaps to aid in natural regeneration or establishing regeneration.

There is no one specific condition to aim for as a condition of old growth, instead it's found more valuable to increase the number of characteristics associated with these types of forest communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include: Accelerate growth in legacy trees: Full or partial crown release. A total of 73 square feet of unacceptable growth is spread out among all size classes.
Controlling invasives and alien plants is imperative to natural regeneration success and aids in planted regeneration growth. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES	DATE
11-1	Single Tree Selection	13.1	2020
	Restoration/mitigation plantings		2020
	Prepare new plan		2035

Edgewood Area: Forest Map 11, Stand 11-2, 75 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by mixed Oak, Hickory and Tulip poplar. Oaks include Willow oak, White oak, Chestnut, Southern red, Northern red, Swamp chestnut and Pin oak. Associate species include Sweetgum and Red maple. This stand has nice quality Oak and Poplar and shows signs of being harvest 25 plus years ago. The understory is comprised of Blueberry, Sweet pepper bush, Holly and Serviceberry. Advance regeneration was found within 83 percent of the plots with an average of approximately 4,800 per acre and scattered Oaks in the 15-20-foot height class. The current Canopy closure is 85 %. This stand is the critical area and borders a marsh on three sides and playing a major role in protecting water quality. Scattered forested wetland dot this stands landscape.

This timber stand has the following diameter distribution:

Mature	26"+	23%
Saw timber	11-23.9"	58%
Pole	6-10.9"	13%
Small tree	2-5.9"	6%

Currently the stand contains 120 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 149 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 64% of the trees are acceptable.

The saw timber volume currently is 12,000 bd. ft. per acre; removing mature and low-quality saw timber will produce approximately 6,000 per acre.

Recommendations

-Aid in releasing natural regeneration, as future seed trees
-Reduce deer browse to ensure sustainability of the forest.
-Shelter wood harvests reduce the basal area to 65 sq. feet per acre of good seed trees.
-Collect data 15 years later for survey of regeneration to see if remaining saw timber can be removed.
-Keep residual stand with advancing regeneration or remove residual crop trees in a final harvest in the shelter wood series the over story removal of residuals which will release established regeneration from competition with the existing over story.

STAND	ACTIVITY	ACRES	DATE
11-2	Shelterwood Cut	75	2020
	Re-inspect Harvest		2030

Edgewood Area: Forest Map 11, Stand 11-9, 16.11 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Sweetgum (95%) with associate species being; Persimmon. The understory is sparse and comprised of Barberry, Multiflora rose, Blueberry and dense Microstegium. Two vines Grape and Va. Creeper are hindering some crowns from developing.

This small sawtimber stand with the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	23%
Pole	6-10.9"	63%
Small tree	2-5.9"	14 %

Currently the stand contains 472 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 182 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 58% of the trees are acceptable.
The acceptable sawtimber volume currently is 3,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume, as more crop tree space is available.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer from Bay.
-This site is in the Critical Area and the harvest plan should be completed.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

From a timber management point of view this stand is in need of a commercial selective harvest. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 182 B.A. and should be reduced to a B.A. of 80 Sq.ft. The initial thinning will involve removing 102 sq.ft. of unacceptable sawtimber and pole timber, as well as 20 Sq.ft. per acre of acceptable pole timber. The trees can be utilized for pulpwood with the thinning producing approximately 25 cords per acre.

STAND	ACTIVITY	ACRES
11-9	Commercial TSI	16.11
	Prepare new Plan	

Edgewood Area: Forest Map 11, Stand 11-10, 29.15 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Sweetgum with associate species being; Southern red oak, Hickory, Red maple, Willow oak, Pin oak, and Cherry. The understory is comprised of Barberry, Viburnum, Blueberry and dense Microstegium. Due to overstocking /stress the Sweetgum trees have Bleeding Canker, (Botryosphaeria) with many trees structurally weak.

This sawtimber stand has the following diameter distribution:

Mature	26"+	2 %
Sawtimber	11-23.9"	70%
Pole	6-10.9"	25%
Small tree	2-5.9"	3 %

Currently the stand contains 176 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 158 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 53% of the trees are acceptable.
The acceptable sawtimber volume currently is 6,500 bd. ft. per acre; once the undesirables are removed the stand will increase in volume, as more crop tree space is available.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-This site is in the Critical Area and the harvest plan should be completed.
-Flag off 100 foot no cut buffer from Bay.

From a timber management point of view this stand is in need of a commercial selective harvest in. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 158 B.A. and should be reduced to a B.A. of 80 Sq.ft. The initial thinning will involve removing 78 sq.ft. of unacceptable sawtimber and pole timber. The trees can be utilized for pulpwood with the thinning producing approximately 25 cords per acre.

STAND	ACTIVITY	ACRES
11-10	Commercial TSI	29.15
	Prepare new Plan	

Edgewood Area: Forest Map 11, Stand 11-11, 34.99 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Sweetgum, Poplar and Pin oak, with associate species being; Southern red oak, Hickory, Red maple, Willow oak, Pin oak, Sassafras, Locust, Persimmon, Black oak and Cherry. The understory is comprised of Barberry, Blueberry, Multiflora rose, Honeysuckle and dense Microstegium. Due to overstocking /stress the Sweetgum trees have Bleeding Canker, (Botryosphaeria) with many trees structurally weak.

This sawtimber stand has the following diameter distribution:

Mature	26"+	16 %
Sawtimber	11-23.9"	67%
Pole	6-10.9"	16%
Small tree	2-5.9"	1 %

Currently the stand contains 180 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 186 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 54% of the trees are acceptable.
The acceptable sawtimber volume currently is 7,500 bd. ft. per acre; once the undesirables are removed the stand will increase in volume, as more crop tree space is available.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-This site is in the Critical Area and the harvest plan should be completed.
-Flag off 100 foot no cut buffer from Bay.

From a timber management point of view this stand is in need of a commercial selective harvest in. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 186 B.A. and should be reduced to a B.A. of 80 Sq.ft. of acceptable growing stock. The initial thinning will involve removing 106 sq.ft. of unacceptable sawtimber/ pole timber and poor quality matures. The trees can be utilized for pulpwood with the thinning producing approximately 30 cords per acre. Oaks should be favored as crop trees.

STAND	ACTIVITY	ACRES
11-11	Commercial TSI	29
	Prepare new Plan	34.99

Edgewood Area: Forest Map 11, Stand 11-12, 18.31 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum and Tulip poplar with scattered mixed Oak species which include; Pin oak, Southern red oak, Willow oak and Chestnut oak. Associate species include Hickory, Cherry, Black gum, Locust and Red maple. The understory is comprised of Barberry, Poison ivy and Blueberry. The ground layer contains a dense cover of Microstegium which is hindering seed development. This stand borders the bay in the MD defined Critical Area along Dove's Cove. 30% of the plots had at least one Oak or Poplar seeding. Currently, shade (Canopy closure) is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	6%
Sawtimber	11-23.9"	67%
Pole	6-10.9"	23%
Small tree	2-5.9"	4%

Currently the stand contains 143 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 152 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 66% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 152 B.A. and should be reduced to a B.A. of 75 Sq.ft. which includes all acceptable trees. The initial thinning will involve removing 77 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 23 cords per acre.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
11-12	Single Tree Selection	18.31
	Control invasives	
	Monitor natural regeneration	

Edgewood Area: Forest Map 11, Stand 11-13, 24.28 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum and Tulip poplar with scattered mixed Oak species which include; White oak, Southern red oak, Willow oak and Black oak. Associate species include Hickory, Dogwood, Black gum, and Locust. There are scattered mature Tulip poplar and Willow oak throughout. The understory is comprised of Greenbrier, Blackberry, New York fern and dense Microstegium. The ground layer contains a dense cover of Microstegium which is hindering seed development. This stand borders the bay in the MD defined Critical Area along Dove's Cove. 60% of the plots had at least one Oak or Poplar seeding. Currently, shade (Canopy closure) is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	11%
Sawtimber	11-23.9"	77%
Pole	6-10.9"	8%
Small tree	2-5.9"	4%

Currently the stand contains 126 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 140 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% stocking level. From a tree form and vigor stand point, 66% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 140 B.A. and should be reduced to a B.A. of 75 sq.ft. which is all acceptable trees. The initial thinning will involve removing 65 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
11-13	Single Tree Selection	24.28
	Control invasives	
	Monitor natural regeneration	

Edgewood Area: Forest Map 11, Stand 11-15, 54.20 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is surrounded by marsh land on 3 sides and contains forested wetlands. Dominated by Tulip poplar, and mixed Oak, Sweetgum and Hickory are also present in the Overstory. The understory consists of Blueberry and Bayberry. The 20 regeneration plots show advanced regeneration in only 15% of the plots; due to shade (canopy closure) 80%, and deer pressure. Invasive Barberry and Wisteria are present in the stand.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	15%
Sawtimber	11-23.9"	61%
Pole	6-10.9"	20%
Small tree	2-5.9"	4%

Currently the stand contains 143 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 120 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 95% plus stocking level. From a tree form and vigor stand point, 42% of the trees outside of the mature class are acceptable. The acceptable sawtimber is 7,000 bd. ft. per acre.

Recommendations

-Logging roads should be maintained for access and fire control
-Flag off 100 ft buffer
-This site is in the Critical Area and a harvest plan should be completed
-TSI

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 120 B.A. and should be reduced to a B.A. of 70 sq.ft. which is all acceptable trees and matures. The initial thinning will involve removing 50 sq.ft. of unacceptable sawtimber, pole timber, and small trees.

Access to this site is difficult, a single narrow road with marsh on both sides

STAND	ACTIVITY	ACRES
11-15	TSI	54.2
	Prepare new plan	

Edgewood Area: Forest Map 11, Stand 11-16, 29.82 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Mixed Oak species which include; White oak, Southern red oak, Willow oak, Pin oak and Black oak. Associate species include Red maple, Ash, Black gum and Sweetgum. There is scattered mature Tulip poplar and Willow oak throughout. The understory is comprised of Blueberry, Blackhaw, Pawpaw, Holly, Barberry, Greenbrier, Blackberry and dense Microstegium. The ground layer contains a dense cover of Microstegium which is hindering seed development in some areas. This stand borders the bay in the MD defined Critical Area. 3% of the plots had at least one Oak or Poplar seeding. Currently, shade (Canopy closure) is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	9%
Sawtimber	11-23.9"	63%
Pole	6-10.9"	17%
Small tree	2-5.9"	11%

Currently the stand contains 132 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 122 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 48% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 122 B.A. and should be reduced to a B.A. of 60 sq.ft. which is all acceptable trees. The initial thinning will involve removing 62 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 18 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
11-16	Single Tree Selection Control invasives Monitor natural regeneration	29.82

Edgewood Area: Forest Map 11, Stand 11-17, 50.4 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Tulip poplar, Sweetgum and Red maple. Associate species include Holly, Hickory, Cherry, Walnut, Oaks and Black gum. The understory is comprised of Spicebush, Barberry, Multiflora rose, Greenbrier, Bittersweet, and Wisteria in some crowns. Regeneration was found in only 10% of plots. The current Canopy closure is 90 %.
This stand contains forested wetland systems.

This timber stand has the following diameter distribution:

Mature	26"+	35%
Saw timber	11-23.9"	55%
Pole	6-10.9"	9%
Small tree	2-5.9"	1%

Currently the stand contains 107 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 137 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 73% of the trees are acceptable, which includes 30 % matures. This stand has numerous blow downs. Since regeneration is poor and trees are mature, a shelter wood system harvest would benefit this stand.

Currently a thinning will reduce competition; the stand has a basal area of 137 B.A. and should be reduced to a B.A. of 60 sq.ft. which is all acceptable trees, involving 50 sq.ft. of high-quality saw timber and 10 sq.ft. of matures. The initial thinning will involve removing 77 sq.ft. of matures, unacceptable saw timber, pole timber and small trees. The trees can be utilized for saw timber,

Recommendations

-Controlling invasive and alien plants
-Shelter wood leaving 60 BA
-Final Shelter wood once advance regeneration is adequate

STAND	ACTIVITY	ACRES	DATE
11-17	Control Invasives	50.4	2020
	Shelterwood harvest		2035

Edgewood Area: Forest Map 12, Stand 12-1, 40.03 Acres

Overstory Summary Narrative

Data was collected in 2011**;** this stand is dominated by Southern red oak, White oak, Willow oak, Chestnut oak, Tulip poplar, Scarlet oak and Sweetgum. The understory is comprised of Holly (dense in patches), Winterberry, Mt. Laurel, Sassafras, Honeysuckle vine and Microstegium. Regeneration of oak was found in 77 percent of the plots. The regeneration is present but not abundant and is in need of more light since the canopy closure is 80-90 percent. In light gaps within the forest, regeneration was more abundant. Deer pressure is heavy.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	10%
Sawtimber	11-23.9"	66%
Pole	6-10.9"	17%
Small tree	2-5.9"	7 %

In 2011 the stand **contained 145 trees per acre** with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 120 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 95% plus stocking level. From a tree form and vigor stand point, **only 53% of the trees outside of the mature class are acceptable.**

Forest restoration work completed in July 2019.

The entire site was scanned for ordinance. The understory was comprised of shrubs that shaded out the forest floor. The majority of the site was mowed to open up the lower canopy level. Currently an adequate seed source is present for regeneration of Oak, Hickory and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 145 sq. feet of Basal Area to 98 sq. feet average. Lower density exists in portions where mature trees have died. The trees per acres currently averages 92 trees. The acceptable **growing stock is 94 percent and prior to restoration was only 53 percent.**

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. High value wildlife trees were marked for retention.

This intermediate thinning improved stand vigor, stand quality and now concentrates growth on the improved species composition.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked of Eagle buffer, waited until buffer clear to work.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Treat invasive plants in a section opposite land fill entrance.
-Met with COR prior to start of project and at completion for approval.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Yr.
12-1	Collect stand data	40.03	2039
	Prepare new Plan		

Edgewood Area: Forest Map 12, Stand 12-2, 24.06 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum, Tulip Poplar and Mixed Oak species which include; Chestnut oak, Southern red oak and Black oak. Associate species include Virginia pine, Red maple, Black gum and Hickory. The understory is comprised of Blueberry, Sassafras, Beech, Greenbrier and Mt. Laurel. This stand borders Canal Creek along the western boundary in the MD defined Critical Area. 66% of the plots had at least one Oak or Poplar seeding with an average of 3000 seedlings per acre; however, they are not distributed evenly throughout the stand. Currently, shade (Canopy closure) is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	12%
Sawtimber	11-23.9"	62%
Pole	6-10.9"	23%
Small tree	2-5.9"	3%

Currently the stand contains 107 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 85% stocking level. From a tree form and vigor stand point, 50% of the trees are acceptable. Since only 50% of the stand is acceptable, this stand should be thinned to increase regeneration.

Recommendations

-This site is in the MD defined Critical Area
-This site is eagle sensitive
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 130 B.A. and should be reduced to a B.A. of 66 sq.ft. which is all acceptable trees. The initial thinning will involve removing 64 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
12-2	Single Tree Selection	24.06
	Control invasives	
	Monitor natural regeneration	

Forest restoration was performed in 2016 from the data was collected in 2014.
Restoration/silvicultural work began in March of 2016. This stand is dominated by Sweetgum, Tulip Poplar and Mixed Oak species which include; Chestnut oak, Northern red oak, Pin oak, Southern red oak, White oak and Willow oak. Associate species include Walnut, Red maple, Beech and Hickory. The understory was comprised of Viburnums, Blueberry and Spicebush. This stand borders Canal Creek along the western boundary. The Oak trees were favored over all others when releasing crop trees and in large areas within the stand the understory was mowed before cutting to increase sunlight to forest floor.

Prior to restoration the stand contained an average B.A. of 130 sq.ft. per acre average. From a tree form and vigor stand point 65% of the trees were acceptable. The restoration removed the vast majority of unacceptable growing stock leaving the residual stand with a Basal area of 80 sq.ft. per acre, with majority of all trees on site having acceptable quality. Once the canopy was open sunlight on the forest floor became available to aid in seed germination and encourage the growth of advance regeneration. Existing oak and hickory were sheltered to ensure their long-term survival as the deer pressure in the stand is high. Due to the lack of acceptable stock a one-acre area is open within the stand for planting as needed.

STAND	ACTIVITY	ACRES	DATE
12-2	maintain shelters	24.06	2018
	Inspect for more advance regeneration		2018
	Collect data for stand stocking.		2036

Edgewood Area: Forest Map 12, Stand 12-3, 42.33 Acres

Overstory Summary Narrative

Data was collected in 2014. The stand is dominated by Sweetgum, Tulip Poplar and Mixed Oak species which include; Chestnut oak, Northern red oak, Pin oak, Southern red oak, White oak and Willow oak. Associate species include Walnut, Red maple and Beech. The understory is comprised of Viburnums, Blueberry, Holly, Beech, Pepperbush, Cherry and Spicebush. This stand borders Canal Creek along the western boundary in the MD defined Critical Area.

Prior to restoration work the stand contained 128 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand an 85% stocking level. From a tree form and vigor stand point 65% of the trees are acceptable therefore this stand should be thinned to increase regeneration.

Following restoration work the stand now contains 75 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 90 sq. ft. per acre average. From a tree form and vigor stand point 85% of the trees are acceptable.

Controlling invasive species and alien plants is imperative to natural regeneration success. Deer control should be increased in this area as well.

Forest restoration work completed in August 2019.

The entire site was scanned for ordinance. The understory was comprised of shrubs that shaded out the forest floor. Invasive multiflora rose and dense vines were common throughout the stand. The majority of the site was mowed to open up the lower canopy level. Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential here is excellent.

Mar-Len Environmental, Inc. (MLE) removed mid-story and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Poplar to dominate the stand, as well as reduced overstocking.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. High value wildlife trees were marked for retention. Vines were cut and invasive plants were spot sprayed.

This restoration thinning improved both stand vigor and quality and now concentrates growth on the improved species composition.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked off Eagle buffer, waited until buffer clear to work.
-Cut trees and consolidated brush piles where possible to expose the forest floor.

-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Treat invasive plants.
-Met with COR prior to start of project and at completion for approval.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Yr.
12-3	Collect stand data	42.33	2039
	Prepare new Plan		

Westwood Area: Forest Map 12, Stand 12-4, 24.81 Acres

Overstory Summary Narrative

Data collected in 2003 states this stand is dominated by Sweet gum and Red maple with associate species being; Sassafras, Black oak, Pin oak, Southern red oak, White oak, Black cherry, Yellow poplar and Green ash. No information was collected on the understory.

This large sawtimber stand has an average diameter of 12.3

Currently the stand contains 110.42 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 132 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 62.2% stocking level. From a tree form and vigor stand point, 45% of the trees are acceptable.
The sawtimber volume currently is 7,156 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest.
-Shelter wood harvest to reduce the basal area to 50-60 sq. feet per acre of good seed trees.
-Collect data 15 years later for regeneration to see if remaining sawtimber can be removed.
-A final harvest in a shelterwood series or the overstory removal of residuals which will release established regeneration from competition with the existing overstory.

STAND	ACTIVITY	ACRES
12-4	shelter wood harvest	24.18
	Collect data/prepare plan for harvest	
	Final harvest	

Westwood Area: Forest Map 12, Stand 12-5, 57.19 Acres

Overstory Summary Narrative

Data was collected originally in 2003 and updated data in 2017. This stand is dominated by Tulip poplar, Southern red oak, White oak and Sweetgum, mature Poplar and Oak are also common throughout. Associate species include; Black oak, Chestnut oak, Willow oak, Black cherry, Black gum, Beech, Hickory, Red maple and Holly. The understory contains native Blueberry, Serviceberry, Spicebush, Hercules club and Muscle wood. Invasive plants (although not abundant) consist of Multiflora rose, Japanese Honeysuckle, Barberry and Wineberry. The stand has nice quality trees in the overstory; however, no advance regeneration was found in any plots. In some gap's sweetgum sapling were noted.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	24%
Sawtimber	11-23.9"	54%
Pole	6-10.9"	15%
Small tree	2-5.9"	7%

Currently the stand contains 174 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 167sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110 % stocking level. From a tree form and vigor stand point, 56% of the trees are acceptable.

This site is high quality and high priority as in contains an Eagle nest and buffers the Bay along the southern boundary.

Recommendations

-The forest lacks natural regeneration, favor Poplar and Oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest.
-Shelter wood harvest to reduce Basal area to 60 sq. feet per acre of good seed trees.
-Collect data 15 years later for regeneration to see if remaining sawtimber can be removed.
-A final harvest in a shelterwood series or the overstory removal of residuals which will release established regeneration from competition with the existing overstory.

If the above cannot be done commercially, a restoration thinning removing 36 sq. ft. of unacceptable and 22 sq. ft. of basal area in poor quality pole timber will provide canopy gaps to increase sunlight to forest floor and aid in regeneration. The areas of dense shrubs and small poor-quality trees can be mowed to aid in preparing the site for restoration.

STAND	ACTIVITY	ACRES	Date
12-5	shelter wood harvest or restoration thinning	57.19	2019-2022
	Collect data/prepare plan for harvest	57.19	2037
	Final harvest if regeneration is adequate		TBD

Edgewood Area: Forest Map 12, Stand 12-6, 20.11Acres

Overstory Summary Narrative

Data was collected in 2019. This stand is dominated by Sweetgum, Tulip poplar and Red maples. Oaks include Southern red oak and Pin oak. Loblolly pine planted in the area has a present in the stands northern corner. The understory is sparse and consists of Holly and Highbush blueberry with invasive Autumn olive, Barberry, Privet and Multiflora rose. The regeneration plots showed no advanced regeneration due to shade (canopy closure) is 85%, deer pressure and plant competition.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	10%
Sawtimber	11-23.9"	68%
Pole	6-10.9"	12%
Small tree	2-5.9"	10%

Currently the stand contains 236 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 156 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand 100% plus stocking level. From a tree form and vigor stand point, 58% of the trees outside of the mature class are acceptable. Bleeding canker is present on some of the stressed Sweetgums.

Recommendations

-Control invasive plant competition
-Thin stand to reduce stocking

From a timber management point of view this stand is in need of a thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 156 B.A. and should be reduced to a B.A. of 80 sq. ft. which will be the acceptable sawtimber, poles and matures. The initial thinning will involve removing 76 sq. ft. of unacceptable sawtimber, pole timber, small trees and poor quality matures.

STAND	ACTIVITY	ACRES
12-6	TSI	20.11
	Prepare new plan 15 yrs. after TSI	

Edgewood Area: Forest Map 12, Stand 12-7, 15.57Acres

Overstory Summary Narrative

Data was collected in 2019. This stand is dominated by mixed Oak. Oaks include Southern red oak, Pin oak, Black red oak, Chestnut oak, Chestnut oak and Willow oak. Associated species include: Loblolly pine, Beech, Red maple, Sweetgum, Cherry and Hickory. The understory consists of Blueberry, Wine berry, Green briar and Multiflora rose. Only 25% of the plots had regeneration due to shade (canopy closure) is 85%, understory invasive competition is also a factor along with deer pressure.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	11%
Sawtimber	11-23.9"	73%
Pole	6-10.9"	13%
Small tree	2-5.9"	3%

Currently the stand contains 155 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 127 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand 100% plus stocking level. From a tree form and vigor stand point 62% of the trees outside of the mature class are acceptable.

Recommendations

-TSI / Restoration
-Control invasive in understory

From a timber management point of view this stand is in need of thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 131 B.A. and should be reduced to a B.A. of 80 sq. ft. which is all acceptable trees and matures. The initial thinning will involve removing 47 sq. ft. of unacceptable sawtimber, pole timber, small trees, and poor quality matures. Once canopy gaps are created by TSI and poorly formed trees are removed, Oak and Poplar regeneration should have a better chance to become established, however deer management is needed. Oaks, Tulip poplar and Loblolly pine should be favored as crop trees.

STAND	ACTIVITY	ACRES
10-9	TSI	110.49
	Manage toward Old Growth	
	Prepare new plan	

Edgewood Area: Forest Map 13, Stand 13-3, 59.93Acres

Overstory Summary Narrative

Data was collected in 2012. This environmentally sensitive stand contains partial Eagle buffers and borders Canal Creek along the stands entire Eastern border. It is dominated by Tulip poplar, White oak, Chestnut oak, Southern red oak, Black oak, Willow oak, Beech, Hickory, and Red maple. The understory consists of Blueberry, Holly, Blackberry, Mountain laurel, Privet, Dogwood, and Bayberry. The 20 regeneration plots show no advanced regeneration in the plots; due to shade, canopy closure 85%, and heavy deer pressure.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	22%
Sawtimber	11-23.9"	47%
Pole	6-10.9"	23%
Small tree	2-5.9"	8%

Currently the stand contains 131 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 118 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 61% of the trees outside of the mature class are acceptable. The acceptable sawtimber and matures is 7,600 bd. ft. per acre.

This site slopes towards the Bay, has numerous drainage patterns, and is too sensitive for intense silvicultural activities. Managing for Old Growth is the ideal. This site is also home to White Turtlehead flowers; which serves as the primary regional host plant for the Baltimore checker spot butterfly (Euphydryas phaeton), Maryland's official state insect.

Phase one, Delivery order #0015 Forest restoration work completed in February 2017. The entire site was scanned for ordinance, however; only 46 acres of forest restoration was performed based on the delivery order. Thirteen acres is still available for future restoration activities.

The understory was comprised of dense Holly which shaded out the forest floor. The vast majority of Holly was removed with the exception of three Variable Retention areas with higher density, creating island for nesting birds.

Currently an adequate seed source is present for regeneration of oak and poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 118 sq. feet of Basal Area to 80 sq. feet average. Lower density exists in portions where mature trees have died.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. Large strangling vines were also cut from crop trees to reduce negative impacts to the heathy crowns. Removing vines reduces the seed source.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.

*Deer control should be increased in this area.

Phase two, Solar project mitigation: Project restored 2.19 acres

Phase three, Delivery order #0170. Complete June 2019. A total of 11.74 acres were restored completing all work within Stand 13-3 for 59.93 acres.

The understory was comprised of dense Holly which shaded out the forest floor. The vast majority of Holly was removed with the exception of three Variable Retention areas with higher density, creating island for nesting birds.

Currently an adequate seed source is present for regeneration of oak and poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 118 sq. feet of Basal Area to 80 sq. feet average. Lower density exists in portions where mature trees have died.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. Large strangling vines were also cut from crop trees to reduce negative impacts to the heathy crowns. Removing vines reduces the seed source.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Cut vines and treated with herbicide.
-Scarified site to promote soil and seed contact.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Date
13-3	Inspect Regeneration	59 .93	2029
13-3	Collect data	59.93	2039

Edgewood Area: Forest Map 13, Stand 13-4, 5.37Acres

Overstory Summary Narrative

Data was collected in 2017. This small stand contains mixed Oak species with White oak being the most common. Associate species include; Tulip poplar, Beech, Hickory and Red maple. The understory consists of Blueberry, Serviceberry and Greenbrier. No regeneration plots showed advanced regeneration; due to shade, canopy closure 85%, and heavy deer pressure.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	20%
Sawtimber	11-23.9"	44%
Pole	6-10.9"	28%
Small tree	2-5.9"	8%

Currently the stand contains 133 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 84 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 75% stocking level. From a tree form and vigor stand point 62% of the trees are acceptable. The existing Oak population provides an excellent seed source.

Recommendations

-To enhance regeneration, a restoration thinning removing 23 sq. ft. of unacceptable sawtimber and 17 sq. ft. of basal area in poor quality pole timber will provide canopy gaps to increase sunlight to forest floor and aid in regeneration. The areas of dense shrubs and small poor-quality trees 10 sq. ft. of B.A. can be mowed to aid in preparing the site for restoration.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Date
13-4	Restore	5.37	2025
13-4	Inspect regeneration /shelter	5.37	2028
13-4	Collect data	5.37	2043

Edgewood Area: Forest Map 13, Stand 13-5, 9.54 Acres

Overstory Summary Narrative

Data was collected in 2017. This an important stand that borders a wetland /marsh along its eastern boundary; this stand also is an interface between building and the wetland. This small stand contains mixed Oak species, Sweetgum and Tulip poplar. Oaks on site include: Pin, Willow and Southern red oak. Associate species include; Beech, Hickory, Ash, Sycamore, Black gum, Cherry, Holly and Red maple. The understory consists of Blueberry, Serviceberry, Multiflora rose, Privet with Bittersweet and Ivy vines. There was no Oak or Poplar regeneration, plots showed advanced regeneration of Beech seedlings. Recent storms have caused mature trees to uproot.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	20%
Sawtimber	11-23.9"	46%
Pole	6-10.9"	21%
Small tree	2-5.9"	13%

Currently the stand contains 195 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 143 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100+% stocking level. From a tree form and vigor stand point only 45% of the trees are acceptable. The existing Oak population provides an excellent seed source.

Recommendations

-To enhance regeneration, a restoration thinning removing 42 sq. ft. of unacceptable sawtimber and 18 sq. ft. of basal area in poor quality pole timber will provide canopy gaps to increase sunlight to forest floor and aid in regeneration. Small poor-quality trees 15 sq. ft. of B.A. can be mowed or cut to aid in preparing the site for restoration.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Date
13-5	Restore	9.54	2025
13-5	Inspect & shelter	9.54	2028
13-5	Collect data	9.54	2043

Edgewood Area: Forest Map 13, Stand 13-13, 23.48 Acres

Overstory Summary Narrative

Data was collected in 2017. This is an important stand adjacent to CAPA field; it borders a wetland /marsh along its entire northern boundary. This small stand contains mixed Oak species, with Sweetgum and Tulip poplar. Oaks on site include: Pin, Black and Chestnut Oak. Associate species include: Beech, Hickory, Ash, Sycamore, Blackgum, Cherry, Holly, Sycamore, Loblolly Pine and Red maple. The understory consists of Blueberry, Serviceberry, Multiflora rose, Barberry with Bittersweet and Ivy vines. There was no Oak or Poplar regeneration found with the plots.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	34%
Sawtimber	11-23.9"	44%
Pole	6-10.9"	22%
Small tree	2-5.9"	5%

Currently the stand contains 165 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 143 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100+% stocking level. From a tree form and vigor stand point only 45% of the trees are acceptable. The existing Oak population provides an excellent seed source.

Recommendations

Stand Management Objectives: Manage towards Old Growth: mark legacy / largest trees in stand in order to distinguish long term growing stock. Relocate the Basal Area to a larger mean diameter by felling the target unacceptable growing stock. Felled trees increase down logs for decomposition. The standing dead snags will greatly add to the wildlife enhancement of the stand. The reduction of canopy coupled with deer density reduction will aid in natural Oak and Poplar regeneration while creating canopy gaps conducive to old growth forest. Structural complexity enhancement is key to long term sustainability and benefits managing towards and for Old growth. The invasive shrubs should be 100% controlled. The stand buffers a first order stream and associated wetlands while providing recreation and aesthetic value to CAPA field.

STAND	ACTIVITY	ACRES	Date
13-13	Manage Old Growth	23.48	2030
13-13	Inspect Regeneration shelter and invasives	23.48	2035
13-13	Collect data	23.48	2045

Wrights Creek Area: Forest Map 13, Stand 13-14, 54.43 Acres

Overstory Summary Narrative

Data collected in 2009 states this mixed oak stand is dominated by White oak and Yellow poplar with associate species being; Black oak, Beech, Red maple, Southern red oak, Hickory, Pin oak, Black gum, Locust, Chestnut oak and Scarlet oak. Holly, Blueberry, Japanese honeysuckle and Greenbrier were found in the understory.

This large sawtimber stand has an average merchantable diameter of 19.7

Currently the stand contains 292.28 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 117.8 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 80% stocking level. From a tree form and vigor stand point, 66.7% of the trees are acceptable.

The acceptable sawtimber volume currently is 10,710.85 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

Dominated by mixed oak and poplar, mature trees are common throughout. This stand has some of the oldest trees within the study and should be set aside and managed as old growth forest.

Objectives:

-Create a multi-layered canopy by utilizing a single tree selection method. Favor mature trees.
- Girdle selected trees with low vigor and leave as snags.
- Allow dead and dying trees to remain standing and on the ground.
- Accelerate growth in largest trees through crown release cuttings.

-To encourage regeneration in both shrubs and trees and create a multiple layer canopy invasive plants should be controlled prior to harvest. This will assure that increased sunlight does not accelerate invasive plant growth. An effort should also be made to control the deer population so that feeding does not hinder plant development.

STAND	ACTIVITY	ACRES
13-14	commercial TSI	54.43
	control invasives	
	examine stand for commercial harvest	

Edgewood Area: Forest Map 14, Stand 14-1, 35.24 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Mixed Oak species which include; Chestnut oak, Scarlet oak, Pin oak, Willow oak, White oak, Black oak with Sweetgum and Tulip Poplar. The understory is comprised of dense areas of Blueberry, Holly, Serviceberry, Sassafras and Blackgum. This stand borders King Creek in the MD defined Critical Area. 60% of the plots had at least one Oak or Poplar seeding, with all of the seedlings being less than 6 inches due to severe deer browsing. Currently, shade (Canopy closure) is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	4%
Sawtimber	11-23.9"	52%
Pole	6-10.9"	34%
Small tree	2-5.9"	10%

Currently the stand contains 202 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 145 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 42% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-This site is eagle sensitive
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 145 B.A. and should be reduced to a B.A. of 61 sq.ft. which is all acceptable trees. The initial thinning will involve removing 84 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 26 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
14-1	Single Tree Selection	35.24
	Control invasives	
	Monitor natural regeneration	

Edgewood Area: Forest Map 14, Stand 14-5, 36.89 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Mixed Oak species which include; Southern Red oak, Chestnut oak, Scarlet oak, Willow oak, White oak and Black oak. Associate species are Red maple, Locust, Blackgum, Hickory and Pine. The understory is comprised of dense areas of Blueberry, Huckleberry, Mt. Laurel, Holly, Serviceberry, Sassafras and Blackgum. This stand borders the open water on three sides in the MD defined Critical Area. 70% of the plots with a total of 4,700 seedlings per acre all need to be released by a thinning. Currently, shade (Canopy closure) is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	12%
Sawtimber	11-23.9"	49%
Pole	6-10.9"	28%
Small tree	2-5.9"	11%

Currently the stand contains 146 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 137 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 48% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-This site is eagle sensitive
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 137 B.A. and should be reduced to a B.A. of 66 sq.ft. which is all acceptable trees. The initial thinning will involve removing 71 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 21 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
14-5	Single Tree Selection	36.89
	Control invasives	
	Monitor natural regeneration	

Forest restoration work was completed in 2016. This stand is dominated by Mixed Oak species which include; Southern Red oak, Chestnut oak, Scarlet oak, Willow oak, White oak and Black oak. Associate species are Red maple, Locust, Blackgum, Hickory and Pine. The understory is comprised of dense areas of Blueberry, Huckleberry, Mt. Laurel, Holly, Serviceberry, Sassafras and Blackgum. This stand borders the open water on three sides in the MD defined Critical Area and is important to wildlife sand water quality.

Currently an adequate seed source is present; regeneration of oak and poplar seedlings have now become established and have been sheltered to protect from deer browse.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Poplar to dominate the stand, as well as reduced overstocking from 137 B.A. to 80-85 B.A. via favoring the highest quality trees. Trees with poor form and vigor were clearly marked to be girdled or cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

Edgewood Area: Forest Map 14, Stand 14-6, 91.05 Acres

Overstory Summary Narrative

Data was collected in 2011**;** this stand is dominated by Chestnut oak, Southern red oak, White oak, Willow oak, Tulip poplar, Red maple, Black oak and Sweetgum. The understory is comprised of Holly, Serviceberry and Blueberry. Regeneration of oak was not found in any of the sub-plots. The acorn production on site is good, however; the canopy closure is 90 percent and the deer pressure is heavy. This stand is an important buffer to the bay and encouraging oak regeneration should be a priority.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	7%
Sawtimber	11-23.9"	58%
Pole	6-10.9"	27%
Small tree	2-5.9"	7 %

Currently the stand contains 131 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 105 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 85% plus stocking level. From a tree form and vigor stand point, only 42% of the trees outside of the mature class are acceptable. The acceptable sawtimber volume currently is 4,800 bd. ft. per acre, once the undesirables are removed the stand will increase in volume, as more crop tree space is available and regeneration will improve as more light is added to the forest floor.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-This site is in the Critical Area and the harvest plan should be completed.
-Flag off 100 foot no cut buffer.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

The shelterwood system is recommended when oak regeneration potential is inadequate or uncertain. It involves two or more harvests several years apart in the same stand. The first harvest is a thinning and the final harvest is a group selection.

The first harvest removes some merchantable timber as well as undesirable species. It creates holes in the canopy that permit sunlight to reach oak seedlings and stimulate their growth and may encourage residual oaks to produce more acorns. Light levels can be regulated by the amount of thinning to favor acorn germination and oak seedling survival while suppressing competition from undesirable trees and shrubs. Make the first cut after a large acorn crop, if possible. Leave the best trees of any desirable species and all un-merchantable oaks capable of producing stump sprouts. Remove all other trees larger than 2 inches diameter, including seed producing trees of undesirable species. This cut should leave a park like stand with a 60 to 70 percent canopy having no major gaps. It is better to leave too many trees than too few, or you may encourage competition.

A good acorn crop within two years of understory removal usually will assure adequate reproduction. If a good acorn crop does not occur within three years, control understory competition a second time, preferably during a good acorn year.
Take the final cut when a forester determines that the advanced reproduction is adequate. This cut releases seedlings and yields more merchantable timber. If a final cut is not desired leave the mature overstory.

-When relying on acorns to reestablish oaks, harvest and disturb the soil after the acorns drop, but before the ground freezes. Soil disturbance helps to bury the acorns and uproot competing vegetation.

To encourage regeneration the first thinning will reduce competition and open the canopy. The stand has a basal area of 105 B.A. and should be reduced to a B.A. of 50 Sq.ft. The initial thinning will involve removing 55 sq.ft. of unacceptable saw timber, pole timber and small tree class. The undesirables can be utilized for pulpwood, some of the trees will produce low grade saw logs which can be separated at time of marking the thinning. The thinning will produce approximately **18** cords per acre. Following the commercial pulpwood sale, the alien and invasive plants should be controlled and deer population reduced to aid oak regeneration.

STAND	ACTIVITY	ACRES
14-6	Stage 1 shelterwood	91.05
	Control invasives	
	Prepare new Plan for possible harvest	

In 2016 MLE performed work on this stand. The initial start of the project called for stand 39-1, which is a 49-acre stand surrounded by water on 3 sides, located off Surveillance Road in Aberdeen. Mar-Len staff along with E.A. UXO techs started the surface visual sweep with Schonstedt assist to prepare site with a safety access trail. After two days onsite and 100 anomalies flagged with permission of DPW Mar-Len pulled off site and moved location to Edgewood stand 14-6.

Stand 14-6 is dominated by Chestnut oak, Southern red oak, White oak, Willow oak, Tulip poplar, Red maple, Black oak and Sweetgum. The understory is comprised of Holly (very dense in areas), Serviceberry and Blueberry. Regeneration of oak was not found in any of the plots prior to the restoration project. The acorn production on site is good, however; the canopy closure was at 90 percent and the deer pressure is heavy. This stand is an important buffer to the bay and encouraging oak regeneration should be a priority.

Mar-Len Environmental, Inc. (MLE) removed unacceptable growing stock; allowing sunlight to filter to the forest floor. Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Vines were cut, and shrubs; including a dense midstory of Holly to help restore the natural forest ecosystem.

Other activities include:

-Secured Range Work Request and organized Tower Support for 39-1.
-2-day UXO scan
-Worked with DPW Environmental to move site locations.
-Prior to any work at 14-6 MLE and DPW had a meeting with the Facility Manager at the site.
-Perform UXO scan of the entire project area.
-Marked poor quality trees for removal.

-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Scarified site to promote soil and seed contact.

Edgewood Area: Forest Map 14, Stand 14-7, 12.68 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Mixed Oak and Tulip Poplar, oak species include; Southern red oak, Chestnut oak, White oak and Black oak. The understory is comprised of dense areas of Blueberry, Sweetgum, Blackgum and Red maple saplings. 0% of the plots have regeneration due to heavy deer browsing activity and dense shade due to the canopy closure of 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	10%
Sawtimber	11-23.9"	61%
Pole	6-10.9"	20%
Small tree	2-5.9"	9%

Currently the stand contains 152 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 144 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 54% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 144 B.A. and should be reduced to a B.A. of 78 sq.ft. which is all acceptable trees. The initial thinning will involve removing 66 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
14-7	Single Tree Selection	12.7
	Control invasives	
	Monitor natural regeneration	

Forest restoration work completed in June 2017. The entire site was scanned for ordinance, restoration was then performed to reduce stand stocking, targeting poor quality growing stock. The future potential for Oak regeneration is good.

Mar-Len Environmental, Inc. (MLE) removed mid story, and unacceptable over story trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring

Oaks, to dominate the stand, as well as reduced overstocking from 144 sq. feet of Basal Area to 70-80 sq. feet average. Lower density exists in portions where mature trees have died.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. Removing vines reduces the seed source. Sparse populations of Barberry and Microstegium were treated.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Treated invasive.
-Oak seedlings will be sheltered in the fall.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Date
14-7	Inspect regen	12.68	2019
14-7	Collect data	12.68	2038

Edgewood Area: Forest Map 14, Stand 14-10, 6.26 Acres

Overstory Summary Narrative

Data was collected in 2017. This small stand contains mixed Oak species with Poplar and sweetgum. Oaks include: Chestnut, Willow Oak, Southern red Oak, Black Oak, and Scarlet Oak. Associate species include: Hickory, Blackgum, Holly, Sassafras and Red maple. The understory consists of Blueberry and scattered Serviceberry. Nonnative plants include: Barberry, Tear thumb and Multiflora rose.
No regeneration plots showed advanced regeneration; due to shade, canopy closure of 80%, and heavy deer pressure. This stand provides an important Bay buffer. Oaks are declining with Chestnut oak showing the most stress. Vines are in some crowns and Black gum and Red maple are filling in canopy gaps.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	21%
Sawtimber	11-23.9"	64%
Pole	6-10.9"	10%
Small tree	2-5.9"	5%

Currently the stand contains 226 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 125 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 70% of the trees are acceptable. The existing Oak and Poplar population provides an excellent seed source.

Recommendations

-To enhance regeneration, a restoration thinning removing 20 sq. ft. of unacceptable sawtimber, 10 in. of low-quality pole timber and 3 sq. ft. of basal area in the poor-quality small trees group is recommended. This will provide canopy gaps to increase sunlight to forest floor and aid in regeneration. The invasive plant community should be treated and vines hindering crown development should be cut.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Date
14-10	Restore	6.26	2026
14-10	Inspect Regeneration/shelter	6.26	2028
14-10	Collect data	6.26	2043

Edgewood Area: Forest Map 14, Stand 14-12, 5.51 Acres

Overstory Summary Narrative

Data was collected in 2017. This small stand is dominated by Tulip poplar and Sweetgum with Willow oak, Southern red oak, Black oak, and Scarlet oak. Associate species include: Blackgum, Black cherry, Locust, Sycamore and Red maple. The understory consists of Blueberry and scattered Dogwood. Nonnative plants include: Barberry, Paulownia, Bittersweet, Honeysuckle and Multiflora rose. There are thick Barberry patches as well. No regeneration plots showed advanced regeneration due to shade, canopy closure of 80% and heavy deer pressure.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	40%
Sawtimber	11-23.9"	51%
Pole	6-10.9"	0%
Small tree	2-5.9"	8%

Currently the stand contains 146 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 155 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point 55% of the trees are acceptable. The existing Oak and Poplar population provides an excellent seed source.

Recommendations

-To enhance regeneration, a restoration thinning removing 50 sq. ft. of unacceptable sawtimber and 6 sq. ft. of basal area in the poor-quality small trees group will provide canopy gaps to increase sunlight to forest floor and aid in regeneration. The invasive plant community should also be treated.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Date
14-12	Restore	5.51	2026
14-12	Inspect Regeneration shelter	5.51	2028
14-12	Collect data	5.51	2043

Westwood Area: Forest Map 14, Stand 14-13, 30.71 Acres

Overstory Summary Narrative

Data collected in 2017. This stand is dominated by Tulip poplar, Sweetgum and mixed Oaks. Oaks include: Southern red oak, Pin oak, Chestnut oak and Willow oak. Associate species include: Black cherry, Blackgum, Locust, Hickory, Walnut, Sycamore, Red maple and Holly. The understory contains Blueberry, Hercules club and Greenbrier. Invasive plants consist of Multiflora rose, Barberry (dense in sections) and Paulownia. No advance regeneration was found in any plots. The entire eastern stand boundary buffers the Bay.

Currently the stand contains 85 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 121 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90 % stocking level. From a tree form and vigor stand point 48 % of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor Poplar and Oak as crop seed trees.
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest.
-Reduce Basal area to 60 sq. feet per acre of good seed trees. Grapevine in crown needs to be removed and Invasive plants.

STAND	ACTIVITY	ACRES	Date
14-13	Restoration thinning /Invasive control	30.71	2020
14-13	Inspect site for regeneration	30.71	2022
14-13	Collect data, prepare new plan.	30.71	2035

Edgewood Area: Forest Map 14, Stand 14-16, 32.2 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum, Tulip poplar and Red maple. Associate species are Southern Red oak, Cherry, Walnut, Willow oak, Persimmon and Virginia pine. The understory is comprised of Blueberry, Barberry and Multiflora rose; vines are thick in areas and hindering tree crown growth. 11% of the plots have regeneration and the canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	7%
Sawtimber	11-23.9"	62%
Pole	6-10.9"	24%
Small tree	2-5.9"	7%

Currently the stand contains 160 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 156 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 43% of the trees are acceptable.

Recommendations

-This site is in the MD defined Critical Area
-This stand is eagle sensitive
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 156 B.A. and should be reduced to a B.A. of 68 sq.ft. which is all acceptable trees. The initial thinning will involve removing 88 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 26 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
14-16	Single Tree Selection	32.2
	Control invasives	
	Monitor natural regeneration	

Edgewood Area: Forest Map 15, Stand 15-2, 13.06 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by mixed Oak which includes: Southern red oak, Willow oak, Northern red oak, Scarlet oak and White oak. Associate species include Red maple, Virginia pine, Sweetgum and Black gum. The understory is comprised of Blueberry, Spicebush, Arrowwood, Mt. Laurel and Wine berry. 60% of the plots have regeneration for a total of 1800 seedlings per acre. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	1%
Sawtimber	11-23.9"	73%
Pole	6-10.9"	18%
Small tree	2-5.9"	8%

Currently the stand contains 176 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 129 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% stocking level. From a tree form and vigor stand point, 57% of the trees are acceptable.

Recommendations

-Enhance regeneration by a Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 129 B.A. and should be reduced to a B.A. of 74 sq.ft. which is all acceptable trees. The initial thinning will involve removing 55 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 16 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
15-2	Single Tree Selection	13.06
	Control invasives/ cut vines	
	Monitor natural regeneration	

In November 2016 MLE performed forest restoration /enhancement mitigation on 13.5 acres, favoring oak species for long term management and wildlife. UXO techs and Mar-Len personnel worked together to preform avoidance and flag anomalies on 13.5 acres. We flagged high quality Oak regeneration to ensure protection during field activity, marked crop trees to leave during restoration, mowed the dense understory to remove the dense shade layer it creates, thinned/cut undesirable growing stock and sheltered regeneration to protect from deer browse

Edgewood Area: Forest Map 15, Stand 15-3, 6.99 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Oak, Tulip poplar and Hickory; associate species include Beech and Muscle wood. The understory is comprised of Multiflora rose, Bittersweet vine and Grapevine. 33% of the plots have regeneration. The current Canopy closure is 85%. There is a large wetland in the southwest portion of the stand and a stream channel in the center; making this sensitive stand difficult to manage.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	38%
Pole	6-10.9"	54%
Small tree	2-5.9"	8%

Currently the stand contains 265 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 162 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 62% of the trees are acceptable.

Recommendations

-Due to wetlands and stream this small acreage stand is too sensitive to manage.

-Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
15-3	Control invasives/ cut vines	6.99

Edgewood Area: Forest Map 15, Stand 15-4, 24.38 Acres

Overstory Summary Narrative

Data was collected in 2014. One of the mature stands in Edgewood, this stand is dominated by mixed Oak which includes: Northern red oak, Willow oak, Pin oak, Scarlet oak and White oak; along with Sweetgum and Tulip poplar. Associate species include Red maple, Holly, Black cherry and Black gum in the midstory. The understory is comprised of Blueberry, Holly, Serviceberry, Viburnum and Sassafras. 33% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	20%
Sawtimber	11-23.9"	58%
Pole	6-10.9"	11%
Small tree	2-5.9"	11%

Currently the stand contains 171 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 156 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 62% of the trees are acceptable.

Recommendations

-Manage toward Old Growth
-Possibly create a recreational trail for the adjacent large office building

From an Old Growth management point of view a thinning will increase the average diameter within the stand. Currently numerous 30+ diameter trees are scattered throughout. Removing the unacceptable sawtimber and unacceptable pole trees will account for 42 sq. ft. per acre of undesirable trees to be removed. The trees can be utilized for pulpwood with the thinning producing approximately 13 cords per acre, along with low grade sawtimber.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
15-4	Manage toward Old Growth	24.38
	Control invasives/ cut vines	
	Monitor natural regeneration	

Edgewood Area: Forest Map 15, Stand 15-5, 9.05 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum, Red maple and Tulip poplar; associate species include Willow oak, White oak, and Southern red oak. The understory is comprised of Blueberry, Black cherry, Holly, Viburnums and Sassafras. 33% of the plots have regeneration. The current Canopy closure is 90%. There are wetlands and a stream within this small stand making it sensitive difficult to manage.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	26%
Sawtimber	11-23.9"	57%
Pole	6-10.9"	14%
Small tree	2-5.9"	3%

Currently the stand contains 127 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 140 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 62% of the trees are acceptable.

Recommendations

-Due to wetlands and stream this small acreage stand is too sensitive to manage; allow the stand to go through natural succession of old growth.

-Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
15-5	Natural Old Growth	9.05

Edgewood Area: Forest Map 15, Stand 15-7, 4.76 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Loblolly with occasional White pine and Black cherry. The understory is comprised of Sweetgum seedlings, Blueberry, with Hickory, Gum and Ash regeneration. None of the plots have regeneration. The current Canopy closure is 80%. This site is publically visible as it is next to both a cemetery and office complex.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	65%
Pole	6-10.9"	23%
Small tree	2-5.9"	12%

Currently the stand contains 340 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 215 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 81% of the trees are acceptable. Loblolly pine mature at 150-300 years; therefore, the stand can be left alone and go through a natural process. However, in order to have healthier, more productive trees the stand could be thinned.

Recommendations

-Single Tree Selection – reduce BA to 90 sq. ft. of acceptable growing stock in the sawtimber class, cutting approximately 37 cords per acre.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-7	Single Tree Selection	4.76

Edgewood Area: Forest Map 15, Stand 15-8, 57.98 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by White oak, Pin oak, Southern red oak, Willow oak, Black oak and Sweetgum. Oaks dominate this site while the understory is comprised of Sweet pepperbush, Blueberry, Viburnums, sassafras, Greenbrier, Serviceberry and Swamp azalea. 66% of the plots have regeneration for a total of 1400 seedlings per acre. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	9%
Sawtimber	11-23.9"	60%
Pole	6-10.9"	20%
Small tree	2-5.9"	11%

Currently the stand contains 186 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 117 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 64% of the trees are acceptable.

Recommendations

-Single Tree Selection

-From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 117 B.A. and should be reduced to a B.A. of 75 sq.ft. which is all acceptable trees. The initial thinning will involve removing 42 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 13 cords per acre, along with low grade sawtimber.

-Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
15-8	Single Tree Selection Control invasives Monitor natural regeneration	57.98

*May have to shelter regeneration of deer browse continues

In 2016 Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Hickory to dominate the stands, as well as reduced overstocking by favoring the highest quality trees. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

The projects included the following activities:

-Had UXO techs and Mar-Len personnel work together to perform avoidance and flag anomalies on 58 acres.
-Flagged high quality Oak regeneration
-Marked crop trees to leave during restoration
-Mowed the dense understory to remove dense shade layer it creates
-Thinned /cut undesirable growing stock to acceptable growing stock levels.
-Sheltered regeneration to protect from deer browse
-Completed forest restoration /enhancement mitigation on 58 acres, favoring oak species for long term management on 1-03-17

Re-Inspect Stand in 2033 to update stand stocking and management recommendations.

Edgewood Area: Forest Map 15, Stand 15-9, 17.48 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is important as it buffers the head waters to Canal Creek and is a good candidate for forest restoration and mitigation. This stand is dominated by Sweetgum, Tulip poplar, White oak, Willow oak, Southern red oak, and Red maple. The understory is comprised of Sweet pepperbush, Hawthorne, Blueberry, Viburnums, Holly, Beech, Cherry, Greenbrier, Serviceberry, Winterberry and Swamp Azalea. 71% of the plots have regeneration with areas of advanced regeneration thicker in some pockets. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	8%
Sawtimber	11-23.9"	72%
Pole	6-10.9"	17%
Small tree	2-5.9"	3%

Currently the stand contains 120 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 120 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 61% of the trees are acceptable.

Recommendations

-Restoration/Mitigation
-Shelter regeneration on a 25x25 spacing
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 120 B.A. and should be reduced to a B.A. of 73 sq.ft. which is all acceptable trees. The initial thinning will involve removing 47 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 14 cords per acre, along with low grade sawtimber. The thinning can be done with a tree shear to reduce impacts.

Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-9	Single Tree Selection	17.48
	Control invasives	
	Mitigation as needed	

*May have to shelter regeneration if deer browse continues

Forest restoration work completed in 2016. This 42.6-acre forest restoration site was a combination of two adjoining stands that are separated by Canal Creek Headwaters**.**

Stand 15-9 was inventoried in 2014. Stand 15-19 was inventoried in 2009.

These stands are dominated by Mixed Oak species which include; Southern Red oak, Chestnut oak, Scarlet oak, Willow oak, White oak and Black oak. Associate species are Red maple, Sweetgum and Tulip poplar. The understory is comprised of holly, Sweetgum, multiflora rose and blueberry.

Currently an adequate seed source is present; regeneration of oak and poplar seedlings have now become established and have been sheltered to protect from deer browse.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Poplar to dominate the stand, as well as reduced overstocking from 117 B.A. in stand 15-9; and 137 B.A. in stand 15-19. The average residual B.A. of acceptable growing stock is currently 83.

Trees with poor form and vigor were clearly marked to be girdled or cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

Edgewood Area: Forest Map 15, Stand 15-10, 5.62 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum and Tulip poplar; Oaks include White oak, Willow oak and Chestnut oak. The understory is comprised of Viburnums, invasive Bittersweet, Multiflora rose and Microstegium. 0% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	1%
Sawtimber	11-23.9"	65%
Pole	6-10.9"	32%
Small tree	2-5.9"	2%

Currently the stand contains 220 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 148 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 65% of the trees are acceptable.

Recommendations

-Single Tree Selection

-From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 148 B.A. and should be reduced to a B.A. of 75 sq.ft. which is all acceptable trees. The initial thinning will involve removing 73 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 22 cords per acre, along with low grade sawtimber.

-Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
15-10	Single Tree Selection	5.62
	Control invasives	

Edgewood Area: Forest Map 15, Stand 15-11, 4.07 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is dominated by Sweetgum, Tulip poplar; and Oaks including White oak, Northern red oak, and Pin oak with associate species being Red maple, Hickory, Cherry, Beech and Persimmon. The understory is comprised of Blueberry, Dogwood, with invasive Dogwood, Bittersweet and Tree of Heaven. 0% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	9%
Sawtimber	11-23.9"	73%
Pole	6-10.9"	12%
Small tree	2-5.9"	6%

Currently the stand contains 140 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 136 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% stocking level. From a tree form and vigor stand point, 73% of the trees are acceptable.

Recommendations

-Due to the wetlands within the stand this site is too sensitive for intense management

-Controlling invasives and alien plants is imperative to natural regeneration success.

-Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
15-11	Control invasives Cut vines in crown	4.07

Edgewood Area: Forest Map 15, Stand 15-12, 6.07 Acres

Overstory Summary Narrative

Data was collected in 2014. This small stand could be managed with stand 15-10, which is 5.6 acres. The stand is dominated by Mixed oak and Sweetgum; Oaks include White oak, Willow oak, Northern red oak, Scarlet oak and Black oak. The understory is dominated by blueberry. 0% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	16%
Sawtimber	11-23.9"	51%
Pole	6-10.9"	24%
Small tree	2-5.9"	9%

Currently the stand contains 140 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 123 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% stocking level. From a tree form and vigor stand point, 57% of the trees are acceptable.

Recommendations

-Single Tree Selection

-From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 123 B.A. and should be reduced to a B.A. of 70 sq.ft. which is all acceptable trees. The initial thinning will involve removing 53 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 16 cords per acre, along with low grade sawtimber.

-Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-12	Single Tree Selection	6.07

Edgewood Area: Forest Map 15, Stand 15-14, 11.72 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand borders Canal Creek and is an important wooded buffer. This is a priority area as it could be used for mitigation/restoration. The stand is dominated by Sweetgum, Tulip Poplar and Red maple. Associate species include Black Cherry, Locust, Persimmon and Pin Oak. The understory is comprised of Multiflora rose, Barberry and vines consisting of Oriental bittersweet and Tear thumb. 0% of the plots have regeneration. The current Canopy closure is 80%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	68%
Pole	6-10.9"	12%
Small tree	2-5.9"	6%

Currently the stand contains 116 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 114 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, 33% of the trees are acceptable.

Recommendations

-Restoration/Mitigation site, large openings in stand.
-Shelterwood

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 114 B.A. and should be reduced to a B.A. of 38 sq.ft. which is all acceptable trees. The initial thinning will involve removing 76 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 17 cords per acre, along with low grade sawtimber.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-14	Shelterwood	11.72
	Control invasives	
	Restoration/Mitigation	

Edgewood Area: Forest Map 15, Stand 15-15, 13.49 Acres

Overstory Summary Narrative

Data was collected in 2014. The stand is dominated by Sweetgum and Red maple. Associate species include Black Cherry, Virginia pine, Persimmon and Willow Oak. The understory is comprised of Sassafras, Holly and Blackberry. 0% of the plots have regeneration. The current Canopy closure is 90%. This area has been highly impacted by man; there are open gaps and wetlands scattered throughout.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	5%
Sawtimber	11-23.9"	72%
Pole	6-10.9"	17%
Small tree	2-5.9"	6%

Currently the stand contains 112 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 116 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, 41% of the trees are acceptable.

Recommendations

-This site is too sensitive to manage.

-Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-15	allow to go through natural succession	13.49

Edgewood Area: Forest Map 15, Stand 15-16, 6.09 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand borders Canal Creek and is an important wooded buffer in the MD defined Critical Area. This is a priority area as it could be used for mitigation/restoration. The stand is dominated by mixed Oaks which include; White oak, Southern red oak, Willow oak, Pin oak and Northern red oak with scattered Sweetgum. The understory is comprised of Pepperbush, Blueberry, Beech and Greenbrier. 60% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	65%
Pole	6-10.9"	23%
Small tree	2-5.9"	12%

Currently the stand contains 150 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% stocking level. From a tree form and vigor stand point, 50% of the trees are acceptable.

Recommendations

-Restoration/Mitigation site, shelter existing regeneration with 25x25 ft spacing
-In MD defined Critical Area
-Thinning can be done with tree shear and girdling to reduce impacts
-Single tree selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 130 B.A. and should be reduced to a B.A. of 65 sq.ft. which is all acceptable trees. The initial thinning will involve removing 65 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre, along with low grade sawtimber.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-16	Single Tree	6.09
	Control invasives	
	Restoration/Mitigation	

Edgewood Area: Forest Map 15, Stand 15-17, 7.55 Acres

Overstory Summary Narrative

Data was collected in 2014. The stand is dominated by mixed Oaks which include; White oak, Southern red oak, Willow oak, Pin oak, Northern red oak and Post oak. This is the only location where Post oak exists that is known throughout GAPG. Associate species include Red maple, Blackgum, Black cherry and Virginia pine. The understory is comprised of Pepperbush, Blueberry, Holly, Serviceberry and Mt. Laurel. 0% of the plots have regeneration. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	64%
Pole	6-10.9"	20%
Small tree	2-5.9"	16%

Currently the stand contains 165 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 152 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 56% of the trees are acceptable.

Recommendations

-Single tree selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 152 B.A. and should be reduced to a B.A. of 75 sq.ft. which is all acceptable trees. The initial thinning will involve removing 77 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 23 cords per acre, along with low grade sawtimber.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-17	Single Tree selection	7.55

Railroad Yard Area: Forest Map 15, Stand 15-19, 44.01 Acres

Overstory Summary Narrative

Data collected in 2009 states this Mixed oak stand is dominated by White oak and Sweet gum with associate species being; Red maple, Yellow poplar, Scarlet oak, Willow oak, Black oak, Northern red oak, Black gum, Hickory, Virginia pine and Holly. Blueberry, Sweet pepper bush, Greenbrier, Holly, Serviceberry, Blackberry, Sweet gum, Black gum, and Multiflora rose, Honeysuckle, Hickory and Cedar were found in the understory.

This large sawtimber stand has an average merchantable diameter of 16.91

Currently the stand contains 215.35 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 137 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90.4% stocking level. From a tree form and vigor stand point, 69% of the trees are acceptable.
The acceptable sawtimber volume currently is 10,674.60 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Dominated by mixed oak, mature trees are common throughout. This stand has some of the oldest trees within the study and should be set aside and managed as old growth forest.

Objectives:
-Create a multi-layered canopy by utilizing a single tree selection method. Favor mature trees.
- Girdle selected trees with low vigor and leave as snags.
- Allow dead and dying trees to remain standing and on the ground.
-Accelerate growth in largest trees through crown release cuttings.

-To encourage regeneration in both shrubs and trees and create a multiple layer canopy invasive plants should be controlled prior to harvest. This will assure that increased sunlight does not accelerate invasive plant growth. An effort should also be made to control the deer population so that feeding does not hinder plant development.

STAND	ACTIVITY	ACRES
15-19	commercial TSI	44.01
	control invasives	
	examine stand for commercial harvest	

Forest restoration work completed in 2016. This 42.6-acre forest restoration site was a combination of two adjoining stands that are separated by Canal Creek Headwaters.

Stand 15-9 was inventoried in 2014. Stand 15-19 was inventoried in 2009.

These stands are dominated by Mixed Oak species which include; Southern Red oak, Chestnut oak, Scarlet oak, Willow oak, White oak and Black oak. Associate species are Red maple, Sweetgum and Tulip poplar. The understory is comprised of holly, Sweetgum, multiflora rose and blueberry.

Currently an adequate seed source is present; regeneration of oak and poplar seedlings have now become established and have been sheltered to protect from deer browse.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Poplar to dominate the stand, as well as reduced overstocking from 117 B.A. in stand 15-9; and 137 B.A. in stand 15-19. The average residual B.A. of acceptable growing stock is currently 83.

Trees with poor form and vigor were clearly marked to be girdled or cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

Forest Map 15: Stand 15-20, 42.68 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow poplar with associate species being; White oak, Red maple, Black oak, Pin oak, Southern red oak, Sassafras, Black cherry, Hickory and Holly. Honeysuckle, Multiflora rose, Japanese honeysuckle, Barberry, Viburnum, Sweet gum, Greenbrier and Blueberry were found in the understory.

This large sawtimber stand has an average merchantable diameter of 22.77

Currently the stand contains 101 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 118 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 61.7% stocking level. From a tree form and vigor stand point 54% of the trees are acceptable. The acceptable sawtimber volume currently is 13,306.94 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations (2009)

-54% of the trees within the stand are unacceptable. A shelterwood harvest is required reducing the basal area to 54 sq. ft. of AGS per acre. A two stage shelterwood cut is recommended; the first stage reducing the stocking by 50% and years later when adequate regeneration is established the remaining trees should be harvested.
-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.

STAND	ACTIVITY	ACRES
15-20	commercial TSI	42.68
	control invasives	
	examine stand for commercial harvest	

Forest restoration work completed in August 2017 by MLE

The entire site was scanned for ordinance, restoration was then performed on 37 acres to reduce stand tree density targeting poor quality growing stock. The future potential for Oak and Poplar regeneration is good.

Mar-Len Environmental, Inc. (MLE) removed mid story, and unacceptable over story trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oak and Poplar to dominate the stand. This mature stand had almost no sunlight reaching the forest floor.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. In 2009 the stand had an overage of 101 trees per acre. Following the removal of undesirable trees the current trees per acre average in 58 trees, the ground was scarified where possible to allow seed drop to

come in direct contact with the soil. Removing vines reduces the seed source. A very dense population of Barberry and Microstegium were treated on three occasions.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep
-Performed UXO scan of the entire project area
-Cut trees and consolidated brush piles where possible to expose the forest floor
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact
-Treated invasive plants and trees
-Deer control should be increased in this area

STAND	ACTIVITY	ACRES	Date
15-20	Inspect regen	42	2019
15-20	Shelterwood cut	42	2029

Edgewood Area: Forest Map 15, Stand 15-21, 12.60 Acres

Overstory Summary Narrative

Data was collected in 2014.This stand contains numerous wetlands and is too sensitive for equipment or management. Several large mature Oaks were noted; including a 46-inch diameter Southern red oak. The stand is dominated by mixed Oaks which include; White oak, Southern red oak, Chestnut oak and Pin oak. Associate species include Red maple, Blackgum, Hickory, Tulip poplar, Sweetgum and Sycamore. The understory is comprised of Viburnum, Blueberry, and Holly along with Wisteria vine and Greenbrier. 40% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	11%
Sawtimber	11-23.9"	57%
Pole	6-10.9"	25%
Small tree	2-5.9"	7%

Currently the stand contains 148 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 126s sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 55% of the trees are acceptable.

Recommendations

-Allow stand to go through natural succession

-Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
15-21	Allow to go through natural succession	12.60

Edgewood Area: Forest Map 16, Stand 16-1, 31.95 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand borders the bay along its entire northern boundary in the MD defined Critical Area. This is a priority area as it could be used for mitigation/restoration. The stand is dominated by mixed Oaks which include; White oak, Chestnut oak, Southern red oak, Black oak, Scarlet and Northern red oak. Associate species include Red maple, Blackgum, Holly and Tulip poplar. The understory is comprised of Blueberry and Serviceberry with dense areas of Red maple and Blackgum. 90% of the plots have regeneration at 6800 seedlings per acre all being browsed by deer. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	10%
Sawtimber	11-23.9"	48%
Pole	6-10.9"	30%
Small tree	2-5.9"	12%

Currently the stand contains 270 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 124 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 105% stocking level. From a tree form and vigor stand point, 52% of the trees are acceptable.

Recommendations

-Restoration/Mitigation site; shelter existing regeneration with 25x25 ft spacing
-In MD defined Critical Area
-Thinning can be done with tree shear and girdling to reduce impacts
-Single tree selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 124 B.A. and should be reduced to a B.A. of 64 sq.ft. which is all acceptable trees. The initial thinning will involve removing 60 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 18 cords per acre, along with low grade sawtimber.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
16-1	Single Tree Control invasives Restoration/Mitigation	31.95

Restoration/ silvicultural activities were performed to reduce stocking and completed in December 2015 under DO #76. This stand borders the bay along its entire northern boundary in the Maryland defined "Critical Area".

This is a priority area to keep Oak dominance. The stand is dominated by mixed Oaks which include; White oak, Chestnut oak, Southern red oak, Black oak, Scarlet and Northern red oak. Associate species include Red maple, Blackgum, Holly and Tulip poplar. The understory was comprised of Blueberry and Serviceberry with dense areas of Red maple and Blackgum. The Gum, Holly and Red maple were removed in most places within the stand, along with dominant and co-dominate trees of undesirable form and vigor.

Prior to thinning the stand had an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 124 sq.ft. per acre average. Currently the average B.A. (in mostly acceptable growing stock) is 80 sq. feet per acre with canopy gaps where the B.A. is low at 50 sq. ft. per acre average.

Since the canopy is now open, sunlight on the forest floor is available to aid in seed germination and encourage growth of advanced regeneration. Existing Oak and Hickory should be sheltered to ensure their long-term survival as the deer pressure in the stand is high.

Edgewood Area: Forest Map 16, Stand 16-2, 20.22 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand borders the bay along its entire southern boundary in the MD defined Critical Area and is highly sensitive. The stand is dominated by mixed Oaks which include; White oak, Chestnut oak, Southern red oak, Black oak along with Tulip poplar and Hickory. Associate species include Sweetgum and dense Holly in the midstory, shading out the understory. The understory is comprised of Blueberry. 16% of the plots have regeneration. The current Canopy closure is 80%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	52%
Pole	6-10.9"	30%
Small tree	2-5.9"	4%

Currently the stand contains 173 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 128 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% stocking level. From a tree form and vigor stand point, 40% of the trees are acceptable.

Recommendations

-In the MD defined Critical Area
-Thinning can be done with tree shear to remove the dense Holly
-Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
16-2	Remove Holly	20.22

Edgewood Area: Forest Map 16, Stand 16-3, 11.44 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand borders the bay along its entire eastern boundary in the MD defined Critical Area and buffers a housing development to the west. The stand is dominated by mixed Oaks which include; White oak, Chestnut oak, Southern red oak and Scarlet oak. Associate species include Red maple, Blackgum, Sweetgum and Holly. The understory is comprised of Blueberry and sparse Serviceberry. 100% of the plots have regeneration for a total of 7000 seedlings per acre; however, they are being heavily deer browsed. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	56%
Pole	6-10.9"	25%
Small tree	2-5.9"	5%

In 2013 the stand contained 175 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 140 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 46% of the trees are acceptable.

Following restoration work in May of 2018 the stand contains **95%** acceptable growing stock.

Currently the stand contains **105** trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of **85** sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a **70%** plus stocking level. From a tree form and vigor stand point, **95%** of the trees are acceptable.

Forest restoration work completed in May 2018. The entire site was scanned for ordinance prior to restoration work.

The understory was comprised of areas of dense Holly which shaded out the forest floor. The vast majority of Holly was removed with the exception of one Variable Retention areas with higher density; creating island for nesting birds with Holly dominating the midstory.

Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential is excellent. Seedling had existing but were being shaded out and browsed.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from **175** trees per acre to **105** trees per acre average. Target trees for removal were Red Maple and Sweetgum along with poor quality trees of any species.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked crop trees to remain.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Stacked/ condensed brush piles.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	DATE
16-3	Inspect regeneration	11.44	2019
	Shelter 18” plus tree on 30 x 30 ft. spacing.		
	Re- examine stand	11.44	2038

Edgewood Area: Forest Map 16, Stand 16-4, 13.54 Acres

Overstory Summary Narrative

Data was collected in 2014.This stand has some very mature Oaks, the largest being a 62-inch White oak. The stand is dominated by mixed Oaks which include; White oak, Red oak, Pin oak, Black oak and Willow oak. Associate species include Hickory, Red maple, Tulip poplar, Sweetgum and Holly. The understory is comprised of Blueberry and Microstegium. 14% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	10%
Sawtimber	11-23.9"	68%
Pole	6-10.9"	16%
Small tree	2-5.9"	6%

Currently the stand contains 150 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 133 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 105% stocking level. From a tree form and vigor stand point, 49% of the trees are acceptable.

Recommendations

-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning. Currently a thinning will reduce competition; the stand has a basal area of 133 B.A. and should be reduced to a B.A. of 65 sq.ft. which is all acceptable trees. The initial thinning will involve removing 68 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre, along with low grade sawtimber.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
16-4	single tree thinning	13.54

Edgewood Area: Forest Map 16, Stand 16-6, 61.39 Acres

Overstory Summary Narrative

Data was collected in 2012. This environmentally sensitive stand borders the Bay on its Northern boundary. It is dominated by White oak, Chestnut oak, Scarlet oak and Southern red oak, with pockets of dense Holly in the midstory. The understory consists of Blackgum, Dogwood, Cherry, Highbush blueberry, and Microstegium. The 19 regeneration plots show advanced regeneration in 21% of the plots; due to shade (canopy closure) 90%, and heavy deer pressure.

*There is an excellent seed source and seed drop; however, the lack of sunlight and high presence of deer prevent seedling germination success.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	28%
Sawtimber	11-23.9"	45%
Pole	6-10.9"	24%
Small tree	2-5.9"	3%

Currently the stand contains 153 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 134 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 60% of the trees outside of the mature class are acceptable. The acceptable sawtimber and matures is 10,000 bd. ft. per acre.

Recommendations

-Logging roads should be maintained for access and fire control
-Flag off 100 ft buffer
-This site is in the Critical Area and a harvest plan should be completed
-Forest Enhancement to promote regeneration
-Control the invasive Microstegium
-Use portion for future mitigation (5.13 acres)

The 25-acre forest enhancement will include the following goals:

-Remove midstory trees allowing sunlight to filter to forest floor.
-Selectively shelter highest quality regeneration to protect from intense deer browse allowing future forest of oak to become established
-Restore the natural distribution of native trees and shrubs.
-Reduce overstocking by releasing the highest quality trees.

Trees with poor form and vigor have been clearly marked to be girdled or cut to reduce environmental stress in the stand. This will improve the stands stocking level assuring that adequate water, nutrients and sunlight are available to the highest quality seed producers.

STAND	ACTIVITY	ACRES
16-6	Forest Enhancement Control invasive Inspect for regeneration Prepare new plan	61.39

Edgewood Area: Forest Map 16, Stand 16-7, 15.83 Acres

Overstory Summary Narrative

Data was collected in 2014.This Eagle sensitive stand is in the MD defined Critical Area. The stand is dominated by mixed Oaks which include; White oak, Chestnut oak, Southern red oak, Scarlet oak and Willow oak. Associate species include Tulip poplar, Sweetgum, Hickory, Virginia pine and dense Holly. The understory is comprised of Blueberry and Holly ranging from 2-10 inches in diameter. 0% of the plots have regeneration. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	12%
Sawtimber	11-23.9"	59%
Pole	6-10.9"	21%
Small tree	2-5.9"	8%

Currently the stand contains 136 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 152 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 59% of the trees are acceptable.

Recommendations

-Eagle sensitive/MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a commercial thinning and removal of midstory Holly to allow sunlight to reach the forest floor to aid in regeneration. Currently a thinning will reduce competition; the stand has a basal area of 152 B.A. and should be reduced to a B.A. of 70 sq.ft. which is all acceptable trees. The initial thinning will involve removing 82 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 25 cords per acre, along with low grade sawtimber.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
16-7	Single tree thinning	15.83

Edgewood Area: Forest Map 16, Stand 16-8, 31.07 Acres

Overstory Summary Narrative

Data was collected in 2014. This Eagle sensitive stand is in the MD defined Critical Area. The stand is dominated by mixed Oaks which include; White oak, Chestnut oak, Southern red oak, Black oak and Willow oak. Associate species include, Black gum, Sweetgum, Red maple and dense Holly. The understory is comprised of Holly, Black gum, Red maple and Sassafras. 50% of the plots have regeneration with an average of 2100 seedlings per acre, not evenly distributed. The current Canopy closure is 95%. Deer pressure on seedlings in heavy.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	28%
Sawtimber	11-23.9"	53%
Pole	6-10.9"	12%
Small tree	2-5.9"	7%

Currently the stand contains 172 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 64% of the trees are acceptable.

Recommendations

-Eagle sensitive/MD defined Critical Area
-Manage toward Old Growth
-Thinning via shear or girdling trees
-Potential mitigation/restoration site

Forest restoration work completed in February 2017. The entire site was scanned for ordinance, however; only 18.00 acres of forest restoration was performed based on the delivery order. Thirteen acres is still available for future restoration activities.

The understory was comprised of dense Holly which shaded out the forest floor. The vast majority of Holly was removed with the exception of a few Variable Retention areas with higher density, creating island for nesting birds.

Currently an adequate seed source is present for regeneration of oak and poplar. The potential is excellent. Very little sunlight was reaching the forest floor to aid in Oak seedling success.

Mar-Len Environmental, Inc. (MLE) removed mid story, and unacceptable over story trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 130 sq. feet of Basal Area to 95 sq. feet average. Lower density exists in portions where mature trees have died.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. Large strangling vines were also cut from crop trees to reduce negative impacts to the heathy crowns.

The trees per acre were reduced from 172 TPA to 118 TPA, while canopy 95 percent to average 75 percent with areas as low as 50 percent.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Mark trees to cut
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Leave Variable Retention areas for nesting.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	YEAR.
16-8	Manage toward old growth	31.07	2017
16-8	Re-examine /Data collection	31.07	2037

Edgewood Area: Forest Map 16, Stand 16-9, 9.58 Acres

Stand 16-9 had no formal data collected in the past. **MLE Forest restoration work completed in October 2017.** This 18-acre forest restoration site was a combination of two adjoining stands Stand 16-9 and Stand 16-11. See report on page that follows.

STAND	ACTIVITY	Date
16-9	inspect for regeneration, shelter if need	2019

Edgewood Area: Forest Map 16, Stand 16-11, 16.10 Acres

Overstory Summary Narrative

Data was collected in 2014. This Eagle sensitive stand is in the MD defined Critical Area, bordering the bay along its southern boundary. The stand is dominated by mixed Oaks which include; White oak, Chestnut oak, Southern red oak, Black oak, Scarlet oak and Pin oak. Associate species include Blackgum, Red maple, Sweetgum and Holly. The understory is comprised of Blueberry. 25% of the plots have regeneration. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	3%
Sawtimber	11-23.9"	62%
Pole	6-10.9"	24%
Small tree	2-5.9"	11%

Currently the stand contains 150 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 136 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 46% of the trees are acceptable.

Recommendations

-Eagle sensitive/MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a thinning and removal of midstory Holly to allow sunlight to reach the forest floor, aiding in regeneration. Currently a thinning will reduce competition as the stand has a basal area of 136 B.A. and should be reduced to a B.A. of 63 sq.ft. which is all acceptable trees. The initial thinning will involve removing 73 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 22 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
16-11	Single Tree Selection	16.10

MLE Forest restoration work completed in October 2017. This 18-acre forest restoration site was a combination of two adjoining stands Stand 16-11 and Stand 16-9.

These stands are dominated by Mixed Oak species which include; Southern Red oak, Chestnut oak, Scarlet oak, Willow oak, White oak and Black oak. Associate species are Red maple, Sweetgum and Tulip poplar. The understory is comprised of holly, Sweetgum, multiflora rose and blueberry.

Currently an adequate seed source is present; regeneration of oak seedlings possible since the acorns can contact bare soil and have adequate light.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and to dominate the stand, as well as reduced overstocking from 136 B.A. and an unacceptable growing stock previously of 46% of all trees, to an average residual B.A. of 80 and an acceptable growing stock of 90 percent.

Trees with poor form and vigor were clearly marked to be girdled or cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

***Re-examine this stand for stocking levels and prepare new plan in 2037**

Supplemental Data: Forest Map 16, Stand 16-12, 31.43 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by White oak, Southern red oak, Black oak, Yellow poplar and Sweet gum with associate species being; Black gum, Chestnut oak, Red maple and Virginia pine. Blueberry, Holly, Serviceberry, Sassafras, Sweet bay magnolia and Greenbrier were found in the understory. Invasive plants include Microstegium and Honeysuckle.

This is a large sawtimber stand d.b.h. ranges 12" – 24".

Currently the stand contains 195 trees per acre, with a B.A. of 120 sq.ft. per acre average. This stand is currently overstocked with 85% canopy closure.

Recommendations

-An effort should be made to control deer population.

STAND	ACTIVITY	ACRES
16-12	commercial TSI	31.43
	control invasives	
	examine stand for commercial harvest	

In 2009 the stand contained 195 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 120 sq. ft. per acre average. The number of trees correlated with the B.A. gave this stand a 100% stocking level. From a tree form and vigor stand point, numerous trees prior to restoration were considered unacceptable growing stock.

Following restoration work in August of 2018 the stand contains **90%** acceptable growing stock. Currently the stand contains an average B.A. of **80** sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a **65%** plus stocking level.

Forest restoration work completed in August 2018. The entire site was scanned for ordinance prior to restoration work.

The understory was comprised of areas of Honeysuckle and patches of stilt grass which shaded out the forest floor.

Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential is excellent. Seedlings had existed but were being shaded out and browsed.

Mar-Len Environmental, Inc. (MLE) removed midstory and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from **195** trees per acre to **75** trees per acre average. Target trees for removal were Red Maple and Sweetgum along with poor quality trees of any species.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. High quality small trees were flag to be protected during cutting.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked crop trees to remain.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Stacked/ condensed brush piles.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	DATE
16-12	Inspect regeneration	31.44	2022
	Shelter 18” plus tree on 30 x 30 ft. spacing		
	Re Examine stand	11.44	2038

Edgewood Area: Forest Map 16, Stand 16-13, 17.2 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Chestnut oak and Black oak with associate species being: Red maple, Hickory, Virginia pine, Scarlet oak and Black gum along with very few Beech and Sweet gum. Dense Holly, Blueberry and Serviceberry were found in the understory. This is a large sawtimber stand D.B.H. ranges 12" – 24". In 2009 the stand contains 200 trees per acre and was overstocked with 80-90% canopy closure.

Following restoration work in April of 2018 the stand contains 95% acceptable growing stock.

Currently the stand contains 82 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 90 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 70% plus stocking level. From a tree form and vigor stand point, 95% of the trees are acceptable. The acceptable sawtimber and matures is 8,000 bd. ft. per acre.

This large sawtimber stand has the following diameter distribution:

Mature	24"+	39%
Sawtimber	11-23.9"	50%
Pole	6-10.9"	8%
Small tree	2-5.9"	3%

Forest restoration work completed in April 2018. The entire site was scanned for ordinance prior to restoration work.

The understory was comprised of dense Holly which shaded out the forest floor. The vast majority of Holly was removed with the exception of two Variable Retention areas with higher density; creating island for nesting birds with Holly dominating the midstory.

Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 200 trees per acre to 82 trees per acre average. Target trees for removal were Red Maple and Sweetgum along with poor quality trees of any species.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked crop trees to remain.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Stacked/ condensed brush piles.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	DATE
16-13	Inspect regeneration	17.2	2019
	Re Examine stand	17.2	20

Edgewood Area: Forest Map 17, Stand 17-1, 21.62 Acres

Data was collected in 2001. This stand is dominated by Tulip poplar, Sweetgum, Red oak, Willow oak and Chestnut oak. Associate species include; Holly, Red maple, Sassafras, Hickory and Black gum. The understory is comprised of Blueberry, Arrowwood, Greenbrier, invasive Barberry, Honeysuckle vine and Microstegium. Regeneration was found in 70 percent of the plots. The regeneration is present but not abundant and is in need of more light since the canopy closure is 80 percent. In light gaps within the forest, regeneration was more abundant. Deer pressure is heavy. This stand borders the bay and has a first order stream and wetland.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	7%
Sawtimber	11-23.9"	61%
Pole	6-10.9"	24%
Small tree	2-5.9"	8 %

Currently the stand contains 276 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 171 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point only 58% of the trees outside of the mature class are acceptable. The acceptable sawtimber volume currently is 8,500 bd. ft. per acre. Once the undesirables are removed the stand will increase in volume. Once more crop tree space is available regeneration will improve as light is added to the forest floor.

Recommendations

-This stand is in need of a harvest. The thinning will reduce competition; the stand has a basal area of 171 B.A. and should be reduced to a B.A. of 80 sq. ft. The initial thinning will involve removing 91 sq. ft. of Basal area per acre, which includes all unacceptable growing stock 66 sq. ft (saw timber, pole timber, small tree class) as well 25 sq. ft. of acceptable stock. The primary product is pulpwood. Some of the trees will produce low grade saw logs which can be separated at time of marking the thinning. Following the commercial pulpwood sale, the alien and invasive plants should be controlled and deer population reduced to aid oak regeneration.

STAND	ACTIVITY	ACRES
17-1	TSI	21.62
	Control invasives	
	Prepare new Plan	

Forest restoration work completed in June 2020.

Mar-Len Environmental, Inc. (MLE) removed mid story and unacceptable overstory trees allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Poplar to dominate the stand, as well as reduced overstocking from 171 B.A. to 90 B.A. Tree density per acre was drastically reduced from 276 trees per acre to 100. Trees with poor form and vigor

were clearly marked and cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. Invasive plants such as Barberry and Microstegium were treated.

Primary objective for intermediate thinning

Improve stand vigor, growth and health by reducing stress from over stocking.

Improve overall stand quality by concentrating growth on most desirable trees of best quality.

Improve stand composition favoring oaks throughout the stand.

Create light gaps favoring both crown growth and native regeneration

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO scan.
-Performed UXO scan of the entire project area.
-Marked high quality trees to remain.
-Marked wetland and wildlife trees prior to working.
-Cut trees and vines and consolidated brush piles where possible to expose the forest floor.
-Scarified site to promote soil and seed contact.
-Treated invasive species.

STAND	ACTIVITY	ACRES	YEAR
17-1	Collect data/prepare new plan	21.62	2040

Edgewood Area: Forest Map 17, Stand 17-2, 26.88 Acres

Overstory Summary Narrative

Data was collected in 2014. The stand is dominated by Sweetgum, Red maple and Pin oak. Associate species include Willow oak, Southern red oak, Hickory, Virginia pine, White oak, Tulip poplar and Loblolly. The understory is comprised of Blueberry with patches of Barberry. 33% of the plots have regeneration. The current Canopy closure is 85%. The high stocking is causing the bleeding canker in the Sweetgum dominating the stand.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	69%
Pole	6-10.9"	28%
Small tree	2-5.9"	3%

Currently the stand contains 178 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 170 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 63% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring Oak as crop trees

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 170 B.A. and should be reduced to a B.A. of 75 sq.ft. which is all acceptable trees. The initial thinning will involve removing 95 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 28 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
17-2	single tree selection	26.88

Restoration and selection thinning to reduce stocking was completed in 2016. Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks to dominate the stands, as well as reduced overstocking by favoring the highest quality trees. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

Edgewood Area: Forest Map 17, Stand 17-3, 18.14 Acres

Overstory Summary Narrative

Data was collected in 2014.The stand is dominated by Loblolly pine which accounts for 74% of the sawtimber class in the stand. Associate species include Willow oak, Southern red oak, Sweetgum and Red maple. The understory is comprised of Blueberry with small areas of Beech and Barberry. 60% of the plots have Oak regeneration. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	55%
Pole	6-10.9"	37%
Small tree	2-5.9"	8%

Currently the stand contains 200 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 162 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 73% of the trees are acceptable.

The Loblolly's were planted in 1964; making them 50+ years old. Loblolly matures at 150-300 years. In order to produce healthy trees, the hardwoods should be removed; such as Red maple and Sweetgum, favoring the Loblolly and Oaks.

Recommendations

-Single Tree Selection, favoring Loblolly and Oak as crop trees

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 162 B.A. and should be reduced to a B.A. of 80 Sq.ft. which is all acceptable trees. The initial thinning will involve removing 82 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 25 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
17-3	Single tree selection	18.14

Restoration and selection thinning to reduce stocking was completed in 2016.
Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Loblolly to dominate the stands, as well as reduced overstocking by favoring the highest quality trees. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil.

Edgewood Area: Forest Map 17, Stand 17-4, 5.82 Acres

Overstory Summary Narrative

Data was collected in 2014. The stand is dominated by Sweetgum, Red maple and Tulip with associate species including Willow oak, Black oak, Pin oak, Virginia pine and Persimmon. The understory is comprised of native Blueberry and invasive Barberry, Bittersweet, Privet, Multiflora rose and Microstegium. Vines are hindering crown development in some trees. 0% of the plots have regeneration. The current Canopy closure is 85%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	66%
Pole	6-10.9"	23%
Small tree	2-5.9"	12%

Currently the stand contains 195 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 148 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 59% of the trees are acceptable.

Recommendations

-Single Tree Selection
-Invasive plant control

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 148 B.A. and should be reduced to a B.A. of 80 sq.ft. which is all acceptable trees. The initial thinning will involve removing 68 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
17-4	Single Tree Selection Invasive plant control	5.82

Edgewood Area: Forest Map 17, Stand 17-5, 8.83 Acres

Overstory Summary Narrative

Data was collected in 2014.The stand is dominated by mixed Oak and Poplar; associate species include Loblolly, Hickory, Sweetgum and Red maple. The understory is comprised of native Blueberry and invasive Barberry. At the time of the inventory 100% of the plots have regeneration. The 2014 Canopy closure was 90%.

This sawtimber stand has the following diameter distribution:

Mature	26"+	1%
Sawtimber	11-23.9"	61%
Pole	6-10.9"	31%
Small tree	2-5.9"	7%

Currently (2014) the stand contained 204 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 160 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 68% of the trees are acceptable.

The focus on the forest stand enhancement is to remove the unacceptable growing stock, allowing high quality trees to remain in the residual stand with less competition and adequate growing /crown space.

Forest restoration work completed in June 2020. The entire site was scanned for ordinance prior to enhancement work. The stand contains 8.87 acres, the contract calls for 13.5 acres of silviculture. The additional acres were gained in the adjacent Stand 17-1 which has 7.12 acres over what is needed to fulfill Enhancement work on a separate contract for that stand.

The pre enhancement stand data showed a very high Basal area of 160 sq. ft. per acre with very high stocking levels. Following the improvement work the Stand now contains a Basal area average of 82 sq. ft. per acre. The trees per acre was reduce to 70 trees per care.

The understory was comprised of Barberry, Multiflora rose and dense areas of Blue berry which help shade out the forest floor. The majority of the invasive nonnative were mowed and treated with herbicide.

Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native

trees, favoring Oaks, Hickory and Poplar to dominate the stand. Target trees for removal were Red Maple and Sweetgum along with poor quality trees of any species.

Trees with good form and vigor were clearly marked as future crop trees that will make up the residual stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. The tops were mowed and the trees stacked in groups for better mission and training access.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked crop trees to remain.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Stacked/ condensed brush piles.
-Herbicide treatment performed on invasive shrubs and grasses.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	DATE
17-5	Examine stand	8.87	2035

Lauderick Creek Area/Edgewood Area: Forest Map 17, Stand 17-6, 23.14 Acres

Overstory Summary Narrative

Data was collected in 2009 and restoration was completed in July 2018; this environmentally sensitive stand borders the Bay on three sides. Dominated by Sweetgum with associate species being: Southern red oak, Red maple, Yellow poplar, White oak, Chestnut oak, and Pin oak. Holly, Greenbrier and Blackberry were found in the understory with the Holly presenting very dense shading out the understory.

The stand contained 320 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 134 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, only 62% of the trees are acceptable.

Forest restoration work was completed in July 2018:

The understory was comprised of dense Holly which shaded out the forest floor. The vast majority of Holly was removed with the exception of three Variable Retention areas with higher density; creating island for nesting birds.

Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed mid- story, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 134 sq. ft. of Basal Area to 75 sq. ft. average. The trees per acre was reduced from 320 per acre 80 trees per acre average. Currently 90 percent of trees on site are acceptable. Poor quality Sweetgum and Red Maple were removed along with the Holly.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	YEAR
17-6	Monitor regeneration	23.14	2020
17-6	Collect data and prepare plan	23.14	2035

Lauderick Creek Area: Forest Map 17 Stand 17-7, 52.78 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow Poplar with associate species being; Sweet gum, Red maple, Chestnut oak, Holly, Black oak, Black cherry, Northern red oak, Willow oak and Southern red oak. Blueberry, Greenbrier, Holly, Barberry and Japanese honeysuckle were found in the understory.

In 2009 the stand contains 208 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 142 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 75% stocking level. From a tree form and vigor stand point 78% of the trees are acceptable.

Recommendations 2009

-TSI is required using single tree selection; reducing the basal area to 78 sq. ft. of AGS per acre.

Restoration

Forest restoration work completed in July 2020. The entire site was scanned for ordinance prior to restoration work.

The understory was comprised of areas of dense Holly which shaded out the forest floor. The vast majority of Holly was removed with the exception of a few Variable Retention areas with higher density; creating island for nesting birds with Holly dominating the mid story.

Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential is excellent. Seedlings that existed were being shaded out and browsed.

Mar-Len Environmental, Inc. (MLE) removed mid story and unacceptable overstory trees; allowing sunlight to filter to the forest floor. The forest floor on the west side of Belardi Road was treated with an herbicide to reduce the dense stilt grass layer. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from **208** trees per acre to **90** trees per acre average. Target trees for removal were Red Maple and Sweetgum along with poor quality trees of any species. The stand has a Basal area of 80 sq. ft. with 95 % of all trees acceptable growing stock.

Trees with good form and vigor were clearly marked as future crop trees that will make up the residual stand. High value wildlife trees dead or alive were marked to remain. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. The tops were mowed and the trees stacked in groups for better mission and training access.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked crop trees to remain.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Stacked/ condensed brush piles.
-Herbicide to treat stilt grass.

*Deer control should be increased in this area.

Primary objective for intermediate thinning

Improve stand vigor, growth and health by reducing stress from over stocking.

Improve overall stand quality by concentrating growth on most desirable trees of best quality.

Improve stand composition favoring oaks throughout the stand.

Create light gaps favoring both crown growth and native regeneration

STAND	ACTIVITY	ACRES	DATE
17-7	collect stand data	52.78	2035

Edgewood Area: Forest Map 17, Stand 17-8, 80 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum and Chestnut oak with associate species being; Southern red oak, Red maple, Scarlet oak, Willow oak and Black oak. Blueberry, Greenbrier, Holly, Barberry, Sweet gum and Japanese honeysuckle were found in the understory.

In 2009 the stand contained 235 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 120 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, 60% of the trees are acceptable**. Note**: The Basal area at the time of restoration was 145 B.A. per acre.

Forest restoration work completed in April 2019.

The entire site was scanned for ordinance. The understory was comprised of shrubs that shaded out the forest floor. The majority of the site was mowed to open up the lower canopy level. Currently an adequate seed source is present for regeneration of Oak, Hickory and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 145 sq. feet of Basal Area to 80 sq. feet average. Lower density exists in portions where mature trees have died. The trees per acres currently averages 98 trees. The acceptable growing stock is 85 to 90 percent.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. High value wildlife trees were marked for retention.

This intermediate thinning improved stand vigor, stand quality and now concentrates growth on the improved species composition.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.

*Deer control should be increased in this area.

17-8	Collect data	2039

Follow silvicultural recommendations associated with new data collected.

Lauderick Creek Area: Forest Map 17, Stand 17-9, 60.02 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Southern red oak, Red maple, Yellow poplar, Black cherry, Northern red oak, Chestnut oak, Scarlet Oak, Virginia pine, Pin oak and White oak. Blueberry, Greenbrier, Barberry and Japanese honeysuckle were found in the understory.

This large sawtimber stand has an average merchantable diameter of 16.77

Currently the stand contains 137.81 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 79.4% stocking level. From a tree form and vigor stand point, 76.7% of the trees are acceptable.

The acceptable sawtimber volume currently is 10,410.06 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-TSI is required using single tree selection; reducing the basal area to 80 sq. ft. of AGS per acre.
-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.

STAND	ACTIVITY	ACRES
17-9	commercial TSI	60.02
	control invasives	
	examine stand for commercial harvest	

Lauderick Creek Area: Forest Map 17, Stand 17-10/17-11, 5.83 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Virginia pine with associate species being; Sweet gum, Black oak, Black gum, Red maple and Southern red oak. Blackberry, Holly, Blueberry, Honeysuckle and Greenbrier were found in the understory.

This small sawtimber stand has an average merchantable diameter of 14.48

Currently the stand contains 160.72 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 105 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 64.1% stocking level. From a tree form and vigor stand point, 52.5% of the trees are acceptable.

The acceptable sawtimber volume currently is 1,911.73 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Currently this stand is dominated by Virginia pine and is going through natural succession. It should be left undisturbed to provide winter habitat for birds and other wildlife during harsh conditions.

STAND	ACTIVITY	ACRES
17-10/11	commercial TSI	5.83
	control invasives	
	examine stand for commercial harvest	

*These stands are not contiguous (see map)

Westwood Area: Forest Map 18, Stand 18-1, 49.68 Acres

Overstory Summary Narrative

Data collected originally in 2003 and updated in 2017. This stand is dominated by Sweetgum with associate species being; Pin oak, Southern red oak, Red maple, Loblolly pine, White oak, Tulip poplar, Beech and Willow oak. The understory contains native Blueberry which is dense and Blackhaw. Invasive plants although not abundant consist of Multiflora rose, Japanese honeysuckle, Stilt grass and Wineberry. No advance regeneration was found in any plots. The sweetgum is showing signs of (Phytophthora) bleeding canker. This stand borders / buffers a first order stream and associated wetland along its south eastern boundary.

Currently the stand contains 176 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 168 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100 % stocking level. From a tree form and vigor stand point, 52% of the trees are acceptable.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	20%
Sawtimber	11-23.9"	46%
Pole	6-10.9"	21%
Small tree	2-5.9"	13%

Recommendations

-The forest lacks natural regeneration, favor Poplar and Oak as crop seed trees
-A commercial TSI or restoration project to reduce basal area to 85 sq. feet per acre of good seed tree with good form and vigor is needed.
-Treat invasive shrubs and forbs.
-Grind up tops and stack logs through out to keep mission access use open.

STAND	ACTIVITY	ACRES	DATE
18-1	TSI or Restoration project	49.68	2020
	Inspect for regeneration/ Shelter	49.68	2023
	Collect data prepare new plan	49.68	2035

Westwood Area: Forest Map 18, Stand 18-2, 22.67 Acres

Overstory Summary Narrative

Data collected originally in 2003 and updated in 2017. This stand is dominated by Sweetgum and six Oak species: Pin oak, Southern red oak, Chestnut oak, White oak and Post oak which is not very common at APG. Associate species includes Red maple, Loblolly pine, Virginia pine, and Tulip poplar, Holly, Blackgum and Cherry. The understory contains native Blueberry, Grapevine and Green briar. Invasive plants consist of Multiflora rose, Japanese Honeysuckle, Stilt grass and Tear thumb. No advance regeneration was found in any plots. Beech and unwanted Sweetgum seedling were noted. This stand borders / buffers a first order stream and associated wetland along its eastern and south eastern boundary.

Currently the stand contains 170 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 161 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100 % stocking level. From a tree form and vigor stand point, 47% of the trees are acceptable.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	20%
Sawtimber	11-23.9"	46%
Pole	6-10.9"	21%
Small tree	2-5.9"	13%

Recommendations

-The forest lacks natural regeneration, favor Poplar and Oak as crop seed trees
-A commercial TSI or restoration project to reduce Basal area to 75 sq. ft. per acre of good seed trees with good form and vigor is needed.
-Treat invasive shrubs and forbs.
-Grind up tops and stack logs through out to keep mission access use open.

STAND	ACTIVITY	ACRES	DATE
18-2	TSI or Restoration project	22.67	2020
	Inspect for regeneration/ Shelter	22.67	2023
	Collect data prepare new plan	22.67	2035

Edgewood Area: Forest Map 18, Stand 18-3, 46.4 Acres

Overstory Summary Narrative

Data was collected in 2016. A very mature stand dominated by Southern red oak, Willow oak, White oak, and Pin oak. Associate species include, Sweetgum, Hickory, and Red maple. The understory is comprised of Blueberry, Pepperbush, Greenbrier and Honeysuckle vine. Only 45% of the plots had regeneration, outside of the plots scattered advanced Oaks averaging 5 foot tall are present. Sweetgum is starting to fill canopy gaps as dead Oaks occur. The current Canopy closure is 65% a reflection of mature tree mortality. This stand is the critical area and borders the bay for a few thousand feet and plays a major role in protecting water quality.

This timber stand has the following diameter distribution:

Mature	26"+	21%
Saw timber	11-23.9"	56%
Pole	6-10.9"	17%
Small tree	2-5.9"	1%

Currently the stand contains 149 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 126 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a100 stocking level. From a tree form and vigor stand point, 60% of the trees are acceptable, which includes the acceptable matures 26 inches in DBH or greater.

Recommendations

-Manage toward old growth favoring healthy legacy trees and acceptable stock
-Restoration to promote regeneration, control dense understory protecting high quality natural regeneration
-Cut vines in crop trees and treat invasive.
-Eagle buffer guidelines apply

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 126 B.A. and should be reduced to a B.A. of 75 sq. ft. which is all acceptable trees. The initial thinning will involve removing 44 sq.ft. of unacceptable saw timber, pole timber and small trees (leaving poor quality matures trees as future den and snag trees. The trees can be utilized for pulpwood or sheared and left as part of the restoration process. This stand has good access and can be easily managed.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	DATE
18-3	Restoration/TSI	46.43	2017
	Collect data/prepare new plan		2032

Edgewood Area: Forest Map 18, Stand 18-4, 50.76 Acres

Overstory Summary Narrative

Data was collected in 2014. The stand is Eagle sensitive and within the MD defined Critical Area. It is dominated by Tulip poplar and Sweetgum with associate species of Southern red oak, Willow oak, Shingle oak and Red maple. This may be the only location of Shingle oak on post. The understory is comprised of native Blueberry, invasive Barberry and Honeysuckle vine. 0% of the plots have regeneration. The current Canopy closure is 85%. Mature Tulip poplar, Willow oak and Southern red oak are scattered throughout the stand.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	8%
Sawtimber	11-23.9"	69%
Pole	6-10.9"	16%
Small tree	2-5.9"	7%

Currently the stand contains 144 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 182 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 66% of the trees are acceptable.

Recommendations

-Eagle sensitive/MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 182 B.A. and should be reduced to a B.A. of 80 sq.ft. which is all acceptable trees. The initial thinning will involve removing 102 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 31 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
18-4	Single Tree Selection Invasive plant control	50.76

Edgewood Area: Forest Map 18, Stand 18-5, 47.4 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is mature with nice specimens of the dominant trees. Dominated by Tulip poplar and mixed Oaks, which include, Willow, Southern red and White oaks. Associate species include, Gum, Beech, Holly (dense in areas) and Red maple. The understory is comprised of Blueberry, Barberry, Holly and Viburnum. Fifty percent of the plots have regeneration but due to extensive deer browse the seedlings are very small. The current Canopy closure is 75-80 %, open gaps are present where mature trees have died. The majority of matures trees are current in good conditions. Good stand for **restoration** to enhance an encourage regeneration in this mature stand.

This large saw timber stand has the following diameter distribution:

Mature	26"+	34%
Saw timber	11-23.9"	39 %
Pole	6-10.9"	21%
Small tree	2-5.9"	6%

Currently the stand contains 186 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 188 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 58% of the trees are acceptable with the majority being mature.

Recommendations

-Manage toward old growth favoring healthy legacy trees and acceptable stock
-Restoration to promote regeneration, control dense understory protecting high quality natural regeneration
-Treat invasive.
-Single Tree Selection, favoring high quality crop trees

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 146 B.A. and should be reduced to a B.A. of 70 sq. ft. which is all acceptable trees. The initial thinning will involve removing 68 sq.ft. of unacceptable saw timber, pole timber and small trees. The trees can be utilized for pulpwood or sheared and left as part of the restoration process.

*Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	DATE
18-5	TSI	47.4	2018
	Collect data/prepare new plan		2033

Edgewood Area: Forest Map 18, Stand 18-6, 38 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Sweetgum and Tulip poplar. Associate species include Persimmon, Red maple Black cherry, Locust, Va. pine, Pin oak and Loblolly pine. The understory is comprised of Blueberry, Holly, Barberry, Wine berry and Microstegium. Ninety percent of the regeneration plots had no seedlings. The current Canopy closure is 85 %. The high stocking is causing stress on the Sweetgum dominating the stand. This stand is the critical area and borders the Bay along the entire eastern boundary and plays a major role in protecting water quality.

This timber stand has the following diameter distribution:

Mature	26"+	18%
Saw timber	11-23.9"	66%
Pole	6-10.9"	16%
Small tree	2-5.9"	0%

Currently the stand contains 144 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 163 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a110% stocking level. From a tree form and vigor stand point, 51% of the trees are acceptable with high quality matures or 39% without mature stock.

Recommendations

-This site is in the MD defined Critical Area
-Manage for Old Growth
-Restoration to enhance regeneration.
-Cut vines in crop trees
-Control invasives

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursuing Old Growth in this mature stand by designating legacy trees, increasing growth to the larger trees, creating standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes; favoring all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth, instead it's found more valuable to increase the number of characteristics associated with these types of forest communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include:

Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type.

-Single Tree Selection, favoring high quality Tulip poplar crop trees and Oaks.

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 163 B.A. and should be reduced to a B.A. of 90 sq.ft. which is all acceptable trees. The initial thinning will involve 73 sq.ft. of unacceptable, matures, saw timber and pole timber. This stand has good access and can be easily managed.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	YEAR
18- 6	TSI and enhancement	38	2020
	Collect data/prepare new plan		2035

Forest restoration work completed in June 2017.

Mar-Len Environmental, Inc. (MLE) removed mid story, and unacceptable over story trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks and Poplar to dominate the stand, as well as reduced overstocking from 163 B.A. to 90 B.A. Tree density per acre was drastically reduced. Trees with poor form and vigor were clearly marked and cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. Invasive plants such as Barberry and Microstegium were treated.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO scan.
-Performed UXO scan of the entire project area.
-Marked poor quality trees for removal.
-Cut trees and vines and consolidated brush piles where possible to expose the forest floor.
-Scarified site to promote soil and seed contact.
-Treated invasive species.

STAND	ACTIVITY	ACRES	YEAR
18- 6	Collect data/prepare new plan	12 +	2035

Westwood Area: Forest Map 18, Stand18-7, 89.35 Acres

Overstory Summary Narrative

Data collected in 2017. This stand borders/buffers a first order stream, a large marsh and the Bay for thousands of feet. Dominated by Sweetgum, Red maple and Tulip poplar; Oaks had a strong presence in 60 percent of the plots. Oaks present include; Pin oak, Southern Red Oak and Willow Oak. Associate species include: Loblolly, Sassafras, Sycamore, Locust, Beech, Holly, and Virginia pine. The understory contains native Blueberry, Grapevine and Greenbrier. Invasive plants consist of Multiflora rose, Japanese Honeysuckle, Stilt grass and Barberry. No advance regeneration was found in any plots. Beech and unwanted sweetgum seedling were noted as well as crowns being hindered by vines. Both Sweetgum and Oaks are showing stress from canker; bleeding canker in the Sweetgum and Hypoxylon canker in Oaks.

This sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	56%
Pole	6-10.9"	25%
Small tree	2-5.9"	5%

Currently the stand contains 159 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 125 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100 % stocking level. From a tree form and vigor stand point, only 40 % of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor Poplar and Oak as crop seed trees.
-A commercial TSI or restoration project to reduce basal area to 60 sq. feet per acre of good seed trees with good form and vigor is needed.
-Treat invasive shrubs and forbs.
-Grind up tops and stack logs through out to keep mission access use open.

STAND	ACTIVITY	ACRES	DATE
18-7	TSI or Restoration project	89.35	2022
	Inspect for regeneration/ Shelter	89.35	2024
	Collect data prepare new plan	89.35	2037

Edgewood Area: Forest Map 18, Stand 18-8, 75 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Tulip poplar and Sweetgum with high quality oaks such as Willow, Chestnut, Southern red and White oaks within the stand. Associate species include, Beech Locust, Hickory. The understory is comprised of Barberry, Multiflora rose, Holly and Viburnum. None of the plots have regeneration, Microstegium is dense. The Canopy closure was 85 %. The stand was also grossly over stocked with a BA of 174.

This large saw timber stand has the following diameter distribution:

Mature	26"+	6%
Saw timber	11-23.9"	78%
Pole	6-10.9"	15%
Small tree	2-5.9"	1%

The stand contains 232 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 174 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a115% stocking level. From a tree form and vigor stand point, 60% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring high quality crop trees of Poplar and Oak.
-Cut vines in crop trees
-Treat invasive
-Shelter regeneration after thinning.

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 174 B.A. and should be reduced to a B.A. of 80 sq. ft. which is all acceptable trees. The initial thinning will involve removing 94 sq. ft. of unacceptable, matures, saw timber, pole timber, small trees as well as some acceptable quality trees. The trees could be utilized for saw logs and pulpwood.

Deer control should be increased in this area as well.

Forest restoration work completed in June 2019.

The entire site was scanned for ordinance. The understory was comprised of shrubs that shaded out the forest floor. The majority of the site was mowed to open up the lower canopy level. Currently an adequate seed source is present for regeneration of Oak, Hickory and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed mid-story and unacceptable overstory trees in allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 174 sq. feet of Basal Area to 80 sq. feet average. Lower density exists in portions of the stand with the lowest Basal Area being 50 sq. ft. per acre. The trees per acres currently averages 80 trees from the 232 in 2016. The

acceptable growing stock is now 90 percent. Stand stocking is high were forested wetlands prohibited access.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. High value wildlife trees were marked for retention with a W.

This intermediate thinning improved stand vigor, stand quality and now concentrates growth on the improved species composition. Sweetgum is still a major component but Oaks and Poplar now make up a greater percentage of high-quality trees.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked crop trees.
-Mark high value wildlife trees.
-Flagged all wetland prior to thinning.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.

*Deer control should be increased in this area.

18-8	Collect data	2039

Follow silvicultural recommendations associated with new data collected.

Lauderick Creek Area: Forest Map 18, Stand 18-9, 58.45 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow poplar with associate species being; Red maple, Sweetgum, Cottonwood, White oak, Black oak, Chestnut oak and Southern red oak. Blueberry, Blackberry, Holly, Greenbrier, Barberry, Sweet gum and Japanese honeysuckle were found in the understory.

This small sawtimber stand has an average merchantable diameter of 13.9

Currently the stand contains 362 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 120 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 74.2% stocking level. From a tree form and vigor stand point, 35% of the trees are acceptable.

Forest restoration work completed in April 2019.

The entire site was scanned for ordinance. The understory was comprised of Holly, dense blueberry shrubs and small sweetgum trees that shaded out the forest floor. The majority of the site was mowed to open up the lower canopy level. Currently an adequate seed source is present for regeneration of Oak, Hickory and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand, as well as reduced overstocking from 120 sq. feet of Basal Area in 2009 to 75-80 B.A. sq. feet average. Lower density exists in sections of forest with the lowest BA of 40 recorded. The trees per acres currently averages 60-80 trees. The acceptable growing stock is 80 percent plus. Prior to restoration only 35 percent of all trees on site were acceptable.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. High value wildlife trees were marked for retention.

This intermediate thinning improved stand vigor, stand quality and now concentrates growth on the improved species composition.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Clearly marked wildlife trees with high potential.
-Marked all acceptable growing stock.
-Flagged wetland and stream buffers prior to working.

Recommendations

Follow silvicultural recommendations associated with new data collected, control deer to allow regeneration to establish.

STAND	ACTIVITY	ACRES	Date
18-9	TSI in remaining	11 .0	2020-22
18-9	Collect data follow new plan recommendations	58.45	2040

Edgewood Area: Forest Map 18, Stand 18-10, 54.6 Acres

Overstory Summary Narrative

Data was collected in 2016. The stand is dominated by Tulip poplar, mixed Oaks and Sweetgum. Oaks include, Southern red, Willow, Pin and Chestnut oaks. The understory is comprised of Blueberry, Barberry, Holly, Multiflora rose, Wine berry and Microstegium. Only one plot had a seedling, the remaining plots had no regeneration. The current Canopy closure is 80 %. The high stocking is causing stress on the Sweetgum dominating the stand. This stand is the critical area and borders the Bay on three sides and plays a major role in protecting water quality.

This timber stand has the following diameter distribution:

Mature	26"+	16 %
Saw timber	11-23.9"	68%
Pole	6-10.9"	15%
Small tree	2-5.9"	1%

Currently the stand contains 187 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 178 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a115 stocking level. From a tree form and vigor stand point, 59% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring high quality Oak crop trees and Tulip poplar
-Cut vines in crop trees
-Treat invasive dense in areas

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 178 B.A. and should be reduced to a B.A. of 80 sq. ft. which is all acceptable trees. The initial thinning will involve removing 98 sq.ft. of unacceptable saw timber, pole timber and small trees. As well as some acceptable timber. The trees can be utilized for saw logs and pulpwood. This stand has good access and can be easily managed.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES	DATE
18-10	Single Tree Selection	54.6	2020
	Prepare new plan		2035

Aberdeen Area: Forest Map 21, Stand 21-17, 124.19 Acres

Overstory Summary Narrative

Data was collected in 2012. This environmentally sensitive stand borders the Bay on three sides, and is part of an Eagle Buffer. This highly disturbed area, historically used as a residence and farm, is diverse in species composition. Species include White oak, Chestnut oak, Sweetgum, Southern red oak, Pin oak, Red maple, Sycamore, Black walnut, Catalpa, Cottonwood, Locust, and Tulip poplar. The understory consists of Dogwood, Bayberry, Horse chestnut, Cherry, Highbush blueberry, Blackgum, Winterberry, Barberry, Tree of Heaven, Oriental bittersweet, and Microstegium. The 25 regeneration plots show no advanced regeneration in the plots; due to deer pressure and heavy invasives.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	37%
Sawtimber	11-23.9"	40%
Pole	6-10.9"	17%
Small tree	2-5.9"	6%

Currently the stand contains 65 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 78 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 55% plus stocking level. From a tree form and vigor stand point, almost no trees are acceptable.

Recommendations

-Flag off 100 ft buffer
-This site is in the Critical Area and a harvest plan should be completed
-Forest restoration to promote regeneration
-Control the invasives

This stand is in need of restoration as it is under stocked and the majority of the trees are in poor condition. The goal should be to establish 100 trees per acre, planting Oak and Poplar as the dominate species. This can be accomplished after each planting location is cleared in a 6 ft. diameter and treated with herbicides.

STAND	ACTIVITY	ACRES
21-17	Forest restoration/planting	124.19
	Prepare new plan	61.4

This site can be used for mitigation and planted as acreage is needed.

Edgewood Area: Forest Map 26, Stand 26-3, 95.94 Acres

Overstory Summary Narrative

Data was collected in 2014. The stand is within the MD defined Critical Area. It is dominated by Tulip poplar with associate species of Beech, Hickory, White oak, Swamp chestnut oak, Pin oak and Red maple. The understory is comprised of native Blueberry, Holly, Sassafras and Bayberry with Wisteria vine and Greenbrier. 23% of the plots have regeneration. The current Canopy closure is 90%. Mature Tulip poplar and Oaks are scattered throughout. Invasive plants include Barberry, Multiflora rose, Microstegium, Bittersweet, Honeysuckle, autumn olive and Privet.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	26%
Sawtimber	11-23.9"	65%
Pole	6-10.9"	8%
Small tree	2-5.9"	1%

Currently the stand contains 100 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 119 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 56% of the trees are acceptable.

Recommendations

-MD defined Critical Area
-Manage for Old Growth
-Control invasives

A large portion of the AGS (33%) is in mature trees, making this stand a good candidate to manage toward Old Growth. There are only 100 trees per acre, many of them are undesirable and/or dying matures which is a component of Old Growth. This stand can be left alone in its current state.

STAND	ACTIVITY	ACRES
26-3	Leave stand in current state Control invasives to encourage regeneration	95.94

Aberdeen Area: Forest Map 26, Stand 26-6, 44.48 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Sweetgum, Red maple, Pin oak, Sycamore, Tulip poplar, Beech, Southern red oak, White oak, and Scarlet oak, with Sweetgum and Red maple being the most prevalent. The understory consists of Blueberry, Holly, Sweetgum, Greenbrier, and Black haw. The 10 regeneration plots show no advanced regeneration in the plots; due to deer pressure, heavy invasives, and canopy closure of 75%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	61%
Pole	6-10.9"	16%
Small tree	2-5.9"	0%

Currently the stand contains 91 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 120 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand an 85% plus stocking level. From a tree form and vigor stand point, 20% of the trees are acceptable, not including matures. This stand is stocked well below C-level, however due to the Eagle habitat, wetlands and proximately to the Romney Creek. This stand is too sensitive for intense management, and should be left alone to go through natural succession.

Recommendations

-This site is in the Critical Area
-Eagle Buffer
-Leave stand in its natural state

STAND	ACTIVITY	ACRES
26-6	Prepare new plan	44.48

Aberdeen Area: Forest Map 26, Stand 26-7, 47.44 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is important as it buffers Romney Creek and houses the C Tower Eagle Nest and part of the Romney Roost. The stand is dominated by Sweetgum, Red maple, and Tulip poplar, with associated species of Black cherry, Sycamore, Ash, Silver maple, willow oak, and Southern red oak. The understory consists of Highbush blueberry, Holly, with downed wood, heavy vines and trees. The 15 regeneration plots show no advanced regeneration in the plots; due to deer pressure and heavy invasives. The majority of the trees are in poor condition, the mortality is high and the stand is in need of restoration.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	32%
Sawtimber	11-23.9"	61%
Pole	6-10.9"	6%
Small tree	2-5.9"	1%

Currently the stand contains 63 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 122 sq. ft. per acre average.

Recommendations

-This site is in the Critical Area
-Eagle Buffer & Nest/Roost
-Restoration to encourage Poplar regeneration

The majority of the stand has large gaps with numerous downed and dead trees. Remove the dense invasive plant layer to encourage seed contact with soil. If regeneration from seed is not successful this area should be planted with Oak and Poplar as the dominate species. It is a great mitigation site for Aberdeen Proving Grounds.

STAND	ACTIVITY	ACRES
26-7	Forest Restoration *	31.0
	Inspect Restoration work	31.0
	Prepare new plan	47.44

*Restoration is scheduled for June 2014, UXO has completed approximately 31 + acres.

Aberdeen Area: Forest Map 26, Stand 26-9, 84.77 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is important as it buffers Romney Creek and is part of the C Tower Eagle buffer and the Romney Roost. The stand is dominated by Sweetgum, Red maple, and Tulip poplar, with associated species of Black cherry, Sycamore, Ash, Silver maple, Willow oak, and Southern red oak. The understory consists of Highbush blueberry, Holly, and Blackhaw, with downed wood, heavy vines and trees. The 20 regeneration plots show no advanced regeneration in the plots; due to deer pressure and heavy invasives. The majority of the trees are in poor condition, the mortality is high and the stand is in need of restoration. The majority of the stand has large gaps with numerous downed and dead trees. The vast majority of the trees, 75% are in poor health and vigor and should be removed to aid in natural regeneration.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	35%
Sawtimber	11-23.9"	47%
Pole	6-10.9"	12%
Small tree	2-5.9"	6%

Currently the stand contains 152 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 85 sq.ft. per acre average with only 21 sq.ft. Being acceptable stock

Recommendations

-This site is in the Critical Area
-Eagle Buffer & Roost
-Shelterwood cut removing all unacceptable stock, control invasives before harvest
-Restoration and enhancement (plant and shelter if harvest does provide adequate regeneration)
-Use as a future mitigation site

STAND	ACTIVITY	ACRES
26-9	Shelterwood harvest Invasive plant removal Inspect regeneration Prepare new plan	84.77

In November of 2014 MLE, Inc. restored the Forest Community in and around the Romney Creek Roost and Eagle Nest; a total of 40.0 acres. The site was under stocked with the majority of trees being unacceptable and damaged. The invasive plant community in the understory was dense with multiflora rose, barberry and microstegium. Poplar dominates the overstory and is an excellent seed source. The goals were completed: girdle undesirable trees, cut vines, scarify the ground layer and treat with herbicide.

Activities:

-Performed first UXO scan of site under DO#50
-GPS site, map attached.
-Prepared Digging Permit and site-specific work order to scarify the ground to a depth of 3".
-Used Fecon Forestry mower to scarify the ground and to remove dense layer of microstegium and shrubs.
-Treated bare ground with a pre-emergent to suppress spring grass seed germination.

NOTE: The project benefited both Eagle Habitat and water quality as the majority of the trees are planted in close proximity to the bay.

Aberdeen Area: Forest Map 26, Stand 26-11, 28.24 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Tulip Poplar. Associate species include; Sweetgum, Black cherry, Beech, Red oak, Walnut, Hickory, and White oak. The understory is comprised of Holly, Wine berry, Barberry, and Microstegium. No regeneration noted in the large canopy gaps after blow down. Highly invasive and alien understory is hindering regeneration along with the intense deer browse. None of the plots had regeneration. This stand is an important buffer to the Bay and is deteriorating.

This mature stand has the following diameter distribution breakdown:

Mature	26"+	54 %
Sawtimber	11-23.9"	37%
Pole	6-10.9"	7%
Small tree	2-5.9"	2 %

*Majority of Mature trees are unacceptable

Currently the stand contains 78 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 169 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, the majority of the trees are unacceptable.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer.
-This site is in the Critical Area and the harvest plan should be completed.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

This stand is in need of a regeneration cut to open up the canopy and allow regeneration to establish. Yellow-poplar is a prolific seeder, and large crops are produced almost annually. A combination of a single tree selection and small less than ½ group selections will aid in regeneration. The Stand is marked in the same manner as with single-tree selection cut, the only difference being that small openings are created in the stand. Single-tree selection cutting occurs between the openings. In these areas the majority of trees are unacceptable and should be removed leaving only acceptable high-quality growing stock. The residual basal area in the single tree selection portions of the stand should be 65 sq.ft. per acre.

Controlling invasive and alien plants directly after the harvest is imperative to natural regeneration success. Deer control should be increased in this area as well. High quality regeneration should be sheltered if the deer population cannot be controlled.

STAND	ACTIVITY	ACRES
26-11	Single tree/small group harvest Control invasives Prepare new Plan	28.24

Edgewood Area: Forest Map 26, Stand 26-12, 10.41 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is within the MD defined Critical Area. It is dominated by Sweetgum, Tulip poplar and Red maple. Associated species are Cherry, Black gum and Sycamore. The understory is comprised of Viburnum, Barberry, Blackberry, Blueberry, Holly and Beech. Wisteria vine is hindering crown development. 0% of the plots have regeneration. The current Canopy closure is 90%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	5%
Sawtimber	11-23.9"	82%
Pole	6-10.9"	13%
Small tree	2-5.9"	0%

Currently the stand contains 115 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 180 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 44% of the trees are acceptable.

Recommendations

-MD defined Critical Area
-Single Tree Selection
-Invasive plant control

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 180 B.A. and should be reduced to a B.A. of 80 sq.ft. which is all acceptable trees. The initial thinning will involve removing 100 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 30 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
26-12	Single Tree Selection Invasive plant control	10.41

Edgewood Area: Forest Map 26, Stand 26-14, 73.19 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is Eagle sensitive within the MD defined Critical Area. It is dominated by Sweetgum, Tulip poplar and Red maple. Associated species are Pin oak, Willow oak, Southern red oak, Walnut and Sycamore. The understory is comprised of Multiflora rose, Barberry, Winterberry, Blueberry and Holly with Wisteria, Bittersweet and Honeysuckle vines. 7% of the plots have regeneration. The current Canopy closure is 70%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	28%
Sawtimber	11-23.9"	57%
Pole	6-10.9"	14%
Small tree	2-5.9"	1%

Currently the stand contains 54 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 114sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 80% stocking level. From a tree form and vigor stand point, 40% of the trees are acceptable.

Recommendations

-Eagle sensitive/MD defined Critical Area
-Old Growth
-Invasive plant control
-Restoration/Mitigation site/potential planting locations
-Shear or girdle undesirables to reduce site impact

A large portion of the AGS (43%) is in mature trees, making this stand a good candidate to manage towards Old Growth. There are only 54 trees per acre, many of them are undesirable and/or dying matures which is a component of Old Growth. This stand can be utilized for restoration, large openings can be planted and microstegium should be controlled to aid in seed germination.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
26-14	Restoration/Mitigation Invasive plant control	73.19

Aberdeen Area: Forest Map 26, Stand 26-18, 55.17Acres

Overstory Summary Narrative

Data was collected in 2012. The stand is dominated by Willow oak, Southern red oak, Beech, White oak, Black gum, Sweetgum, Tulip poplar, Northern red oak, and Swamp chestnut oak. The understory consists of Blueberry, Greenbrier, with patches of dense Holly. The 20 regeneration plots show only Beech and Sweetgum regeneration, no advanced Oak regeneration shows in the plots.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	33%
Sawtimber	11-23.9"	67%
Pole	6-10.9"	15%
Small tree	2-5.9"	0%

Currently the stand contains 114 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 116 sq. ft per acre average. The number of trees correlated with the B.A. gives this stand a 90% plus stocking level. From a tree form and vigor stand point, 38% of the trees outside of the mature class are acceptable. This stand has numerous drainage patterns/wetlands and hydric soils. It is too sensitive for intense management.

Recommendations

-This site is in the Critical Area
-Eagle Buffer
-Leave in natural state

STAND	ACTIVITY	ACRES
26-18	Prepare plan	55.17

Aberdeen Area: Forest Map 26, Stand 26-1/2, 39.2 Acres

Overstory Summary Narrative

Data was collected in 2012. This entire stand is part of the Chilbury Eagle Nest & Buffer and borders the Bay to the Northwest. Dominate species include Tulip poplar, Red maple, Sweetgum, Sycamore and Willow oak. The understory consists of Multiflora rose, Barberry, Honeysuckle vine, and Microstegium. The 10 regeneration plots show no advanced regeneration in the plots; due to deer pressure and heavy invasives.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	34%
Sawtimber	11-23.9"	54%
Pole	6-10.9"	6%
Small tree	2-5.9"	6%

Currently the stand contains 52 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 103 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 75% plus stocking level. From a tree form and vigor stand point, 39% of the trees are acceptable, not including matures.

Recommendations

-Flag off 100 ft buffer
-This site is in the Critical Area
-Forest restoration
-Control the invasives
-Eagle Buffer

In April, 2013, Forest restoration at Chilbury was completed in part of the buffer itself; for a total of 9 acres. The site was under stocked with the majority of the trees being unacceptable and damaged. The invasive plant community in the understory was dense with multiflora rose and microstegium. The goal was to create an invasive free location, approximately 6 foot in diameter for each tree, and plant an oak and poplar dominated community in the understory.

STAND	ACTIVITY	ACRES
26-1/2	Forest restoration/planting	30.2
	Prepare new plan	39.2

Aberdeen Area: Forest Map 26, Stand 26-19, 26.34 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Sweetgum and Tulip poplar and scattered Red maple. The dominating Sweetgum has canker due to stress. The understory consists of Blueberry, dense areas of Barberry, Wine berry, Blackhaw, and Microstegium. The 10 regeneration plots show no advanced regeneration in the plots; due to deer pressure, heavy invasives, and canopy closure of 80%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	15%
Sawtimber	11-23.9"	69%
Pole	6-10.9"	16%
Small tree	2-5.9"	0%

Currently the stand contains 112 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 128 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% plus stocking level. From a tree form and vigor stand point, 45% of the trees are acceptable, not including matures. Sawtimber and matures account for 8,500 bd. ft. per acre.

Recommendations

-Flag off 100 ft buffer
-This site is in the Critical Area
-Control the invasives
-TSI
-Logging access roads should be maintained for management access and fire control.
-Restoration /mitigation site

From a timber management point of view this stand is in need of a commercial thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 128 B.A. and should be reduced to a B.A. of 70 Sq.ft. which is all acceptable trees. The initial thinning will involve removing 58 sq.ft. of unacceptable mature, sawtimber, and pole timber. The trees can be utilized for pulpwood with the thinning producing approximately 18 cords per acre.

STAND	ACTIVITY	ACRES
26-19	Control Invasives	23.65
	TSI	23.65
	Prepare new plan	26.4

In 2013, a small 2.75-acre portion along the bay was planted for Eagle habitat restoration and a 0.25 acre adjoining section was planted to satisfy mitigation for Poole's Island.

Aberdeen Area: Forest Map 26, Stand 26-20, 42.24 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Yellow poplar, Sweet gum, Willow oak, Pin oak, Sycamore, Black cherry, Black oak and Beech with associate species being; Sassafras, Black gum, Red maple and Holly. No information was collected on the understory.

This stand has the following diameter distribution breakdown:

Mature	26"+	32%
Sawtimber	11-25.9"	55%
Pole	6-10.9	11%
Small tree	2-5.9"	2%

Currently the stand contains 100 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 124 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 43% of the trees are acceptable.

The acceptable sawtimber volume currently is 10,360 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.
-This stand provides FID habitat.
-TSI to remove undesirables and reduce stocking.

As per the 2001 data, this stand has 100% stocking with 43% of the trees being acceptable. The basal area should be reduced to 60 sq.ft. per acre. This will favor crop trees, as well as provide sunlight for regeneration.

STAND	ACTIVITY	ACRES
26-20	commercial TSI collect data/prepare plan	42.24

Edgewood Area: Forest Map 27, Stand 27-3, 65.36 Acres

Overstory Summary Narrative

Data was collected in 2014.The stand is Eagle sensitive within the MD defined Critical Area. It is dominated by mixed Oak, Sweetgum, Tulip poplar and Red maple. Associated species are River birch, Blackgum, Beech, Persimmon and Sycamore. The understory is comprised of Blueberry, Bayberry, Holly, Viburnum, Serviceberry and Sassafras. The understory is sparse in general. 20% of the plots have regeneration; however, an excellent Oak seed source is present. The current Canopy closure is 95%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	11%
Sawtimber	11-23.9"	60%
Pole	6-10.9"	17%
Small tree	2-5.9"	12%

Currently the stand contains 106 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 95 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, 72% of the trees are acceptable.

Recommendations

-Eagle sensitive/MD defined Critical Area
-Single Tree Selection

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 95 B.A. and should be reduced to a B.A. of 65 sq.ft. which is all acceptable trees. The initial thinning will involve removing 30 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 9 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
27-3	Single Tree Selection	65.36

Aberdeen Area: Forest Map 29, Stand 29-1, 56.40 Acres

Overstory Summary Narrative

Data was collected in 2012. 16.7 acres of restoration has occurred within this stand, including 9 acres along the shoreline; near the Cannery planting. This essential Eagle buffer and major Roost area is dominated by Sycamore, Tulip Poplar and Red maple, with associate species of Cherry, Locust, Ash, and Walnut. The understory is heavily invasive with Microstegium, Multiflora rose, Wine berry, Honeysuckle, Climbing bittersweet, Mile a Minute weed, and Barberry. The 19 regeneration plots show no advanced regeneration, due to invasives and excessive deer browsing.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	38%
Sawtimber	11-23.9"	54%
Pole	6-10.9"	6%
Small tree	2-5.9"	2%

Currently the stand contains 44 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 65 sq. ft per acre average. The number of trees correlated with the B.A. gives this stand a 40% plus stocking level. From a tree form and vigor stand point, 30% of the trees outside of the mature class are acceptable. This stand is in need of Restoration on the remaining 39.7 acres of the site.

Recommendations

-This site is in the Critical Area
-Eagle Buffer & Roost
-Restoration

Restoration involved creating access throughout the stand for maintenance. Removing vines from crowns in acceptable trees, creating a 6 ft diameter cleared planting location, and planting Oak and Poplar dominating species with tree shelters.

This is an excellent mitigation site for the Aberdeen area.

STAND	ACTIVITY	ACRES
29-1	Restoration	39.7
	Prepare new plan	56.40

Aberdeen Area: Forest Map 29, Stand 29-2, 25.45 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Sweetgum, Red maple, and Silver maple, with associate species of Tulip poplar and Sycamore, with occasional Willow oak and Southern red oak. The understory is heavily invasive with Microstegium, Multiflora rose, Japanese honeysuckle, climbing bittersweet, and Barberry. The 10 regeneration plots show no advanced regeneration, due to invasives.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	18%
Sawtimber	11-23.9"	68%
Pole	6-10.9"	12%
Small tree	2-5.9"	2%

Currently the stand contains 74 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 97 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 70% plus stocking level. From a tree form and vigor stand point, 35% of the trees outside of the mature class are acceptable.

Recommendations

-This site is in the Critical Area & Eagle Roost/Buffer
-Forest Enhancement

STAND	ACTIVITY	ACRES
29-2	Forest Enhancement Prepare plan	254.5

In February of 2014 restoration work was complete; removing an invasive shrub layer, extensive vine cutting and girdling unacceptable growing stock that was marked. In spring of 2014 invasives that re sprout will be treated with herbicide.

Aberdeen Area: Forest Map 29, Stand 29-3, 17.53 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is dominated by Sweetgum and Red maple, with associate species of Willow oak, Hickory, Walnut and Ash. The understory is heavily invasive with Microstegium, Multiflora rose, Japanese honeysuckle, climbing bittersweet, and Barberry. The 10 regeneration plots show no advanced regeneration, due to invasives.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	5%
Sawtimber	11-23.9"	78%
Pole	6-10.9"	12%
Small tree	2-5.9"	5%

Currently the stand contains 114 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 133 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 27% of the trees outside of the mature class are acceptable.

Recommendations

-This site is in the Critical Area & Eagle Roost
-Forest Enhancement

STAND	ACTIVITY	ACRES
29-3	Forest Enhancement	8.5
	Prepare plan	17.53

In February of 2014 restoration work was complete; removing an invasive shrub layer, extensive vine cutting and girdling unacceptable growing stock that was marked. In spring of 2014 invasives that re sprout will be treated with herbicide.

8.5 acres was removed from the restoration site due to extensive ordinance found in January 2014 survey.

Aberdeen Area: Forest Map 29, Stand 29-4, 75.05 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand is an important buffer to Romney Creek; it has an existing pond in the center and a large wetland swamp in its Northern portion. One area along the Northwest side of the stand is in very poor quality, almost impassible. This stand is dominated by Sweetgum and Tulip poplar with associated species being, Red maple and Willow oak. The understory is heavily invasive with Barberry, and also contains Microstegium, Multiflora rose, and Japanese honeysuckle. The 20 regeneration plots showed one plot (5%) with advanced regeneration, due to invasives.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	30%
Sawtimber	11-23.9"	60%
Pole	6-10.9"	9%
Small tree	2-5.9"	1%

Currently the stand contains 93 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 107 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% plus stocking level. From a tree form and vigor stand point, 21% of the trees outside of the mature class are acceptable.

Recommendations

-This site is in the Critical Area
-Eagle Roost
-Too sensitive for management, leave in its natural state

STAND	ACTIVITY	ACRES
29-4	Prepare a new plan	75.05

Phillips Army Airfield Area: Forest Map 29, Stand 29-5, 195.35 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by American beech and Sweet gum with associate species being; Red maple, White oak, Black gum, Willow oak, Southern red oak, Yellow poplar, Black oak, Pin oak, Walnut and Sycamore. Greenbrier, Sweet pepperbush, Blueberry, Honeysuckle, Wine berry, Barberry, Holly and Japanese honeysuckle were found in the understory.

This large sawtimber stand has an average merchantable diameter of 18.41

Currently the stand contains 104.37 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 89.5 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 60.6% stocking level. From a tree form and vigor stand point, 39.0% of the trees are acceptable.

The acceptable sawtimber volume currently is 7,192.51 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft^2/ac average with at least 70 percent canopy closure at all times.

-This site contains an Eagle Buffer follow APG Eagle restrictions.

-This stand has 2.3% cover in the ground layer. Ground vegetation is comprised of vegetation from 0 - 3 ft. in height. This includes grasses, sedges, ferns, club mosses, seedlings and wild flowers.

STAND	ACTIVITY	ACRES
29-5	commercial TSI	195.35
	control invasives	
	examine stand for commercial harvest	

Phillips Army Airfield Area: Forest Map 29, Stand 29-6, 10.22 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow poplar with associate species being; Red maple, Sweet gum, Sycamore, Black gum and Walnut. Blueberry, Multiflora rose, Barberry, Greenbrier, Honeysuckle and Holly were found in the understory.

This large sawtimber stand has an average merchantable diameter of 18.24

Currently the stand contains 93.44 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 110 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 52.5% stocking level. From a tree form and vigor stand point, 60% of the trees are acceptable.

The acceptable sawtimber volume currently is 9,571.75 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft²/ac average with at least 70 percent canopy closure at all times.

-This site contains an Eagle Buffer follow APG Eagle restrictions.

Fire has damaged many of the trees in this stand. A TSI can help remove the unacceptable stock (45%), and leave an under stocked poplar forest with 50 sq. ft. of growing stock. The invasive plant community is high and the site needs to be restored to allow the poplar and other native species to regenerate. If invasive plants cannot be controlled, planting a native understory would help with future stocking.

STAND	ACTIVITY	ACRES
29-6	commercial TSI	10.22
	control invasives	
	examine stand for commercial harvest	

Forest Map 29, Stand 29-7, 10.10 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Red maple, Black locust and Sweet gum with associate species being; Black cherry, Ash and Black walnut. Grapevine, Greenbrier and Blueberry were found in the understory. Invasive plants include Microstegium, Barberry and Grapevine.

This is a mature sawtimber stand d.b.h. ranges 12" – 24".

This stand is under stocked with 60% canopy closure.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft^2/ac average with at least 70 percent canopy closure at all times.
-This site contains an Eagle Buffer follow APG Eagle restrictions.
-Fragmented with large openings and some vine intrusion into canopy.
-Good restoration site.

STAND	ACTIVITY	ACRES
29-7	commercial TSI	10.10
	control invasives	
	examine stand for commercial harvest	

Aberdeen Area: Forest Map 29, Stand 29-8, 43.9 Acres

Overstory Summary Narrative

Data was collected in 2019. Buffering the Romney Creek, this stand is dominated by Poplar, Sweetgum and Red maple. Associate species include Sycamore, Pin oak, Willow oak and Walnut in the overstory. The mid and understory are comprised of Blueberry, Beech, Dogwood, Holly and Sassafras. This stand is very important for water quality. The regeneration plot survey found advanced regeneration in none of the plots, however: large grass openings adjacent to the Romney and could be planted. Currently shade (Canopy closure) is 80% and deer pressure is heavy.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	22%
Sawtimber	11-23.9"	63%
Pole	6-10.9"	13%
Small tree	2-5.9"	2%

Currently the stand contains 134 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 145 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% plus stocking level. From a tree form and vigor stand point, 66% of the trees are acceptable.

Recommendations

-Survey planting acreage availability
-Control beech and Vines in crowns
-Remove unacceptable growing stock
-Manage toward old growth

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursue Old Growth in this mature stand by designating legacy trees, increasing growth to the larger trees, creating standing dead and canopy gaps to aid in natural regeneration, establishing a diversity of trees sizes; favoring all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth, instead it's found more valuable to increase the number of characteristics associated with these types of forest communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include:

Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type.

Create snags and down woody debris: Girdle trees (if approval is given) of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.

Accelerate growth in legacy trees: Full or partial crown release. A total of 62 square feet of unacceptable growth is spread out among sawtimber, pole and small trees size classes.

Controlling invasive and alien plants is imperative to natural regeneration success. Deer control should be increase in this area as well.

STAND	ACTIVITY	ACRES
29-8	Single Tree Selection TSI. Basal spray young Beech and Gum. Manage for Old Growth	43.9

Aberdeen Area: Forest Map 29, Stand 29-9, 243.1 Acres

Overstory Summary Narrative

Data was collected in 2019. This stand is dominated by Yellow poplar, White oak, Willow oak, Swamp white oak, Black gum, Pin oak, and American beech. Associate species include, Red maple, Sweetgum, Hickory and Pine. The understory container Highbush blueberry, Clethra and Laurel. Invasive understory plants include; Barberry, Wine berry and areas of Microstegium. Unique features in this large stand with excellent forest interior habitat for birds, include: Large areas of forested wetlands and large mature Poplar and Oaks in the 40-inch range.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	37%
Sawtimber	11-25.9"	43%
Pole	6-10.9	12%
Small tree	2-5.9"	8%

Currently the stand contains 171 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) 132 of sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90-stocking level. From a tree form and vigor stand point, 55 % of the trees are acceptable. Forested wetlands account for 70 acres of this stand, data was collected in the forested wetlands except large open body waters.

Silvicultural recommendations of most concern, is to start eliminating the Beech, seedlings, saplings, small tree and pole class. Areas exist were large openings have occurred naturally and Beech has occupied these areas in what is called a Beech desert where nothing else can compete. The present and occupation of Beech in the Last 20 year was aggressive.

Recommendations

-GPS blocks with in the stand of 20 acres that need treatment.
-Prepare treatment block maps.
-Apply a post emergent treatment on seeding, Basal application to treat sapling and small size class trees.
-The pole and larger trees should be cut and each stump treated to prevent sprouting.
-Invasive plants within treatment blocks should be address at the same time.

STAND	ACTIVITY	ACRES
29-9	GPS / Map treatment blocks	20-acre units
	Reduce Beech impact on stand	
	Request re exam 2040	243.09

Aberdeen Area: Forest Map 29, Stand 29-10 41.7 Acres

Overstory Summary Narrative

Data was collected in 2019. The stand is dominated by Sweetgum and Red maple. Sweetgum, the dominate species shows signs of bleeding canker. Associate species include; Pin oak, Cherry, Persimmon, White oak and Tulip poplar. The understory is comprised of Barberry, Multiflora rose, Holly, Blueberry and Viburnum. None of the plots have regeneration and Microstegium is dense in areas. The current Canopy closure is 78 %. The stand is grossly over stocked with a BA of 187 and borders a small stream along the southern boundary.

This large saw timber stand has the following diameter distribution:

Mature	26"+	0%
Saw timber	11-23.9"	67%
Pole	6-10.9"	23%
Small tree	2-5.9"	10%

Currently the stand contains 270 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 187 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a100 +% stocking level. From a tree form and vigor stand point, 47% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring high quality crop trees of Poplar and Oak.
-Cut vines in crop trees
-Treat invasive
-Restoration

From a timber management point of view this stand is in need of a thinning to reduce competition. The stand has a basal area of 187 B.A. and should be reduced to a B.A. of 90 sq. ft. which is all acceptable trees. The initial thinning will involve removing 97 sq. ft. of unacceptable matures, saw timber, pole timber and small trees as well as some acceptable quality trees.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
29-10	TSI /restoration	41.7
	Collect data/prepare new plan	

Aberdeen Area: Forest Map 29, Stand 29-11, 31.12 Acres

Overstory Summary Narrative

Data was collected in 2019. The stand is dominated by Tulip poplar, Sweetgum and Red maples. Associate species are Willow oak, Pin oak, Swamp white oak, Swamp White and Swamp Chestnut oaks, Ash, Black gum and Sycamore. The understory is comprised of Beech, Holly, Barberry, Multiflora rose, Holly and Viburnum. None of the plots have regeneration. The current Canopy closure is 75 %.

This large saw timber stand has the following diameter distribution:

Mature	26"+	27%
Saw timber	11-23.9"	53%
Pole	6-10.9"	12%
Small tree	2-5.9"	10%

Currently the stand contains 118 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 115 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand an 80 % stocking level. From a tree form and vigor stand point, only 45% of the trees are acceptable. The stand does not have enough acceptable growing stock to perform a thinning, coupled with the sites hydrology this stand is not a good candidate for restoration.

Recommendations

-Allow stand to go through nature succession.
- Deer control should be increased
-Monitor for stand health.

STAND	ACTIVITY	ACRES	DATE
29-11	Collect data/prepare new plan	31.12	2035

Aberdeen Area: Forest Map 29, Stand 29-12, 34.29 Acres

Overstory Summary Narrative

Data was collected in 2012. Restoration has occurred in this stand, within a 2.75-acre area. Seventy-five trees on 1/4th of an acre, along the shoreline were planted for Poole's Island mitigation. The remaining 2.5 acres was planted to restore the Eagle habitat where a portion of the stand was in decline.

The stand is dominated by Tulip poplar, with associated species of Sycamore, Red maple, Walnut, and Sweetgum. Numerous Tulip poplars are in the 30-inch dbh range. The understory consists of Microstegium, Multiflora rose, Wine berry, and Barberry. The 10 regeneration plots show no advanced regeneration, due to shade, invasives and excessive deer browsing.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	48%
Sawtimber	11-23.9"	36%
Pole	6-10.9"	15%
Small tree	2-5.9"	0%

Currently the stand contains 76 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 99 sq. ft per acre average. The number of trees correlated with the B.A. gives this stand a 75% plus stocking level. From a tree form and vigor stand point, 27% of the trees outside of the mature class are acceptable. This stand has a large drainage pattern that runs through the middle of the stand and feeds a Marsh before entering the bay.

Recommendations

-This site is in the Critical Area and needs a Harvest Plan
-Eagle Buffer
-Shelterwood cut

This stand is in need of a regeneration cut to open up the canopy and remove undesirable trees which will allow regeneration to be established. Yellow-poplar is a prolific seeder, and large crops are produced almost annually. The shelterwood system is recommended when regeneration potential is inadequate or uncertain. It involves two or more harvests several years apart in the same stand. The first harvest is a thinning and the final harvest is a group selection.

The first harvest removes some merchantable timber as well as undesirable species. It creates holes in the canopy that permit sunlight to reach oak seedlings and stimulate their growth and may encourage residual oaks to produce more acorns. Light levels can be regulated by the amount of thinning to favor acorn germination and oak seedling survival while suppressing competition from undesirable trees and shrubs. Make the first cut after a large acorn crop, if possible. Leave the best trees of any desirable species and all un-merchantable oaks capable of producing stump sprouts. Remove all other trees larger than 2 inches diameter, including seed producing trees of undesirable species. This cut should leave a park like stand with a 40 to 50 percent.

The stand has a basal area of 99 B.A. and should be reduced to a B.A. of 40 Sq.ft. The initial thinning will involve removing 59 sq.ft. of unacceptable trees. Following the shelterwood sale the alien and invasive plants should be controlled and deer population reduced to aid in Poplar regeneration.

Inspect the Harvest in ten years for regeneration, to see if regeneration is viable. If Poplar regeneration is adequate, proceed with removing the remaining canopy.

STAND	ACTIVITY	ACRES
29-12	Shelterwood Harvest Follow up for 2nd harvest Prepare new plan	34.29

Aberdeen Area: Forest Map 30, Stand 30-1, 91.29 Acres

Overstory Summary Narrative

Data was collected in 2012. This stand contains FIDS Habitat and is part of a large forested wetland system. The stand is dominated by mixed Oak, which include Swamp chestnut oak, Pin oak, White oak, Northern red oak, Willow with associated species being, Tulip poplar, Beech and Blackgum. The understory is dense with Holly, Sweet pepperbush, Greenbrier, and Highbush blueberry. The 20 regeneration plots showed one plot (5%) with advanced regeneration. This stand has very heavy deer browsing.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	49%
Pole	6-10.9"	24%
Small tree	2-5.9"	11%

Currently the stand contains 150 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 98 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 85% plus stocking level. From a tree form and vigor stand point, 48% of the trees including the mature class are acceptable. This area has a lot of deadwood from past Gypsy Moth damage.

Recommendations

-This site is in the Critical Area
-FIDS Habitat
-Too sensitive for management, leave in its natural state

STAND	ACTIVITY	ACRES
30-1	Prepare new plan	91.29

Aberdeen Area: Forest Map 30, Stand 30-8, 20.96 acres
Previously was part a larger stand

Overstory Summary Narrative

Data was collected in 2019. The stand is dominated by Sweetgum and Red maple. Associate over story trees include; Sycamore, Walnut, Willow oak, and Sothern red oak. The understory is comprised of Barberry, Multiflora, Blueberry and Viburnum. None of the plots have regeneration. The current Canopy closure is 77%. The stand is stocked with a BA of 122. This stand borders a forested wetland to the south.

This large saw timber stand has the following diameter distribution:

Mature	26"+	10%
Saw timber	11-23.9"	70%
Pole	6-10.9"	19%
Small tree	2-5.9"	1%

Currently the stand contains 96 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 122 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90 +% stocking level. From a tree form and vigor stand point, 42% of the trees are acceptable.

Recommendations

-Single Tree Selection, favoring high quality crop trees of Poplar and Oak.
-Cut vines in crop trees
-Treat invasive
-Enhancement
-Due to the over quality this Stand should be low on the enhancement schedule.

From a management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 122 B.A. and should be reduced to a B.A. of 60 sq. ft. which is all acceptable trees. The initial thinning will involve removing unacceptable, saw timber and pole timber.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
30-8	Enhancement	20.96
	Collect data/prepare new plan	

Edgewood Area: Forest Map 30, Stand 30-14, 46.45 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is within the MD defined Critical Area. It is dominated by Sweetgum and Red maple, with associated species being Pin oak, Willow oak, Tulip poplar, Southern red oak and Sycamore. The understory is comprised of Greenbrier, Barberry, Blueberry, Holly, Wisteria and Grapevine. The Barberry is extremely dense, almost impassible in some areas. 0% of the plots have regeneration. The current Canopy closure is 80%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	19%
Sawtimber	11-23.9"	62%
Pole	6-10.9"	16%
Small tree	2-5.9"	3%

Currently the stand contains 102 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 124s sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 38% of the trees are acceptable.

Recommendations

-MD defined Critical Area
-Single Tree Selection
-Control invasives

From a timber management point of view this stand is in need of a thinning. Currently a thinning will reduce competition; the stand has a basal area of 124 B.A. and should be reduced to a B.A. of 70 sq.ft. which is all acceptable trees. The initial thinning will involve removing 54 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 16 cords per acre.

Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
30-14	Single Tree Selection Control invasives	46.45

Forest Map 30-15, 28.39 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum, White oak and Red maple with associate species being; Beech, Willow oak, Swamp white oak and Pin oak. Blueberry, Black willow and Greenbrier were found in the understory.

This is a large sawtimber stand d.b.h. ranges 12" – 24".

This stand is fully stocked with 70% canopy closure. Mature tree die off.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft^2/ac average with at least 70 percent canopy closure at all times.

-Large forested wetland, standing water throughout.

STAND	ACTIVITY	ACRES
30-15	commercial TSI control invasives examine stand for commercial harvest	28.39

Edgewood Area: Forest Map 30, Stand 30-16, 37.74 Acres

Overstory Summary Narrative

Data was collected in 2014. This stand is within the MD defined Critical Area and has a large potential planting location along the North side where the stream is present. The stand is dominated by Tulip poplar, Beech and mixed Oak; oaks include Swamp chestnut oak, Swamp white, Black oak, White oak, Northern red oak, Scarlet oak and Willow oak. The understory is very sparse comprising of native Blueberry and Greenbrier. 40% of the plots have regeneration. The current Canopy closure is 70%.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	45%
Sawtimber	11-23.9"	40%
Pole	6-10.9"	8%
Small tree	2-5.9"	7%

Currently the stand contains 100 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 60% of the trees are acceptable.

Recommendations

-MD defined Critical Area
-Manage for Old Growth
-Control invasives
-Restoration/Mitigation potential

A large portion of the AGS (60%) is in mature trees, making this stand a good candidate to manage toward Old Growth. There are only 100 trees per acre, many of them are undesirable and/or dying matures which is a component of Old Growth. This stand can be restored, removing the undesirable saw and pole timber as well as the undesirable small trees such as Beech and Gum and sheltering existing regeneration on a 25x25 spacing and monitoring future regeneration.

STAND	ACTIVITY	ACRES
30-16	Manage toward old growth Restoration/Mitigation	37.74

In 2016 MLE performed restoration work on this forest enhancement site is in the Critical Area. This stand borders Romney Creek tidal waters. This stand had little to no advanced regeneration. The stand is dominated by Tulip poplar, Beech and mixed Oak; oaks include Swamp chestnut oak, Swamp white, Black oak, White oak, Northern red oak, Scarlet oak and Willow oak. The understory is very sparse comprising of native Blueberry and Greenbrier.

Mar-Len Environmental, Inc. (MLE) removed unacceptable growing stock; allowing sun light to filter to the forest floor. Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Vines were cut, shrubs and Beech regeneration treated to help restore the natural forest ecosystem.

Other activities include:

-Secured Range Work Request and organized Tower Support.
-UXO scan of entire site prior to any restoration work.
-Marked poor quality trees for removal.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Scarified site to promote soil and seed contact.
-Prepared and submitted Excavation permit for approval from APG Safety to allow permission to stake and shelter regeneration.
-UXO team scanned each shelter location and were on site for intrusive activity.
-Treated with herbicide to prevent Beech from becoming dominant in the understory.
-Prepared and submitted herbicide report for Mr. Stanley Futch.

Aberdeen Area: Forest Map 30, Stand 30-17, 6.74 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by White oak, Yellow poplar and American beech with associate species being; Sweet gum and Southern red oak. No information was collected on the understory.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	51.8%
Sawtimber	11-25.9"	33.7%
Pole	6-10.9	4.5%
Small tree	2-5.9"	0%

Currently the stand contains 41.29 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 90 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 51.7% stocking level. From a tree form and vigor stand point, 61.8% of the trees are acceptable.
The acceptable sawtimber volume currently is 12,701.46 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft²/ac average with at least 70 percent canopy closure at all times.

-Control heavy deer pressure.

-No activity needed; allow the natural succession and continue to provide a buffer for Romney Creek.

STAND	ACTIVITY	ACRES
30-17	collect data/prepare plan	6.74

Aberdeen Area: Forest Map 30, Stand 30-18, 18.68 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Sweet gum, Pin oak, Yellow poplar, White oak and Red maple with associate species being; Black cherry, American beech, Black gum, Blueberry and Holly. No information was collected on the understory.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	17%
Sawtimber	11-25.9"	63%
Pole	6-10.9	18%
Small tree	2-5.9"	2%

Currently the stand contains 112 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 107 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 85% stocking level. From a tree form and vigor stand point, 28% of the trees are acceptable.

The acceptable sawtimber volume currently is 8,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft^2/ac average with at least 70 percent canopy closure at all times.
-Romney Creek travels through the center of this stand. It is too sensitive for any kind of management.
-Inspect for forest health and possible restoration.

STAND	ACTIVITY	ACRES
30-18	collect data/prepare plan	18.68

Aberdeen Area: Forest Map 30, Stand 30-19, 49.8 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Yellow poplar, Sweet gum, American beech, White oak and Red maple with associate species being; Black oak, Northern red oak, Willow oak, Pin oak and Black gum. No information was collected on the understory.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	38.5%
Sawtimber	11-25.9"	53%
Pole	6-10.9	3.8%
Small tree	2-5.9"	0%

Currently the stand contains 51.61 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 95.4 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 54.3% stocking level. From a tree form and vigor stand point, 61.5% of the trees are acceptable.

The acceptable sawtimber volume currently is 11,948 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-No access, no active management.
-Inspect forest health in 15 years.
-This stand provides FID habitat and should maintain a basal area of 90 ft²/ac average with at least 70 percent canopy closure at all times.

STAND	ACTIVITY	ACRES
30-19	collect data/prepare plan	49.63

Aberdeen Area: Forest Map 30, Stand 30-20, 76.67 acres

Overstory Summary Narrative

Data was collected in 2019. This stand is dominated by mature Tulip poplar, Beech and mixed Oak species including Willow oak, Southern red oak, Pin oak and White oak. Associate species include Sweetgum and Red maple. The understory is comprised of Barberry, Blueberry and Holly. The largest tree measured was a 59-inch Willow oak. This stand borders the Romney and is very important for water quality. The regeneration plot survey found advanced regeneration in 0% of the plots. Currently, shade (Canopy closure) is 90%. This stand is impressive due to all of the matures trees.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	35%
Sawtimber	11-23.9"	47%
Pole	6-10.9"	14%
Small tree	2-5.9"	4%

Currently the stand contains 162 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 141 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% plus stocking level. From a tree form and vigor stand point 55% of the trees are acceptable.

Recommendations

-Old Growth
-Leave in natural state
-Control beaver dams flooding areas.
-Inspect for forest health

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursue Old Growth in this mature stand by designating legacy trees, increasing growth to the larger trees, creating standing dead and create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes; favoring all species and create down woody debris often found in Old growth forest.

Access to stand with equipment is difficult and the stand is unique in its maturity. Due to this we recommend to let the stand go through natural succession.

STAND	ACTIVITY	ACRES
30-20	Monitor stand health	76.67 ac
	Manage for Old Growth	

Aberdeen Area: Forest Map 30-22, 16.99
Previously part of Stand 30-8

Overstory Summary Narrative

Data was collected in 2019. This stand was flood from Beaver and currently has a low stocking and high mortality due to flooding. The stand is dominated by Red maples, Sweetgum with Pin oak and Persimmons present. The understory is comprised of Highbush blueberry, Willow, Greenbrier, Swamp azalea and Clethra. No of the plots have regeneration. The current Canopy closure is 17 %.

This large saw timber stand has the following diameter distribution:

Mature	26"+	%
Saw timber	11-23.9"	64%
Pole	6-10.9"	36%
Small tree	2-5.9"	0%

Currently the stand contains 230 trees per acre with 157 per acre dead or 70 percent of a trees per acre dead or dying. The B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 28 sq. ft. per acre average. The number of trees correlated with the B.A. gives the stand an understocked level.

Recommendations

-Allow stand to go through nature succession.

STAND	ACTIVITY	ACRES	DATE
30-22	Collect data/prepare new plan	16.99	2040

Aberdeen Area: Forest Map 30, Stand 30-23, 20.96 acres
Previously was part a larger stand 30-8

Overstory Summary Narrative

Data was collected in 2019. The stand is dominated by Tulip poplar, Sweetgum and Red maple. The Canopy closure is 70% and the stand is fully stocked. This stand borders a forested wetland to the north. Due to fire that impacted the entire stand the vast majority of the trees are under stress and of poor quality, reducing the stands overall quality.

This large saw timber stand has the following diameter distribution:

Mature	26"+	12%
Saw timber	11-23.9"	61%
Pole	6-10.9"	21%
Small tree	2-5.9"	6%

Currently the stand contains 156 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 155 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100 +% stocking level. From a tree form and vigor stand point only 39% of the trees are acceptable.

Recommendations

-Due to the poor-quality trees and its location, the stand should be left alone to go through natural succession.

-Deer control should be increased in this area as regeneration has little competition and native tree species will occupy stand.

STAND	ACTIVITY	ACRES
30-23	Collect data/prepare new plan	20.96

Aberdeen Area: Forest Map 30-24, 20.68 acres
Previously part of Stand 30-8

Overstory Summary Narrative

Data collected in 2019 shows the stand contains numerous mature and large sawtimber class trees, dominated by Tulip poplar and Oaks. Oaks include: Willow, Black, Pin, White and Southern Red. The understory is comprised of Highbush blueberry, Greenbriar, Bayberry and Black haw. The stand contains numerous man-made drainage ditches and wetlands.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	43%
Sawtimber	11-25.9"	38%
Pole	6-10.9	15%
Small tree	2-5.9"	4%

Currently the stand contains 120 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 136 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 95% stocking level. From a tree form and vigor stand point 60% of the trees are acceptable. The plots had no Oak or Poplar regeneration, a thinning will aid in regeneration.

Recommendations

-Enhancement cut, favoring high quality crop trees of Poplar and Oak.
-Cut vines in crop trees
-Treat invasive

From a management point of view this stand is in need of a thinning. Currently a thinning will reduce competition. The stand has a basal area of 136 B.A. and should be reduced to a B.A. of 80 sq. ft. which is all acceptable trees. The initial thinning will involve removing 56 sq. ft. of unacceptable, matures, saw timber, pole timber and small tree class trees.

STAND	ACTIVITY		ACRES
30-24	Enhancement		20.68
	collect data/prepare plan	2040	20.26

Westwood Area: Forest Map 33, Stand 33- 18, 64.98 Acres

Overstory Summary Narrative

Data collected in 2017. This stand has a first order stream and a large marsh; dominated by Willow oak, and Sweetgum, Oaks had a strong presence in 80 percent of the plots. Oaks present include: Pin oak and Southern Red Oak. Associate species include: Persimmon, Sycamore, Locust, Beech, Holly and Black cherry. The understory contains native Blueberry and Viburnums. Invasive plants consist of Multiflora rose, Japanese honeysuckle, Stilt grass, Bittersweet and Barberry which comprises 70 percent of the understory. No advance regeneration was found in any plots. Beech seedlings were noted as they do well in the 90 percent canopy closure.

This sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	61%
Pole	6-10.9"	16%
Small tree	2-5.9"	8%

Currently the stand contains 146 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 125 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100 % stocking level. From a tree form and vigor stand point only 48 % of the trees are acceptable.

Recommendations

-Restoration project to reduce basal area to 60 sq. ft. per acre of good seed trees with good form and vigor is needed. Favor Poplar and Oak as crop seed trees
-Treat invasive shrubs and forbs which are dense.
-Grind up tops and stack logs through out to keep mission access use open.

Note: Due to the stream and marsh only 39 acres can be managed.

STAND	ACTIVITY	ACRES	DATE
33-18	TSI or Restoration project	39	2023
	Inspect for regeneration/ Shelter	39	2025
	Collect data prepare new plan	39	2038

Aberdeen Area: Forest Map 33, Stand 33-22, 107.14 Acres

Overstory Summary Narrative

Data was collected in 2019. This stand is dominated by mature mixed Oak species, Poplar, Sweetgum and Beech. Oak species include Willow oak, Southern red oak, Pin oak and White oak. Associate species include Sweetgum and Red maple. The understory is comprised of Blueberry, Beech and Holly. The largest tree measured was a 48-inch Willow oak with numerous Oaks ranging from 130 to 220 years old. This stand borders the bay and is very important for water quality. The regeneration plot survey found advanced regeneration in 10% of the plots however, no Oak or Poplar were present. Currently, shade (Canopy closure) is 90% and deer pressure is heavy.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	26%
Sawtimber	11-23.9"	41%
Pole	6-10.9"	16%
Small tree	2-5.9"	17%

Currently the stand contains 218 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 145 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a100% plus stocking level. From a tree form and vigor stand point, 46% of the trees are acceptable.

Recommendations

-Manage for Old Growth
-Control beech and Sweetgum saplings/small tree.
-Forested wetland throughout.

Old Growth forest have well developed structures, legacy or large trees, multiple aged trees and abundant down wood and numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursuing Old Growth in this mature stand by designating legacy trees, increasing growth to the larger trees, creating standing dead, creating canopy gaps to aid in natural regeneration, establish a diversity of trees sizes; favoring all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth; instead it's found more valuable to increase the number of characteristics associated with these types of forest communities. Structural objectives and silvicultural techniques used to achieve structural enhancement may include:

Multiple Canopy: Single tree selection using a target diameter, release advance regeneration, encourage new regeneration associated with natural forest type.

Create snags and down woody debris: Girdle trees (if approval is given) of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.

Accelerate growth in legacy trees: Full or partial crown release. A total of 79 square feet of unacceptable growth is spread out among all size classes.

Controlling invasive and alien plants is imperative to natural regeneration success. Deer control should be increased in this area as well. **Due to large forested wetland and a sparse tree and shrub wetland area in the south east area of the stand areas of potential and accessible to silviculture should be GPS location for accurate acreage.**

STAND	ACTIVITY	ACRES
33-22	Single Tree Selection Basal spray young Beech and Gum. Manage for Old Growth	107.14

Aberdeen Area: Forest Map 33, Stand 33-25, 39.49 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Swamp white oak, White oak, American beech, Sweet gum and Red maple with associate species being; Holly, Black gum, Spice bush and Locust. Blueberry and Brambles were found in the understory.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	20%
Sawtimber	11-25.9"	52%
Pole	6-10.9	20%
Small tree	2-5.9"	8%

Currently the stand contains 126 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 87 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 75% stocking level. From a tree form and vigor stand point, 56% of the trees are acceptable.

The acceptable sawtimber volume currently is 8,800 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Due to past high mortality in White oaks from past Gypsy Moth damage, inspections are needed.
-This stand provides FID habitat and should maintain a basal area of 90 ft/ac average with at least 70 percent canopy closure at all times.
-This stand was not overstocked in 2001.

STAND	ACTIVITY	ACRES
33-25	collect data/prepare plan	39.49

Westwood Area: Forest Map 34, Stand 34-15, 81.61 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand buffers Romney Creek along its north western boundary for thousands of feet and is dominated by Sweetgum, Red maple and Tulip poplar. Oaks present include; Pin oak, Southern Red Oak and Willow oak. Associate species include: Sassafras, Sycamore, Persimmon, Beech, Holly and Blackgum. The understory contains native Blueberry, Grapevine, Viburnum, Winterberry and Holly. Invasive plants consist of Multiflora rose, Japanese honeysuckle, Stilt grass, Greenbrier and Barberry. No advance regeneration was found in any plots. Beech seedlings were noted as well as crowns hinder by vines. Sweetgums showing stress from bleeding canker.

This sawtimber stand has the following diameter distribution:

Mature	26"+	15%
Sawtimber	11-23.9"	70%
Pole	6-10.9"	10%
Small tree	2-5.9"	5%

Currently the stand contains 131 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 144 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100 % stocking level. From a tree form and vigor stand point, only 46 % of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees.
-Restoration project to reduce basal area to 70 sq. ft. per acre of good seed trees with good form and vigor is needed.
-Treat invasive shrubs and forbs.
-Grind up tops and stack logs through out to keep mission access use open.
-Potential planting site along Romney outside of flood plain.

STAND	ACTIVITY	ACRES	DATE
34-15	Restoration project	81.61	2025
	Inspect for regeneration/ Shelter	81.61	2027
	Collect data prepare new plan	81.61	2040

*Site has good access.

Aberdeen Area: Forest Map 34, Stand 34-17, 140.45 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Sweet gum, Red maple, Willow oak, Pin oak and Black locust with associate species being; Northern red oak, Southern red oak, White oak, Black cherry, Black gum, Yellow poplar and Ash. No information was collected on the understory.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	23.9%
Sawtimber	11-25.9"	52.2%
Pole	6-10.9	25.7%
Small tree	2-5.9"	0%

Currently the stand contains 120.26 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 101.7 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 63.8% stocking level. From a tree form and vigor stand point, 44.8% of the trees are acceptable.

The acceptable sawtimber volume currently is 6,801 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft/ac average with at least 70 percent canopy closure at all times.
-Avoid cutting in forested wetlands which are scattered throughout.
-A shelterwood cut is needed to encourage regeneration. This should be done in 20-acre patches, leaving residual basal areas of 40-50 ft^2/ac. of acceptable growing stock.
-Cut in three, 20-acre patches for a total of 60 acres per cycle. These do not have to be adjacent.

STAND	ACTIVITY	ACRES
34-17	shelterwood harvest	60
	shelterwood harvest	60
	collect data/prepare plan	140.45

Forest Map 35, Stand 35-15, 45.88 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Yellow poplar, Paulownia, Persimmon and Cherry. Blueberry and Holly were found in the understory. Invasive plants include Microstegium, Multiflora rose, autumn olive and Honeysuckle.

This is a pole timber stand d.b.h. ranges 6" – 11.9".

This stand is adequately stocked with 90% canopy closure.

360 Trees per acre.

Recommendations

-Grapevine hindering canopy and dense grass hindering potential regeneration.
-Recommend area for potential reclamation in the form of mowing and replanting.

STAND	ACTIVITY	ACRES
35-15	commercial TSI	45.88
	control invasives	
	examine stand for commercial harvest	

Forest Map 35, Stand 35-16, 48.28 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Yellow poplar, Locust, Cherry and a few large Walnut with associate species being; Cherry, Walnut and Locust. Multiflora rose was found in the understory. Invasive plants include Microstegium, Multiflora rose and Ailanthus.

This is a mature sawtimber stand d.b.h average 24".

This stand is fully stocked with 80-90% canopy closure except in wetland.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.
-Deer pressure.
-100' of successional Sweet gum along the road and large open wetland in eastern portion of the stand.

STAND	ACTIVITY	ACRES
35-16	commercial TSI	48.28
	control invasives	
	examine stand for commercial harvest	

Edgewood Area: Forest Map 37 Stand 37-8, 58.98 Acres

Overstory Summary Narrative

Data was collected in 2017. An important stand that borders the Romney along its entire southern Boundary. This stand is predominately Sweetgum with Tulip poplar and Red maple. Mature Southern red oak and Willow oak are scattered throughout as well as Pin oak. The understory consists of Blueberry, Winterberry, Bayberry, Multiflora rose, Autumn Olive and Barberry. There was no Oak or Poplar regeneration. The Sweetgum is showing signs of canker due to stress and breaking apart.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	6%
Sawtimber	11-23.9"	68%
Pole	6-10.9"	23%
Small tree	2-5.9"	3%

*Mature Poplar along Romney in a portion of the stand.

Currently the stand contains 142 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 136 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100+ stocking level. From a tree form and vigor stand point only 50% of the trees are acceptable. The existing Oak and Poplar population provides an excellent seed source once sunlight can reach forest floor to aid in germination.

Recommendations

-To enhance regeneration a restoration thinning removing 33 sq. ft. of unacceptable sawtimber and 30 sq. ft. of basal area in poor quality pole timber will provide canopy gaps to increase sunlight to forest floor and aid in regeneration. Small poor-quality trees can be mowed or cut to aid in preparing the site for restoration.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	Date
37-8	Restore/thin	58.98	2025
37-8	Inspect regeneration/ shelter	58.98	2028
37-8	Collect data	58.98	2043

Aberdeen Area: Forest Map 37, Stand 37-12, 110.67 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Yellow poplar, Red maple, Sweet gum, Pin oak, Ash, White oak and Black cherry with associate species being; Dogwood, Holly and Hickory. Multiflora rose, Serviceberry, Greenbrier and autumn olive were found in the understory.

This sawtimber has the following diameter distribution breakdown:

Mature	26"+	14%
Sawtimber	11-25.9"	53%
Pole	6-10.9	30%
Small tree	2-5.9"	3%

Currently the stand contains 188 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 113 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, 32% of the trees are acceptable.

The acceptable sawtimber volume currently is 8,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Sustain health of the riparian forest and flood plain.
-No silvicultural recommendations.
-Collect new data.

STAND	ACTIVITY	ACRES
37-12	collect data/prepare plan	110.67

Aberdeen Area: Forest Map 38, Stand 38-5, 72.70 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Sweetgum with associate species being Red maple, Willow oak, Pin oak, and Tulip poplar. The understory is comprised of, Winterberry, Barberry, Blueberry, Honeysuckle and Microstegium. Due to overstocking/stress the Sweetgum trees have Bleeding Canker, (Botryosphaeria) with many trees structurally weak.

This sawtimber stand has the following diameter distribution:

Mature	26"+	3 %
Sawtimber	11-23.9"	60%
Pole	6-10.9"	27%
Small tree	2-5.9"	11 %

Currently the stand contains 225 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 134 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 53% of the trees are acceptable.

The acceptable sawtimber volume currently is 6,800 bd. ft. per acre; once the undesirables are removed the stand will increase in volume, as more crop tree space is available.

Recommendations

-Logging access roads should be maintained for management access and fire control.

From a timber management point of view this stand is in need of a commercial thinning. Currently a (TSI) thinning will reduce competition; the stand has a basal area of 134 B.A. and should be reduced to a B.A. of 70 Sq.ft. which is all acceptable trees. The initial thinning will involve removing 64 sq.ft. of unacceptable sawtimber, pole timber and small trees. The trees can be utilized for pulpwood with the thinning producing approximately 20 cords per acre.

STAND	ACTIVITY	ACRES
38-5	Commercial TSI	72.70
	Prepare new Plan	

Forest Map 38, Stand 38-17, 31.60 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Pin oak, Red maple, Locust, Cherry, Catalpa and Sycamore. Blueberry, Greenbrier and American holly were found in the understory. Invasive plants include Microstegium and Honeysuckle vine.

This is a small sawtimber stand d.b.h. ranges 6" – 24".

This stand is adequately stocked with 60% canopy closure.

Recommendations

-Fragmented
-Deer pressure

STAND	ACTIVITY	ACRES
38-17	commercial TSI	31.60
	control invasives	
	examine stand for commercial harvest	

Aberdeen Area: Forest Map 38 Stand 38-18, 42.26 Acres

Overstory Summary Narrative

Data was collected in 2017. An important stand that borders the Romney along a portion of its southern boundary. Harvested approximately 10 years ago the mature stand still contains mostly unacceptable stock and a dense understory of stilt grass. This stand is predominately Tulip poplar with mature Oaks and Sweetgum. The understory consists of Blueberry and Blackberry. Nonnative plants include; Bayberry, Multiflora rose and Barberry. There was no Oak or Poplar regeneration. The stand has a large opening that can be planted for mitigation/ restoration. An 8 acres section starting within the 100-foot Bay buffer was laid out.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	40%
Sawtimber	11-23.9"	53%
Pole	6-10.9"	6%
Small tree	2-5.9"	1%

Currently the stand contains only 66 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 70+ stocking level. From a tree form and vigor stand point only 37% of the trees are acceptable. The existing Oak and Poplar population provides an excellent seed source. The entire stand needs invasive plant control to expose soil, which is currently covered in stilt grass.

Recommendations

-Treat the entire 8 acre proposed planting area and plant Oak and Polar on a 15 x 15-foot spacing once invasives are controlled to ensure success. Three-gallon potted trees would provide enough immediate height; shelter with 5-foot shelters.

STAND	ACTIVITY	ACRES	Date
38-18	Remove invasive and plant	8	2019
38-18	Treat remaining stand acres	34	2021
38-18	Collect data	42.26	2035

Phillips Army Airfield Area: Forest Map 38, Stand 38-19, 74.58 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Red maple, Willow oak, Pin oak, Black cherry, Black gum, Yellow poplar, Sassafras and Southern red oak. Japanese honeysuckle, Blueberry, Sweet gum, Barberry, Multiflora rose, Black gum, Greenbrier, Beech, Wine berry and Holly were found in the understory.

This large sawtimber stand has an average merchantable diameter of 16.80

Currently the stand contains 166.39 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 150 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 87.8% stocking level. From a tree form and vigor stand point, 90.7% of the trees are acceptable.

The acceptable sawtimber volume currently is 12,296.90 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Harvested in 2009.
-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

STAND	ACTIVITY	ACRES
38-19	commercial TSI	74.58
	control invasives	
	examine stand for commercial harvest	

Phillips Army Airfield Area: Forest Map 38, Stand 38-20, 12.49 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Red maple, Willow oak and Pin oak. Blueberry, Multiflora rose, Japanese honeysuckle, Barberry and Greenbrier were found in the understory.

This large sawtimber stand has an average merchantable diameter of 15.24

Currently the stand contains 360.59 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 146.7 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 97% stocking level. From a tree form and vigor stand point, 83.3% of the trees are acceptable.

The acceptable sawtimber volume currently is 9,240.54 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-TSI is required using single tree selection; reducing the basal area to 80 sq. ft. of AGS per acre.
-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.

STAND	ACTIVITY	ACRES
38-20	commercial TSI	12.49
	control invasives	
	examine stand for commercial harvest	

Phillips Army Airfield Area: Forest Map 38, Stand 38-21, 31.47 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Red maple, Black cherry, Southern red oak, Yellow poplar and Pin oak. Blueberry, Honeysuckle, Multiflora rose, Barberry and Wine raspberry were found in the understory.

This large sawtimber stand has an average merchantable diameter of 16.69

Currently the stand contains 76.3 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 101.3 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 55.3% stocking level. From a tree form and vigor stand point, 67.5% of the trees are acceptable.

The acceptable sawtimber volume currently is 10,229.22 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.

STAND	ACTIVITY	ACRES
38-21	commercial TSI	31.47
	control invasives	
	examine stand for commercial harvest	

Phillips Army Airfield Area: Forest Map 38, Stand 38-22, 38.86 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Red maple, Willow oak, Pin oak, White oak, Southern red oak and Ash. Barberry, Blueberry, Honeysuckle, Greenbrier, Sweet gum, Multiflora rose and Japanese honeysuckle were found in the understory.

This large sawtimber stand has an average merchantable diameter of 17.14

Currently the stand contains 145.38 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 121.1 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 76.3% stocking level. From a tree form and vigor stand point, 82.2% of the trees are acceptable.

The acceptable sawtimber volume currently is 10,805.79 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This stand was harvested between 2007 and 2009. Unacceptable growing stock still remains consisting of 39 sq. ft. per acre. TSI is required.
-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.
-The southern portion of this site contains an Eagle Buffer follow APG Eagle restrictions.

STAND	ACTIVITY	ACRES
38-22	commercial TSI	38.86
	control invasives	
	examine stand for commercial harvest	

Aberdeen Area: Forest Map 38, Stand 38-23, 73.81 Acres

Overstory Summary Narrative

Data was collected in 2011**,** this stand is dominated by Sweetgum with associated species being; Pin oak, Southern red oak, White oak, Willow oak and Red maple. The understory is comprised of Holly, Blueberry, Multiflora rose, and areas of dense young Beech saplings. Regeneration was found in 36 percent of the plots. Deer pressure is heavy. Due to overstocking /stress the Sweetgum trees have Bleeding Canker (Botryosphaeria) with many trees structurally weak.

This small sawtimber stand has the following diameter distribution:

Mature	26"+	4%
Sawtimber	11-23.9"	70%
Pole	6-10.9"	22%
Small tree	2-5.9"	4 %

Currently the stand contains 176 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 139 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 95% plus stocking level. From a tree form and vigor stand point, only 57% of the trees outside of the mature class are acceptable. The acceptable sawtimber volume currently is 8,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume, more crop tree space will be available and regeneration will improve as more light is added to the forest floor.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

This stand is in need of a commercial harvest. The thinning will reduce competition. The stand has a basal area of 139 sq. ft. and should be reduced to a B.A. of 80 sq.ft. The initial thinning will involve removing 55 sq.ft. of unacceptable (saw timber, pole timber, small tree class). The undesirables can be utilized for pulpwood. The thinning will produce approximately **18** cords per acre. Following the commercial pulpwood sale, the alien and invasive plants should be controlled and deer population reduced to aid regeneration.

STAND	ACTIVITY	ACRES
38-23	Commercial TSI	73.81
	Control invasives	
	Prepare new Plan	

Aberdeen Area: Forest Map 39, Stand 39-3, 21.55 Acres

Overstory Summary Narrative

Data was collected in 2011; this stand is dominated by Tulip Poplar. Associate species include; Sweetgum, Beech, Southern red oak, Walnut, Hickory, and White oak. The understory is comprised of Blueberry, Wine berry, Multiflora rose, Barberry, and Microstegium. Regeneration was noted in 37 percent of the plots, but is being hindered by thousands of pawpaw seedlings/saplings. This stand is an important buffer to the Bay and is deteriorating.

This mature stand has the following diameter distribution breakdown:

*Mature	26"+	54 %
Sawtimber	11-23.9"	38%
Pole	6-10.9"	7%
Small tree	2-5.9"	1 %

*Majority of Mature trees are unacceptable.

Currently the stand contains 110 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 148 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, the majority of the trees are unacceptable.

Recommendations

-Logging access roads should be maintained for management access and fire control.
-Flag off 100 foot no cut buffer.
-This site is in the Critical Area and the harvest plan should be completed.
-This site contains an Eagle Roost follow APG Eagle restrictions.

This stand is in need of a regeneration cut to open up the canopy and allow regeneration to establish. Yellow-poplar is a prolific seeder, and large crops are produced almost annually. A combination of a single tree selection and small less than ½ group selections will aid in regeneration. The Stand is marked in the same manner as with single-tree selection cut, the only difference being that small openings are created in the stand. Single-tree selection cutting occurs between the openings. In these areas the majority of trees are unacceptable and should be removed leaving only acceptable high-quality growing stock. The residual basal area in the single tree selection portions of the stand should be 60 sq.ft. per acre.

Controlling the pawpaw and invasive plants directly after the harvest is imperative to natural regeneration success. Deer control should be increased in this area as well. High quality regeneration should be sheltered if the deer population cannot be controlled.

STAND	ACTIVITY	ACRES
39-3	Single tree/small group harvest	21.55
	Control invasives	
	Prepare new Plan	

Phillips Army Airfield Area: Forest Map 40, Stand 40-6, 15.68 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Red maple with associate species being; Black cherry, Yellow poplar, Black gum, White oak and Sweet gum. Multiflora rose, autumn olive, Wine berry, Blueberry, Honeysuckle and Greenbrier were found in the understory.

This large sawtimber stand has an average merchantable diameter of 19.05

Currently the stand contains 74.63 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 95 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 44.5% stocking level. From a tree form and vigor stand point, 30% of the trees are acceptable.

The acceptable sawtimber volume currently is 6,045.86 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

This large sawtimber stand contains 15.6 acres with a very low relative density of 44%. It has a canopy closure of only 67%. This stand contains highly invasive species and should be cleared and planted with native species to create a healthy forest.

STAND	ACTIVITY	ACRES
40-6	commercial TSI	15.68
	control invasives	
	examine stand for commercial harvest	

Phillips Army Airfield Area: Forest Map 40, Stand 40-7, 31.34 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Black cherry with associate species being; Sweet gum, Dogwood, Persimmon, Walnut and Paulownia. Autumn olive, Honeysuckle, Grapevine, Multiflora rose and Wine berry were found in the understory.

This small sawtimber stand has an average diameter of 7.44

Currently the stand contains 158.92 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 65 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 41% stocking level. From a tree form and vigor stand point, 16.7% of the trees are acceptable.

The acceptable sawtimber volume currently is 1,713.16 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This stand is highly invasive with 74% of the trees being unacceptable.

-This stand should be cleared and planted for mitigation.

STAND	ACTIVITY	ACRES
40-7	commercial TSI	31.34
	control invasives	
	examine stand for commercial harvest	

Phillips Army Airfield Area: Forest Map 40, Stand 40-8, 43.59 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Red maple, Willow oak, Persimmon, Southern red oak, Black cherry, Yellow poplar, Sycamore, Osage orange and Norway maple. Autumn olive, Multiflora rose, Privet, Barberry, Poison ivy, Sweet gum, Honeysuckle and Grapevine were found in the understory.

This large sawtimber stand has an average merchantable diameter of 17.32

Currently the stand contains 145.06 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 116 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 67% stocking level. From a tree form and vigor stand point, 26.3% of the trees are acceptable.

The acceptable sawtimber volume currently is 7,830.29 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

This site is being considered for forest restoration to satisfy mitigation requirements for the test track at GAPG. The goal is to restore the forests ecological integrity by reducing the environmental stress influenced by exotic invasive plants and to restore the natural distribution of native trees and shrubs. A Timber Stand Improvement (TSI) to reduce overstocking will release the canopy of the highest quality trees.

-An effort should be made to control deer population.
-Prior to site activities; stream buffers and drainage swales should be marked clearly.

STAND	ACTIVITY	ACRES
40-8	commercial TSI	43.59
	control invasives	
	examine stand for commercial harvest	

Aberdeen Area: Forest Map 40, Stand 40-9, 19.23 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Yellow poplar, Red maple, Sweet gum and Pin oak with associate species being; Black cherry, Sassafras, Black locust, Dogwood and Paulownia. No information was collected on the understory.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	14%
Sawtimber	11-25.9"	59%
Pole	6-10.9	23%
Small tree	2-5.9"	4%

Currently the stand contains 146 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 119 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 95% stocking level. From a tree form and vigor stand point, 28% of the trees are acceptable.

The acceptable sawtimber volume currently is 11,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-No silvicultural recommendations due to lack of data collected in 2001.
-Collect data and prepare a management plan.

STAND	ACTIVITY	ACRES
40-9	collect data/prepare plan	19.23

Aberdeen Area: Forest Map 40, Stand 40-10, 29.69 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Sweet gum, Red maple and Black locust with associate species being; Scarlet oak, Sassafras, Sycamore and Osage orange. Dense autumn olive, Grapevine and Honeysuckle were found in the understory.

This pole timber stand has the following diameter distribution breakdown:

Mature	26"+	0%
Sawtimber	11-25.9"	11%
Pole	6-10.9	72%
Small tree	2-5.9"	17%

Currently the stand contains 292 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 100 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, 50% of the trees are acceptable.
The acceptable sawtimber volume currently is 1,400 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Maintain the current condition to provide a screen for test track.

STAND	ACTIVITY	ACRES
40-10	collect data/prepare plan	29.69

Phillips Army Airfield Area: Forest Map 40, Stand 40-11, 13.05 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Persimmon and Dogwood. Autumn olive, Grapevine, Multiflora rose and Honeysuckle were found in the understory.

This pole stand has an average diameter of 7.40

Currently the stand contains 117.15 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 40 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 29.0% stocking level. From a tree form and vigor stand point, 14% of the trees are acceptable.

The acceptable sawtimber volume currently is 584.71 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-This pole size Sweet gum stand contains 13 acres with a very low relative density of 29%. It has a canopy closure of only 35%. This stand is dominated by invasive species and should be cleared and planted with native species to create a healthy forest.

STAND	ACTIVITY	ACRES
40-11	commercial TSI	13.05
	control invasives	
	examine stand for commercial harvest	

Aberdeen Area: Forest Map 41, Stand 41-1, 18.8 Acres

Overstory Summary Narrative

Data was collected in 2011**;** this stand was dominated by mixed Oak and Sweetgum. Oaks include Southern red oak, White oak, Willow oak, Swamp white oak and Pin oak. Associate species include Red maple, Beech Black gum and Hickory. The understory was comprised of Holly, Blueberry, Persimmon and Pawpaw with invasive Barberry, Microstegium and Multiflora rose. Regeneration of Oak was found in 12 percent of the plots. The canopy closure was 90 percent and the deer pressure is heavy.

This small sawtimber stand had the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	43%
Pole	6-10.9"	21%
Small tree	2-5.9"	22 %

The stand had contained 191 trees per acre with an average, following restoration the stand has an average of **90 trees** per acres. B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) was 114 sq. ft. per acre average. The residual Basal Area is now **75 sq. ft.** per acre. The number of trees correlated with the B.A. gives this stand a 100% stocking level, prior to thinning. Current stocking level is 60 percent +. From a tree form and vigor stand point, only 57% of the trees outside of the mature class were acceptable. The site now contains 80 percent acceptable growing stock.

Forest restoration work completed in July 2018. The entire site was scanned for ordinance prior to restoration work on the 18.8 acres. The remaining 2.44 acres of restoration was moved off site in Map 16.

The understory was comprised of Holly which shaded out the forest floor. The majority of the Holly and invasive shrubs were removed.

Currently an adequate seed source is present for regeneration of Oak and Poplar. The potential is excellent.

Mar-Len Environmental, Inc. (MLE) removed midstory, and unacceptable overstory trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, Hickory and Poplar to dominate the stand. Target trees for removal were Red Maple and Sweetgum along with poor quality trees of any species. Sweetgum were showing signs of Canker.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked crop trees to remain.

-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.
-Scarified site to promote soil and seed contact.
-Stacked/ condensed brush piles.

*Deer control should be increased in this area.

STAND	ACTIVITY	ACRES	DATE
41-1	Inspect regeneration	18.80	2021
	Re Examine stand	17.2	2036

Aberdeen Area: Forest Map 41, Stand 41-2, 24.11 Acres

Overstory Summary Narrative

Data was collected in 2011**;** this stand is dominated by Sweetgum and Willow oak. Associate species include Red maple, Beech, Persimmon, Black gum and Ash. The understory is comprised of Holly, Blueberry, Pawpaw, and Beech with invasive Honeysuckle, Microstegium and Multiflora rose. Regeneration of oak was found in 33 percent of the plots. The canopy closure is 85 percent and the deer pressure is heavy.

This small sawtimber stand has the following diameter distribution:

Mature	26"+	2%
Sawtimber	11-23.9"	45%
Pole	6-10.9"	35%
Small tree	2-5.9"	18 %

Currently the stand contains 236 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 122 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, only 55% of the trees outside of the mature class are acceptable. The acceptable sawtimber volume currently is 6,500 bd. ft. per acre; once the undesirables are removed the stand will increase in volume, as more crop tree space is available and regeneration will improve as more light is added to the forest floor.

Recommendations

-This stand has man-made drainage patterns, wetlands and should be managed when the site is dry or frozen to prevent rutting.

From a timber management point of view this stand is in need of a commercial selective harvest. The thinning will reduce competition; the stand has a basal area of 114 B.A. and should be reduced to a B.A. of 70 Sq.ft. The initial thinning will involve removing 52 sq.ft. of unacceptable saw timber, pole timber and small size class trees. The undesirables can be utilized for pulpwood. The thinning will produce approximately **12-15** cords per acre. Following the commercial pulpwood sale, the alien and invasive plants should be controlled and deer population reduced to aid oak regeneration.

STAND	ACTIVITY	ACRES
41-2	Commercial TSI	24.1
	Control invasives	
	Prepare new Plan	

Aberdeen Area: Forest Map 41, Stand 41-13, 45.85 Acres

Overstory Summary Narrative

Data was collected in 2011, this stand is dominated by Southern red oak, White oak, Swamp chestnut oak 43", Tulip poplar, Willow oak and Sweetgum with associate species being; Red oak, Pin oak, Beech, Black gum and Red maple. This stand has trees over 200 years old. The understory is comprised of Blueberry, Arrow wood, Sweet pepperbush and Pawpaw. Regeneration was found in only 23 percent of the plots, factors hindering regeneration include the intense deer browse and dense canopy closure of 90 percent.

This mature stand has the following diameter distribution breakdown:

Mature	26"+	28%
Sawtimber	11-23.9"	51%
Pole	6-10.9"	15%
Small tree	2-5.9"	6 %

Currently the stand contains 146 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 115 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90% stocking level. From a tree form and vigor stand point, only 39% of the trees outside of the mature class are acceptable.

Recommendations

Manage towards Old Growth: Actively pursue Old Growth in this mature stand by; designating legacy trees, increase growth in the larger trees, create standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes, favor all species and create down woody debris often found in Old growth forests. Beech and Pawpaw in the understory should be controlled when they dominate in localized areas.

Structural objectives and silvicultural techniques used to achieve structural enhancement may include;
Multiple Canopy: Single tree selection using a target diameter, release advanced regeneration, encourage new regeneration associated with natural forest types.

Create snags and down woody debris: Girdle trees of various sizes that are unacceptable, felling and leaving trees of healthiest trees with large diameters.

Accelerate growth in legacy trees: Full or partial crown release.

Once canopy gaps are created by girdling poorly formed trees, shelter 200 existing high-quality seedlings per acre (with a 6-foot shelter) so the regeneration can become established without deer pressure. Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
41-13	Active manage for Old Growth	45.85
	Shelter existing seedlings	
	Control invasives	
	Prepare new Plan	

Phillips Army Airfield Area: Forest Map 41, Stand 41-22, 68.38 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum, Red maple and Willow oak with associate species being; Pin oak, Ash and White oak. Beech, Blueberry, Honeysuckle, Multiflora rose, Barberry and Greenbrier were found in the understory.

This small sawtimber stand has an average diameter of 4.32

Currently the stand contains 271.28 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 82 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 55.5% stocking level. From a tree form and vigor stand point, 56% of the trees are acceptable.

The acceptable sawtimber volume currently is 7,530.05 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-Harvested in 2008.
-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.

STAND	ACTIVITY	ACRES
41-22	commercial TSI	68.38
	control invasives	
	examine stand for commercial harvest	

Phillips Army Airfield Area: Forest Map 41, Stand 41-23, 27.82 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Red maple, Willow oak and Pin oak. Blueberry, Multiflora rose, Japanese honeysuckle, Barberry, Greenbrier, Persimmon, Grape vine, Beech and Bayberry were found in the understory.

This small sawtimber stand has an average merchantable diameter of 15.62

Currently the stand contains 454.36 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 123.3 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 78.5% stocking level. From a tree form and vigor stand point, 76.7% of the trees are acceptable.

The acceptable sawtimber volume currently is 8,886.42 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

Recommendations

-TSI is required using single tree selection; reducing the basal area to 80 sq. ft. of AGS per acre.
-Invasive plants should be controlled prior to harvest.
-An effort should be made to control deer population.

STAND	ACTIVITY	ACRES
41-23	commercial TSI	27.82
	control invasives	
	examine stand for commercial harvest	

Aberdeen Area: Forest Map 42, Stand 42-5, 37.54 Acres

Overstory Summary Narrative

Data was collected in 2011**,** storm damage in the form of uprooted trees occurred in this stand in 2011**.** Dominated by Tulip poplar and mixed oak. Oaks include; Southern red oak, White oak, Northern red oak, Chestnut oak and Black oak, with Sweetgum and Red maple also present in the overstory. The understory is comprised of dense Pawpaw (approximately 2,500 per acre), Holly, Mt. Laurel, Blueberry, Witch hazel and Beech. Regeneration was not found in any plots; the lack of a sustainable forest is due to a dense canopy and shrubs layer as well as deer pressure which is intense. This stand plays a critical role in water quality.

This mature stand has the following diameter distribution:

Mature	26"+	43%
Sawtimber	11-23.9"	46%
Pole	6-10.9"	7%
Small tree	2-5.9"	4%

Currently the stand contains 78 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 112 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 75% plus stocking level.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.

To aid in regeneration this environmentally sensitive stand should have the understory removed to control the dense shade layer of Pawpaw; this will allow sunlight in where the downed and dead trees exist. Shelter advanced oak and poplar regeneration to protect from the heavy deer population.

STAND	ACTIVITY	ACRES
42-5	Control understory	37.54
	Control invasives	
	Prepare new Plan	

Aberdeen Area: Forest Map 43, Stand 43-4, 27.74 Acres

Overstory Summary Narrative

Data collected in 2001 states this stand is dominated by Yellow poplar, Sweet gum, Red oak, Willow oak and Black cherry with associate species being; Dogwood, Hickory, Red maple, Scarlet oak, Muscle wood, Ash and Spice bush. No information was collected on the understory.

This large sawtimber has the following diameter distribution breakdown:

Mature	26"+	31%
Sawtimber	11-25.9"	42%
Pole	6-10.9	24%
Small tree	2-5.9"	3%

Currently the stand contains 114 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 130 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 100% stocking level. From a tree form and vigor stand point, 62% of the trees are acceptable.

The acceptable sawtimber volume currently is 13,000 bd. ft. per acre; once the undesirables are removed the stand will increase in volume as more crop space becomes available.

In 2011 restoration activities occurred on 10 acres within this stand. Trees were girdled and invasive plants were mechanically removed and treated with chemical. Advanced regeneration was sheltered with protection using a 25' by 25' spacing.

Recommendations

-Continue to treat understory to control invasives.
-Maintain tree shelters.

STAND	ACTIVITY	ACRES
43-4	control invasives/maintain shelters	10
	collect data/prepare plan	27.74

Aberdeen Area: Forest Map 44, Stand 44-2, 7.49 Acres

Overstory Summary Narrative

Data was collected in 2011. Major storm damaged occurred in this stand in 2011, a large number of Poplar are uprooted and or have severe crown damage. Dominated by Tulip poplar, associate species include; Locust, Beech, Red maple, Hickory and Willow oak. The understory is comprised of Holly, Winterberry, Pawpaw and Black cherry with invasive Honeysuckle vine, Wine berry, Tear thumb and Microstegium. No regeneration was noted in any plot.

This sawtimber stand has the following diameter distribution:

Mature	26"+	0%
Sawtimber	11-23.9"	82%
Pole	6-10.9"	9%
Small tree	2-5.9"	9 %

Currently the stand contains 80 trees per acre (this is low, due to storm damage) with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 80 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 50% stocking level. From a tree form and vigor stand point, only 50% of the trees are acceptable.

Recommendations

The stand needs a salvage harvest to aid in natural regeneration. Along with removing all downed trees the unacceptable sawtimber 26 sq. ft. per acre and the unacceptable pole timber 6 sq.ft. per acre should be removed, leaving only high-quality seed trees. Once all trees have been removed the shrub layer should be removed or sprayed and the ground prepared to accept the seed.

STAND	ACTIVITY	ACRES
44-2	Salvage Harvest	7.49
	Control invasives	
	Prepare new Plan	

Aberdeen Area: Forest Stand 44-3, 24.90 Acres

Overstory Summary Narrative

Data was collected in 2011**.** The stand is dominated by mixed oak and Tulip poplar. Oaks include; Southern red oak, White oak, Northern red oak, Scarlet oak, Chestnut oak and Black oak. Associate species include; Beech, Sweetgum, Hickory, Sassafras and Black gum. The understory is comprised of Pawpaw, Holly, Blackberry, Spicebush, Black haw and Beech with invasive, Honeysuckle, Wine berry, Tree of Heaven and Multiflora rose. Regeneration was found in 50% of the plots, however; their overall composition per acre is low. The lack of adequate regeneration is due to a dense canopy and shrub layer as well as deer pressure which is intense. This stand plays a critical role in water quality; it occupies steep slopes and has a large drainage pattern that carries storm flow from the intensely developed adjacent land.

This mature stand has the following diameter distribution:

Mature	26"+	45%
Sawtimber	11-23.9"	40%
Pole	6-10.9"	12%
Small tree	2-5.9"	3%

NOTE: 40” diameter trees are common

Currently the stand contains 120 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 119 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 85% plus stocking level.

Recommendations

-Sustaining this stand is crucial to the bay’s health, however; access due to steep slopes makes management difficult. Where regeneration is becoming established shrubs and other low-quality plants/trees that are impeding growth should be removed. Where dead and dying trees occur the understory should be cleared to encourage regeneration.

STAND	ACTIVITY	ACRES
44-3	Control understory near regeneration	24.90
	Prepare new Plan	

Aberdeen Area: Forest Map 44, Stand 44-5, 10.24 Acres

Overstory Summary Narrative

Data was collected in 2011**,** within the two plantations. The younger plantation occupies the northern half of the site and is approximately 10 years old. Dominated now by Ash and Pin oak the planting is only 50 percent stocked since no maintenance was performed. A dense grass base, Multiflora rose and Calvary pear dominate the ground and shrub layer. Deer pressure is intense.

Recommendations

Specific recommendations include, strip spraying all trees rows to remove dense grass, mow the entire site and replant 150 (1-3-gallon oaks per acre) for a total of 750 trees to adequately stock the plantation.

The second plantation is approximately 20 years old and is dominated by Trident maple that was planted. Associate species that are well established are White oak, Pin oak and Willow oak. The plantation is functional and productive.

Long Term Harwood plantation Maintenance:

All plantations at Aberdeen Proving Ground should be managed beyond the two-year maintenance and survival period.

Below are popular silvicultural methods used to maintain tree plantations:

Integrated Vegetation and Pest management

Integrated Vegetation Management should include mowing to control most of the weed growth. Post and pre-emergent herbicides should be used selectively around the tree seedlings and samplings. After planting care is very important; trees should be inspected regularly for invasion from insects and/or animals. For most insects Malathion and Pyrethrum can be used for control. For deer, rabbits, ground hogs, voles and mice, Repellex or a similar type product is most effective.

Weed control is needed after the trees have been established. A pre -emergent should be re-applied in early spring (March) before leaf-out occurs. When applying a post emergent during the growing season, it is important to prevent tree/shrub leaf contact when spraying the base for weeds.

The main objective of managing pests and diseases in plantations is to keep them in a healthy, productive condition. IPM inspections help define the outbreak and the most ecologically available control method. Often chemicals do not need to be used; as beneficial insects (such as spiders and ladybugs) will control an unwanted population of insects on their own.

Insects and disease can be a secondary factor with the primary causes of the pest or disease, being stress from overstocking, over-maturity, poor site/species relationship. A sound IPM program for each plantation consists of prevention and suppression. Prevention consists of actions taken to make trees and forests less hospitable to the build-up of pests and diseases and/or preventing new introductions. Direct

suppression consists of biological, chemical or mechanical tactics designed to reduce pest and disease populations and subsequent losses. IPM systems consist of a combination of monitoring and action tools designed to reduce pest-induced losses.

Deer control falls within pest management activities. Deer shelters are the best mechanisms available until population density can be controlled. Shelters need to be maintained 3 to four times annually to make insure they are functional.

Corrective Pruning

The purpose of pruning is to train trees to a single straight stem and develop more valuable, knot-free trunks. Pruning and thinning should be considered together. Do not prune a weak, poorly formed tree that will be removed at a thinning. High-density plantations have lower pruning costs than low-density plantations. The larger the initial tree spacing, the more artificial pruning will be required to produce a clear bole. However, a higher tree density requires a thinning earlier to reduce competition. The close spacing of trees in high-density plantations forces an upright growth habit and causes natural pruning of the lowest branches as a result of lack of light.

Pruning some branches increases the growth rate of the remaining branches as the same amounts of nutrients are available to a lesser amount of tree. This beneficial effect lasts for one year. By directing the tree's growth through pruning, one can improve the growth and form of the tree. In contrast, careless pruning can significantly reduce growth, introduce disease, and reduce timber value. Pruning to develop a single stem can begin when trees are 2 years old. Young trees 1 to 6 years old are most commonly pruned in late winter, as close to bud break as practical. The most common problems that require pruning are co dominant stems (upright branches that compete with the main leader of the tree), low limbs growing upward into the canopy, forks (vigorous lateral branches arising from the central leader with a narrow, less than 45˚ branch angle), dead branches, epicormic sprouts, and branches that cross over each other. Pruning should start at the top of each tree and proceed down to the trunk. This top-to-bottom approach is valuable because pruning cuts will be overgrown rapidly with the onset of active growth in the spring.

Regardless of tree age, it is important to remove any dead, broken, diseased, or dying branches. A key factor is to identify the main stem or leader, any branches that will compete with it, and decide how much of the competing stems should be removed. Any branch that originates in the bottom half of the tree that has grown into the top third of the canopy should be either removed or subordinated. No more than 25 to 30 percent of the foliage should be removed in any year, especially if a tree is mature. Side limbs should be pruned before they reach 1 inch in diameter. One and a half to 2-inch limbs may also be pruned safely if proper technique is used. Lower limbs larger than 2 inches may be cut back to a short stub and gradually removed over a 2 to 3-year period.

Pruning too many limbs can lead to bole sprouts (epicormic sprouts). Hardwood species differ widely in their tendency to grow epicormic sprouts. For example, white oak is very prone to epicormic sprouting. Epicormic sprouts should be removed as soon as possible because they will lead to the formation of knots.
Timber trees must have a harvestable butt log with a clear stem a minimum of 8 ½ feet in length. The goals should be to produce a clear stem 17 feet in length requiring pruning to a height of 18 to 20 feet.

Coppicing

Badly malformed trees may be cut back close to the ground; a pruning technique known as coppicing. This low coppice should take place while trees are dormant. If there is plenty of light, the stump will typically produce several shoots. The larger the diameter of the coppiced stump, the more shoots will grow. A single shoot should be selected from the many stump sprouts after 1 or 2 years of growth, and the other competing branches and stems removed.

Thinning

As a plantation matures, trees become crowded and competition among them causes growth rates to decline. Thinning is the selective process of removing trees to allow the maximum growth especially grown development in others. Thinning also provides the opportunity to selectively remove poorly formed trees and species of lower value. The need for thinning will arise faster and be more important for high-density plantation on good sites with high survival.
The goal of thinning is to maintain a steady growth rate; therefore, monitoring the growth rate of the trees is important.

Trees planted at high density usually require two pre-commercial thinning before harvest. In pure hardwood plantations, a first thinning is typically necessary when the trees are 8 to 15 years old; just before the crowns start to touch each other (crown closure). The second thinning occurs when trees are between 20 and 25 years of age.

Note: All plantations should be inspected twice a year at minimum to record site condition's and customize a silvicultural plan based on current stand conditions.

STAND	ACTIVITY	ACRES
44-5	Perform maintenance on younger plantation	5
	Re-establish plantation when mitigation is needed	
	Inspect twice a year	
	Prepare new Plan	10.24

Aberdeen Area: Forest Map 44, Stand 44-7, 27.34 Acres

Overstory Summary Narrative

This stand has been set aside to satisfy Forest Mitigation associated with Bay Side Development. Data was collected in 2011, this stand is dominated by Northern Red oak and Tulip poplar with associate species being; Sweetgum, Black cherry, Beech, Black gum and Ash. This stand has trees over 150 years old. The understory is comprised of an average 1,800 Sweet gum saplings per acre. Privet, Oriental bittersweet, Honeysuckle, English ivy, Catalpa and Multiflora rose are also present. Advanced Oak, Ash or Poplar regeneration was found in 90 percent of the plots but is competing with dense Sweet gum. Highly invasive and alien understory is hindering regeneration as well, along with the intense deer browse. This stand had storm damage that created openings and uprooted mature trees, leaving only invasive plants in the void.

This very mature stand has the following diameter distribution breakdown:

Mature	26"+	72%
Sawtimber	11-23.9"	25%
Pole	6-10.9"	3%
Small tree	2-5.9"	0 %

Currently the stand contains 66 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 107 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand an 80% stocking level. From a tree form and vigor stand most of the trees are acceptable.

Recommendations

Manage towards Old Growth:

Old Growth forests have well developed structures; legacy or large trees, multiple aged trees and abundant down wood along with numerous standing dead snags. Old growth structure creation/restoration through active low-key management leaving all trees and biomass on site can be performed to enhance these characteristics. Actively pursue Old Growth in this mature stand by, designating legacy trees, increasing growth for the larger trees, create standing dead, create canopy gaps to aid in natural regeneration, establish a diversity of trees sizes, favor all species and create down woody debris often found in Old growth forest.

Researchers have found that there is no one specific condition to aim for as a condition of old growth, instead find it more valuable to increase the number of characteristics associated with these types of forest communities.

Create Multiple Canopy Layers: Release advanced regeneration and encourage new regeneration associated with natural forest type. To accomplish this goal, all Sweet gum in the understory should be removed and treated with an herbicide to prevent sprouting; this will release the existing natural forest type regeneration. Undesirable saw and pole timber 12 sq. ft per acre can be girdled, left standing for wildlife while creating additional growing space for regeneration and allowing sunlight to reach the forest floor.

Once canopy gaps are created by girdling poorly formed trees and the understory is free of Sweet gum and invasives, shelter 200 trees per acre (with a 6-foot shelter height) of Oak and Poplar to aid in regeneration of this stand. Controlling invasives and alien plants is imperative to natural regeneration success. Deer control should be increased in this area as well.

STAND	ACTIVITY	ACRES
44-7	Actively manage for Old Growth to encourage regeneration	27.34
	Control invasives	
	Prepare new Plan	

Forest Map 45, Stand 45-3, 43.14 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Poplar and Sweet gum with associate species being; Hickory, Red oak, White oak, Sycamore, Black cherry and Red maple. Paw paw were found in the understory. Invasive plants include Honeysuckle, Multiflora rose, Grapevine and Poison ivy.

This is a mature sawtimber stand d.b.h. ranges 12" – 24".

This stand is adequately stocked with 85-90% canopy closure.

Recommendations

-This site contains an Eagle Buffer follow APG Eagle restrictions.
-This stand has giant trees throughout. Multiple 38" Sweet gum and Poplar along with a 40" + White oak.
-This area has potential to be managed as an old growth forest.

STAND	ACTIVITY	ACRES
45-3	commercial TSI	43.14
	control invasives	
	examine stand for commercial harvest	

Forest restoration work completed in July 2017. The site was scanned for ordinance, forest restoration was performed based on the delivery order. Thirty-one acres is still available for future restoration activities.

The understory was comprised of dense Pawpaw, Brambles and Vines which shaded out the forest floor. Mar-Len Environmental, Inc. (MLE) removed mid story, and unacceptable over story trees; allowing sunlight to filter to the forest floor. MLE also restored the natural distribution of native trees, favoring Oaks, and Poplar to dominate the stand. Lower density exists in portions where mature trees have died and alien plants have filled the gaps.

Trees with poor form and vigor were clearly marked to be cut to reduce environmental stress in the stand, numerous trees were hollow, dying or diseased. Following the removal of undesirable species, the ground was scarified where possible to allow seed drop to come in direct contact with the soil. Large strangling vines were also cut from trees to reduce negative impacts to the heathy crowns. Removing vines reduces the seed source.

Other activities include:

-Secured Range Work Request and organized Tower Support for UXO sweep.
-Perform UXO scan of the entire project area.
-Marked poor quality trees for removal.
-Cut trees and consolidated brush piles where possible to expose the forest floor.
-Mowed tops and lops to reduce fuel load.

-Scarified site to promote soil and seed contact.
-Flagged 300 locations and UXO scanned for planting
-Treated site with herbicide to remove invasive plant competition.

Forest Map 46, Stand 46-17, 3.48 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum, Sycamore, Red maple and Yellow poplar with associate species being; Persimmon and Black cherry. Sweet gum regeneration and Holly were found in the understory. Invasive plants include Microstegium, Barberry, Switch grass and Ailanthus.

This stand is a mixture of sawtimber 12" – 23.9" and pole timber 6" – 11.9".

This stand is under stocked with 60% canopy closure.

Recommendations

-This stand provides FID habitat and should maintain a basal area of 90 ft/ac average with at least 70 percent canopy closure at all times.
-This site contains an Eagle Buffer follow APG Eagle restrictions.

STAND	ACTIVITY	ACRES
46-17	commercial TSI	3.48
	control invasives	
	examine stand for commercial harvest	

Westwood Area: Forest Map 46, Stand 46-18, 7.35 Acres

Overstory Summary Narrative

Data collected in 2003 states this stand is dominated by Loblolly pine with associate species being; White oak, Sweet gum, Green ash and Red maple. No information was collected on the understory.

This small sawtimber stand has an average diameter of 10.7

Currently the stand contains 249.72 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 180 sq.ft. per acre average. The number of trees correlated with the B.A. gives this stand a 108.3% stocking level. From a tree form and vigor stand point, 75.0% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration and is grossly overstocked
-Favor pines with a good crown ratio as well as any oaks in the stand
-Reduce basal area to 70- 80 sq. feet per acre of high-quality trees at each 10-year thinning.
-Allow this 48-year-old stand to mature to 80 years old before seed tree cut

STAND	ACTIVITY	ACRES
46-18	TSI	7.35
	Collect data / plan for regeneration	

Spesutie Island: Forest Map 46, Stand 46-19, 4.43 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Pin oak, Persimmon and Black gum. Blueberry and Sweet gum saplings were found in the understory. Invasive plants include Honeysuckle and dense Multiflora rose.

This is a sawtimber stand d.b.h. ranges 12" – 23.9".

Currently the stand contains 150 trees per acre. This stand is adequately stocked with 95-100% canopy closure.

Recommendations

-Favor high quality Sweetgum as crop trees
-Reduce Basal area to 80 sq. feet per acre, let grow for 15 years.
-Follow Eagle restrictions

STAND	ACTIVITY	ACRES
46-19	commercial TSI	4.43
	control invasives	
	examine stand for commercial harvest	

Spesutie Island: Forest Map 46, Stand 46-20, 11.88 Acres

Overstory Summary Narrative

Data collected in 2009 states this stand is dominated by Sweet gum with associate species being; Pin oak and Persimmon. Blueberry, Holly, Multiflora rose, Honeysuckle, Greenbrier and some grass were found in the understory. Invasive plants include Honeysuckle, climbing bittersweet, Multiflora rose and Grapevine.

This is a pole timber stand d.b.h. ranges 6" – 16".

Currently the stand contains 300 trees per acre. This stand is currently overstocked with 100% canopy closure.

Recommendations

-An effort should be made to control deer population.
-Remove invasive plants concentrating on heavy Multiflora rose.
-Harvest with stand SP-2, adjacent smaller stand.
-Reduce to 80 BA of high-quality crop trees, let grow 15 years.
-Follow Eagle restrictions

STAND	ACTIVITY	ACRES
46-20	commercial TSI	11.88
	control invasives	
	examine stand for commercial harvest	

Churchville: Forest Map 48, Stand 48-1, 15.54 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand is dominated by high quality mature Tulip poplar, mixed upland Oaks and Beech. Associate species include: Ash, Hornbeam, Blackgum and Dogwood. The understory contains native Paw paw, which tends to become dense if not controlled. Invasive plants although not abundant consist of Barberry and Wineberry. The stand has nice quality trees in the overstory; however, no advance regeneration was found in any plots

This large sawtimber stand has the following diameter distribution:

Mature	26"+	42%
Sawtimber	11-23.9"	49%
Pole	6-10.9"	8%
Small tree	2-5.9"	1%

Currently the stand contains 92 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 176 sq. ft per acre average. The number of trees correlated with the B.A. gives this stand a 110 % stocking level. From a tree form and vigor stand point 67% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest using a two stage shelterwood harvest.
-Shelter wood harvest to reduce Basal area to 60 sq. feet per acre of good seed trees.
- Collect data 15 years later for regeneration to see if remaining sawtimber can be removed.
-A final harvest in a shelterwood series or the overstory removal of residuals which will release established regeneration from competition with the existing overstory.

A commercial saw log sale, removing 70 sq. ft. of mature trees and 38 sq. ft. of basal area in poor quality sawtimber (when merchantable timber is removed canopy gaps will increase sunlight to forest floor and aid in regeneration). The areas of dense shrubs and small poor-quality trees can be mowed to aid in preparing the site for restoration.

STAND	ACTIVITY	ACRES	Date
48-1	shelter wood harvest	15.54	2019
	collect data/prepare plan for harvest	15.54	2029
	(Final harvest if regeneration is adequate)		
	Prepare new plan	15.54	2035

Churchville: Forest Map 48, Stand 2 7.95 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand is dominated by high quality mature Tulip poplar, mixed upland Oaks and Beech. Associate species include: Ash, Hornbeam, Hickory, Sassafras, Blackgum and Dogwood. The understory contains native Black haw which tends become dense if not controlled. Invasive plants, although not abundant consist of Barberry, Autumn olive and Wineberry. The stand has nice quality trees in the overstory; however, no advance regeneration was found in any plots

This large sawtimber stand has the following diameter distribution:

Mature	26"+	43%
Sawtimber	11-23.9"	49%
Pole	6-10.9"	7%
Small tree	2-5.9"	1%

Currently the stand contains 166 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 110 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 90 % stocking level. From a tree form and vigor stand point, 49% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest.
-Harvest with stand 48-1.
-A commercial saw log sale with low grade logs primary part of the 47 sq. ft. per acres of unacceptable sawtimber will be cut leaving the high quality matures and acceptable sawtimber for a total Basal Area remaining in crop trees of 54 sq. ft. Canopy gaps will increase sunlight to forest floor and aid in regeneration. The areas of dense shrubs and small poor-quality trees can be mowed to aid in preparing the site for restoration.

STAND	ACTIVITY	ACRES	Date
48-2	Selection harvest	7.95	2019
	Prepare new plan	7.95	2035

Churchville: Forest Map 48, Stand 48-3, 26.43 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand is dominated by high quality mature Tulip poplar, mixed upland Oaks and Beech. Associate species include: Hickory, Hornbeam, Blackgum and Dogwood. The understory contains native Spicebush and Mt. Laurel which can become dense if not controlled. Invasive plants although not abundant consist of Barberry and Wineberry. The stand has nice quality trees in the overstory however; no advance regeneration was found in any plots

This large sawtimber stand has the following diameter distribution:

Mature	26"+	51%
Sawtimber	11-23.9"	32%
Pole	6-10.9"	11%
Small tree	2-5.9"	6%

Currently the stand contains 112 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 180 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110 % stocking level. From a tree form and vigor stand point, 73% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest using a two stage shelterwood harvest.
-Shelter wood harvest to reduce Basal area to 65 sq. feet per acre of good seed trees.
-Collect data 10 years later for regeneration to see if remaining sawtimber can be removed.
-A final harvest in a shelterwood series or the overstory removal of residuals which will release established regeneration from competition with the existing overstory.
-Steep north facing slopes along Deer Creek will need to be buffered at 50 ft. from stream and 4 ft. for every 1% slope.

A commercial saw log sale, removing 72 sq. ft. of mature trees and 24 sq. ft. of basal area in poor quality sawtimber (when merchantable timber is removed canopy gaps will increase sunlight to forest floor and aid in regeneration). The areas of dense shrubs and small poor-quality trees can be mowed to aid in preparing the site for restoration.

STAND	ACTIVITY	ACRES	Date
48-3	shelter wood harvest	26.43	2019
	collect data/prepare plan for harvest	26.43	2029
	final harvest if regeneration is adequate.		
	Prepare new plan	all	2035

Churchville: Forest Map 48, Stand 48-4, 11.84 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand is dominated by high quality mature Tulip poplar, mixed upland Oaks and Beech. Associate species include: Hickory, Hornbeam, Blackgum and Dogwood. The understory contains native Spicebush and Mt. Laurel which can become dense if not controlled. Invasive plants although not abundant consist of Barberry, Privet and Wineberry. The stand has nice quality trees in the overstory however; no advance regeneration was found in any plots

This large sawtimber stand has the following diameter distribution:

Mature	26"+	51%
Sawtimber	11-23.9"	32%
Pole	6-10.9"	11%
Small tree	2-5.9"	6%

Currently the stand contains 90 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 146 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 68% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest using a two stage shelterwood harvest.
-Shelter wood harvest to reduce Basal area to 65 sq. feet per acre of good seed trees.
-Collect data 10 years later for regeneration to see if remaining sawtimber can be removed.
-A final harvest in a shelterwood series or the overstory removal of residuals which will release established regeneration from competition with the existing overstory.

A commercial saw log sale removing 47 sq. ft. of mature trees and 32 sq. ft. of basal area in poor quality sawtimber (when merchantable timber is removed canopy gaps will increase sunlight to forest floor and aid in regeneration). The areas of dense shrubs and small poor-quality trees can be mowed to aid in preparing the site for restoration.

STAND	ACTIVITY	ACRES	Date
48-4	shelter wood harvest	11.84	2019
	collect data/prepare plan for harvest	11.84	2029
	final harvest if regeneration is adequate.		
	Prepare new plan	all	2035

Churchville: Forest Map 48, Stand 48-5, 11.57 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand is dominated by high quality mature Tulip poplar, mixed upland Oaks and Beech. Tulip poplar is the most prevalent tree. Associate species include: Hickory, Hornbeam, Ash, Blackgum and Dogwood. Invasive plants although not abundant consist of Barberry, Stilt grass and Wineberry. The stand has nice quality trees in the overstory however; no advance regeneration was found in any plots

This large sawtimber stand has the following diameter distribution:

Mature	26"+	14%
Sawtimber	11-23.9"	75%
Pole	6-10.9"	7%
Small tree	2-5.9"	4%

Currently the stand contains 165 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 197 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 120% stocking level. From a tree form and vigor stand point, 70% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest using a two stage shelterwood harvest.
-Commercial harvest to reduce Basal area to 80 sq. feet per acre of good seed trees.
-Buffer small stream along eastern boundary.
-Kill beech seedlings and saplings.

A commercial saw log sale removing 28 sq. ft. of mature trees and 38 sq. ft. of basal area of acceptable sawtimber and 30 sq. ft. of poor quality sawtimber; when merchantable timber is removed canopy gaps will increase sunlight to forest floor and aid in regeneration.

STAND	ACTIVITY	ACRES	Date
48-5	Commercial harvest	11.57	2019
	Prepare new plan	all	2035

Churchville: Forest Map 48, Stand 48-6, 6.14 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand is dominated by high quality mature Tulip poplar. Associate species include: Hickory, Black Oak, Locust, Ash, Black gum and Sassafras. Invasive plants although not abundant consist of Barberry, Stilt grass, Autumn olive and Wine berry. The stand has nice quality trees in the overstory however; no advance regeneration was found in any plots

This large sawtimber stand has the following diameter distribution:

Mature	26"+	9%
Sawtimber	11-23.9"	79%
Pole	6-10.9"	19%
Small tree	2-5.9"	1%

Currently the stand contains 147 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 216 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 120% stocking level. From a tree form and vigor stand point, 71% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability of the forest using a two stage shelterwood harvest.
-Commercial harvest to reduce Basal area to 80 sq. feet per acre of good seed trees.
-Kill beech seedlings and saplings.
-Treat with herbicide invasive plants.

A commercial saw log sale removing 20 sq. ft. of mature trees and 53 sq. ft. of basal area of acceptable sawtimber and 40 sq. ft. of poor quality sawtimber (when merchantable timber is removed canopy gaps will increase sunlight to forest floor and aid in regeneration).

STAND	ACTIVITY	ACRES	Date
48-6	commercial wood harvest	6.14	2019
	prepare new plan	all	2035

Churchville: Forest Map 48, Stand 48-7, 9.11 Acres

Overstory Summary Narrative

Data was collected in 2017. This stand is dominated by high quality mature Tulip poplar. Associate species include: Hickory, Maple, Beech, Ash, Blackgum and Virginia pine. Invasive plants although not abundant consist of Barberry Stilt grass, Autumn olive and Wine berry. No regeneration was present.

This large sawtimber stand has the following diameter distribution:

Mature	26"+	23%
Sawtimber	11-23.9"	50%
Pole	6-10.9"	16%
Small tree	2-5.9"	11%

Currently the stand contains 160 trees per acre with an average B.A. (Basal Area- a measure of stand density measured in square feet per acre taken at 4 ½ feet above the ground) of 134 sq. ft. per acre average. The number of trees correlated with the B.A. gives this stand a 110% stocking level. From a tree form and vigor stand point, 57% of the trees are acceptable.

Recommendations

-The forest lacks natural regeneration, favor poplar and oak as crop seed trees
-Reduce deer browse and thin the stand to allow natural regeneration to ensure sustainability
-Stand improvement cut to reduce Basal area to 75 sq. feet per acre
-Kill beech seedlings and saplings
-Treat with herbicide invasive plants

The acceptable mature 32 sq. ft per acre, along with the acceptable sawtimber 40 sq. ft. and 4 sq. ft. of quality pole timber create the stocking need to provide a quality stand. The unacceptable stock can be removed in a pulp or fire wood thinning or restoration project.

STAND	ACTIVITY	ACRES	Date
48-7	TSI	9.11	2019
	Prepare new plan	all	2035

EXPLAINATIONS OF STAND MANAGEMENT RECOMMENDATIONS

The following information explains the actual processes of suggested practices from the Detailed Forest Study Data and should assist in carrying out the individual stand recommendations.

All silvicultural recommendations are for the purpose of reducing stocking to allow crop trees room to grow (TSI-Timber Stand Improvement) or to establish natural regeneration. Oak are the most ecologically important trees in the Chesapeake Bay Water shed and should be favored as a Forest Cover type (The Conservation Fund, "The State of Chesapeake Forest" 2006). Quercus is the genus in which all oaks are classified. This genus has three subgenera, of which only two are found in the United States; *Lepidobalanus* which includes the white oaks and *Erythrobalanus* which includes the red and black oaks. The red oak group takes two years to produce an acorn while white oaks develop acorns annually. Both produce maximum acorn production from age 50 to 200 years (Society of American Foresters, "Forest Cover Types of North America", 1975).

All plants require sunlight to become established and survive. Adequate sunlight is crucial for successful oak regeneration. Trees that compete best for full sunlight are often found in the upper canopy of the forest.

Poplar trees require full sunlight to become established and are considered intolerant to shade while oaks are considered mid-tolerant and can establish but **not** thrive in partial shade.

The mature Oak and Oak Poplar forests in the Proving Ground are the result of continuous clearing or large-scale disturbances. Soil disturbance creates ideal seed beds for acorns to become established. Repeated fires aided oak regeneration and canopy removal provided adequate sunlight which increased the plants photosynthetic production stimulating regeneration.

A study by Hix et al (1991) found repeated browsing on oaks gives competing vegetation such as; red maple, black gum, beech and exotic species a greater advantage of occupying the forest.

STAND RECOMMENDATIONS

Note: Deer must be controlled prior to any type of activities to increase regeneration in ALL Stands, as well as removal and control of undesirable vegetation that hinders the development of the desired natural regeneration.

Forest Sustainability

Sustainable forestry requires a focus on growing new trees; we cannot practice sustainable forestry if we do not regenerate a healthy, young forest for future generations.

Most regeneration of hardwood forests occurs naturally, that is, without trees being planted; but many factors can affect forest regeneration. To regenerate naturally, the current forest must produce seedlings; stump sprouts, and root suckers that will become the next forest following a harvest. The main three factors affecting forest regeneration are:

-Deer impact,

-Competing vegetation

-and lack of light on the forest floor.

With regard to deer impact, through selective feeding deer have the ability to broadly affect forest plant communities. Specifically, they can reduce tree seedling numbers of preferred regeneration, such as oaks and tuliptree, as well as non woody plants, such as native wildflowers. In many areas, deer have reduced seedling numbers, shifted tree species composition to less desirable species, and slowed the growth of surviving seedlings. Research has shown that when the deer population density exceeds what the land can support, forest regeneration suffers. Deer have the ability to completely change the species found in the forest understory. Selective browsing can greatly reduce or eliminate preferred species or those not resilient to browsing. Obviously, this selective feeding favors less preferred, more resilient species. Deer food preferences vary by region and season, but in general, deer prefer oak, maple, ash, and tuliptree over species such as beech, sweetgum, and cherry. Deer, on average, consume four to eight pounds of browse per day for seven months of the year. Clearly, the deer herd has a tremendous potential to influence what grows in the forest.

TYPES OF SILVICULTURAL SYSTEMS FOR RENGENERATION

At the time of the inventories in 2001, 2003, 2009, 2011, 2014 and 2016 inventory work shows that the forest within GAPG exhibit extensive and intensive lack of natural regeneration. The sustainability of the forest, and its value, are dependent upon the continued recruitment of small trees, seedlings, shrubs, and herbaceous plants. Silvicultural treatments that guide the existing forest community toward the development of advanced regeneration (seedlings, saplings, etc.) are called ***reproductive methods*** and are rightly considered to be part of a complete silvicultural system. Compounding the constraints on the choice of regeneration systems is the presence of extremely high deer populations, which is the principal cause of the present lack of suitable advanced regeneration. Deer control needs to be a commitment, prior to any regeneration activity.

GROUP SELECTION METHOD

Information From: *Maryland DNR Forest Service*

The group selection system does mimic natural forest processes by creating small canopy gaps. Such canopy gaps would normally occur due to individual and group mortality of trees. The periodic opening of canopy gaps leads to the formation of microclimates at and near the ground that are conducive to seedling emergence and development. Regeneration takes place under the protective cover of the older trees and approaches the process of the indigenous forest. The existing humus layer provides a favorable medium for seed germination and provides a protective environment for seedling development.

The group selection method, an uneven-aged silvicultural system, is used to convert an even-aged forest to an uneven-aged condition. Techniques to recreate adequate advanced regeneration through the group selection method include an initial preparatory felling to allow the best individual trees to expand their crowns and become more prolific seed producers, and five to eight years later the creation of one-half acre to one-acre plots. This method requires:

a. The identification of individual trees by vigor and species that will contribute good genotypes for the next generation;
b. Orderly guidance of the forest community to a site-specific condition; and
c. Opening the forest canopy to allow the degree of light needed, to stimulate the development of the desired species of seedlings, to reach the forest floor. The release of the residual trees from crown level competition will also stimulate seed production, while continuing to provide watershed protection and an aesthetically pleasing environment.

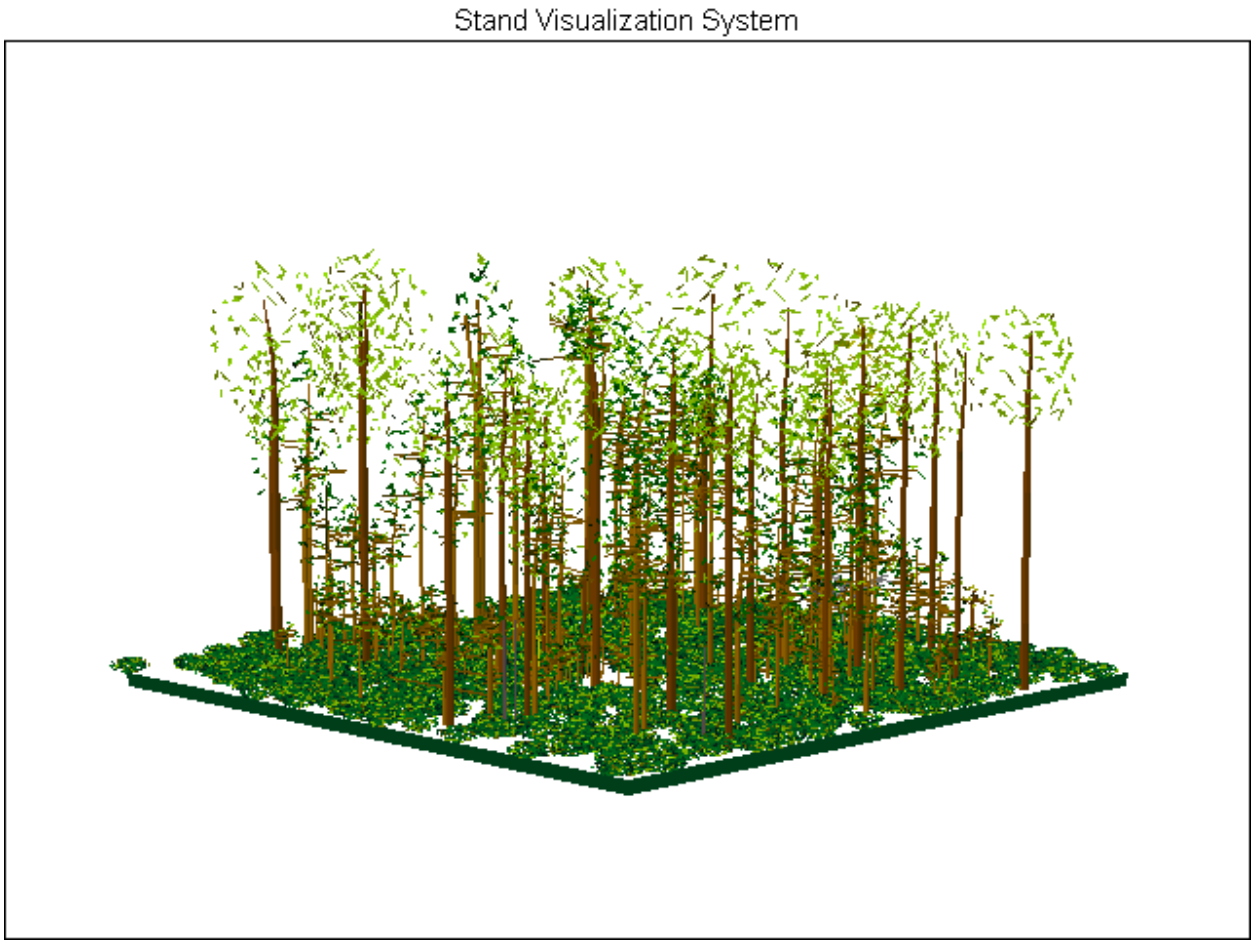
Advantages of the group selection method also include (*Matthews 1989*):

a. It is very flexible and well-suited to small forest areas where intensive working and close supervision are possible.
b. It can accommodate a wide variety of species, from light-demanders to those that endure shade.
c. Variation in sites can be matched to specific species and plant communities.
d. It provides protection to tree species which are sensitive to frost, drought, and cold winds.
e. The likelihood of damage by wind is reduced.
f. The soil is protected through the gradual and cautious removal of the overstory.
g. There is less risk of encroachment by invasive and exotic species.
h. There is a reduced chance of insect infestation.
i. Nitrogen sequestering remains high because the openings are buffered by adjacent Stands.
j. The variation in heights and sizes adds to the aesthetic value of the areas being converted.

Disadvantages of the group selection method include:

a. Silvicultural skill is needed in selecting groups for regeneration as well as for retention.
b. The work of felling and extraction is scattered and at a small scale. It must be done by skilled workers under close experienced and knowledgeable supervision.

Visualization of a Forest Stand after a Selective Harvest:



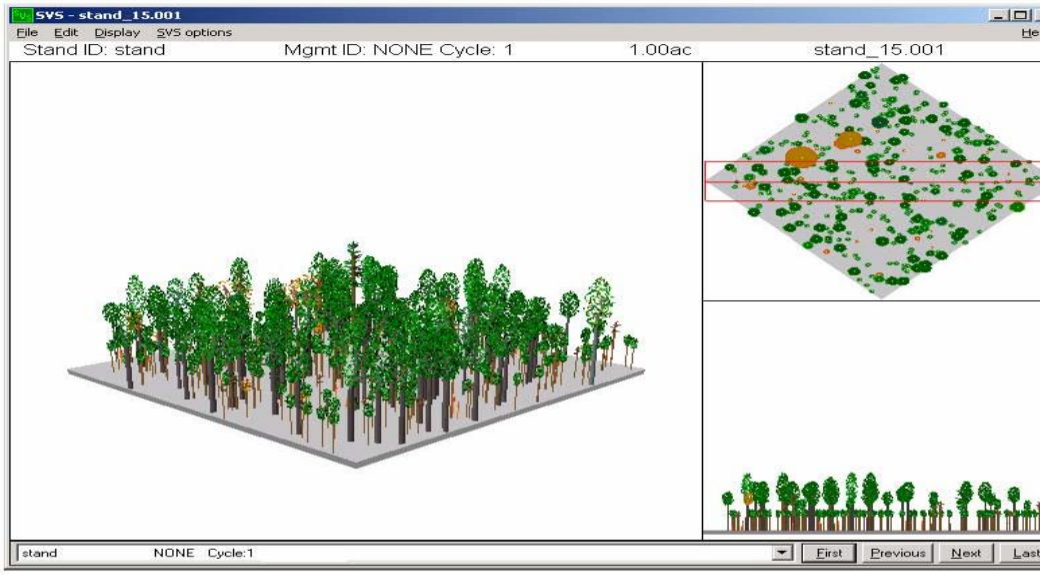
An option at GAPG is to aid the process of natural regeneration with artificial stocking to reduce the risk of failure, correct deficiencies in stock and provide the appropriate species composition to ensure that the Stand moves toward its optimum ecological range.

Generalized Procedure:

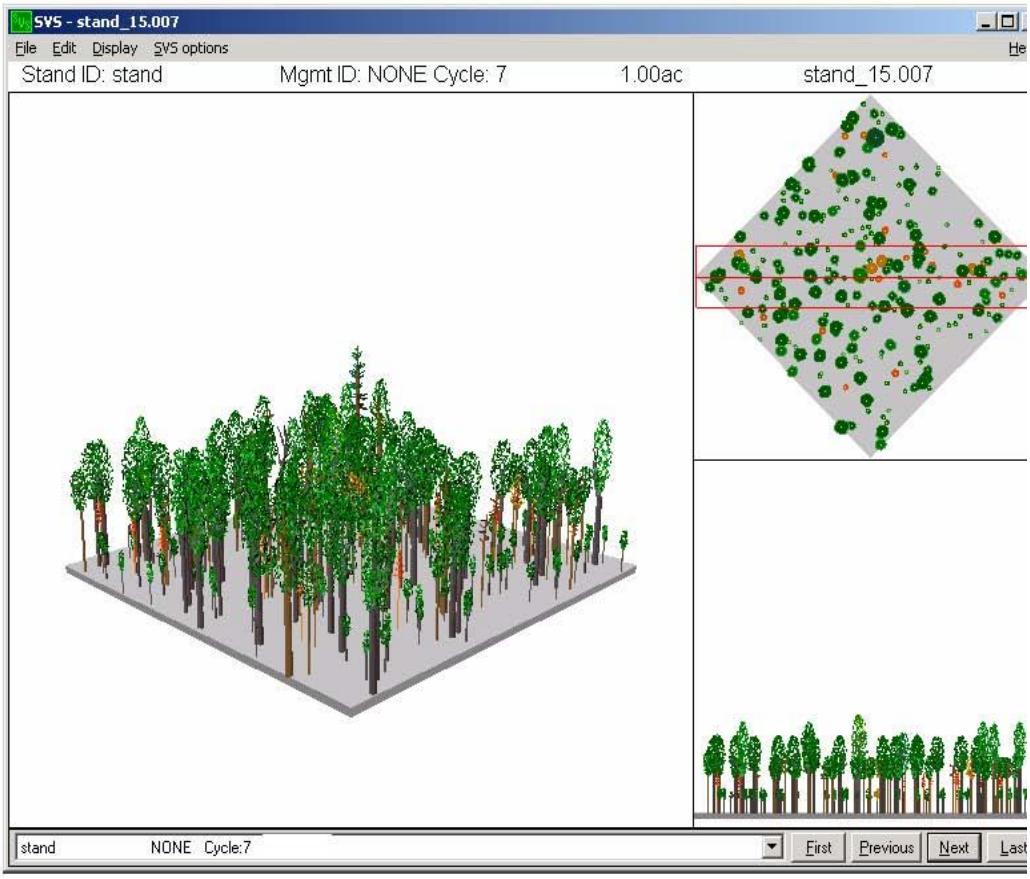
1. The Stand is reviewed to determine if the forest type is on its optimum site, or if the forest type will be redirected over the course of the initial phase of the group selection system.
2. The relative density of the dominant trees will be reduced to 50 percent for regeneration of shade intolerant species or 60 -70 percent for shade tolerant species.
3. Stocking of advanced regeneration will be reviewed periodically to determine the need for supplemental planting.
4. The second cut will occur when the forester has identified the satisfactory level of advanced regeneration. The second cut will lower the relative density to 25 percent. Trees that are left as the super dominants should be capable of withstanding the temporary open conditions and be resistant to wind throw and epicormic branching. These trees (25 percent) will form the Standards for this high forest configuration. These Standards will remain for 175 to 200 years.

Stand Visualization System Diagrams for Group Selection Regeneration Method:

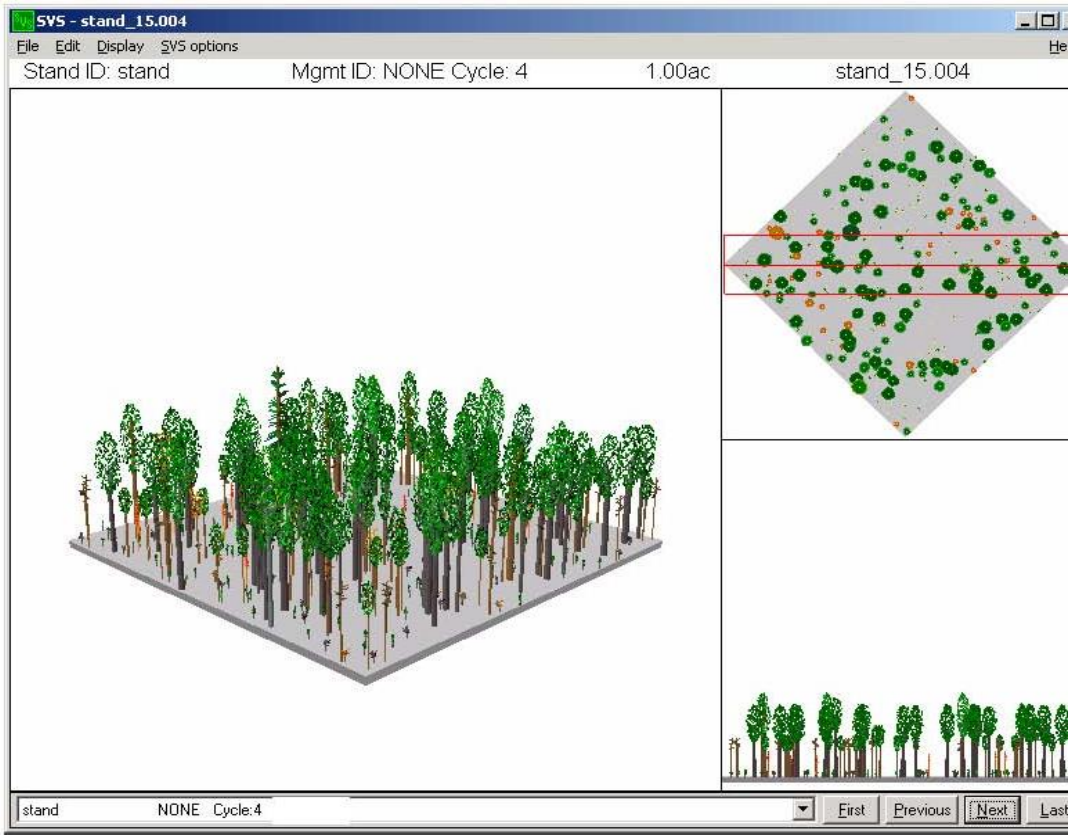
Visualization is of a fully stocked Stand as is common throughout GAPG.



Visualization 15 years post group selection where groups of trees were removed to create larger canopy openings ½ acre or less.



Visualization 20-years after creating openings. The release of residual trees from crown level competition stimulates seed production.



SHELTERWOOD METHOD

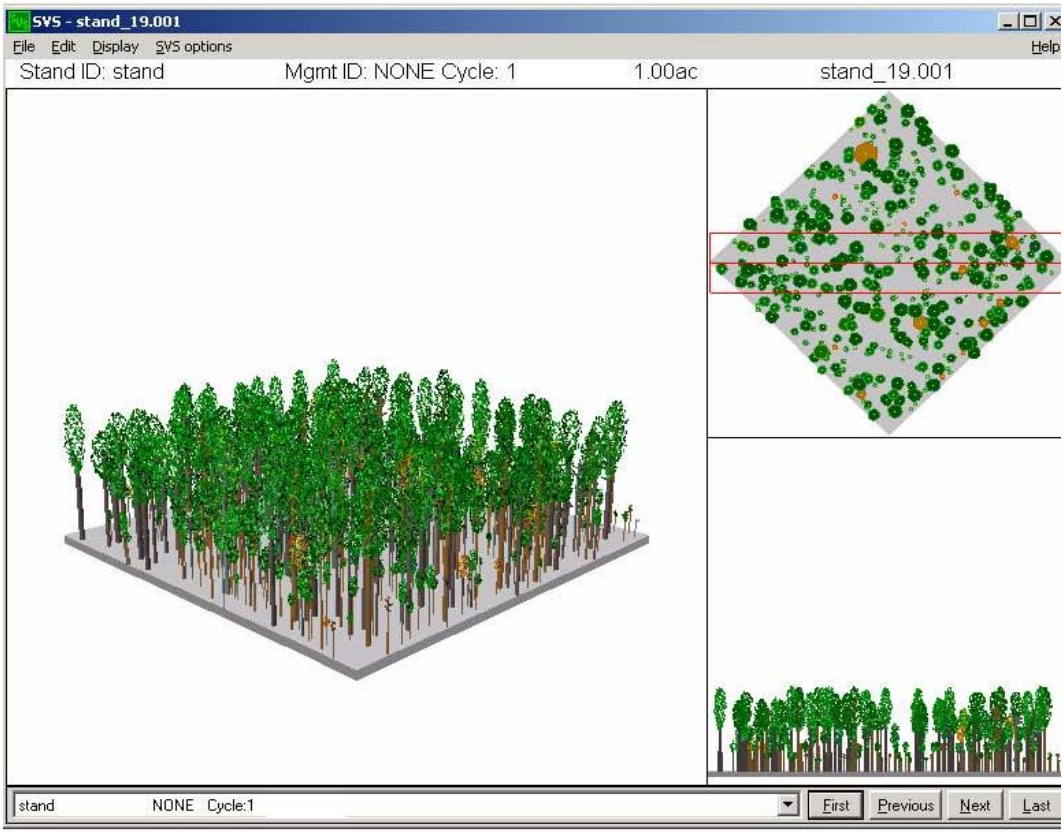
The shelterwood method produces an even-aged Stand, but in contrast to opening patches, this method commonly consists of a series of two or more partial cuts spaced over several years. The major ecological objective of a shelterwood is to create a partially shaded and protected environment in the understory where young trees can become established and grow. This is particularly beneficial for species that initially do not compete well with other trees and shrubs due to lack of sunlight. Once the desired reproduction is well-established, the remaining larger trees are harvested. One advantage of the shelterwood method is that it produces far less negative visual impact than a clear cut because the harvested area always is dominated by trees, while the debris (branches, tops, etc.) generated by the harvest is less visible.

A two or three cut shelterwood system has been used to reproduce a variety of hardwood species. In a three-cut system, the first cut removes enough of the Stand to stimulate the crowns to increase seed production and hastens the decomposition of soil surface organic matter to form a suitable seedbed. Several years later (commonly 5 yrs. to 10-15 yrs.), a second cut removes approximately half of the remaining stand to create conditions suitable for the establishment and early growth of young trees. Finally, several years later when adequate regeneration has become established, the remaining trees are harvested. Some care is necessary during the final harvest to minimize damage to the young, even-aged Stand that is developing. The final cut can be eliminated and mature trees can be left to grow creating a more uneven–aged forest.

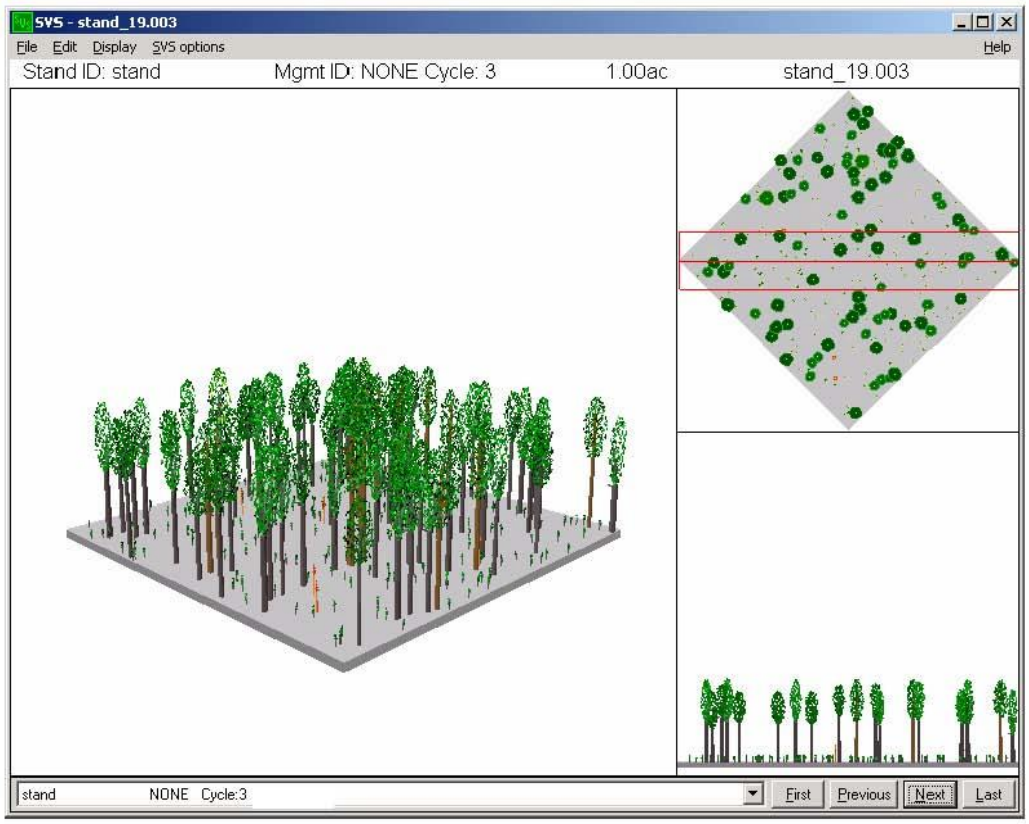
SHELTERWOOD	
Advantages	Disadvantages
• Reproduction of desirable species may be more certain than with clear cutting. • Slash disposal less of a problem than with clear cutting. • May be more effective with heavy-seeded species such as oaks. • Less invasion of undesirable vegetation than with clear cutting. • Opportunity for genetic improvement in the regenerated Stand.	• Requires a market for small and low-quality trees. • Remaining trees must be wind-firm. • Requires more technical skills of forester and logger than clear cutting. • Removal cutting damages some young trees. • Epicormic branching on trees in final harvest may result in decreased quality.

Stand Visualization System Diagrams for Shelterwood Regeneration Method:

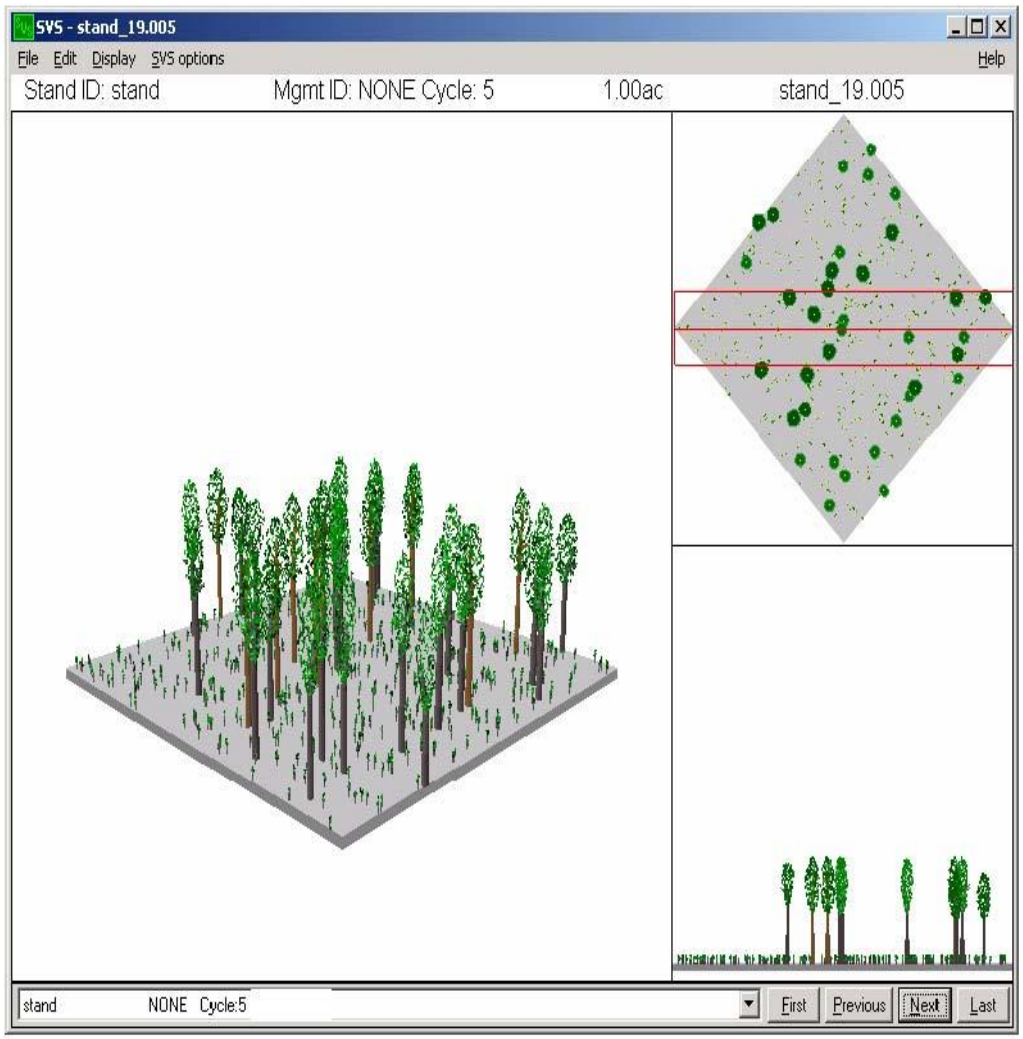
Visualization of overstocked Stand with little to no regeneration and a dense canopy.



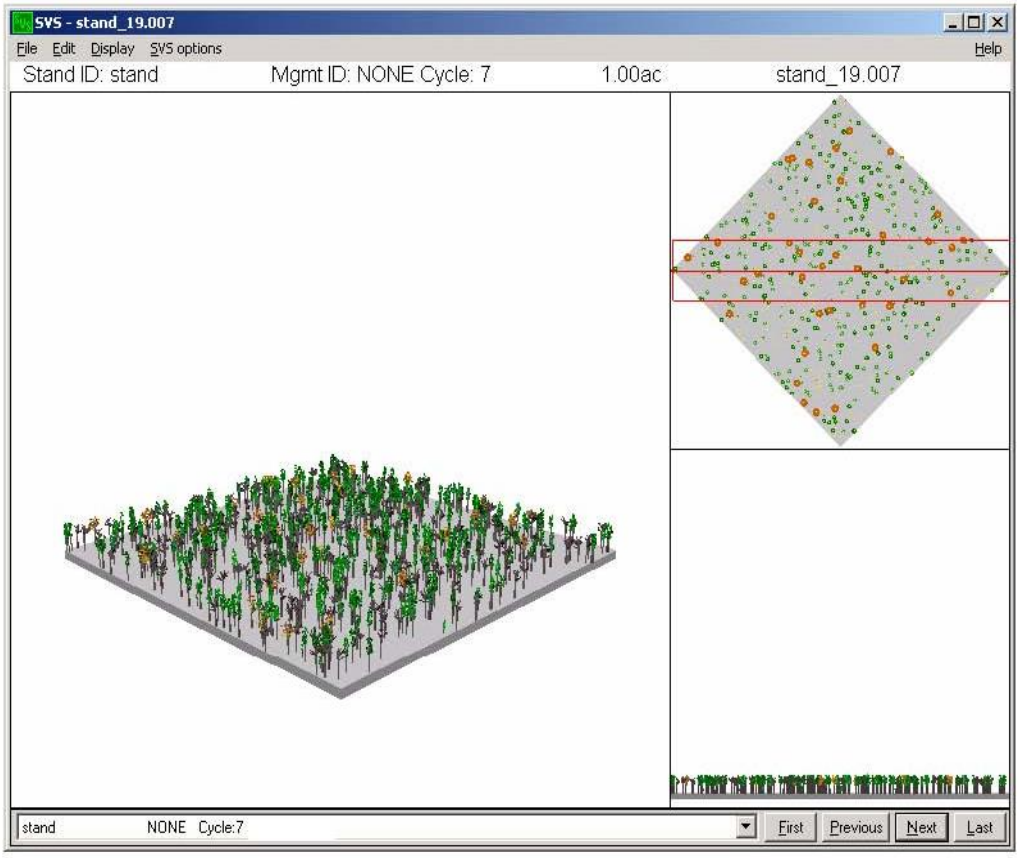
Visualization, first thinning involves removing a large portion of the trees, leaving high quality seed trees.



Visualization shows a second thinning further reducing Stand density 10 years after first thinning.



Visualization, twenty years after initial thinning all overstory trees are removed, allowing Oak and Poplar regeneration (1-3 inches in diameter) to receive full sunlight for maximum growth.



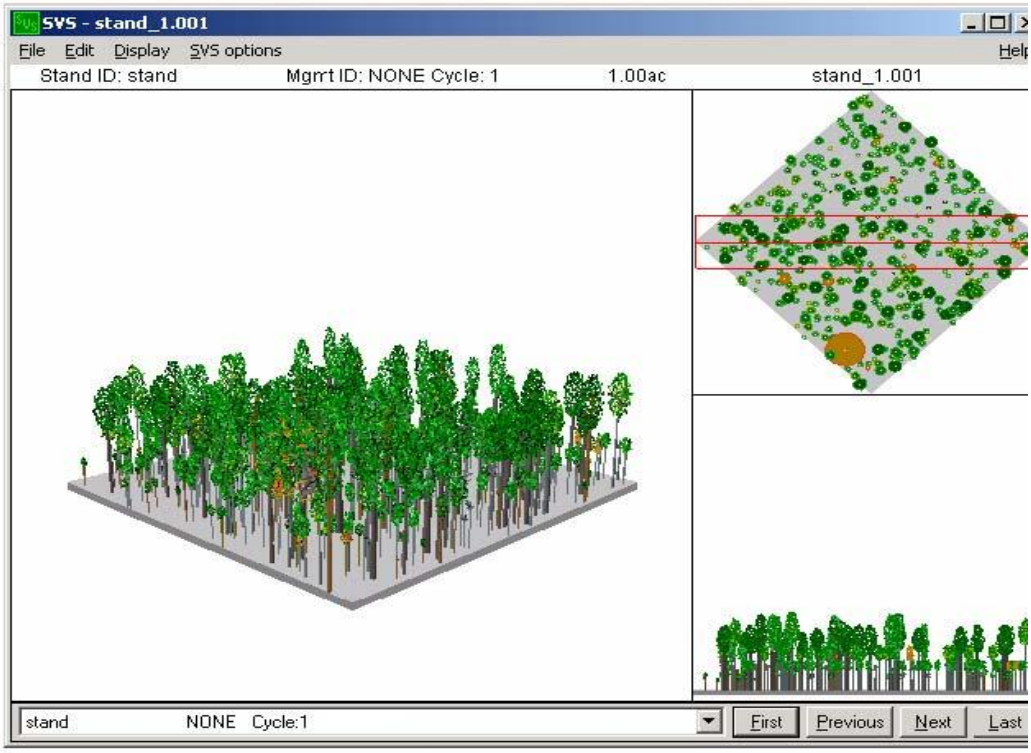
SINGLE TREE SELECTION METHOD

Selection is a regeneration method in which individual trees are periodically (commonly every 10-15 years) harvested based on their density, size, species, quality, condition, and spacing. Selection is used to create and maintain an uneven-aged Stand. When individual trees are selected for harvest (individual-tree selection), they are replaced either by new seedlings or by small trees already present. Individual-tree selection is best suited for shade-tolerant species. Aesthetically, individual selection has the least visual impact of any regeneration method. The overall integrity and appearance of the forest is only slightly modified, and after a few years much of the residue from the harvest will have decomposed.

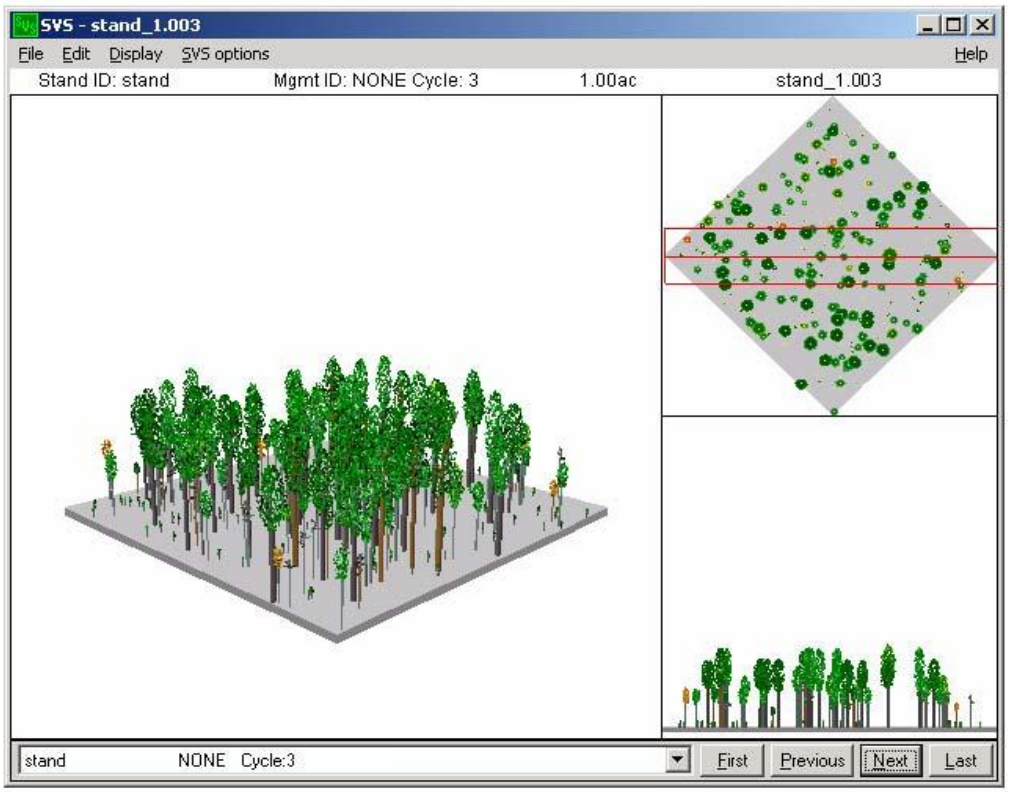
SELECTION	
Advantages	Disadvantages
• Maintains continuous forest cover on land. • Usually perceived as having less visual impact. • Forest usually less susceptible to wind, insect, and disease damage. • Reproduction not exposed to heavy competition from herbs and shrubs. • Can combine intermediate and regeneration harvests into one. • Some form of natural reproduction will occur. • Beneficial to some forms of wildlife.	• Takes more skill to implement than other regeneration methods. • More expensive in terms of inventory, marking, and harvesting. • Trees harvested are variable in size. • Some damage to residual trees may result. • Some residual trees may develop epicormic branching. • May be detrimental to some Wildlife species requiring openings and early successional vegetation.

Stand Visualization System Maps for Single Tree Regeneration Selection:

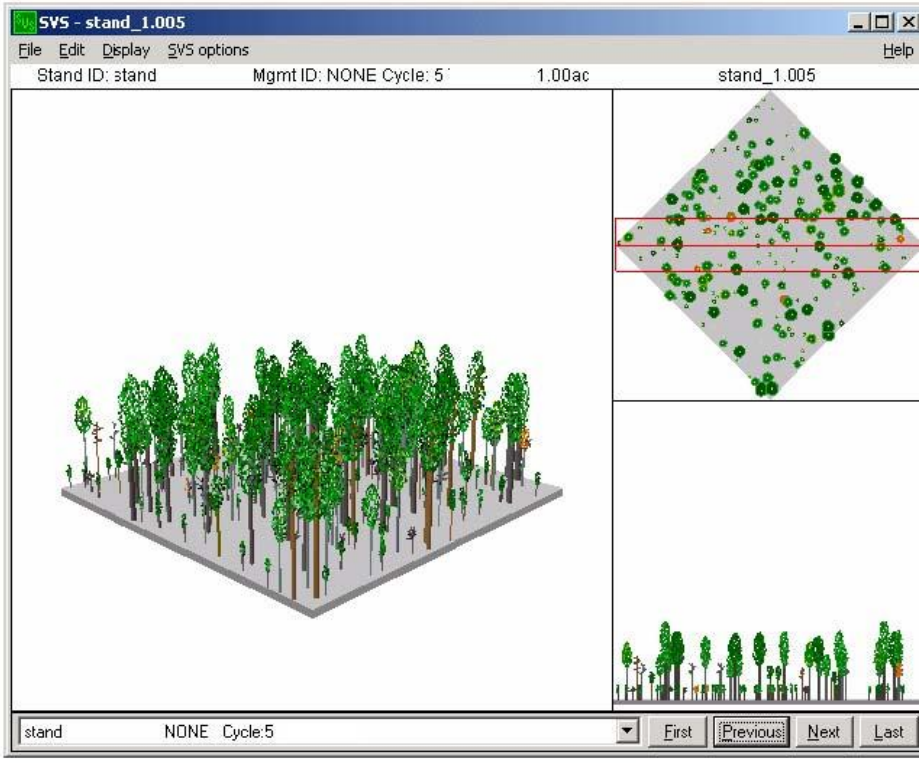
Visualization of a Stand fully stocked with a Basal Area of 150 Square Feet per acre; initial thinning reducing a high BA with visualizations in ten consecutive years.



Visualization ten years after the Basal was reduced to 80 Square Feet per acre, noted spacing and canopy gaps to allow sunlight to reach forest floor.



Twenty years following initial thinning to encourage oak regeneration.



OLD GROWTH FOREST POTENTIAL

In the early 1900's nearly all forest in Maryland were cut down and the land was denuded. New forest growth now covers 43% of the State or approximately 2.6 million acres. The State has studied the, *Rare Threaten and Endangered species*, of both plants and animals that are found in Maryland. However, they lack knowledge on a very rare ecosystem known as, *Old Growth Forest*. Currently only .0002 percent of the State is known to contain Old Growth Forest or less than 1,000 acres.

The following criteria are helpful in evaluating a Stand:

1. Shade tolerant species are present in all age/ size classes
2. There are randomly distributed canopy gaps
3. There is a high degree of structural diversity characterized by multiple growth layers
4. There is accumulation of dead wood of varying sizes and stages of decomposition
5. Pit and Mound topography can be observed, if the soil conditions permit

Note: One factor researcher's can agree on is that Old Growth Trees must exceed a level at one half their obtainable maximum lifespan. For example, the lifespan of Tulip Poplar- Liriodendron tulipifera is 250 years. Half of maximum obtainable age must be present or 125-year-old Poplars.

Management Techniques/Objectives

Structural Objective	**Silvicultural Technique**
Multi-layered canopy	• Single tree selection using a target diameter distribution • Release advanced regeneration • Establish new cohort
Elevated large snag densities	• Girdling of selected medium to large sized, low vigor trees
Elevated downed woody debris densities and volume	• Felling and leaving, or • Pulling over and leaving
Variable horizontal density	• Harvest trees clustered around "release trees" • Variable density marking
Re-allocation of basal area to larger diameter classes	• Rotated sigmoid diameter distribution • High target basal area (34 m^2/ha.) • Maximum target tree size set at 90 cm dbh
Accelerated growth in largest trees	• Full and partial crown release of largest, healthiest trees

ENVIRONMENTAL CONCERNS

Protecting the soil and water resources is an important concern during forest regeneration activities. The removal of trees typically requires the use of heavy equipment that disturbs the porous organic layer of the forest floor. The mineral soil is then exposed to the erosive forces of raindrops and surface runoff. Soil may move down slope off the area and become sediment in the streams. The implementation of best management practices (BMPs) can substantially reduce soil erosion and its negative effects. BMPs include such activities and considerations as the proper location and construction of skid trails and management roads; preservation of forested buffer strips along streams; diversion of runoff into the forest from roads and trails; and seeding of landings, roads, and trails upon completion of the harvest. For specifications and guidelines see Timber Harvest Regulations in the BMP section.

Prior to any silvicultural operations, a Maryland licensed forester should certify that erosion and sediment control plans for Forest Harvest Operations have been designed in accordance with approved ordinances, regulations, standards and criteria as stated in (COMAR 26.17.01.07.B.3.i). GAPG is not currently responsible to follow Maryland State law or regulations required for an erosion and sediment control plan before undertaking any earth disturbing activity in excess of 5,000 square feet or 100 cubic yards. However, the process application and proper BMP's for a successful operation should be completed and filed in house at the Proving Ground. The critical area law for Forest Harvest Operation **does apply** to GAPG. For specifications and guidelines see the BMP section.

GENERAL RECOMMENDATIONS FOR CONTROL (DEER, AND EXOTIC, INVASIVE PLANT SPECIES)

This section of the Assessment and Management Plan contains recommendations for the following categories of management actions:

-Insect Control
-Deer Control
-Invasive Plant Control
-Forest Restoration and Invasive Plant Control
-Wildlife Recommendations

INSECT CONTROL

The most pressing threat to the forest is the presence of Gypsy Moth, which defoliate Oak and other hardwoods. Although not found in the most recent study the moth species was present just south of the Magnolia gate on Interstate 95.

DEER CONTROL

Due to the excessive browsing and lack of natural regeneration, the deer population far exceeds the carrying capacity of the forest, greatly affecting regeneration of the forest. Studies show, according to the 2006 publication, *The State of the Chesapeake Forests*, that densities greater than 20 deer per square mile restrict regeneration and diversity of woody vegetation. Densities of even ten deer per square mile can limit the full regeneration of the forest under stories.

Deer control, to be effective, should be in the form of hunting. Additional control should be in the form of sharp shooters who can hunt at night when traffic at the Garrison slows down. Currently 72% of all inventoried plots lacked commercial regeneration and any effort to restore and regenerate the forest for the future must include deer control or the efforts will be futile.

INVASIVE PLANT CONTROL

Open fields and edges adjacent to the forest, which are more prone to invasive plants, should be inspected. Invasive plants should be controlled to prevent their spread into the forest.

FOREST RESTORATION AND INVASIVES CONTROL

The following goals for integrated restoration of the forest at GAPG are recommended:

Goals:

-Restore the forest's ecological integrity by reducing the environmental stresses imposed by exotic invasive plants.
-Restore the natural distribution of native trees and shrubs favor oak species.
-Restore natural tree regeneration to levels adequate to quickly recover control of hydrology and nutrient cycling following large-scale disturbances.

The restoration process can be done on any scale with the following sequence in order to add balance to the required silvicultural activities. Mechanical, manual and chemical treatments will all be part of the tool box for eradication and control. A small tractor or Bob-cat, on level-to-moderate slopes, can push or pull out some of the larger shrubs and vines that are hindering the establishment of native plants. Smaller shallow-rooted plants can be manually pulled out or can be chemically treated by spot spraying selected shrubs and vines. Cut stumps can also receive an herbicide application. The control will be vital to the success of the re-establishment. Prior to eradication of any alien plants, native trees or shrubs in close proximity, if using a chemical treatment, should be flagged for identification to remain and be protected from herbicides. Other military bases have "Weed Warrior" programs were volunteers spend a day eradicating invasives.

Vines: Vines should be controlled first. Vines on the site include: Oriental bittersweet, Japanese Honeysuckle, tear thumb and grapevine. Grapevine is a native vine and an excellent wildlife food but should be cut if it becomes too aggressive. Vines can be controlled by the three methods described above. The larger vines too tall to spray should be cut first then sprayed. **Systemic** herbicides are most effective and include glyphosates and triclopyr. Both herbicides will migrate into the roots when sprayed on the foliage and kill the entire plant. Triclopyr is also effective as a stump treatment when painted on freshly cut stumps. Both herbicides, when applied as a foliar spray, should be used when the plants are in full foliage and actively growing.

Alien Shrubs: These shrubs include: multiflora rose, autumn olive, Japanese honeysuckle, Japanese barberry, privet and wineberry. Where possible the larger shrubs can be pushed or pulled out with equipment preferably before they are full with seed. Where cutting is appropriate, treat the stumps with triclopyr to prevent re-sprouting. Smaller shrubs can be dug out or sprayed. Foliar spray is most effective but should be limited to spot spraying, not broadcast spraying, which could damage natives. Systemics are effective for foliage application.

Grasses: The major grass of concern is Japanese stilt grass, which has no biological control. **Systemic** herbicides are most effective and include glyphosates and triclopyr.

Follow up: No treatment will be effective with one application since sprouting and root suckering usually occurs. Birds also spread the seed and new plants may become established due to available sunlight once larger shrubs are removed. Inspect the site throughout the growing season and spot spray the leafed-out plants or cut and treat the stumps.

INVASIVE PLANTS AT APG

The following descriptions and preferred control methods are provided for the major invasive plants at APG. The source of photos is *Least Wanted* (Swearingen, Jil M., National Park Service, Washington, DC, http://www.nps.gov/plant/alien).

Multiflora rose (*Rosa Multiflora*)

Characteristics: thorny shrub, with clusters of white to pink flowers. Multiflora rose develops bright red fruit or rose hips. It is spread by Wildlife dispersing the seed and by forming new plants.

Control: Frequent cutting or mowing of the plants through the growing season is effective. Application of triclopyr to freshly cut stumps and spraying re-growth with an herbicide during the growing season may be the most effective.

Japanese Honeysuckle (*Lonicera japonica*)

Characteristics: Japanese honeysuckle is a semi-evergreen vine, with white to yellow tubular flowers. It is spread by seeds dispersed by wildlife.

Control: prescribed burning and herbicides are a good method of control. While mowing may reduce the spread of vegetative stems (on R/W), spraying herbicides on the leaves of the plant is found to be most effective. It may be necessary to re-spray sprouting plants.

Honeysuckle Shrub (*Lonicera spp.*)

Characteristics: a tall bush from 6 to 15 feet high, with white to yellow flowers and red to orange fruits with many seeds. It is spread by Wildlife dispersing seeds and by vegetative sprouting.

Control: Hand removal of small plants and treatment with herbicides are the only methods of treatment.

Oriental bittersweet (*Celastrus orbiculatus*)

Characteristics: woody, deciduous vine with glossy finely toothed leaves. Oriental bittersweet has abundant clusters of small greenish flowers, globular greenish yellow fruits and red seeds.

Control: vines can be pulled out by the root, or cut to ground level. Re-sprouting leaves can be sprayed with a herbicide.

Oriental Bittersweet (Celastrus orbiculatus) growing at Trustom Pond National Wildlife Refuge Photo by Lisa Gould

Tear Thumb (*Polygonum perfoliatum*)

Characteristics: fast growing weeds with vine-like stems and light blue green triangular leaves. Spines on stems are downward curving. Tear thumb bears a blue fruit and black seeds.

Control: The roots pull out easily to remove plants by hand. The most effective treatment is spraying with glyphosate and later applying a pre-emergent to the soil to prevent seeds from germinating.

Japanese Stilt Grass (Microstegium vimineum)

Characteristics: The leaves are pale green, lance-shaped, asymmetrical, 1-3 in. (3-8 cm.) long, and have a distinctive shiny midrib. Japanese stilt grass is especially well adapted to low light conditions. It threatens native plants and natural habitats in open to shady, and moist to dry locations. Where deer are over-abundant, they may facilitate its invasion by feeding on native plant species and avoiding stilt grass.

Control: For extensive stilt grass infestations, use of a systemic herbicide such as glyphosate is a more practical and effective method. Be careful to avoid application to non-target plants because glyphosate is a non-specific herbicide that will kill or damage most plant species it contacts.

Wineberry (Rubus phoenicolasius)

Characteristics: The hairs give the canes a reddish color when seen from a distance. Under favorable conditions canes may grow up to 9 feet. Leaves consist of three heart-shaped, serrated leaflets with purplish veins and are silvery white tomentose on the underside

Control: Manual, mechanical and chemical means of control are available. Removal of plants by hand pulling or use of a 4-prong spading fork can be effective especially if the soil is moist and the roots and any cane fragments are removed or by treating the canes with a systemic herbicide like glyphosate or triclopyr.

Japanese Barberry (*Berberis thunbergii* DC.)

Characteristics: This multi-branched dense shrub grows to 2.5 m (8.2 ft). Seedlings may grow 2-4 ft in one season. The semi-evergreen leaves are alternate, or grow in alternate clusters. They are entire, and 0.4-1.2 in. long. Leaves are bright green to burgundy, and wedge-shaped at the base. Twigs are brown, three-ridged downward from the node, with simple thorns.

Control: Mowing is appropriate for initial small populations. Repeated mowing or cutting will control the spread of Japanese barberry but will not eradicate it. Stems should be cut at least once per growing season as close to ground level as possible. Apply a 2% solution of glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves.

Tree-of-Heaven - *Ailanthus altissima*

Characteristics: a rapidly growing, deciduous tree in the mostly tropical quassia family (Simaroubaceae). Mature trees can reach 80 feet or more in height. Ailanthus has smooth stems with pale gray bark, and twigs that are light chestnut brown, especially in the dormant season. The wood of Ailanthus is soft, weak, coarse-grained and creamy white to light brown in color. All parts of the tree, especially the flowers, have a strong, offensive odor, which some have likened to cat urine

Control: Targeting large female trees for control will help reduce spread by seed. Young seedlings may be pulled or dug up, preferably when soil is moist. Care must be taken to remove the entire plant including all roots and fragments as these will almost certainly re-grow. It can be effectively controlled using any of several readily available general use herbicides such as triclopyr or imazapyr. Follow label and state requirements. The herbicides may be applied as a foliar (to the leaves), basal bark, cut stump, or hack and squirt treatment. Basal bark application is one of the easiest methods and does not require any cutting. It works best during late winter/early spring and in summer. The cut stump method is useful in areas where the trees need to be removed from the site and will be cut as part of the process. The hack-and-squirt or injection method is very effective and minimizes sprouting and suckering when applied during the summer.

References: http://www.nps.gov/plants/alien/fact/aial1.htm, www.nps.gov/plants/alien

Autumn Olive
Elaeagnus umbellata

Background
Autumn olive was introduced into the United States in 1830 and widely planted as an ornamental, for Wildlife habitat, as windbreaks and to restore deforested and degraded lands.

Distribution and Ecological Threat
Autumn olive is commonly found at APG. It is drought tolerant and thrives in a variety of soil and moisture conditions. This trait allows it to invade grasslands, fields, open woodlands and disturbed areas. It threatens native ecosystems by out-competing and displacing native plant species, creating dense shade and interfering with natural plant succession and nutrient cycling. **Description and Biology**

-Plant: deciduous shrub that can grow to 20 feet in height; stems, buds and leaves have a dense covering of silvery to rusty scales.

-Leaves: egg or lance-shaped, smooth margined and alternate along the stem; underside of leaves covered with silver-white scales.

-Flowers, fruits and seeds: plants begin to flower after three years. Small, light yellow, aromatic flowers appear in June and July; fruits are small, round, pink to reddish and dotted with scales.

-Spreads: by seed, although some vegetative propagation also occurs. Birds and mammals disperse fruits.

Prevention and Control
Do not plant autumn olive. Individual young plants can be hand-pulled, ensuring that roots are removed. Cutting, in combination with herbicide application, is effective. Hedges can be cut down using a brush type mower, chain saw, or similar tool, and stumps treated with a systemic herbicide like glyphosate or triclopyr. Application of these herbicides to foliage is also effective but is likely to impact non-target species. Herbivorous animals are not known to feed on it and few insects seem to utilize or bother it. Canker disease is occasionally a problem but not enough to be useful as a control agent.

FOREST MANAGMENT RECOMMENDATIONS FOR WILDLIFE

Wildlife abounds at GAPG; it is home to 55 neo tropical bird species, more than 40 species of reptiles and amphibians, nearly 250 species of birds, and more than 40 species of mammals.

Wildlife has four basic requirements for survival: food, water, cover and breeding space. Little can be done to provide space and water. However, food and cover can be managed for the benefit of wildlife. Management of Wildlife is based on ecological principles. Forest Wildlife management on this tract can be in the form of attracting Wildlife species by creating natural snags and by creating an edge through developing access roads or trails. An edge allows a variety of habitats to exist in close proximity to each other. Large and small mammals will utilize even small openings.

Neotropical migratory birds are long-distance migrants that breed in North America and winter in Central and South America. They represent well over half (119 of 202) of all bird species that breed in Maryland and over two thirds of the breeding bird species in the eastern United States. This large, diverse group includes a variety of songbirds including warblers, thrushes, vireos and tanagers, as well as our state bird, the Baltimore Oriole. Other Neotropical migrants include Maryland's smallest bird, the Ruby-throated Hummingbird, nighthawks, swallows, cuckoos and a number of hawk and woodpecker species. Recent and growing international concern over declining populations of many Neotropical migrant species has prompted conservation initiatives throughout the Western Hemisphere. The loss and fragmentation of habitat, especially on the breeding grounds, have been implicated as important factors in these declines. Species of particular concern are forest and grassland breeding birds that require large contiguous tracts of habitat in which to successfully breed. The loss of habitat where Neotropical migrants concentrate during migration is also drawing increasing attention within the scientific and conservation communities.

A source of concern at GAPG is fragmentation caused by utility rights-of-way, paved and unpaved road ways and expansion in the form of structures. Species can also be impacted due to habitat degradation resulting from over browsing of native forest vegetation by white-tailed deer, and invasions of exotic, invasive plant species. The largest, most-contiguous and least-disturbed forest tracts are considered priority conservation areas for forest-nesting birds. GAPG is considered regionally important given its relatively large size and location within a predominantly forested landscape and the potential for even greater habitat quality through the reduction of deer density.

The following are general Wildlife recommendations for GAPG:

1. **Create and maintain soft forest edges.**
   Most forest borders at GAPG are hard abrupt edges. Forest birds nesting in forests near hard (vs. soft) forest edges tend to experience low nest success. Hard edges also provide little if any nesting habitat for early successional forest and edge-nesting birds. Managing forest borders as soft feathered edges will increase reproductive success of forest breeding birds. It also represents a tremendous opportunity to increase both the quantity and quality of edge habitat without causing additional forest loss or fragmentation.

2. **Reduce the availability of feeding areas for non-forest dwelling birds.**
   Control the habitat for Brown-headed Cowbirds, Common Grackles and European Starlings in artificial non-forested habitats (e.g., grassy roadside berms, forest openings, frequently mowed fields) using the following management practices:

a. Along roads that must be maintained, maintain canopy closure over the roadbed and establish a soft forest-roadside edge.

b. In fields, maintain a grass height of at least 10 inches during April - August.

3. Monitor and control white-tailed deer populations at or below carrying capacity to reduce over browsing of forest understory vegetation.

The loss of forest structural diversity and changes in forest composition due to high deer densities have had substantial and long-term impacts on the ecological integrity of the forest communities and their ability to support FIDS. Forest interior dwelling species that require a dense shrub and/or herb layer probably have been most seriously affected (e.g., Hooded Warbler, Kentucky Warbler). Effective forest breeding bird conservation requires maintenance of deer densities at or below habitat carrying capacity. A combination of regulated hunting and a reduction in the amount of hard edge habitat are recommended.

4. Implement the following field mowing practices.

a. Do not mow fields during April-August, the breeding season for most grassland bird species.

b. If mowing must occur during April-August, minimize impacts to nesting birds using the following guidelines:

(1) Limit mowing to those periods outside of May-early July, the peak nesting period for most grassland birds in this region.

(2) Mow on a rotational basis, leaving at least half of the field un-mowed during May-early July, or for at least 6 consecutive weeks within this period. Allow the un-mowed portion to occur in one large contiguous block or, minimally, leave un-mowed areas in large blocks

(3) Maintain a cutting height of at least 10 inches.

(4) Do not mow at night.

c. To increase habitat diversity within fields, use an annual rotational mowing system in which some sections are left un-mowed each year.

d. Favor early spring (March -early April) mowing over late summer - fall (August - October) mowing to provide winter habitat for grassland birds

5. Create and maintain soft edges along grassland-forest borders.

Soft, feathered edges at least 10 feet in width provide breeding habitat for a variety of early successional forest and edge-nesting birds that might otherwise be absent or much less abundant in grassland if only a hard forest edge or border existed. They also provide hunting and singing perches for many grassland birds and may reduce nest predation rates for birds nesting in the adjacent forest.

6. Create snags.

Standing dead trees (snags) and dead parts of live trees offer both room and board for many forms of wildlife. Tree cavities in live or dead trees are used by 35 species of birds and 20 species of mammals. The objective is to create 3 snags per acre (minimum). In addition to the Standing snags, trees can be felled and left on the ground. Downed logs create a new ecosystem, as

decomposed logs provide new habitats for micro-organisms, insects, amphibians, reptiles, and plants.

There is life in dead trees and the GAPG forest is currently fully-stocked with plenty of trees to create snags.

Snags can be created by girdling, which involves cutting a band between 1"-6" wide through the bark and completely around the tree. This practice will kill the tree, thus creating a snag. Maple or tulip poplar trees of poor form make excellent candidates for snag creation because of their soft wood, which is easily girdled, and they are also more easily excavated by cavity-building Wildlife species. By selecting trees of poor form, the quality of the forest can be improved at the same time. At least one tree per acre that is greater than 18 inches in diameter should be chosen because pileated and red-bellied woodpeckers will not utilize smaller trees. Oak trees should not be used for creating snags because of the contribution that oak species make to the forest acorn crop, the majority of the hard mast in the forest. Favoring the oaks as crop trees will ensure good crown growth, thus insuring good acorn production for forest regeneration.

ACCESSING FOREST HEALTH

Forest management through the help of a forest professional is the way to achieve and maintain your woodland health. The first step in managing your forest is through regular health assessments of the dominant tree species.
Many tools are used to help forest professionals maintain healthy woodland ecosystems. Long term monitoring through yearly assessments of the forests well being is necessary to maintain and protect the overall fitness of your woodland.

The purpose of this section, "Assessing Forest Health", is to describe the diseases and insects that are commonly observed in the dominant woodland species throughout the GAPG and suggested actions if detected.

This paper will discuss treatments to the following species:

-Oaks
-Red Maple
-Sweet Gum
-Tulip Poplar

Oak Decline

Although the most frequent outbreaks of oak decline have been in southern New England, the Middle Atlantic States, and the Southeastern States, the disease has occurred throughout the range of oak in both forest and urban locations. It is not limited to any one specie or species group. Outbreaks have been most frequent and severe among red (*Quercus rubra*), scarlet (*Q. coccinea*), pin (*Q. palustris*), and black oak (*Q. velutina*) in the red oak group and among white (*Q. alba*) and chestnut oak (*Q. prinus*) in the white oak group.

Disease Progression
Trees are weakened by environmental stresses such as drought, waterlogging, frost or by pests such as defoliating or sucking insects. Weakened trees are then invaded and killed by insects and diseases that cannot successfully attack healthy trees. Usually the progression of decline is slow, occurring over several years.

Trees affected by oak decline show a general and progressive dying back from the tips of the branches. Other symptoms include production of chlorotic, dwarfed, and sparse foliage; development of sprouts on main branches and stem; and premature autumn leaf color and leaf drop. Often, growth is reduced before the appearance of symptoms. The amount of food stored as starch is reduced, especially in the roots.

The initiating stress factors associated most frequently with oak decline are drought, frost injury, or insect defoliation. Trees on ridge tops and in wet areas suffer most severely from drought. Frost often affects trees growing in valleys and frost pockets. Defoliated trees that refoliate the same season may exhibit dieback symptoms the next year. Other factors such as leaf diseases and soils that are waterlogged compacted, or shallow have occasionally been implicated in oak decline. Waterlogging is especially important in the heavier clay soils of the Midwest. Stress factors may be more frequent and severe in urban forests, where trees are often subjected to disturbances associated with human activities.

These stress factors often weaken trees so much that they succumb, sometimes suddenly, to the root killing and girdling actions of insects and diseases. The two major pests associated with oak decline are *Armillaria mellea* (Vahl: Fr.), a root disease commonly called armillaria root rot, and *Agrilus bilineatus* (Weber), the two lined chestnut borer.

Diagnosing Oak Decline

Dieback symptoms can result from the effects of stress alone. Indeed, stress, if sufficiently severe or prolonged, can result in tree mortality. However, the continued decline and death of stressed oaks usually results from lethal attacks by armillaria root rot and two lined chestnut borers. Final symptoms of oak decline primarily reflect the root killing and girdling effects of these organisms. In attacked trees, leaves sometimes fail to develop in the spring or wilt shortly after bud break; sometimes they wilt or brown suddenly in the latter part of the growing season.

A characteristic of oak decline is that it may develop suddenly on many trees in the area affected by the initiating stress factor. However, within the affected areas decline and mortality occur in patterns, which may reflect the intensity and severity of the stress, the distribution of the hosts, the aggressiveness of armillaria root rot, and the abundance of two lined chestnut borers, coupled with site features such as poor or excessive soil drainage and frost pockets (see figure below)

Pockets of oak mortality resulting from the interaction of stress, insects, diseases, and site factors.

In many instances, the species that are affected and their location can provide clues to the cause of oak decline. For example, symptoms only on white oaks or only on red oaks might suggest that preferential insect defoliation was the cause. Frost may be implicated if damage is limited to trees growing in depressions or valley bottoms.

Symptom development can also indicate the stage of decline and approximate beginning of the problem. The age of bole sprouts and patterns of radial and terminal growth can be used to estimate the events that triggered their development. Although some trees die soon after being stressed, others may not succumb for 5 years or more. The timing of peak mortality, if known, can give some indication of when the stress may have occurred. For example, mortality is usually highest 2 years after heavy insect defoliation. Such tree growth information, when coupled with an analysis of weather and forest records, can be used to develop a composite picture of the cause and stage of the oak decline problem.

In the diagnosis of oak decline, it is important to determine if stress factors are associated with the specific problem and at the same time, to rule out the involvement of primary pathogenic organisms such as the oak wilt fungus.

Oak wilt caused by the fungus *Ceratocystis fagacearum* (Bretz) Hunt has been reported from the Lake States east to Pennsylvania and south to Texas. It has not been found in New England, New York, or New Jersey. All oak species are susceptible to the fungus. Red oaks are more susceptible than white oaks.

Control

The unique relationship of cause and effect, and patterns of distribution of oak decline must be considered, and control efforts should focus on reducing or preventing the predisposing stress factors.

In the forest, factors such as drought and frost cannot be controlled. However, management can reduce their effects. Thinning can reduce competition for moisture and nutrients and promote better physiological condition of the remaining trees. Silvicultural practices designed to encourage species best adapted to the site can help reduce the effects of drought or frost. Removal of weak and dying trees may also reduce or delay population buildup of the two lined chestnut borer. Stress from insect defoliation can be reduced or eliminated in high-value forest stands by spraying the trees with insecticides.

Landowners can get specific information on insecticides available for control from cooperative extension agents or local forestry officials.

In urban sites, additional control measures are feasible. Moisture shortages can be alleviated by watering, mulching to reduce competition from sod, and reducing or avoiding soil compaction. Trees can also be treated to control sucking and defoliating insects and disease organisms that cause defoliation. Nutritional deficiencies can be corrected by fertilizing. These practices eliminate some forms of stress and promote good physiological condition.

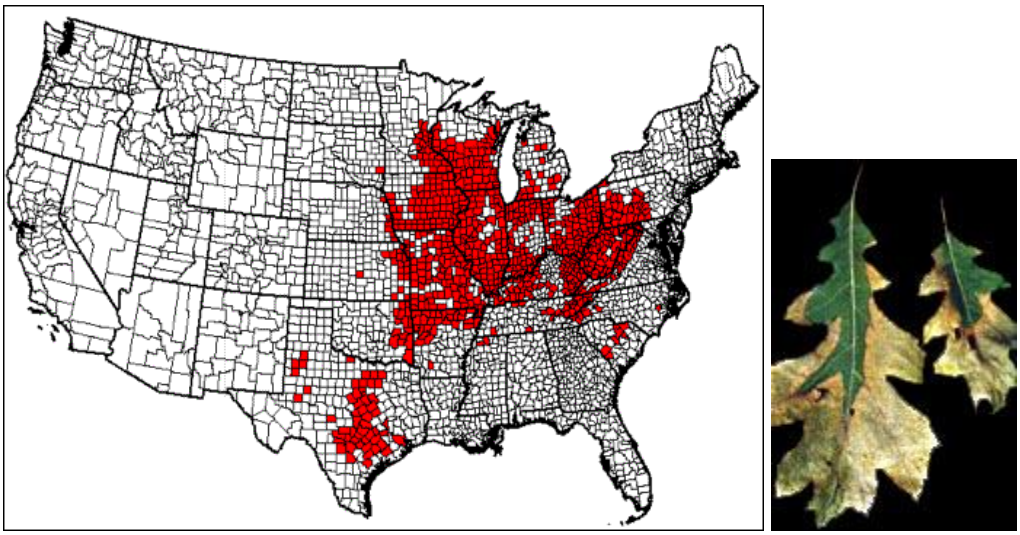
Oak decline is initiated by stresses, which can disappear before effects are manifested. A systematic evaluation of the problem can usually reveal the initiating factors and the agents responsible for mortality. Practices to promote good tree health can reduce the potential impacts of damage by oak decline.

Oak Wilt

Oak wilt is an aggressive disease that affects many species of oak (*Quercus* spp.). It is one of the most serious tree diseases in the eastern United States, killing thousands of oaks each year in forests, woodlots, and home landscapes.

Distribution

Oak wilt was first identified in 1944. The fungal pathogen that causes the disease, *Ceratocystis fagacearum*, is thought by most to be native to the eastern United States, but difficulty in isolating and identifying the fungus delayed recognition of the extent of its impact until the 1980's. Some plant pathologists think that oak wilt is an exotic disease, arriving in North America in the early 1900's, but the fungus has never been reported from any country other than the United States. The disease has also become much more apparent in some local areas since the 1980's because of increased tree wounding, due primarily to home construction in oak woods. The current known distribution of oak wilt is shown in red.



In 1998, oak wilt was distributed over much of the eastern United States.

Hosts

Oaks can be organized into three main groups, based on leaf shape: red oaks, white oaks, and live oaks. Trees in the red oak group have fan-shaped leaves with sharply pointed tips; those in the white oak group have fan-shaped leaves with rounded or blunt tips; and trees in the live oak group have oval leaves with rounded tips.

All species in the white oak group are moderately resistant to oak wilt, but if infected, trees can be killed over a period of one to several years. Resistance in white oaks appears to be related to characteristics of physiology and morphology. Upon wounding, infection, or as a part of the natural aging process, white oaks tend to form minute plugs called ***tyloses*** in their sapwood vessels. These plugs make the wood of white oaks impermeable to water, and also appear to prevent the fungus from moving throughout the vascular system of the tree.

The tendency for white oaks to form tyloses also explains why these are the species of choice for wood used in cooperage for storing wine and whiskey. The presence of tyloses ensures that barrels made from white oak wood will not leak.

Throughout the range of oak wilt in the United States, red oaks are the most important hosts, but susceptibility varies somewhat by species. Mortality in red oaks can occur within 3 weeks after infection by the oak wilt pathogen under some circumstances. Recovery from oak wilt infections in red oaks can occur, but is rare. Texas live oak *(Q. virginiana)* is moderately susceptible to the disease, but because of its tendency to form large, root-connected clones through which the disease can spread, it is also considered to be an important host.

Although the disease is not known west of Texas, inoculation studies have shown that most oaks in the red oak group, including several western species, are susceptible to the disease, and are at risk should the fungus ever be transmitted to them in their native habitat (Appel, 1994).

Symptoms

Oak wilt disease symptoms progress differently in red oaks, white oaks, and Texas live oak.

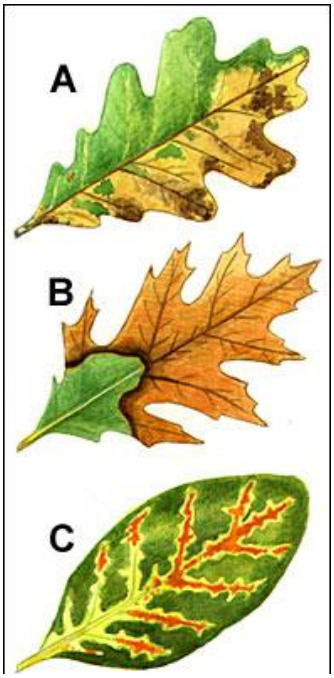


Figure 1. Symptoms of oak wilt in A. white oak, B. red oak

Red Oak Group

Oak wilt is usually identified in red oaks by the symptoms of rapid leaf discoloration and wilting. Often the initial symptom is a subtle off-green color shift that may be visible in the upper portion of the tree crown. This symptom is apparent in the northern part of the disease range in late June to early July. Shortly after this initial color shift, the leaves begin to wilt from the top of the crown downward. As the disease progresses, individual leaves quickly discolor, taking on a "bronzed" appearance. The discoloration progresses around the margins of the leaf from the tip to the base (Fig. 1B). The progressing discoloration may be interrupted by the leaf veins, as shown in the white oak leaf in Fig. 1A, or may affect the entire upper portion of the leaf, as shown in the red oak leaf in Fig. 1B.

Leaves are cast rapidly as the infection progresses. Commonly, infected trees are almost entirely defoliated within a few weeks of symptom onset. Fallen leaves usually are brown at the tips and margins, and sometimes green at the base and along the lower veins. Trees are often killed in groups or disease "centers," when infection occurs through grafted roots.

Occasionally the outer ring of vessels of diseased trees will be plugged with a brown substance that may be visible in cross sections as a ring or a series of dark spots through the outer sapwood, and in tangential cuts as longitudinal streaking of wood exposed after removing the bark. However, this is not always obvious to an untrained observer, especially in the red oaks. The discoloration may be very light or appear as flecks in such sections. Discoloration is most readily seen in tangential cuts on branches.

White Oak Group

White oaks usually die slowly, one branch at a time, over a period of one to many years. Wilting and death of leaves on individual branches occur in a similar fashion to the disease in red oaks, but usually progresses much more slowly. Affected leaves exhibit a pattern of discoloration similar to that seen in red oaks, with discoloration proceeding from the margins to the base, sometimes interrupted by the leaf veins (Fig. 1A). Brown streaking in the outer growth rings is often readily apparent even to an untrained observer in infected white oaks and bur oaks, but may be missing.

http://na.fs.fed.us/ - Northeastern Area USDA Forest Service

Control

Stopping spread of the fungus through common root systems is most important and can be done by mechanical barriers using a vibratory plow with a 5-foot blade. Barriers in the soil must be positioned outside of trees with the fungus. Often two lines are recommended: a primary line outside of apparently

healthy trees and a secondary barrier outside of every obviously infected tree. The fungus can be in a tree for 2-3 weeks without leaf symptoms appearing. Barrier placement requires experience. If buried utilities are present, the soil sterilant, Vapam, can be used, but it is not nearly as effective as the mechanical barrier.

Overland spread by insects can be prevented by following these guidelines on when to prune and when to paint.

> **High Risk Period**. April, May, and June. Don't wound or prune! If trees are accidentally wounded or pruning is unavoidable, cover the wounds immediately-within minutes-with one of the preferred materials such as water-based paint or shellac.
>
> **Low Risk Period**. July through October. On rare occasions-depending on weather conditions and insect populations-infections may occur. Covering wounds is optional.
>
> **Safe Period**. November through March. This is the preferred time for pruning since the fungal pathogen and insect vectors are inactive.
>
> Tree climbing irons should never be used on living oak trees.

As further precaution, infected red oaks on which spores may form in spring should be eliminated by debarking, burning, burying, or wrapping and sealing in 4-6 ml plastic until July 1. Experience is needed to detect these trees before spores are produced. The spores are carried by the sap beetles to wound oaks during May and June.

Logs from wilting, or recently wilted trees should not be moved in any form, including firewood, to areas where oak wilt is not present. Oak wilt mats may form on these logs. Long distance movement of firewood obtained from such logs has accounted for establishment of oak wilt centers in distant areas that previously had been unaffected by the disease.

In high value white oaks, systemic injection with propiconazole by qualified arborists may prevent infection of trees adjacent to oak wilt affected ones. Propiconazole treatment of white oaks exhibiting early symptoms of oak wilt (less than 30% of crown affected) can also prevent further disease development for at least 2 years.

http://www.extension.umn.edu/distribution/naturalresources/DD3174.html - University of Minnesota College of Food, Agriculture and Natural Resources

Bacterial Leaf Scorch

Symptoms

Trees infected with *Xylella fastidiosa* exhibit marginal leaf necrosis, or browning, bordered by a pale halo band separating the dead or scorched tissue from the green tissue. Leaf discoloration begins at the leaf margin and moves toward the midrib. Symptoms recur each year and spread over the tree's crown, thus, reduction in growth and dieback are common in affected trees.

In the early stages of this disease, portions of the tree remain unaffected, while other branches exhibit symptoms typical of the disease. Infected leaves in red oaks exhibit a pronounced, marginal discoloration

with a dull red or yellow halo between scorched and green tissues (see below). Due to determinant growth, all leaves on oak develop symptoms at the same time. As the disease progresses, more branches develop symptoms. Within plantings, disease incidence usually appears randomly; trees neighboring severely affected trees are often not affected. Leaf symptoms in pin oak are not as distinct, but the distribution of the disease within the canopy and between trees is the same.

In all known oak hosts, symptoms usually occur in mid- to late-summer on leaves of one or more branches in the canopy. Affected leaves may curl and drop prematurely. As the infection progresses over several years, branches die, and the tree declines. Affected trees eventually decline to the point where they must be removed. The process of tree decline may occur quickly or slowly depending on the tree or the environment. Epicormic sprouts can be prominent on severely diseased trees, and scale insects, borers, Armillaria root rot, and other biotic diseases may be present as secondary pests.

Symptoms of marginal leaf scorch on northern red oak. (Photograph courtesy of A. B. Gould.)

Vectors

Because this bacterium occurs in the xylem of plants, it is not surprising that all currently known vectors are xylem-sap feeding insects. A recent finding has been the identification of treehoppers (Membracidae) as potential vectors.

Management Strategies

There is no effective preventative treatment or cure for bacterial leaf scorch, so one should expect diseased trees to be gradually lost over the years. The best remedy for bacterial leaf scorch is tree replacement. However, in the meantime, infected trees can be made to look somewhat presentable for a few more years if the dead wood is pruned out. Careful scouting combined with judicious pruning can help to rid the tree of symptomatic branches especially since there are no chemicals registered for treatment.

- Leafhoppers, which spread the disease, are active most of the growing season making it impractical to control this disease by insecticidal treatments. Transmission of this disease is so unpredictable that efforts to prevent it by preventing vector feeding are likely to be futile.
- Trunk injections with antibiotics have been shown to suppress symptoms. Treatments must be made annually in late May or early June. The antibiotic oxytetracycline has been tested as a treatment, but it only caused the remission of symptoms; it did not provide a cure.
- Pruning has been another possible treatment; however, with only limited success in delay of scorch development. Pruning has been devoted to public safety in trees that have shown some natural resistance to the disease.
- Mulching and irrigating during periods of little rainfall will reduce moisture stress and possibly delay scorch development.
- The effects of fertilization are still unclear with this disease. Fertilizing should be performed when a soil or leaf analysis shows a nutrient deficiency.
- Removing trees has been necessary to maintain safety and is considered when trees no longer add to the landscape.

http://www.usna.usda.gov/Research/BacterialLeafScorch.html - US National Arboretum

***BLS is commonly found in other tree species such as sycamore, elm and red maple. Please follow the above guidelines.**

Smooth Patch Disease

Aleurodiscus oakesii, is a small but very common and overlooked fungus that decompose the rough, dead outer bark of trees. However, its effects can be seen from quite a distance. Although *A.oakesii* is not a parasite, it lives on the bark of trees, primarily oaks. Over time this results in smooth grayish patches that are adjacent to the normal, rough bark. These patches may expand slowly over time, coalescing to form smooth grayish areas that are several feet in length.

Oak trees with smooth patch – Purdue Extension

These smooth patch fungi, however, do not cause cankers or internal decay. They cause no known harm to the tree.

Oak anthracnose

Symptoms

This disease is most serious on white oaks. Individual trees can be severely damaged from repeated infection by the fungus Gnomonia quercina. Individual leaves develop irregular brown, dead areas and may be slightly cupped or distorted. The fungus also attacks and kills leaf buds and new shoots. Repeated attacks will cause a stunted, brooming effect to diseased branches.

Anthracnose fungi overwinter in leaf debris on the ground and/or in dead areas of the bark on the tree, called cankers. In early spring, spores of the fungus are produced in fruiting structures and are dispersed by splashing rain. These spores infect expanding leaf buds, shoots, or in some cases young leaves.

The infection process is favored by relatively cool temperatures and prolonged periods of leaf wetness. Therefore, the disease tends to be more severe during wet, cool springs. After infection, the anthracnose fungus colonizes leaf tissue and begins to produce new fruiting structures and spores capable of reinfecting expanding leaf tissue. Disease development may continue throughout the spring into early summer if favorable weather persists. These diseases tend to be less of a problem during hot, dry summer weather.

Control

Anthracnose rarely causes significant damage to shade trees in the area; consequently, specific control measures generally are not required. The disease also can increase susceptibility to other disease or insect problems in areas where trees are attacked year after year.

Several cultural practices can reduce the severity of anthracnose. Removal of dead leaves in the fall will help limit the amount of fungal inoculum present for infection of new leaves the following spring. However, this practice rarely eliminates the problem, especially for those anthracnose fungi that may also survive in blighted twigs on the tree.

Proper tree spacing and placement to promote good air circulation reduces the number of hours leaf surfaces remain wet, and decreases the likelihood of fungal infection. Many trees recover rapidly from anthracnose if they are maintained in a vigorous condition.

Trees should be watered and fertilized regularly. In some cases, nitrogen fertilization may actually increase the tree's tolerance or resistance to anthracnose.

Red oaks tend to have fewer problems with the disease than the white oak group; and there appears to be variation in individual elms and black walnuts to their respective anthracnose diseases. Avoid planting highly susceptible trees in areas with poor air circulation.

For forests, monitoring of overall stand health is recommended, with removal of severely diseased trees if disease pressure is high throughout stand population.

*** Anthracnose foliar disease is commonly found in other tree species such as sycamore, elm, hickory and red maple. Please follow the above guidelines.**

Gypsy Moth

The gypsy moth, *Lymantria dispar* Linnaeus, is one of the most notorious pests of hardwood trees in the Eastern United States. Since 1980, the gypsy moth has defoliated close to a million or more forested acres each year. In 1981, a record 12.9 million acres were defoliated. This is an area larger than Rhode Island, Massachusetts, and Connecticut combined.

Gypsy moth infestations alternate between years when trees experience little visible defoliation (gypsy moth population numbers are sparse) followed by 2 to 4 years when trees are visibly defoliated (gypsy moth population numbers are dense).

The gypsy moth is not a native insect. It was introduced into the United States in 1869 by a French scientist living in Massachusetts. The first outbreak occurred in 1889. By 1987, the gypsy moth had established itself throughout the Northeast. The insect has spread south into Virginia and West Virginia, and west into Michigan. Infestations have also occurred in Utah, Oregon, Washington, California, and many other States outside the Northeast.

Life Cycle

The gypsy moth passes through four stages: egg, larva, pupa, and adult (moth stage). Only the larvae damage trees and shrubs.

Female gypsy moth laying eggs.

Gypsy moth egg masses are laid on branches and trunks of trees, but egg masses may be found in any sheltered location. Egg masses are buff colored when first laid but may bleach out over the winter months when exposed to direct sunlight and weathering.

The hatching of gypsy moth eggs coincides with budding of most hardwood trees. Larvae emerge from egg masses from early spring through mid-May.

Hosts

Gypsy moth larvae prefer hardwoods, but may feed on several hundred different species of trees and shrubs. In the East the gypsy moth prefers oaks, apple, sweetgum, speckled alder, basswood, gray and white birch, poplar, willow, and hawthorn, although other species are also affected. The list of hosts will undoubtedly expand as the insect spreads south and west.

Factors That Affect Gypsy Moth Populations

Natural enemies play an important role during periods when gypsy moth populations are sparse. Natural enemies include parasitic and predatory insects such as wasps, flies, ground beetles, and ants; many species of spider; several species of birds such as chickadees, blue jays, nuthatches, towhees, and robins; and approximately 15 species of common woodland mammals, such as the white-footed mouse, shrews, chipmunks, squirrels, and raccoons.

The *Calosoma* beetle, a ground beetle of European origin, cuckoos, and flocking birds, such as starling, grackles, and red-winged blackbirds, are attracted to infested areas in years when gypsy moth populations are dense.

Diseases caused by bacteria, fungi, or viruses contribute to the decline of gypsy moth populations, especially during periods when gypsy moth populations are dense and are stressed by lack of preferred foliage.

Wilt disease caused by the nucleopolyhedrosis virus (NPV) is specific to the gypsy moth and is the most devastating of the natural diseases. NPV causes a dramatic collapse of outbreak populations by killing both the larvae and pupae. Larvae infected with wilt disease are shiny and hang limply in an inverted "V" position.

Weather affects the survival and development of gypsy moth life stages regardless of population density. For example, temperatures of -20°F. (-29°C.) lasting from 48 to 72 hours can kill exposed eggs; alternate periods of freezing and thawing in late winter and early spring may prevent the overwintering eggs from hatching; and cold, rainy weather inhibits dispersal and feeding of the newly hatched larvae and slows their growth.

Managing the Gypsy Moth

A number of tactics have the potential to minimize damage from gypsy moth infestations and to contain or maintain gypsy moth populations at levels considered tolerable. These tactics include monitoring gypsy moth populations, maintaining the health and vigor of trees, discouraging gypsy moth survival, and treating with insecticides to kill larvae and protect tree foliage. The tactic or combination of tactics used will depend on the condition of the site and of the tree or stand and the level of the gypsy moth population. Tactics suggested for homeowners are probably too costly and too labor intensive for managers to use in forest stands.

Gypsy moth larvae emerging from egg mass.

Silvicultural Guidelines for Forest Stands and Woodlots

Several interrelated factors determine the vulnerability of forest stands and woodlots to gypsy moth defoliation. An awareness of these factors will enable land managers and woodlot owners to prescribe silvicultural actions that will minimize the impact caused by gypsy moth defoliation. Three of these factors include the abundance of favored food species (mainly oaks), site and stand factors, and tree conditions.

Stands of trees that are predominately oak and grow on poor, dry sites (such as sand flats or rock ridges) are frequently stressed and often incur repeated, severe defoliations. Trees growing under these conditions frequently possess an abundance of structural features such as holes, wounds, and deep bark fissures that provide shelter and habitats for gypsy moth larvae and aid their survival.

Stands of trees that are predominantly oak but grow on protected slopes or on sites with adequate moisture and organic matter are more resistant to defoliation by the gypsy moth.

Slow-growing trees on poor sites frequently survive a single, severe defoliation better than fast-growing trees typically found on well-stocked better sites.

More trees are killed in stands that contain mainly oak species than in oak-pine or mixed hardwood stands.

Subdominant trees are killed more rapidly and more often than dominant trees.

Silvicultural Treatment-What and When?

Appropriate silvicultural treatment will be determined by an anticipated occurrence of gypsy moth defoliation, by characteristics of the stand, and by the economic maturity of the stand. Foresters refer to treatments discussed here as "thinning's." Thinning's are cuttings made in forest stands to remove surplus trees (usually dominant and subdominant size classes) in order to stimulate the growth of trees that remain.

Predefollation treatments: When gypsy moth defoliation is anticipated, but not within the next 5 years, **predefoliation thinning** to selectively remove preferred-host trees can reduce the severity of defoliation, increase the vigor of residual trees, and encourage seed production and stump sprouting. Thinning's should not be conducted in fully stocked stands that will reach maturity within the next 6 to 15 years. Thinning results in a short-term "shock effect" to residual trees. This shock effect, coupled with defoliation-caused stress, renders trees vulnerable to attack by disease organisms such as *Armillaria*.

In fully stocked stands that will reach maturity within the next 16 or more years, two kinds of thinning can be applied. The method of thinning should depend on the proportion of preferred host species present.

If more than 50 percent of the basal area in a stand is preferred host species (mainly oaks), **presalvage thinning** should be applied. Presalvage thinning is designed to remove the trees most likely to die (trees with poor crown condition) from stress caused by gypsy moth defoliation.

If less than 50 percent of the basal area in a stand is in preferred host species, **sanitation thinning** can be applied to reduce further the number of preferred host trees. This will result in fewer refuges for gypsy moth larvae and in improved habitats for the natural enemies of the gypsy moth.

Treatment during outbreaks: If defoliation is current or is expected within the next 5 years, thinning's should be delayed because of potential "shock effect." High-value stands can be protected by applying pesticides. In low-value stands or those that are at low risk (less than 50 percent basal area in preferred host species), protective treatments are optional.

Post-outbreak treatments: After a defoliation episode, the land manager or woodlot owner should pursue efficient salvage of dead trees, but should delay decisions about additional salvage, regeneration, or other

treatments for up to 3 years. At the end of 3 years, most defoliation-caused mortality will be complete and the need for treatments can be assessed on the basis of damage level, current stocking conditions, and stand maturity.

Above portions on gypsy moth are from: http://www.na.fs.fed.us/SPFO/pubs/fidls/gypsymoth/gypsy.htm

Orangestriped Oakworm

Symptoms

Identifying the Insect - The larvae of the orange striped oak worm are black with eight narrow yellow stripes, the pink striped oak worm larvae are greenish brown with four pink stripes, and the spiny oak worm larvae are tawny and pinkish with short spines. Larvae are about 2 inches (50 mm) long and have a pair of long, curved "horns". The adult moths are a similar yellowish red, with a single white dot on each of the forewings.

Identifying the Injury - Young larvae feed in groups, skeletonizing the leaf. Later they consume all but the main veins and usually defoliate one branch before moving onto another. Older larvae are less gregarious and can be found crawling on lawns and the sides of houses.

Control

Natural enemies generally prevent widespread defoliation. Chemical control may be needed for high value trees, but is rarely recommended.

Red Maple

Red maple is considered very susceptible to defects, such as decay and structural defects in branching and form. Especially on poor sites, red maple often has poor form and considerable internal defects. Discoloration and decay advance much faster in red maple than in sugar maple.

Although many insects and diseases feed upon and infect this species, it is considered very resistant to these damaging agents. However, because of its thin bark, it is susceptible to mechanical and fire damage. Much of the time secondary decay fungus and pathogens produce significant heart rot after bark damage to trunk.

Sweet Gum

Distribution

Sweetgum *(Liquidambar styraciflua* L.) occurs naturally in the Southeastern United States.

Disease

Sweetgum is rarely attacked by insects but is frequently marred by trunk canker and trunk lesion caused by *Botryosphaeria ribis.* This disease causes sunken areas on the trunk and profuse "bleeding". Infected bark and sapwood will be brown and dead. There is no chemical control for canker diseases. Severely infected trees will die or produce large cavities or rotted portions on the lower trunk. Sweetgum is predisposed to this disease when the trunk is damaged.

Botryosphaeria ribis canker on trunk.

Leaf spots of various types may attack Sweetgum, causing premature defoliation, but are not serious.

Management Considerations - Monolithic Stands

Recently cleared coastal areas are frequently repopulated with sweet gum. The vigorous regrowth of this species will suppress the regeneration of other more desirable woody plants; virtually creating a sweet gum desert. Thus, areas that are normally dominated by other higher value species, such as oak, will be suppressed because of the aggressive repopulation of sweet gum. Stands of sweet gum on high quality sites should be thinned before the largest trees exceed 6 inches in diameter at breast height; otherwise, vigor and growth of most other tree species are reduced or eliminated.

Tulip Poplar

Distribution

Tulip poplar is exacting in soil and moisture requirements. It does best on moderately moist, deep, well drained, loose textured soils; it rarely grows well in very dry or very wet situations. It will tolerate a pH of 4.5 to 7.5.

Pests and Potential Problems

Tulip poplar is unusually free from insects and disease. The yellow-poplar weevil, nectria canker, and fusarium canker are three of the more important enemies of this species; but are rarely considered a threat to overall stand health.

This species is prone to wind damage and ice damage in exposed situations.

Recommendations Regarding Fuel Loads

Propane can result in a large-scale forest fire:

-Several fire prevention and propane industry references recommend maintaining a 10-foot clearance between liquid fuel/propane storage tanks and combustible vegetation.

-Fuel breaks and Fire breaks can help solve problems.

-A fire break is defined as a strip of bare soil or fire-retardant vegetation meant to control or stop the spread of fire.

-Fuel breaks are strips or blocks of vegetation that have been altered to both slow and control the spread of fire.

-Some notable benefits and purposes to use Fuel and Fire breaks are:

- Wildfire hazards are reduced
- Greater safety to fire fighters by creating a defensible area
- Reduced intensity of wildfire
- If applied in a woodland, trees may respond to increased growing space with improved growth
- Improved access Improved visual quality
- Generally, reduce the fuel volume, break up the fuel continuity and eliminate the fuel chain between structures and surrounding forest vegetation
- If trees are involved, space the crowns to allow heat to escape. Prune dead lower limbs on larger trees and remove accumulations under them. Pruning also improves the visibility around the structure and helps tree growth. Also, interrupt any connection between the ground and the possible for a fire to “step-up” into the crowns. Adequately dispose of any sash created from installing this practice.

CONCLUSION

Natural events like wildfires, wind, diseases, and insects are important factors in forest ecosystems. The ongoing challenge for forestry professionals is to achieve and maintain healthy forests with a balanced approach to the naturally occurring events.

Actively scouting or monitoring areas at risk due to unnatural or extreme conditions is the first step in maintaining healthy woodlands. Both active and passive management can have some short-term adverse impacts and cannot eliminate all forest health or wildfire hazards. A substantial and growing body of research and professional experience, however, shows that active management can produce much more reliable and positive results than a passive-management approach.

APPENDIX J

Sustainable Range Vegetation Management Plan

SUSTAINABLE RANGE VEGETATION MANAGEMENT PLAN

U.S. Army Aberdeen Proving Ground
October 2020

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TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

APG	Aberdeen Proving Ground
ARL	Army Research Laboratory
ATC	Aberdeen Test Center
ATEF	Automotive Technology Evaluation Facility
CARA	20th Chemical, Biological, Radiological, Nuclear, Explosives Command – Analytical and Remediation Activity
CBC	Chemical Biological Center
DPW	Directorate of Public Works
GIS	geographic information system
LWE	Littoral Warfare Environment
OB/OD	Open Burning/Open Detonation
PAAF	Phillips Army Airfield
PDTDF	Prototype Detonation Test and Destruction Facility
REC	record of environmental consideration
RRB	Recoilless Rifle B
SUGV	Small Unmanned Ground Vehicle
UGV	Unmanned Ground Vehicle
U.S.	United States
UTF	Underwater Explosion Test Facility
UXO	unexploded ordnance

1. INTRODUCTION

1.1 PURPOSE

The sustainment of the military mission requires that range areas remain available and accessible for testing and training activities. Range operations require lines of sight and access for data collection, scoring, target placement, SAFETY OF PERSONNEL, and other activities required to execute a successful test. For safety considerations, many range areas are only accessed when they are required for testing and training operations, so that personnel are not exposed to unnecessary risks from unexploded ordnance (UXO). In addition, resources (funding and labor) for annual vegetation management continue to be limited. Delaying vegetation management for safety and resource considerations, coupled with the aggressive spread and regeneration of early successional tree species into operational range areas, impedes access to ranges and hinders the ability to execute testing and training missions.

The purpose of this Sustainable Range Vegetation Management Plan is to prescribe environmentally sound practices for managing vegetation on range areas, with a multi-year time frame in mind. To ensure compliance with Maryland's Coastal Zone Management Program, this Sustainable Range Vegetation Management Plan is accompanied by a Federal Consistency Determination (Attachment 1). The Federal Consistency Determination quantifies the one-time offsets for periodic maintenance clearing of vegetation. This Sustainable Range Vegetation Management Plan is a component plan and appendix to the APG Integrated Natural Resources Management Plan.

Implementation of this plan will require continued coordination with the Garrison Directorate of Public Works (DPW) – Environmental Division, Natural Resources Team to ensure compliance with multiple subject areas (forests; wetlands; rare, threatened, endangered plants; bald eagles; migratory birds; bats; other threatened, endangered, protected species), and may require submission of a Record of Environmental Consideration (REC) for individual action (see Section 2).

1.2 SCOPE

This Sustainable Range Vegetation Management Plan prescribes vegetation management practices and timeframes for ranges on U.S. Army Aberdeen Proving Ground (APG). This plan addresses existing ranges operated by the Army Research Laboratory (ARL), the Aberdeen Test Center (ATC), the Chemical Biological Center (CBC), and the 20th Chemical, Biological, Radiological, Nuclear, Explosives Command – Analytical and Remediation Activity (CARA). This plan may be updated and amended in the future, as warranted, to include additional range areas. However, any new range constructions or expansion of existing ranges will require a separate Federal Consistency Determination.

1.3 RESPONSIBILITIES

The development of this plan is a collaborative effort between Garrison and tenant organizations that have a vested interest in range sustainment on the installation.

1.3.1 Garrison

The DPW Environmental Division – Natural Resources Team provides guidance and recommendations on vegetation management activities to ensure mission sustainment in accordance with legal requirements. The Natural Resources Team is responsible for:

- Updating this plan, with input from the tenant organizations
- Developing and submitting the plan's General Consistency Determination
- All communications with regulators
- Providing input to controlled burn plans
- Coordinating aerial herbicide application with the tenant environmental personnel, ATC Range Operations Division, and ATC Airfield Operations, as well as the DPW Integrated Pest Management Coordinator

The DPW Integrated Pest Management Coordinator is responsible for:

- Maintaining the license to apply herbicide
- Overseeing the application of all herbicide on the installation
- Approving herbicides proposed for use
- Overseeing the preparation of the herbicide
- Maintaining list of individuals approved to spray under license

The Directorate of Emergency Services (DES) – Fire Department is responsible for helping to plan the controlled burns, and for coordinating with the ATC Controlled Burn Manager to execute the controlled burns.

1.3.2 Tenant

1.3.2.1 Range Managers

The tenant range managers are responsible for meeting the recommendations of this plan for their range. If range managers possess the appropriate equipment to conduct the maintenance, they will execute the plan as prescribed. Range managers are responsible for ensuring maintenance of the equipment that is provided to the range.

1.3.2.2 Environmental

The tenant environmental personnel are responsible for submitting appropriate documentation to fulfill the requirements of the National Environmental Policy Act (NEPA). For this plan, tenants are required to submit a Record of Environmental Consideration (REC) to the DPW NEPA office prior to any vegetation maintenance other than grass mowing.

The tenant environmental personnel are responsible for tracking the range vegetation maintenance across their ranges to ensure that each range is meeting the

recommended timelines. Maintenance will be tracked by calendar year of execution, month and day not required, to allow for flexibility with range schedules.

The tenant environmental personnel are responsible for reporting range vegetation maintenance to the DPW Natural Resources Team annually by 1 March.

1.3.2.3 Range Operations

The Commander of ATC is the Range Officer in Charge for APG. The ATC Range Operations Division provides control and coordination for range operations on APG land, water, and restricted airspace. The ATC Range Operations Division is responsible for reviewing, approving, and scheduling range work requests (from all tenants) for vegetation maintenance on all ranges; and for clearing work crews into downrange areas.

The ATC Range Operations Division will appoint a Controlled Burn Manager. The Controlled Burn Manager is responsible for coordinating controlled burn activities with the DES Fire Department, ATC Aviation Operations Division, tenant range managers, tenant environmental personnel, and the DPW Natural Resources Team.

Currently, the Controlled Burn Manager only coordinates controlled burns on ATC ranges. There is no current identified need for controlled burns on ARL or CBC ranges. If a future burn is required on an ARL and/or CBC range, then a formal written agreement between commands will be established in advance (i.e., interagency agreement).

1.3.2.4 Aviation Operations

The ATC Aviation Operations Division is responsible for providing aerial support to controlled burn and herbicide application activities. Pilots for herbicide application must possess: 1) a valid license from the Maryland Department of Agriculture for aerial herbicide application, and 2) a category 11 (aerial application pest control) certification from a DoD-sponsored course.

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2. METHODS OF VEGETATION MANAGEMENT

There are three primary means of managing vegetation on ranges: mechanical, controlled burning, and herbicidal spraying. Each method was considered for every range, and the prescriptions in this plan outline the best methods for each range. In some cases, multiple methods may be viable for a given area.

Any proposed activity, except routine (at least twice per year) grass mowing, requires submission of a REC to the DPW NEPA office. There may potentially be time of year restrictions or other impact minimization measures for bald eagle nesting or other protected species, a requirement for a site visit coordinated with the DPW Natural Resources Team, or other site-specific requirements; these requirements will be captured upon review of the REC.

2.1 MECHANICAL MANAGEMENT

Mechanical management includes: mowing, cutting, trimming, or other above ground methods that involve mechanical equipment in the control of vegetation. Mechanical management does not include grubbing, stump grinding, or stump removal. All tree trimming or cutting must be coordinated in advance with the DPW Forester.

Best management practices for mechanical maintenance include:

- No grubbing, stump grinding, or stump removal
- No bulldozing
- Limit ground disturbance from equipment, utilize ground mats if necessary
- Do not dump or push debris (logs, branches, trimmings, etc) into wetland areas or waterways
- Make clean flush cuts (to branch collar) when trimming limbs
- Always remove dead or damaged branches
- Trim branches contacting buildings and structures or encroaching on roads and signs
- Remove less than ¼ of tree crown per year
- Remove branches from no more than lower 1/3 of main trunk of tree (when limbing up for clearance)
- Refer to APG Forest Management Plan (appendix to APG Integrated Natural Resources Management Plan)
- Submit REC to the DPW NEPA office prior to any mechanical management, except routine (at least twice per year) grass mowing

2.2 HERBICIDAL SPRAYING

There are circumstances where mechanical management alone is less effective at curtailing vegetative growth and herbicidal spraying is needed to supplement vegetation management. Herbicides are particularly effective for spot treating around building and

pad perimeters, along fences, and within gravel pads and roads, and as a precursor to controlled burns for common reed control. All herbicidal spraying must be coordinated in advance with the DPW Integrated Pest Management Coordinator. Spray activities must occur under the APG herbicide license. Herbicidal applications must be conducted by a certified pesticide applicator, with all volumes reported to the DPW Integrated Pest Management Coordinator using form DD 1532-1.

Best management practices for herbicidal spraying include:

- Avoid herbicide applications if rainfall is expected within 24 hours
- Minimize drift onto non-targeted vegetation, be aware of wind speed and direction
- Use minimal volume and dose necessary to control vegetation
- Wear appropriate personal protective equipment (as specified by applicable laws, regulations and/or the pesticide label)
- Refer to APG Integrated Pest Management Plan
- Submit REC to the DPW NEPA office prior to any herbicidal spraying

2.3 CONTROLLED BURNING

All controlled burning activities must be coordinated in advance with the ATC Controlled Burn Manager, who coordinates with the DES Fire Department. All controlled burns (also called open burns) need Harford County Health Department permits. Each semiannual permit specifies all burns anticipated during the upcoming six-month period (January-June and July-December). The ATC Controlled Burn Manager and DES Fire Department must coordinate with the DPW Environmental Division, Air Program Team prior to each six-month period to obtain such a permit. Controlled burns are not permitted from 1 June to 31 August. The Garrison-appointed Wildland Fire Manager is the lead on setting and managing the fires in accordance with the APG Integrated Wildland Fire Management Plan. A controlled burn plan is submitted for Garrison approval by the ATC Controlled Burn Manager prior to burn season each year.

Best management practices for controlled burning include:

- Evaluate meteorological conditions when scheduling controlled burns
- Provide trained fire management professionals for execution of controlled burns
- Keep helicopters with “bambi buckets” on standby during controlled burns
- Utilize back burns as appropriate to keep fire within boundaries and/or to protect sensitive areas (e.g., test infrastructure, bald eagle nests, etc.)
- Maintain and utilize fire breaks and fuel breaks
- Conduct pre- and post-burn monitoring to evaluate effectiveness of fire at eliminating fuel load while sustaining mission land and ecosystem
- Refer to APG Integrated Wildland Fire Management Plan (appendix to APG Integrated Natural Resources Management Plan)
- Submit REC to the DPW NEPA office prior to any controlled burn

3. RANGE PRESCRIPTIONS

The following sections prescribe methods and frequencies for managing the vegetation on existing APG ranges. The range boundaries are based on the DPW Real Property Inventory and Range Operations firing lines. These boundaries have been slightly adjusted, as necessary, to reflect the DPW's most current Geographic Information System (GIS) aerial layers.

Frequencies included in these prescriptions are minimum recommended frequencies for maintenance. Frequencies were identified based on current and foreseeable mission needs. Any mitigation for tree removal, as identified in Federal Consistency Determination, will be required one time only, provided that recommended maintenance frequency is followed. Maintenance that does not meet these minimum recommended timelines may require future mitigation. Maintenance will be tracked by year (not month) of execution, allowing for flexibility in conducting vegetation management on active, operational test ranges.

The ranges are divided into areas based on vegetation maintenance prescriptions, with areas represented by individual polygons. Common area designations are:

- **Berm**
  Engineered soil berm, typically grass covered with potential for encroaching woody vegetation

- **Encroachment – Trees to Clear**
  Trees that are encroaching on range operations that need to be cut down to the ground (no grubbing or stump removal)

- **Gravel Stands, Pads**
  Gravel stands, pads, and/or impervious surfaces; maintain (at least annually) 15-foot clearance on each side; potential for vegetative growth in gravel; potential for overhanging or dead tree limbs that encroach on clearance

- **Magazine**
  Storage magazine or bunker; maintain (at least annually) 50-foot clearance around perimeter in accordance with security regulations; potential for vegetative growth along fence; potential for overhanging tree limbs that encroach on clearance

- **Natural Area**
  Consolidated trees, forest, and/or wetlands that are monitored for encroachment; potential for overhanging tree limbs that encroach on adjacent areas and/or imbedded road and utility right of ways (right of ways need to be maintained)

- **Natural Area – Mitigation**
  Natural areas that are enhanced or planted to offset permitted impacts; monitored for encroachment; potential for overhanging tree limbs that encroach on adjacent areas

- **Open**
  Grass lawns and fields that may include roads, trails, pads, buildings, and some trees; maintained through mowing (at least twice per year); potential for overhanging or dead tree limbs that encroach on adjacent areas; potential for vegetative growth along fences and building perimeters

- **Shoreline, Beach, Riprap**
  Shoreline areas that may include beach and/or stabilized areas of riprap that are monitored for erosion; potential for vegetative growth in riprap that impacts integrity of stabilized shoreline

- **Stormwater Management**
  Engineered retention pond, drainage inlet, swale and/or other stormwater management structure with potential for encroaching woody vegetation

- **Support Area**
  Fields, roads, and/or pads that may also include some trees and/or small wetlands; maintained less frequently than "open" areas; potential for vegetative growth along fences and building perimeters and in gravel roads and pads

Range roads, magazines, buildings, storage yards, and temperature control unit pads not otherwise addressed in this plan have standard vegetation maintenance prescriptions, as outlined below.

- **Range Roads**
  Range roads not otherwise identified in this plan are to have 15-foot shoulders on both sides that are mechanically managed at least every 10 years to keep the roads open. Many range roads act as fire breaks, and more frequently maintained vegetated shoulders can serve as fuel breaks. Both fuel breaks and fire breaks are critical to executing successful controlled burns. Trees may need to be trimmed along road shoulders to maintain safe clearance, but all tree trimming or cutting must be coordinated in advance with the DPW Forester.

- **Magazines**
  Magazines not otherwise identified in this plan are to have 50 feet of open area around the perimeter in accordance with security regulations. These areas will be mechanically managed at least annually. Herbicide may be applied (by permitted applicators only, with volumes reported to the DPW Integrated Pest Management Coordinator using form DD 1532-1) around fences where mechanical maintenance is less effective. Trees that border the open areas may need to be trimmed to maintain security clearance, but all tree trimming or cutting must be coordinated in advance with the DPW Forester.

- **Buildings, Pads, Fences, and Stored Equipment**
  Buildings not otherwise identified in this plan are generally surrounded by turf grasses and herbaceous weeds. Building yards will be mechanically managed at least annually. Herbicide may be applied (by permitted applicators only, with volumes reported to the DPW Integrated Pest Management Coordinator using form DD 1532-1) around buildings, pads, fences, and stored equipment, where mechanical maintenance is less effective. Trees may need to be trimmed around building perimeters, pads, and along fences to maintain safe clearance, but all tree trimming or cutting must be coordinated in advance with the DPW Forester.

- **Swales**
  Swales not otherwise identified in this plan will be mechanically managed at least every 5 years, or as recommended in the APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded).

- **Temperature Control Unit Pads**
  Temperature control unit pads not otherwise identified in this plan are to have a 50-foot fuel break around the pad. The fuel breaks will be kept clear of all readily combustible materials such as dry grass, dead wood, or brush. Live vegetation is acceptable, with grass as the preferred vegetation. The fuel breaks will be mechanically managed at least annually.

This plan addresses 89 range areas within APG, broken down into 19 ARL ranges, 63 ATC ranges, 6 CBC ranges, and 1 CARA range. This plan may be amended in the future to include additional ranges. The ranges currently included in this plan are:

ARL

ATC Ranges

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3.1 ARL RANGES

3.1.1 Airbase 6 and 7

The Airbase 6 and 7 ranges are located in the Aberdeen Area. The ranges encompass approximately 49 acres.

The Airbase 6 and 7 ranges are delineated into 4 areas (Figure 3-1) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	44
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Berm	Mechanical, with or without herbicide spraying	Every 2 years	0.6 (A) 2.1 (B)
4	Natural Area	Conservation	Monitor for encroachment	0.7 (A) 1.1 (B)

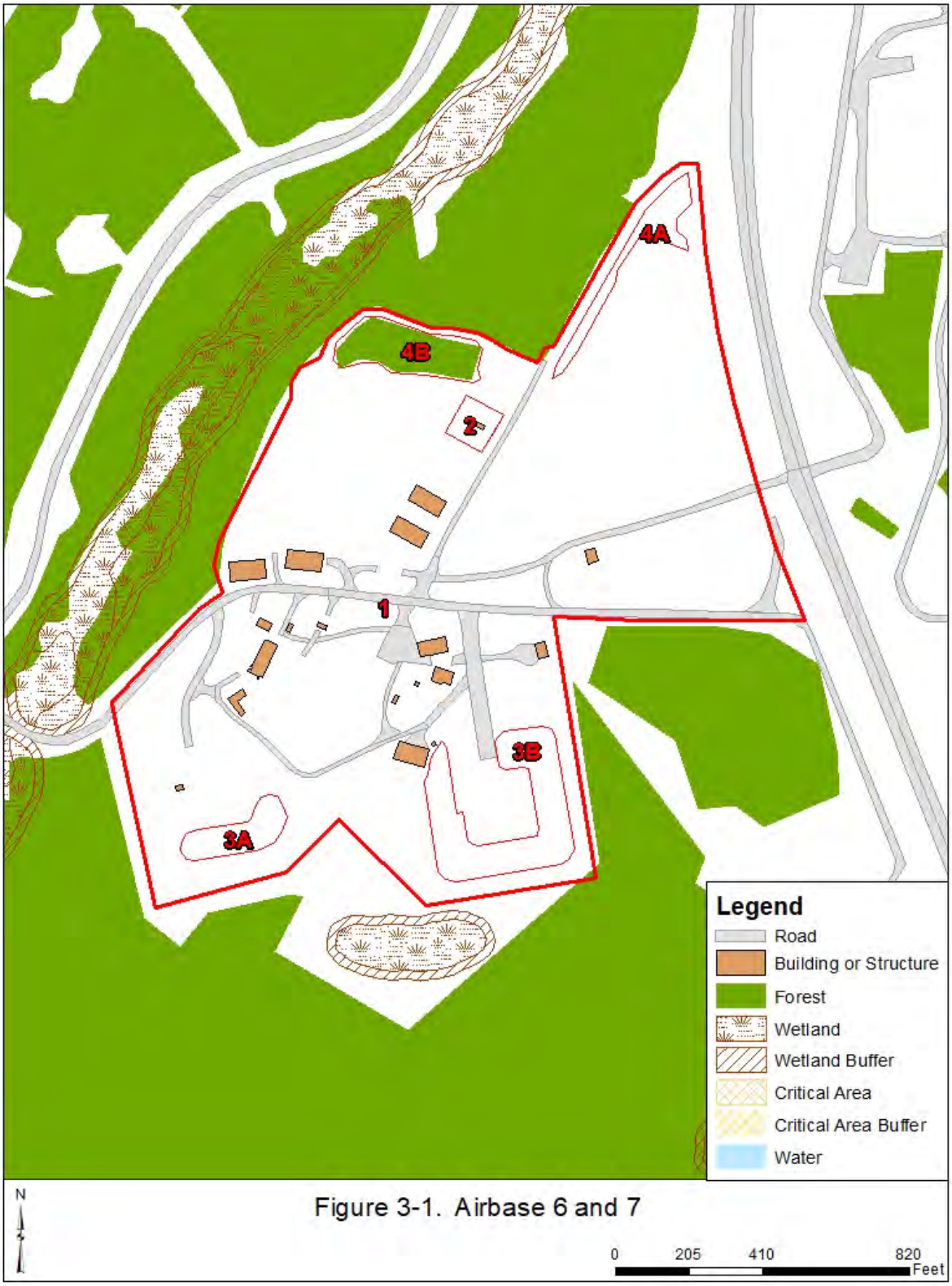

Figure 3-1. Airbase 6 and 7

3.1.2 Brier Point

The Brier Point range is located in the Aberdeen Area. The range encompasses approximately 13 acres.

The Brier Point range is delineated into 2 areas (Figure 3-2) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	13
2	Natural Area	Conservation	Monitor for encroachment	0.6

Figure 3-2. Brier Point

3.1.3 EF 7

The EF 7 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 11 acres.

The EF 7 range is delineated into 2 areas (Figure 3-3) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	7.6
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Natural Area	Conservation	Monitor for encroachment	2.3 (A) 0.6 (B)

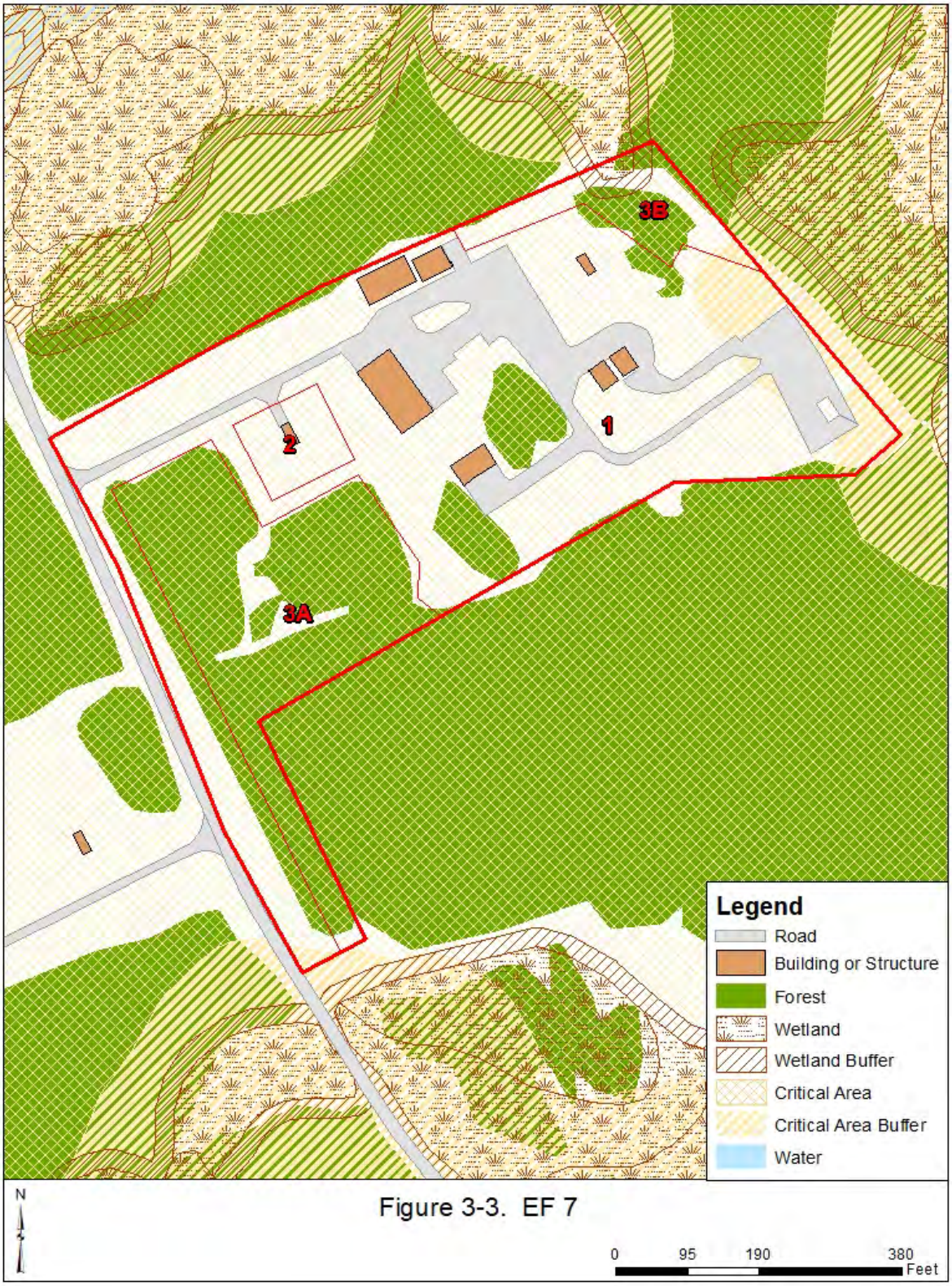

Figure 3-3. EF 7

3.1.4 EF 7A

The EF 7A range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 11 acres.

The EF 7A range is delineated into 2 areas (Figure 3-4) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	5.9
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Natural Area	Conservation	Monitor for encroachment	0.7 (A) 4.2 (B) 0.2 (C)

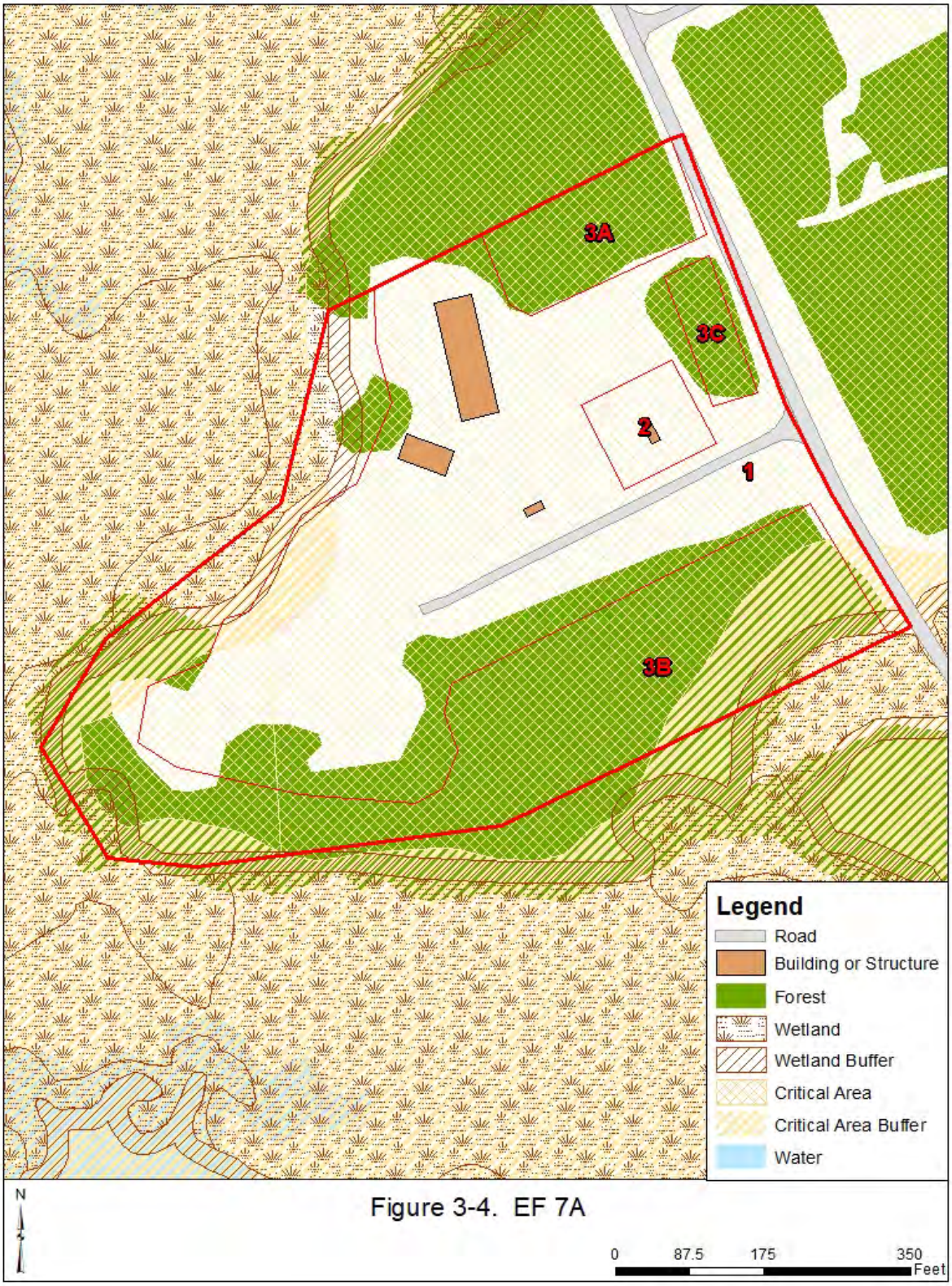

Figure 3-4. EF 7A

3.1.5 EF 8

The EF 8 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 14 acres.

The EF 8 range is delineated into 4 areas (Figure 3-5) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	9.4
2	Natural Area – Mitigation	Conservation	Monitor for encroachment	3.1
3	Natural Area	Conservation	Monitor for encroachment	1.7
4	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.3

Figure 3-5. EF 8

3.1.6 EF 9

The EF 9 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 15 acres.

The EF 9 range is delineated into 2 areas (Figure 3-6) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	13
2	Natural Area	Conservation	Monitor for encroachment	2.1

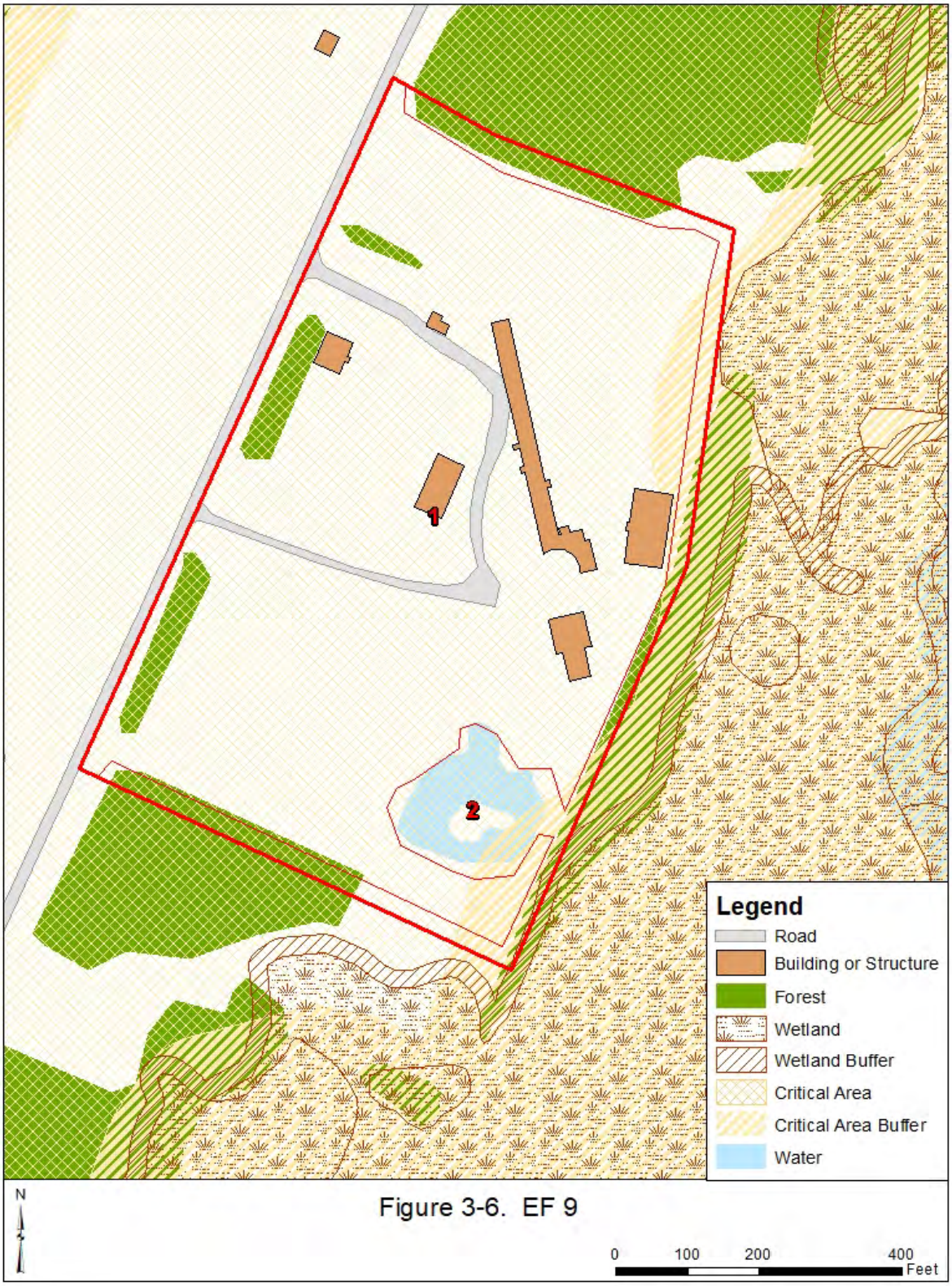

Figure 3-6. EF 9

3.1.7 EF 10

The EF 10 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 12 acres.

The EF 10 range is delineated into 3 areas (Figure 3-7) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	10
2	Natural Area	Conservation	Monitor for encroachment	0.2 (A) 0.05 (B) 0.07 (C) 0.4 (D) 1.1 (E)
3	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.2

Figure 3-7. EF 10

3.1.8 EF 11

The EF 11 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 18 acres.

The EF 11 range is delineated into 3 areas (Figure 3-8) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	14
2	Natural Area	Conservation	Monitor for encroachment	0.2 (A) 2.4 (B) 0.4 (C) 1.4 (D)
3	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.5

Figure 3-8. EF 11

3.1.9 EF 12

The EF 12 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 25 acres.

The EF 12 range is delineated into 2 areas (Figure 3-9) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	13
2	Natural Area	Conservation	Monitor for encroachment	12

Figure 3-9. EF 12

3.1.10 EF 12A

The EF 12A range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 30 acres.

The EF 12A range is delineated into 2 areas (Figure 3-10) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	13
2	Natural Area	Conservation	Monitor for encroachment	9.6 (A) 2.5 (B) 5 (C)

Figure 3-10. EF 12A

3.1.11 EF 14

The EF 14 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 29 acres.

The EF 14 range is delineated into a single area (Figure 3-11) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	29
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3

Figure 3-11. EF 14

3.1.12 EF 15

The EF 15 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 4 acres.

The EF 15 range is delineated into 3 areas (Figure 3-12) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	2.7
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Natural Area	Conservation	Monitor for encroachment	1.3
4	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.04

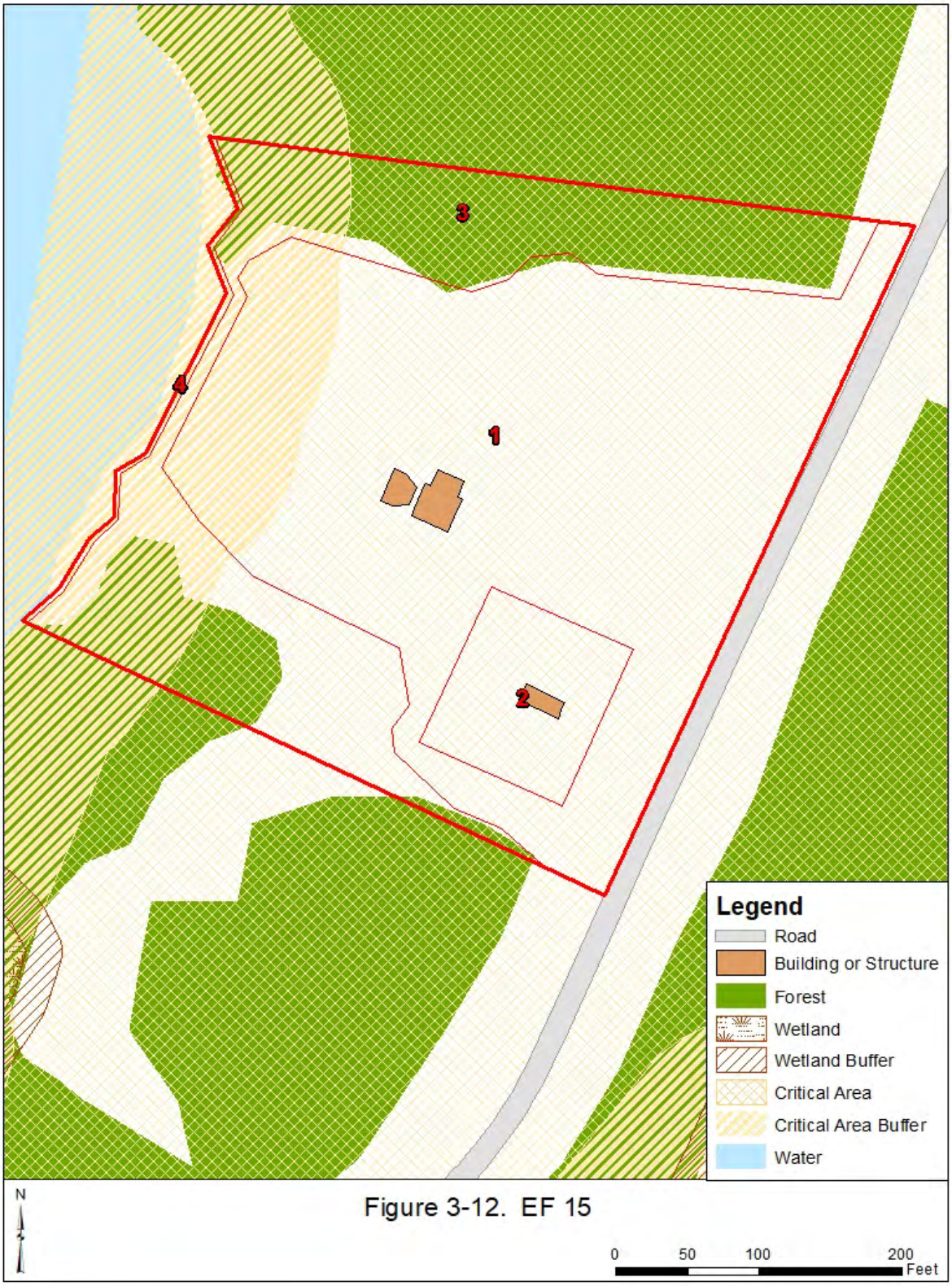

Figure 3-12. EF 15

3.1.13 EF 16

The EF 16 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 17 acres.

The EF 16 range is delineated into 3 areas (Figure 3-13) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	14
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Natural Area	Conservation	Monitor for encroachment	1.8
4	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.5

Figure 3-13. EF 16

3.1.14 EF 17

The EF 17 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 12 acres.

The EF 17 range is delineated into 2 areas (Figure 3-14) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	5
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Natural Area	Conservation	Monitor for encroachment	6.4

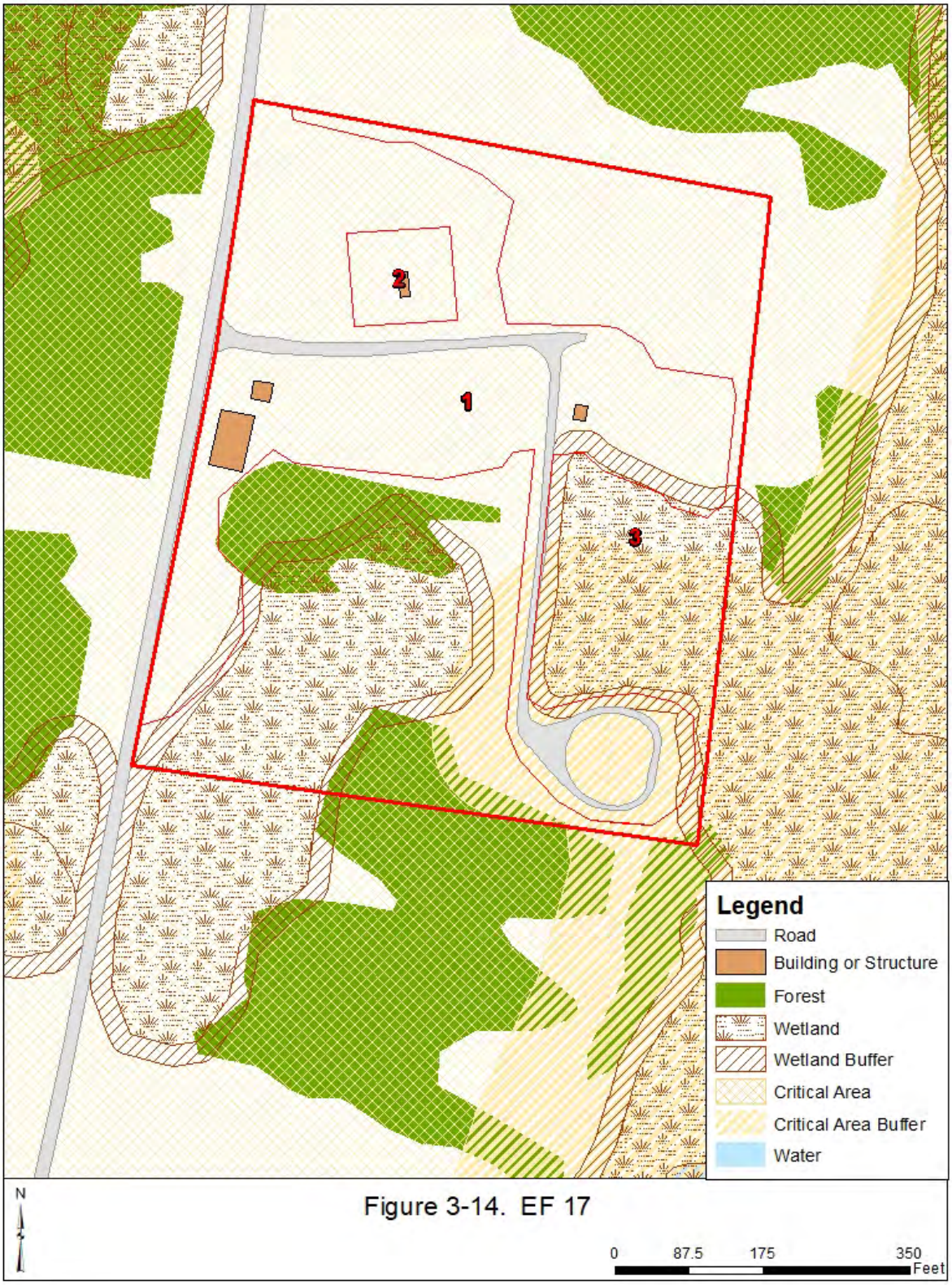

Figure 3-14. EF 17

3.1.15 EF 20

The EF 20 range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 6 acres.

The EF 20 range is delineated into 3 areas (Figure 3-15) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	5.4
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Natural Area	Conservation	Monitor for encroachment	0.1

Figure 3-15. EF 20

3.1.16 Fuze Range

The Fuze Range is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 20 acres.

The Fuze Range is delineated into 2 areas (Figure 3-16) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	14
2	Natural Area	Conservation	Monitor for encroachment	0.2 (A) 0.3 (B) 0.07 (C) 6.1 (D)

Figure 3-16. Fuze Range

3.1.17 KD Range

The KD Range is located in the Aberdeen Area. The range encompasses approximately 51 acres.

The KD Range is delineated into 2 areas (Figure 3-17) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	20
2	Natural Area	Conservation	Monitor for encroachment	23 (A) 2 (B) 6.3 (C) 0.2 (D)

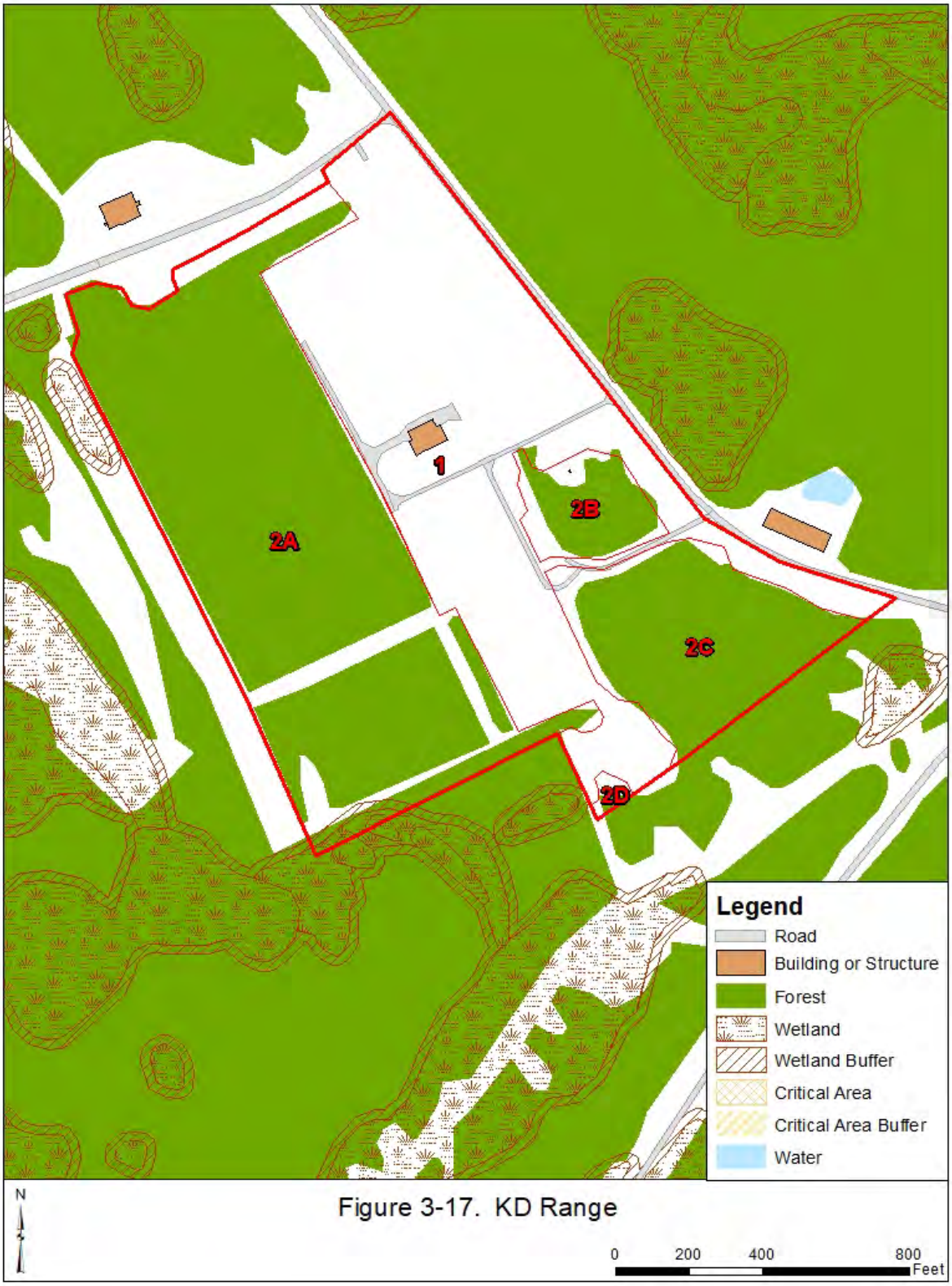

Figure 3-17. KD Range

3.1.18 M Range

The M Range is located in the Aberdeen Area. The range encompasses approximately 48 acres.

The M Range is delineated into 3 areas (Figure 3-18) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	45
2	Natural Area	Conservation	Monitor for encroachment	0.5 (A) 0.3 (B) 1.6 (C)
3	Cemetery	Cemetery	Not applicable	0.3

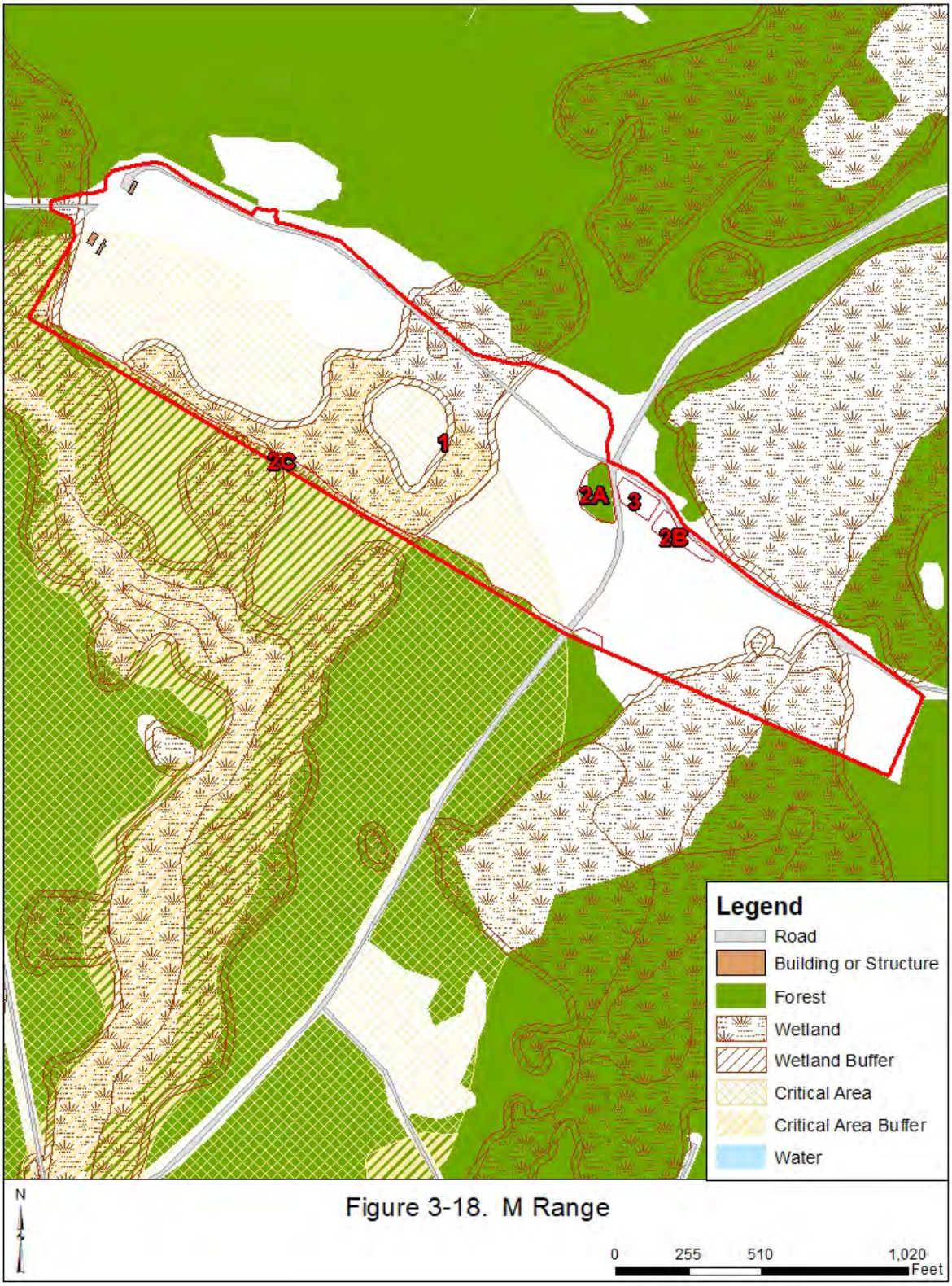

Figure 3-18. M Range

3.1.19 Transonic Range

The Transonic Range is located in the Aberdeen Area. The range encompasses approximately 32 acres.

The Transonic Range is delineated into 3 areas (Figures 3-19a and 3-19b) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	30
2	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	0.02 (A) 0.07 (B) 0.02 (C) 0.06 (D) 0.04 (E) 0.02 (F) 0.1 (G)
3	Natural Area	Conservation	Monitor for encroachment	0.08 (A) 0.2 (B) 1.1 (C)

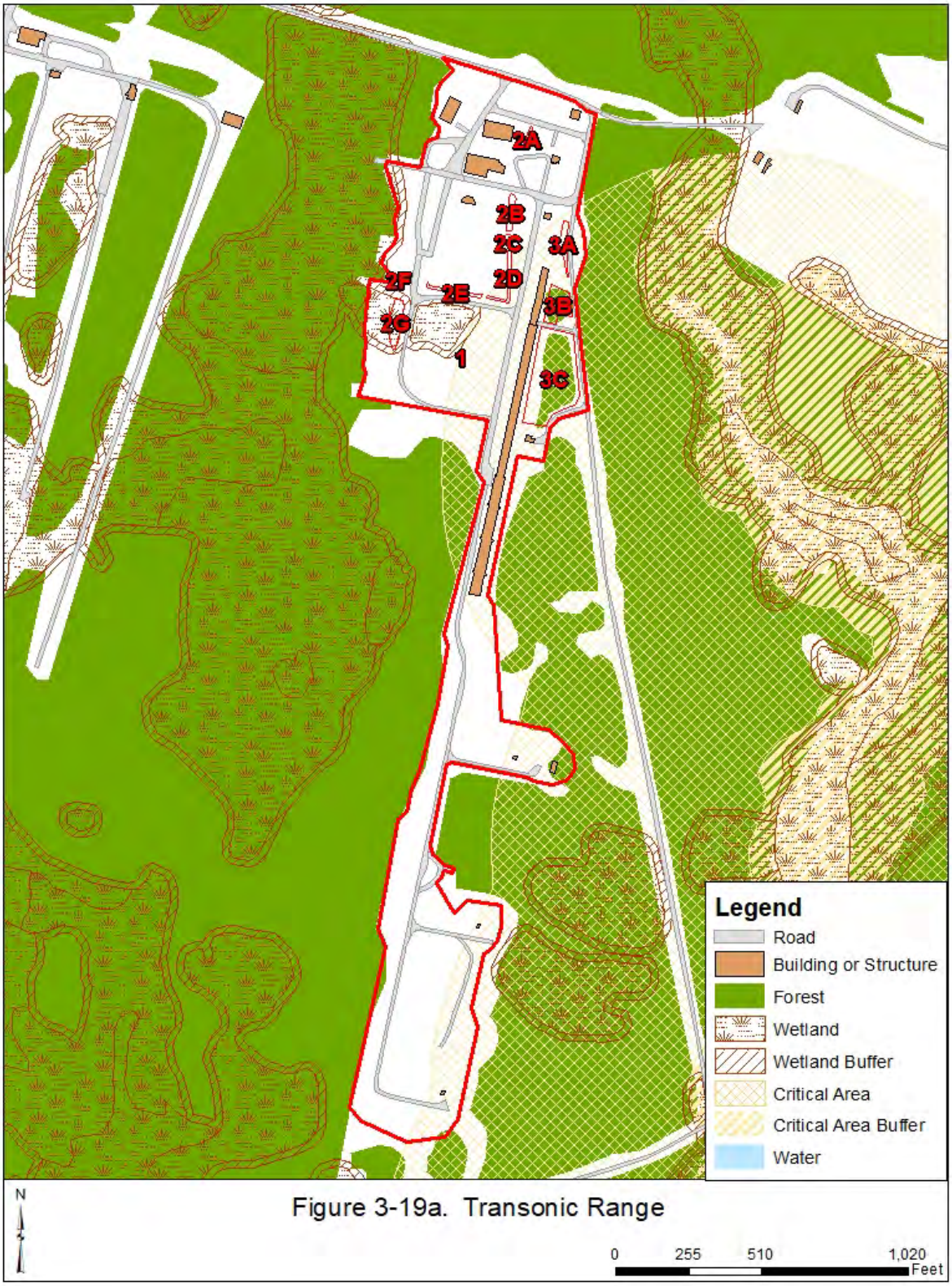

Figure 3-19a. Transonic Range

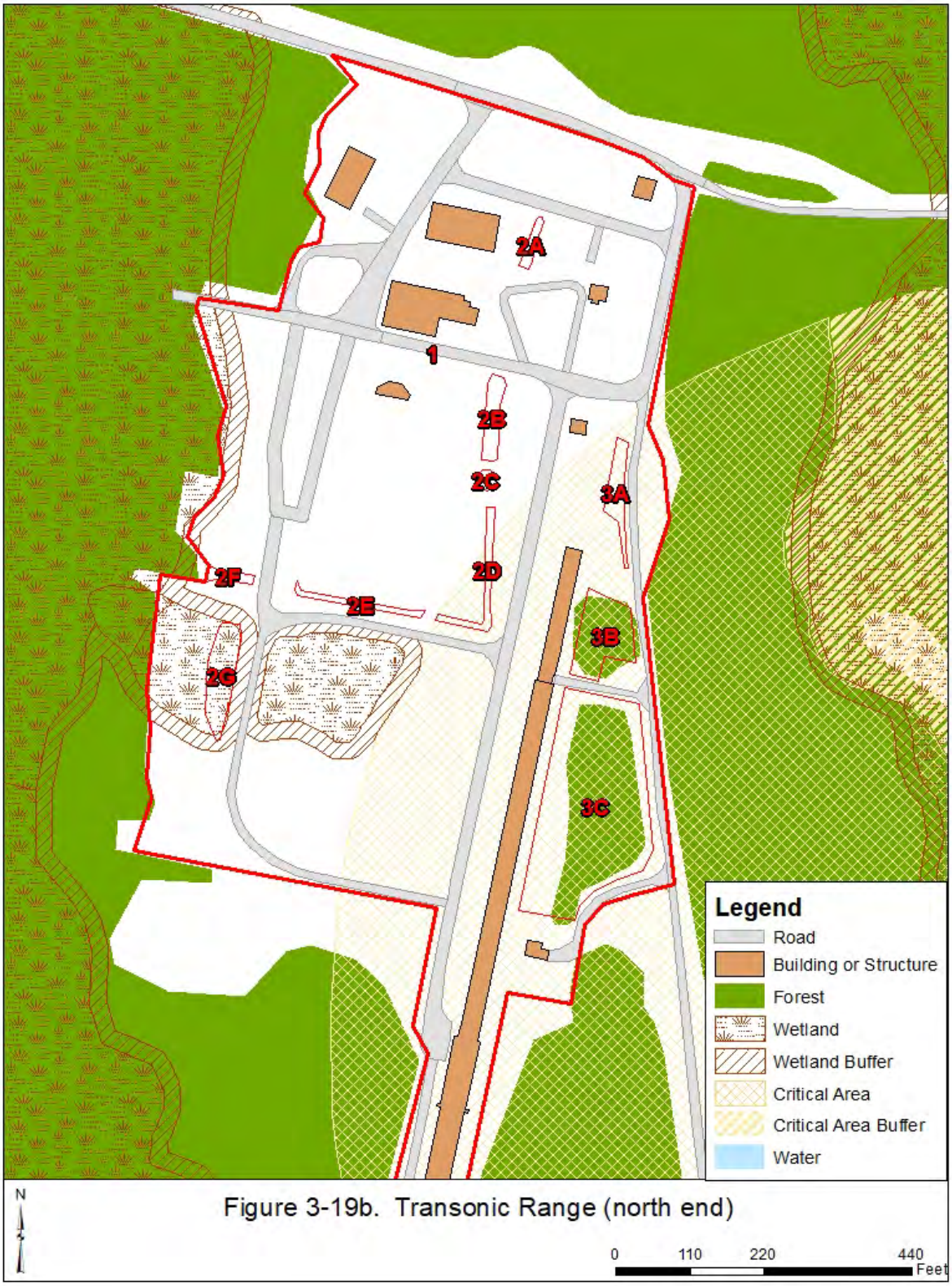

Figure 3-19b. Transonic Range (north end)

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3.2 ATC RANGES

3.2.1 40-Foot Drop Tower

The 40-Foot Drop Tower range is located in the Aberdeen Area. The range encompasses approximately 4 acres.

The 40-Foot Drop Tower range is delineated into 2 areas (Figure 3-20) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	4.2
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Once, then maintain as open (Area 1)	0.5

Figure 3-20. 40-Foot Drop Tower

3.2.2 7600 Recovery Field

The 7600 Recovery Field is located in the Aberdeen Area. The range encompasses approximately 70 acres.

The 7600 Recovery Field is delineated into 2 areas (Figure 3-21) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Encroachment – Trees to Clear (primary impact area)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 20 years	25
2	Encroachment – Trees to Clear (expanded impact area)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 20 years	45

Figure 3-21. 7600 Recovery Field

3.2.3 9600 Recovery Field

The 9600 Recovery Field is located in the Aberdeen Area. The range encompasses approximately 162 acres.

The 9600 Recovery Field is delineated into 2 areas (Figure 3-22) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Encroachment – Trees to Clear	Mechanical and/or controlled burn, with or without herbicide spraying	Every 20 years	107
2	Natural Area	Conservation	Monitor for encroachment	17 (A) 38 (B)

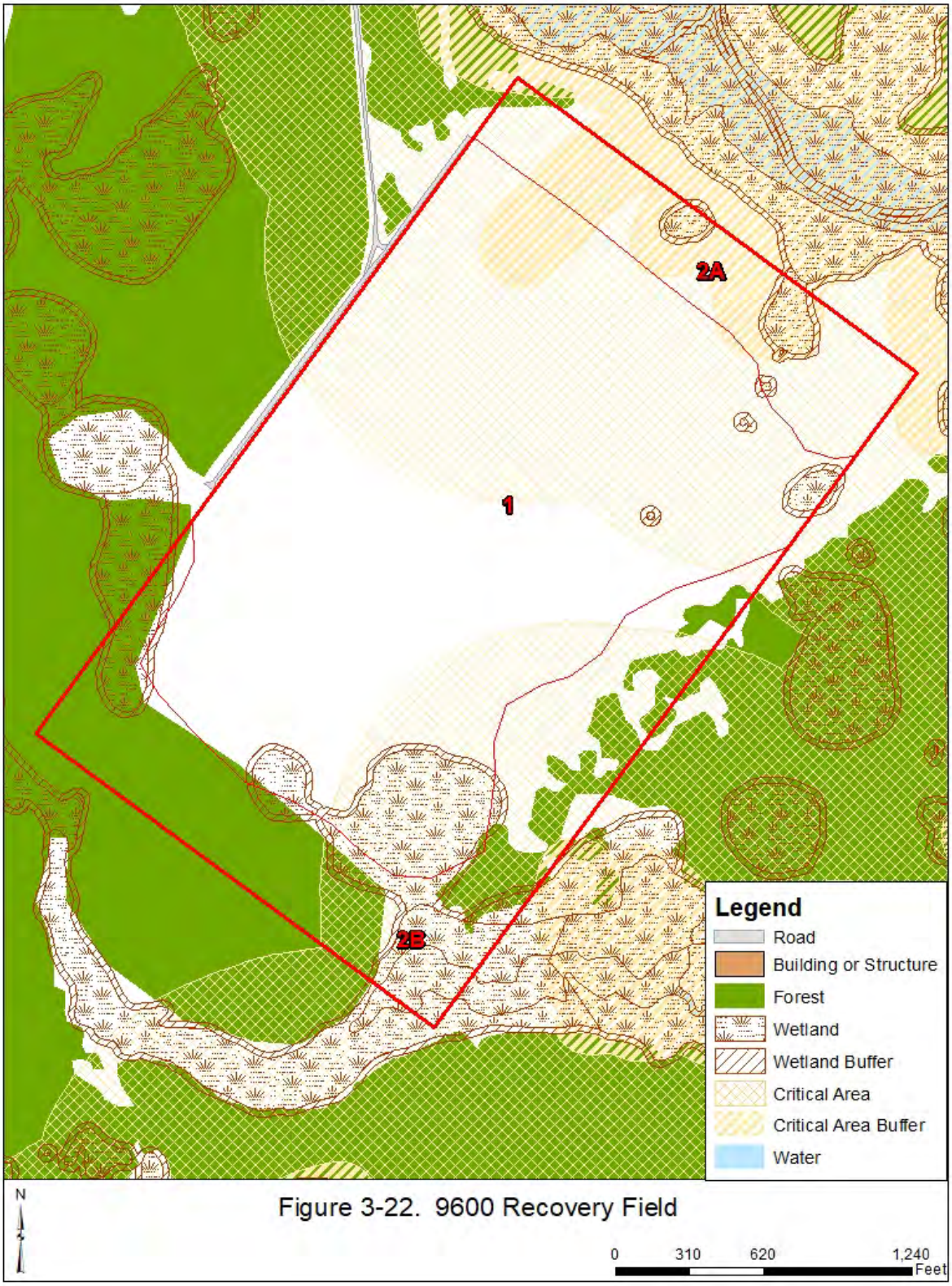

Figure 3-22. 9600 Recovery Field

3.2.4 AA3

The AA3 range is located in the Aberdeen Area. The range encompasses approximately 7.5 acres.

The AA3 range is delineated into 3 areas (Figure 3-23) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	2.6
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 2 years	0.4 (A) 0.7 (B)
3	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	3.8

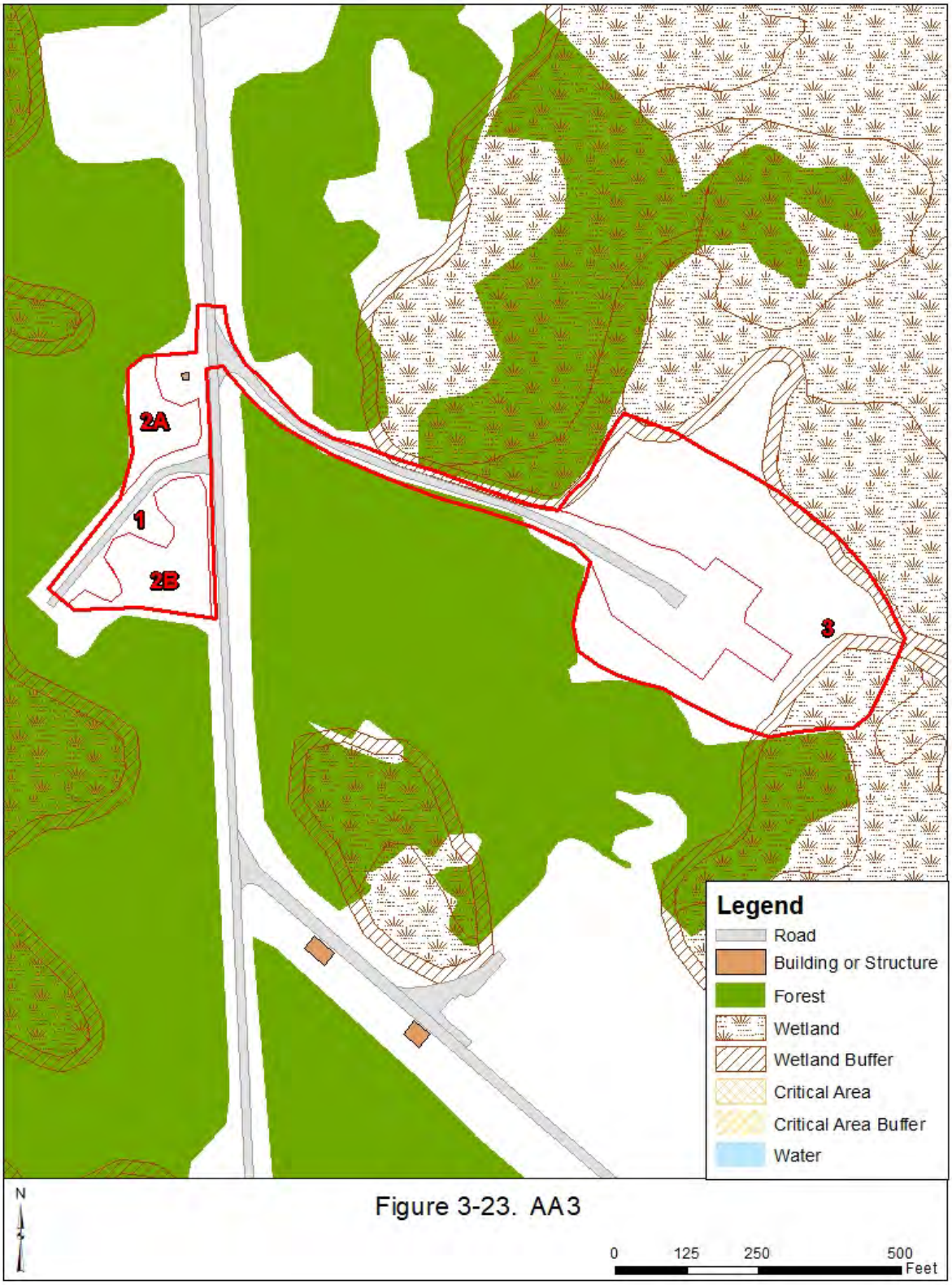

Figure 3-23. AA3

3.2.5 AA5

The AA5 range is located in the Aberdeen Area. The range encompasses approximately 47 acres.

The AA5 range is delineated into 4 areas (Figure 3-24) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	37
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	0.7
3	Natural Area	Conservation	Monitor for encroachment	0.3 (A) 0.3 (B) 0.3 (C) 7.1 (D) 1.2 (E)
4	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.07

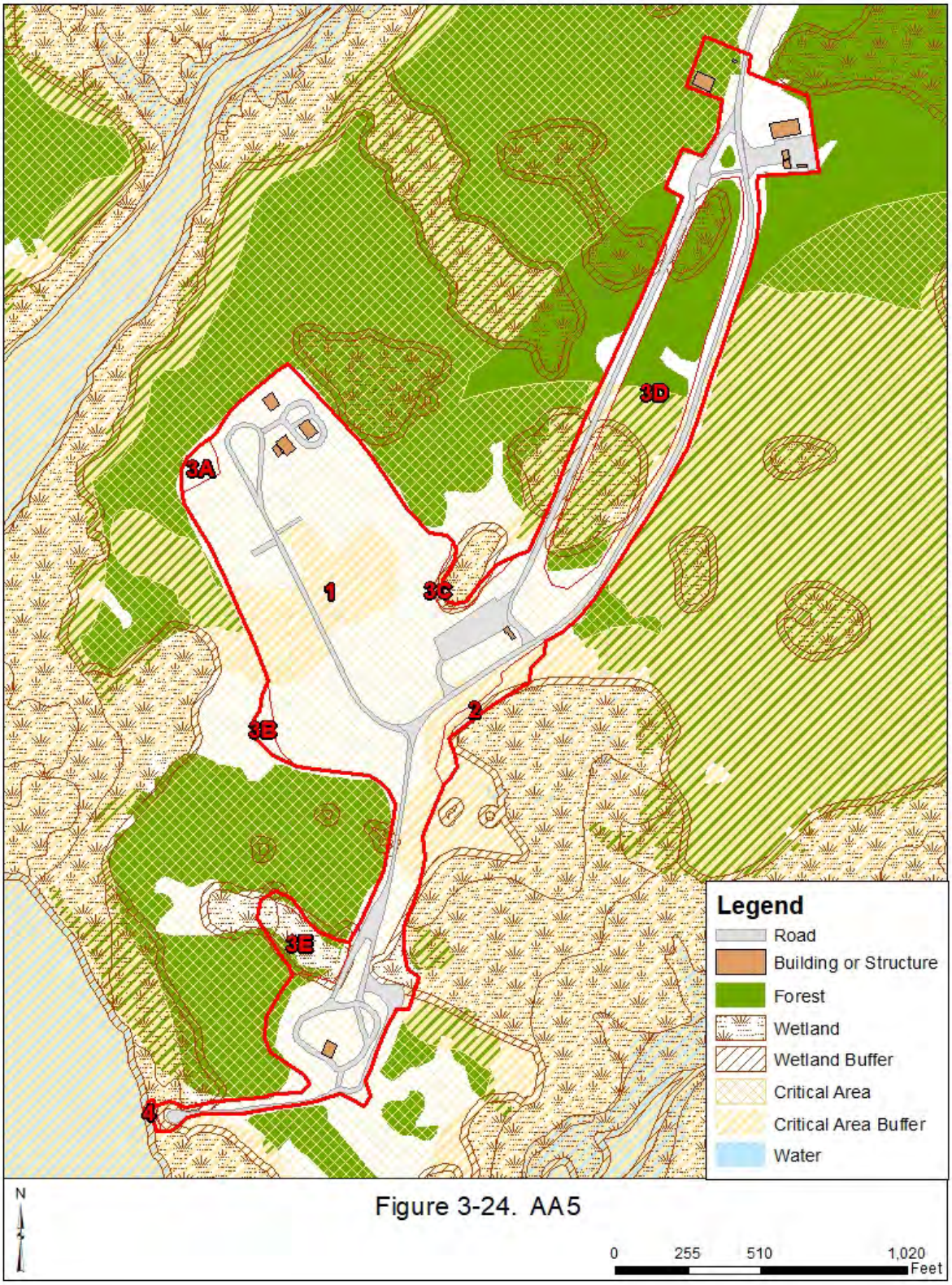

Figure 3-24. AA5

3.2.6 Abbey Field

The Abbey Field is located in the Aberdeen Area. The range encompasses approximately 102 acres.

The Abbey Field is delineated into 4 areas (Figures 3-25a and 3-25b) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area (access roads)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	4 (A) 2.2 (B)
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	53 (A) 28 (B) 11 (C) 1.7 (D)
3	Encroachment – Trees to Clear	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	0.4
4	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	2.1

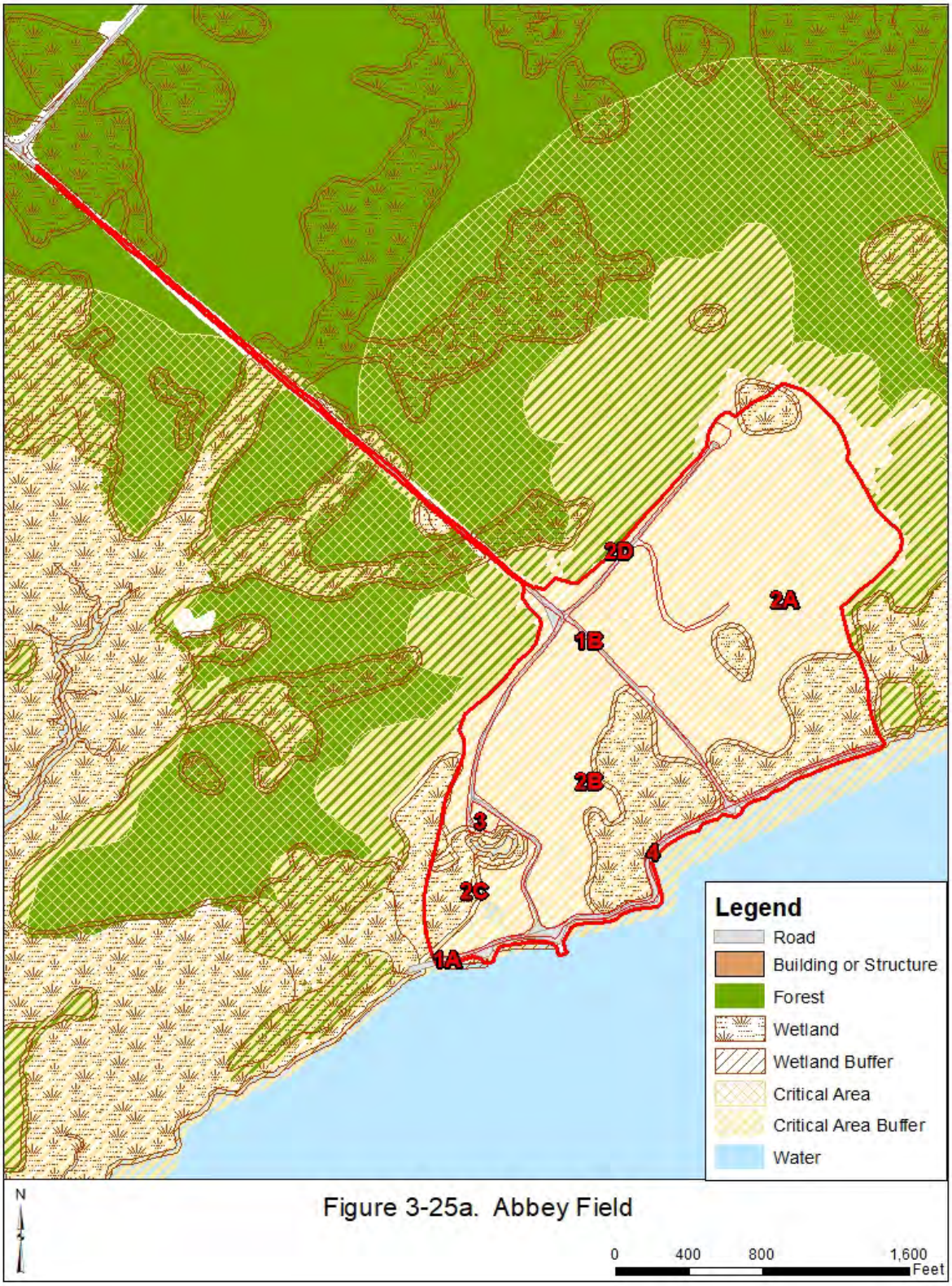

Figure 3-25a. Abbey Field

Figure 3-25b. Abbey Field (field portion)

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3.2.7 Airbase 3 and 4

The Airbase 3 and 4 range is located in the Aberdeen Area. The range encompasses approximately 5.8 acres.

The Airbase 3 and 4 range is delineated into 2 areas (Figure 3-26) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	5.3
2	Berm	Mechanical, with or without herbicide spraying	Every 2 years	0.5

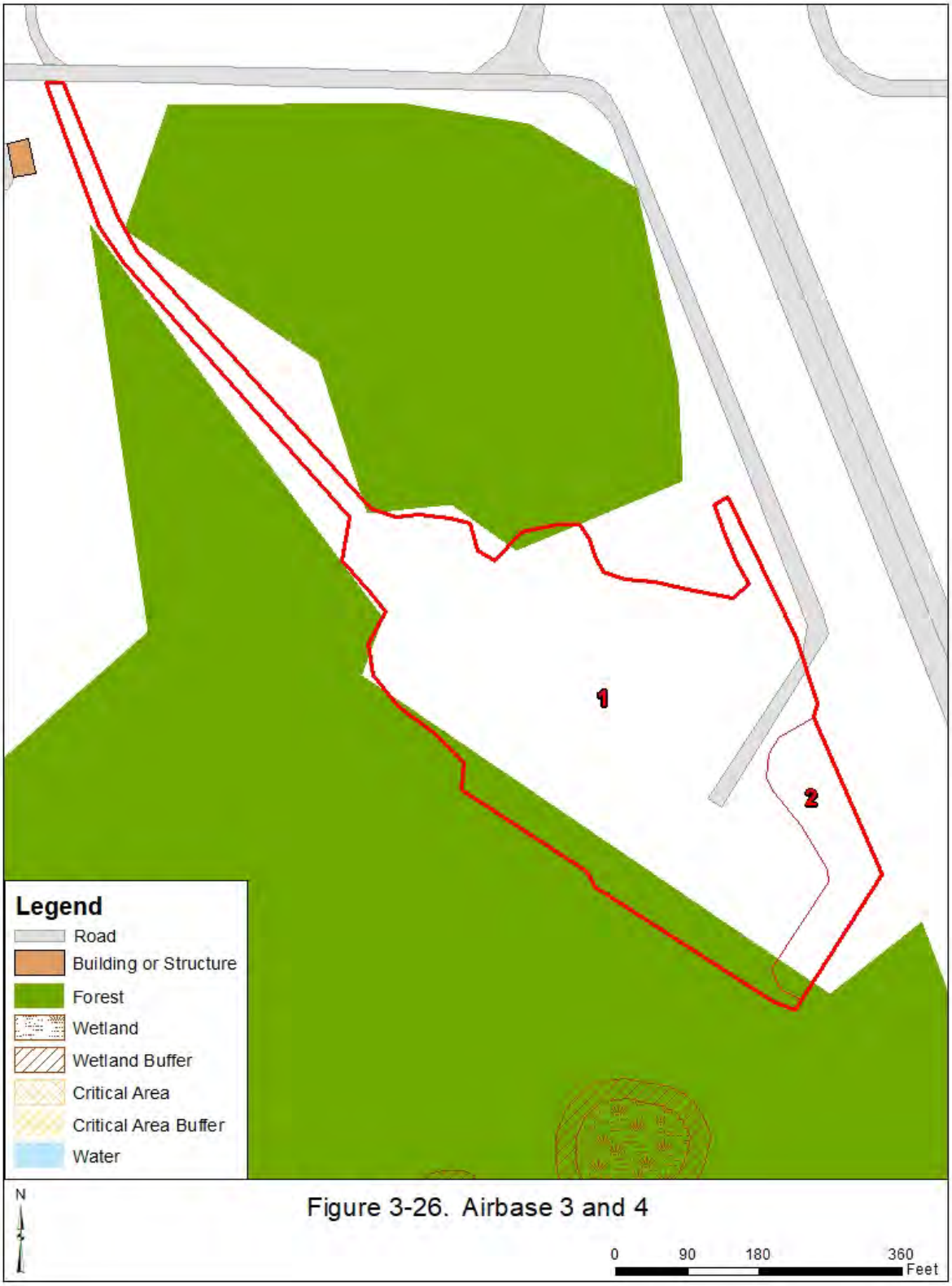

Figure 3-26. Airbase 3 and 4

3.2.8 Airbase 5

The Airbase 5 range is located in the Aberdeen Area. The range encompasses approximately 15 acres.

The Airbase 5 range is delineated into 4 areas (Figure 3-27) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	13
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Once, then maintain as open (Area 1)	0.2
3	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	0.1
4	Natural Area	Conservation	Monitor for encroachment	2.4

Figure 3-27. Airbase 5

3.2.9 Airbase 8

The Airbase 8 range is located in the Aberdeen Area. The range encompasses approximately 13 acres.

The Airbase 8 range is delineated into 3 areas (Figure 3-28) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	11
2	Support Area (fence lines)	Mechanical, with or without herbicide spraying	Every 2 years	0.2 (A) 0.2 (B)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	1.5

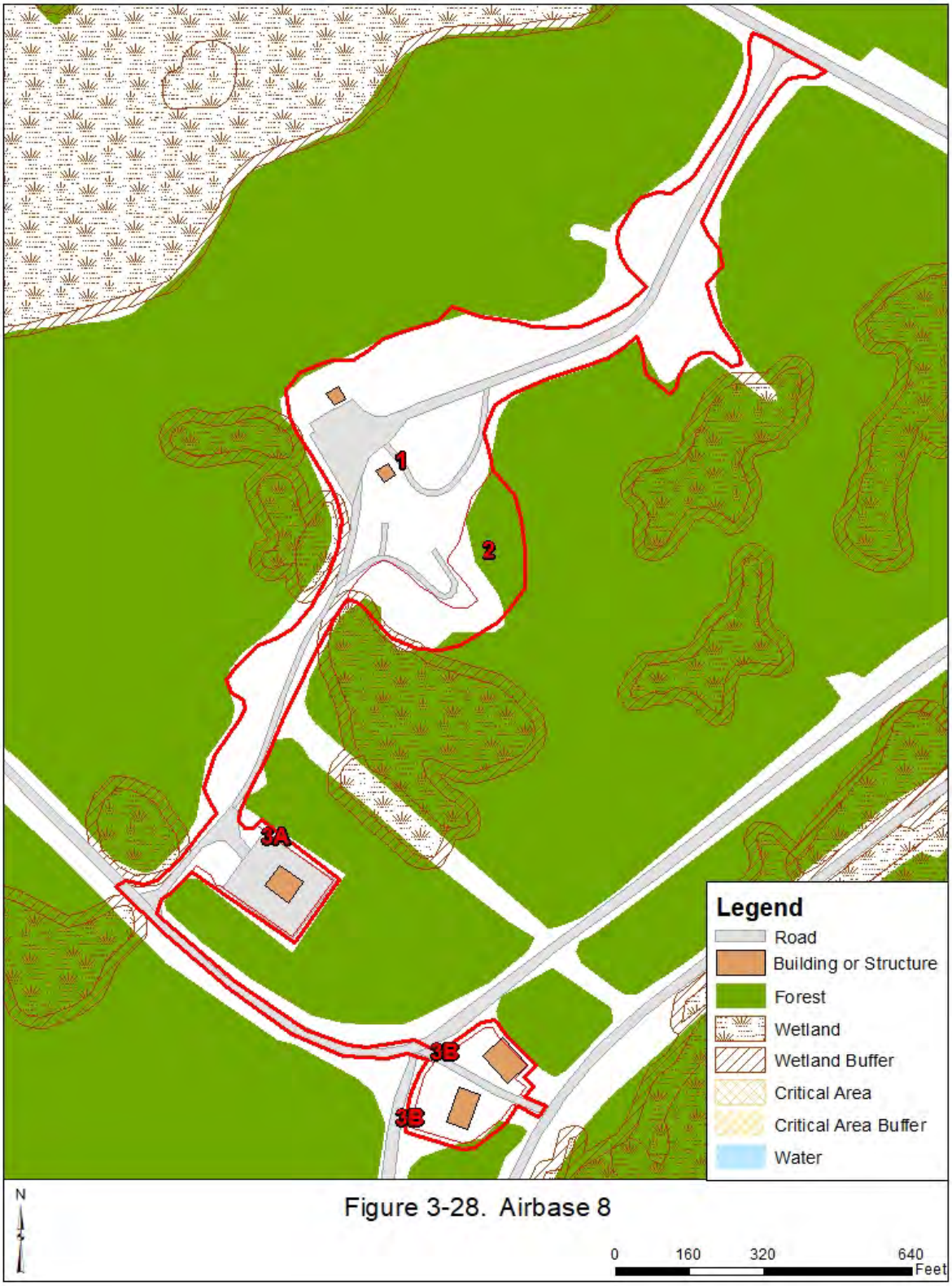

Figure 3-28. Airbase 8

3.2.10 Airbase 9

The Airbase 9 range is located in the Aberdeen Area. The range encompasses approximately 6 acres.

The Airbase 9 range is delineated into 4 areas (Figure 3-29) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	1.6
2	Support Area	Mechanical, with or without herbicide spraying	Once per year	3.5
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.7
4	Natural Area	Conservation	Monitor for encroachment	0.1 (A) 0.2 (B)

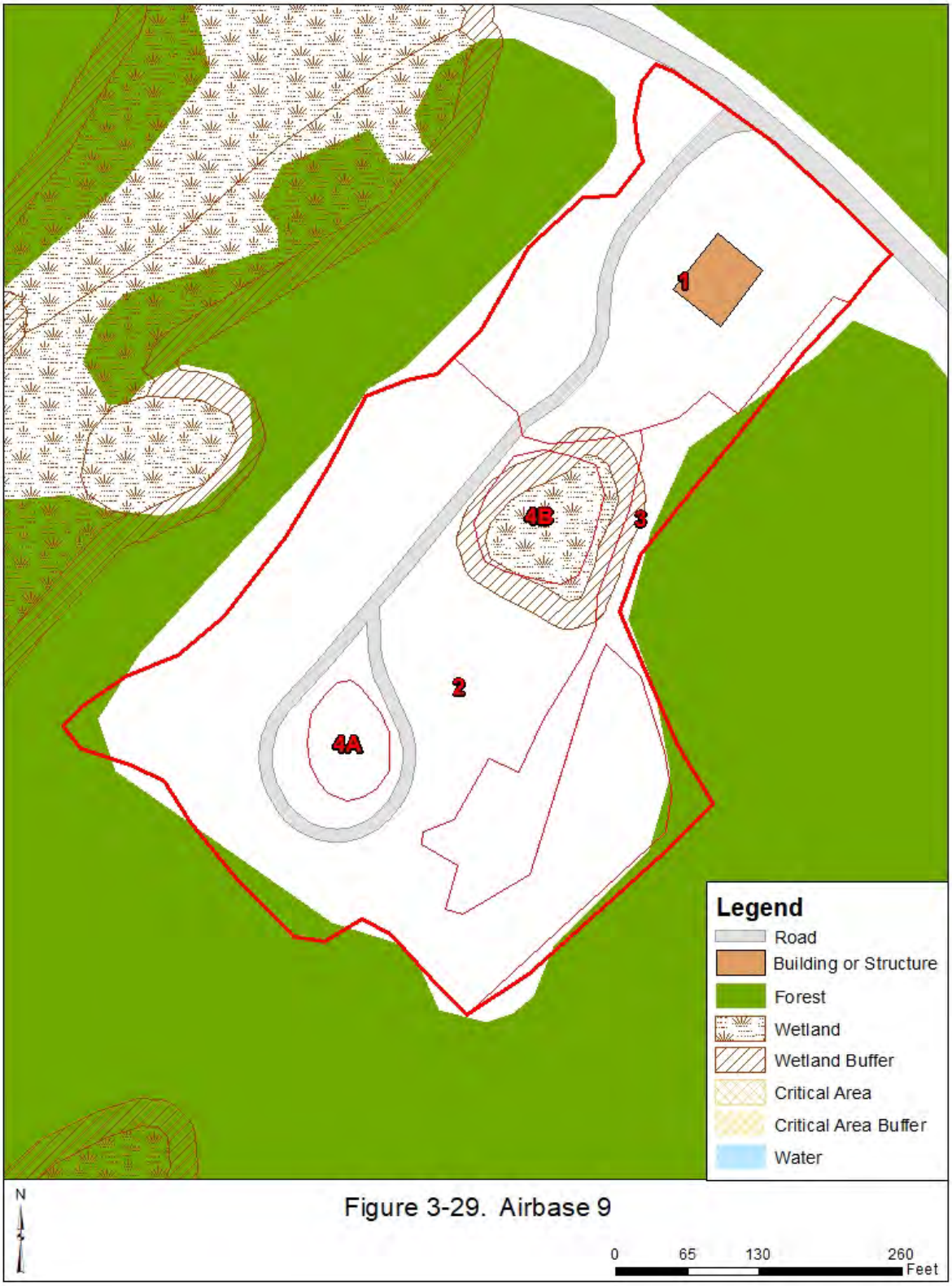

Figure 3-29. Airbase 9

3.2.11 Airbase 10

The Airbase 10 range is located in the Aberdeen Area. The range encompasses approximately 5 acres.

The Airbase 10 range is delineated into a single area (Figure 3-30) with associated vegetation maintenance prescription.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	5.3

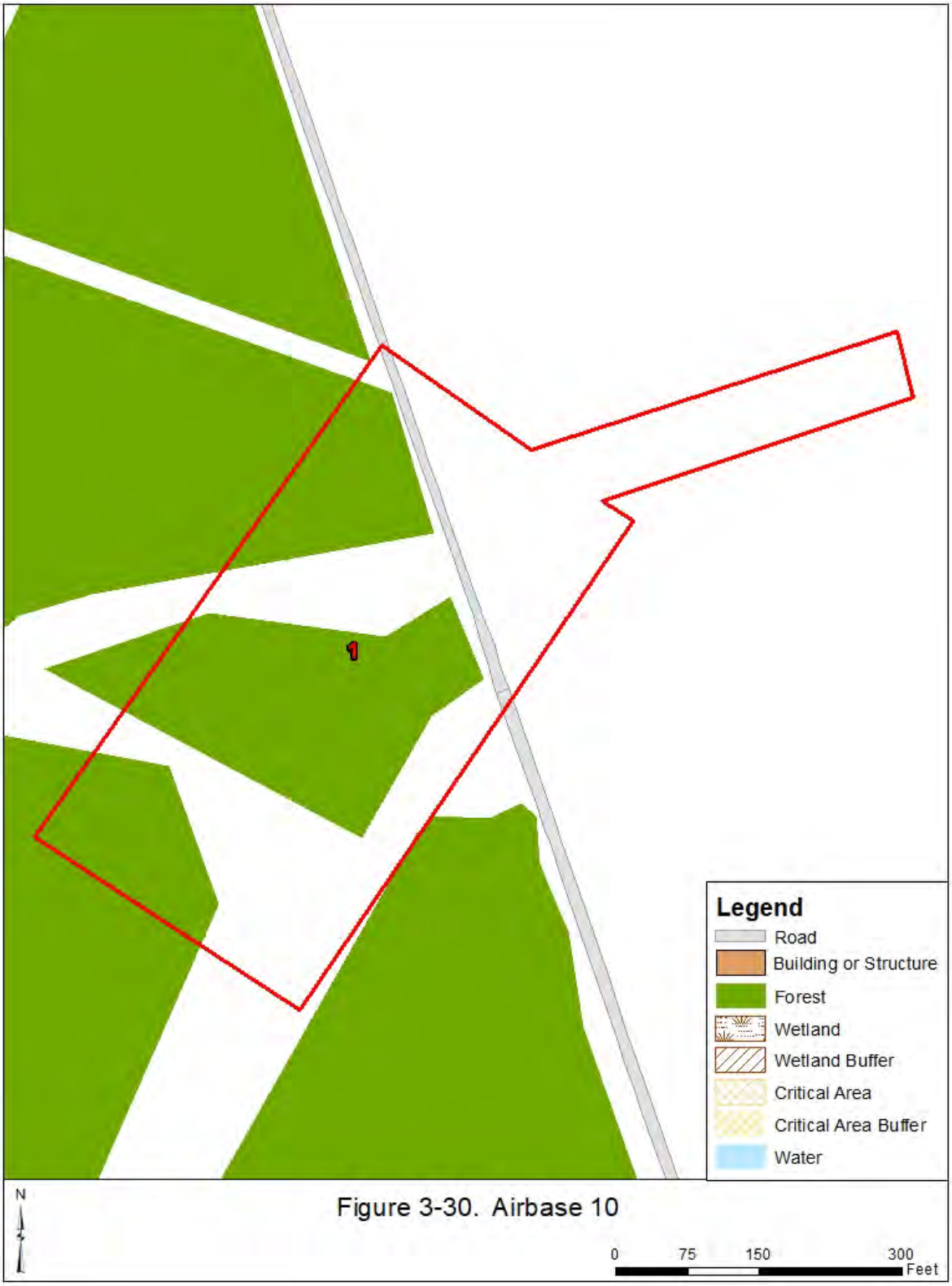

Figure 3-30. Airbase 10

3.2.12 Amphibious Landing

The Amphibious Landing is located in the Aberdeen Area. The range encompasses approximately 7 acres.

The Amphibious Landing is delineated into 4 areas (Figure 3-31) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	2.7
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	2.8
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.4
4	Natural Area	Conservation	Monitor for encroachment	1.4 (A) 0.1 (B)

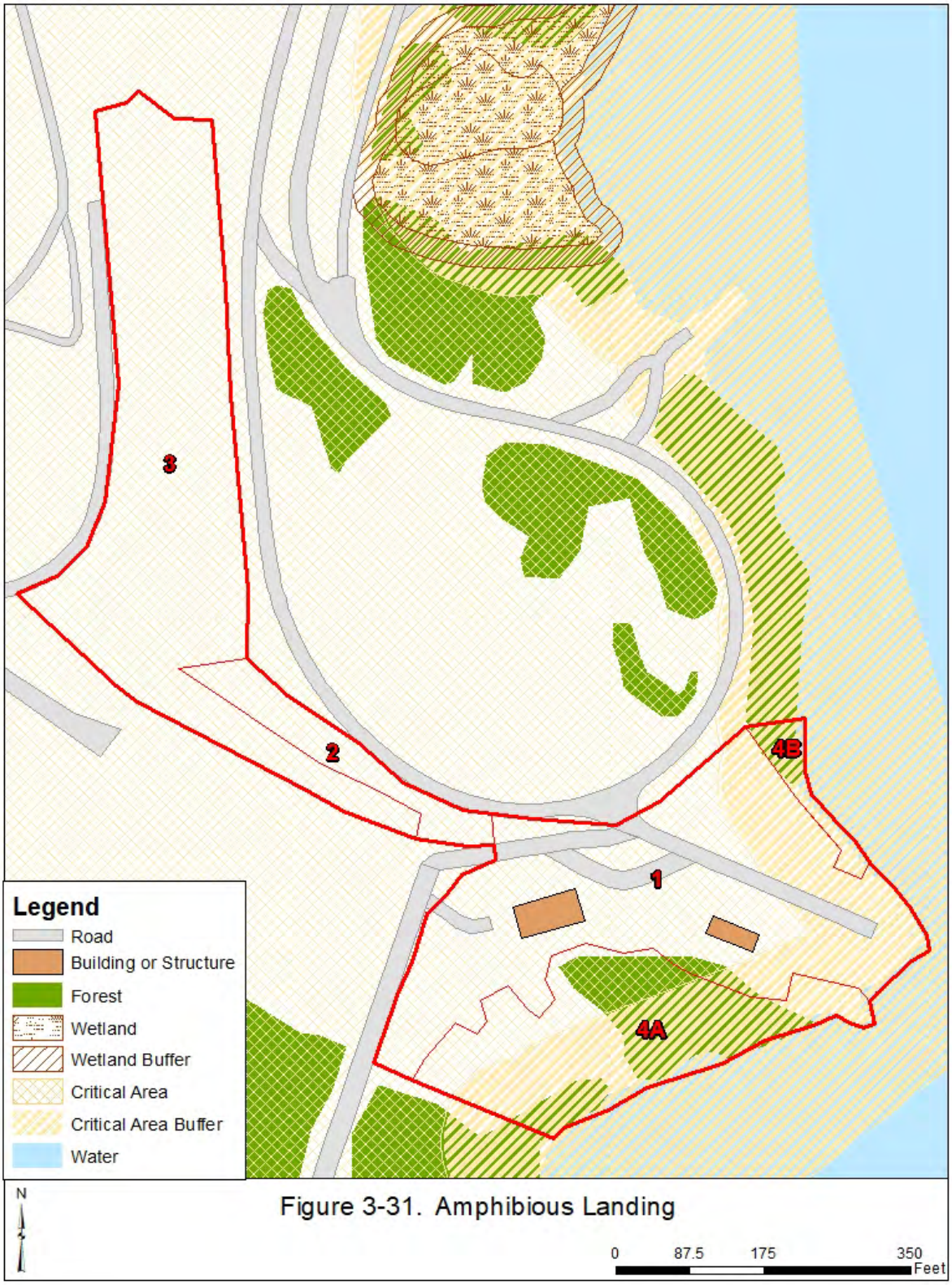

Figure 3-31. Amphibious Landing

3.2.13 Automotive Technology Evaluation Facility (ATEF)

The ATEF is located in the Aberdeen Area. The range encompasses approximately 101 acres.

The ATEF is delineated into 2 areas (Figure 3-32) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	99
2	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	2.4

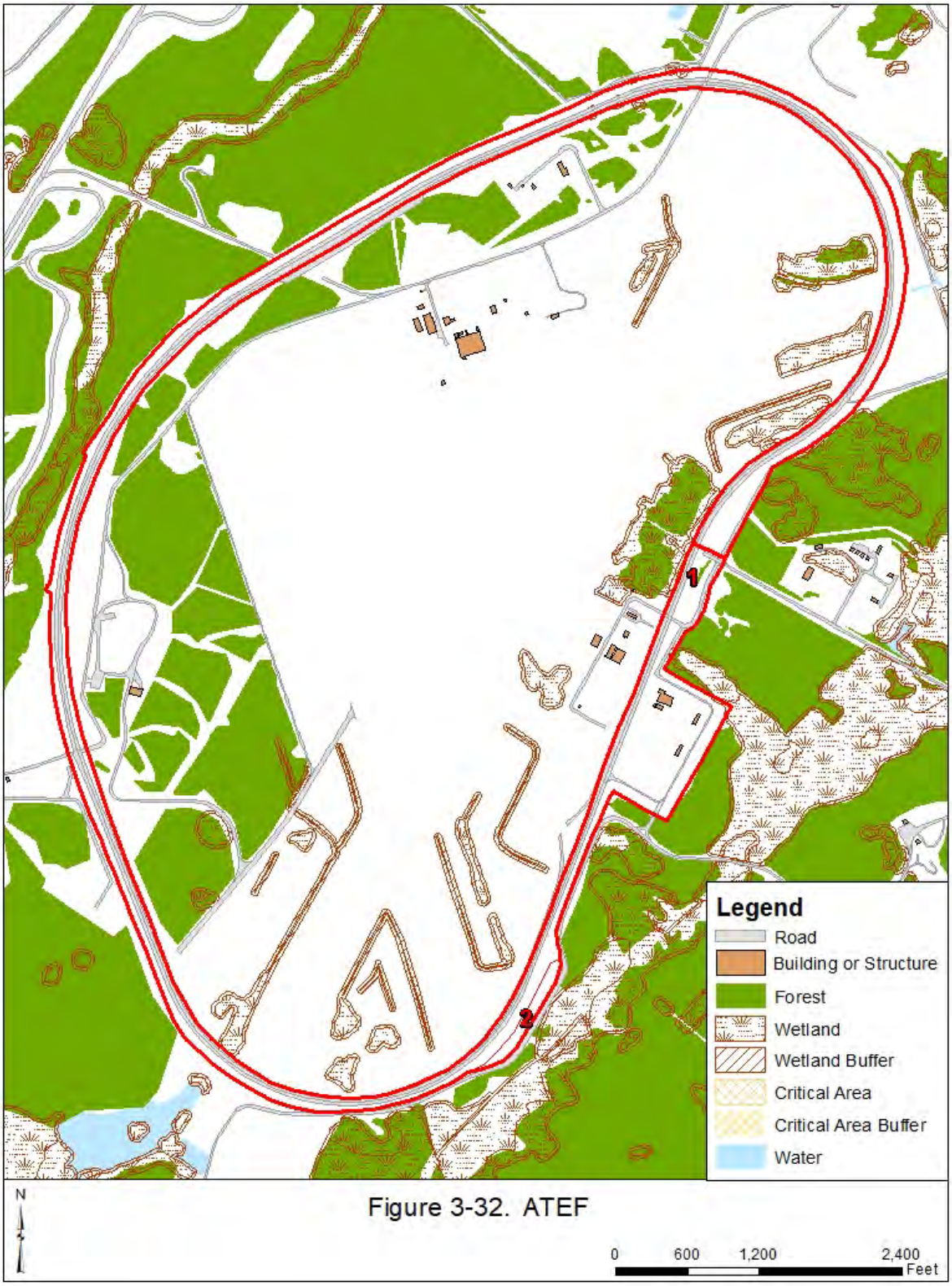

Figure 3-32. ATEF

3.2.14 Ballistic Range and New Barricade

The Ballistic Range and New Barricade range are located adjacent to one another in the Aberdeen Area. The ranges encompass approximately 17 acres.

The Ballistic Range and New Barricade ranges are delineated into 5 areas (Figure 3-33) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	6.9
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 2 years	5.3
3	Encroachment – Trees to Clear	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	2.5
4	Natural Area	Conservation	Monitor for encroachment	0.4 (A) 0.3 (B) 1.1 (C)
5	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.6

Figure 3-33. Ballistic Range and New Barricade

3.2.15 Barricade B

The Barricade B range is located in the Aberdeen Area. The range encompasses approximately 6 acres.

The Barricade B range is delineated into 4 areas (Figure 3-34) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	2.5
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	2.2
3	Encroachment – Trees to Clear	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	0.8
4	Natural Area	Conservation	Monitor for encroachment	0.3

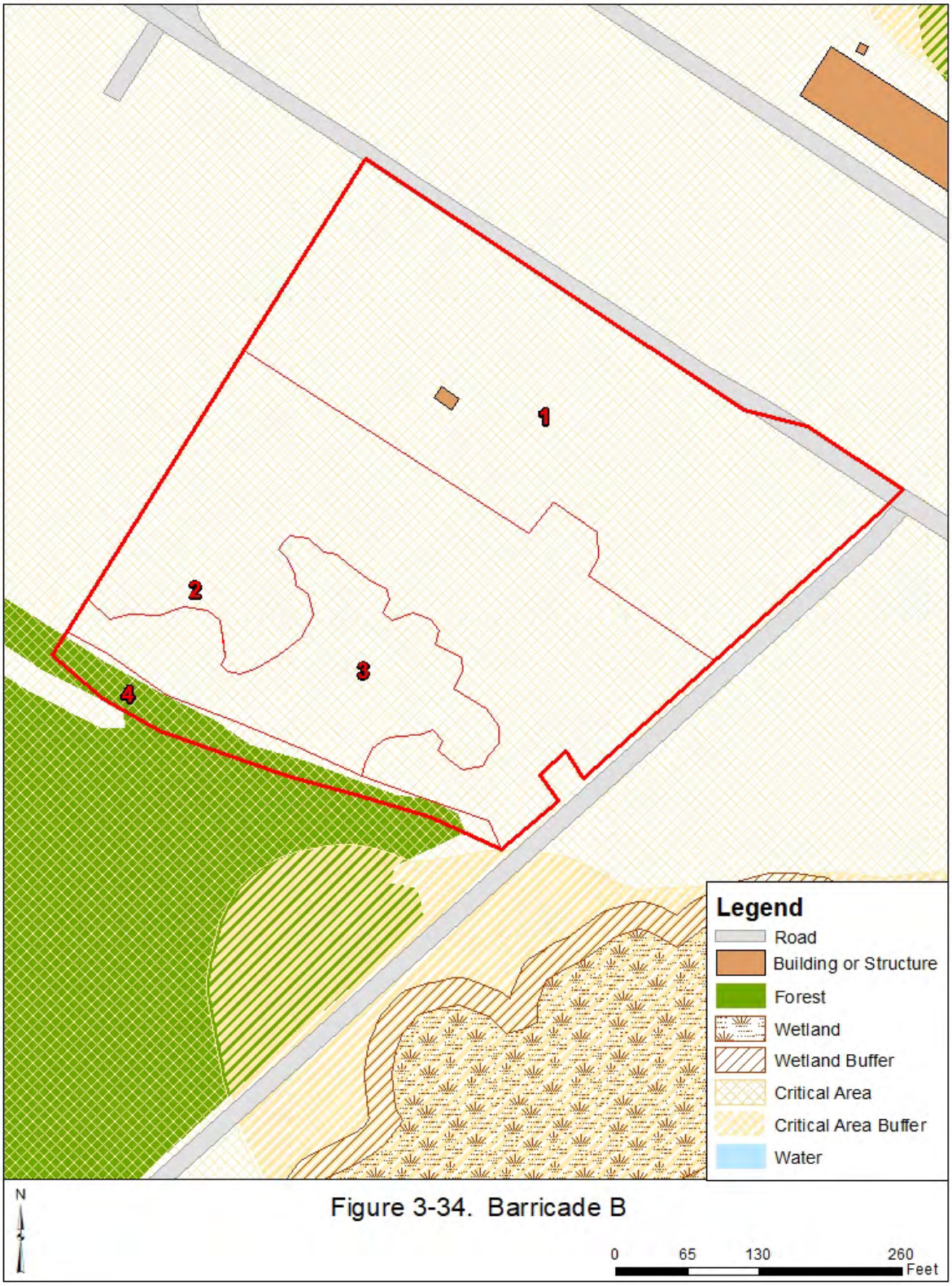

Figure 3-34. Barricade B

3.2.16 Barricade C

The Barricade C range is located in the Aberdeen Area. The range encompasses approximately 21 acres.

The Barricade C range is delineated into 3 areas (Figure 3-35) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	7.3
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	13.2
3	Natural Area	Conservation	Monitor for encroachment	0.4 (A) 0.3 (B)

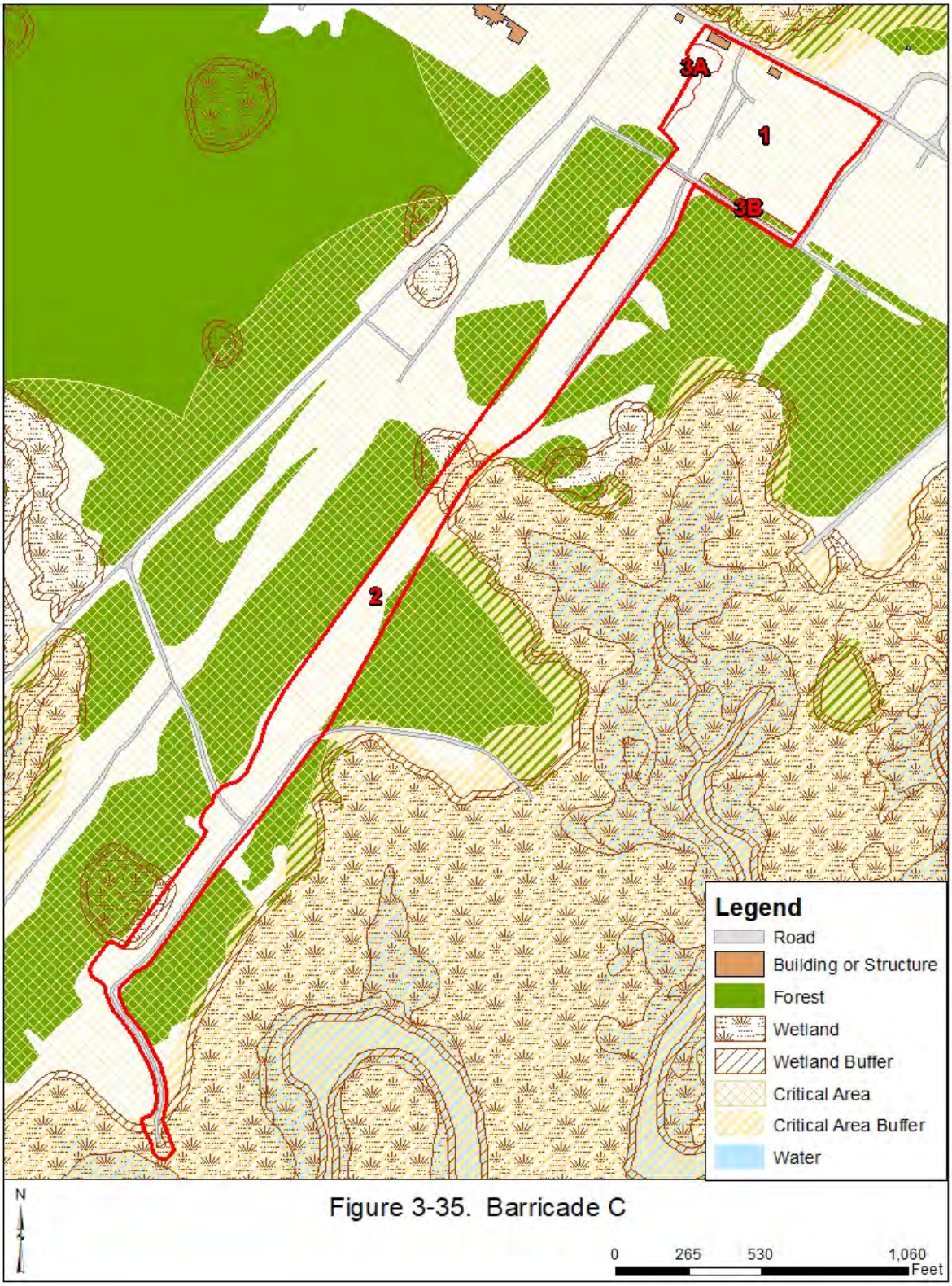

Figure 3-35. Barricade C

3.2.17 Briar Point

The Briar Point range is located in the Aberdeen Area. The range encompasses approximately 142 acres.

The Briar Point range is delineated into 6 areas (Figure 3-36) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	3.4 (A) 18 (B)
2	Support Area	Mechanical, with or without herbicide spraying	Every 2 years	33
3	Support Area	Mechanical, with or without herbicide spraying	Every 10 years	11
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 10 years	1.2
5	Berm	Mechanical, with or without herbicide spraying	Every 10 years	2.2
6	Natural Area	Conservation	Monitor for encroachment	6.1 (A) 13 (B) 1 (C) 6.7 (D) 0.8 (E) 46 (F)

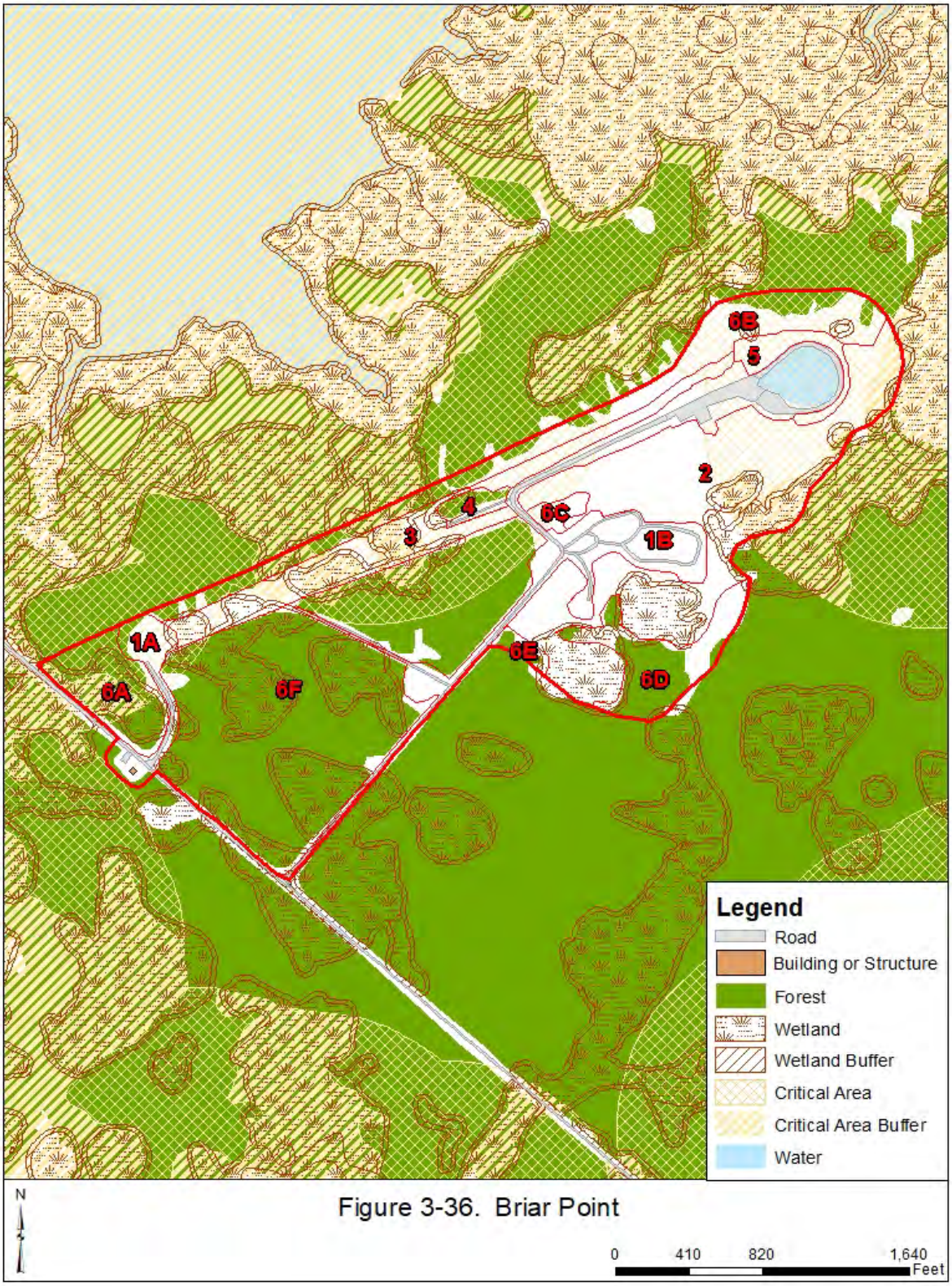

Figure 3-36. Briar Point

3.2.18 BTD Complex

The BTD Complex is located in the Aberdeen Area. The range encompasses approximately 14 acres.

The BTD Complex is delineated into 4 areas (Figure 3-37) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	12.8
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Once, then maintain as open (Area 1)	0.04 (A) 0.08 (B) 0.05 (C)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Once per year	0.5
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 2 years	0.3

Figure 3-37. BTD Complex

3.2.19 Building 699 and Magazines

The Building 699 and Magazines are located in the Aberdeen Area. The range encompasses approximately 13 acres.

The Building 699 and Magazines are delineated into 3 areas (Figure 3-38) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area	Mechanical, with or without herbicide spraying	Once per year	12
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3 (A) 0.4 (B) 0.4 (C) 0.3 (D)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 2 years	0.09 (A) 0.03 (B)

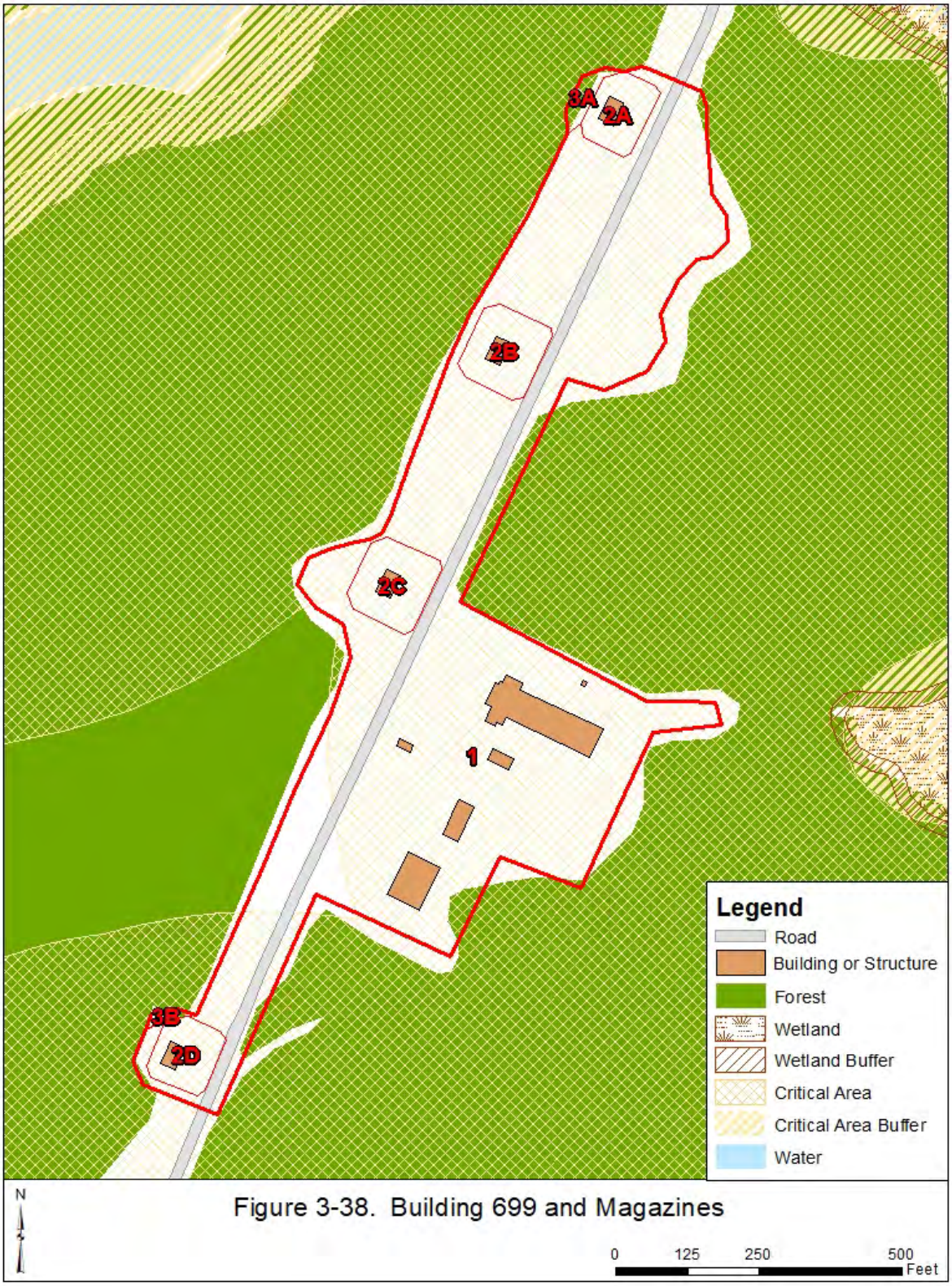

Figure 3-38. Building 699 and Magazines

3.2.20 Building 700 and Magazines

The Building 700 and Magazines are located in the Aberdeen Area. The range encompasses approximately 14 acres.

The Building 700 and Magazines are delineated into 3 areas (Figure 3-39) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area	Mechanical, with or without herbicide spraying	Once per year	13
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	1.7
3	Natural Area	Conservation	Monitor for encroachment	0.1

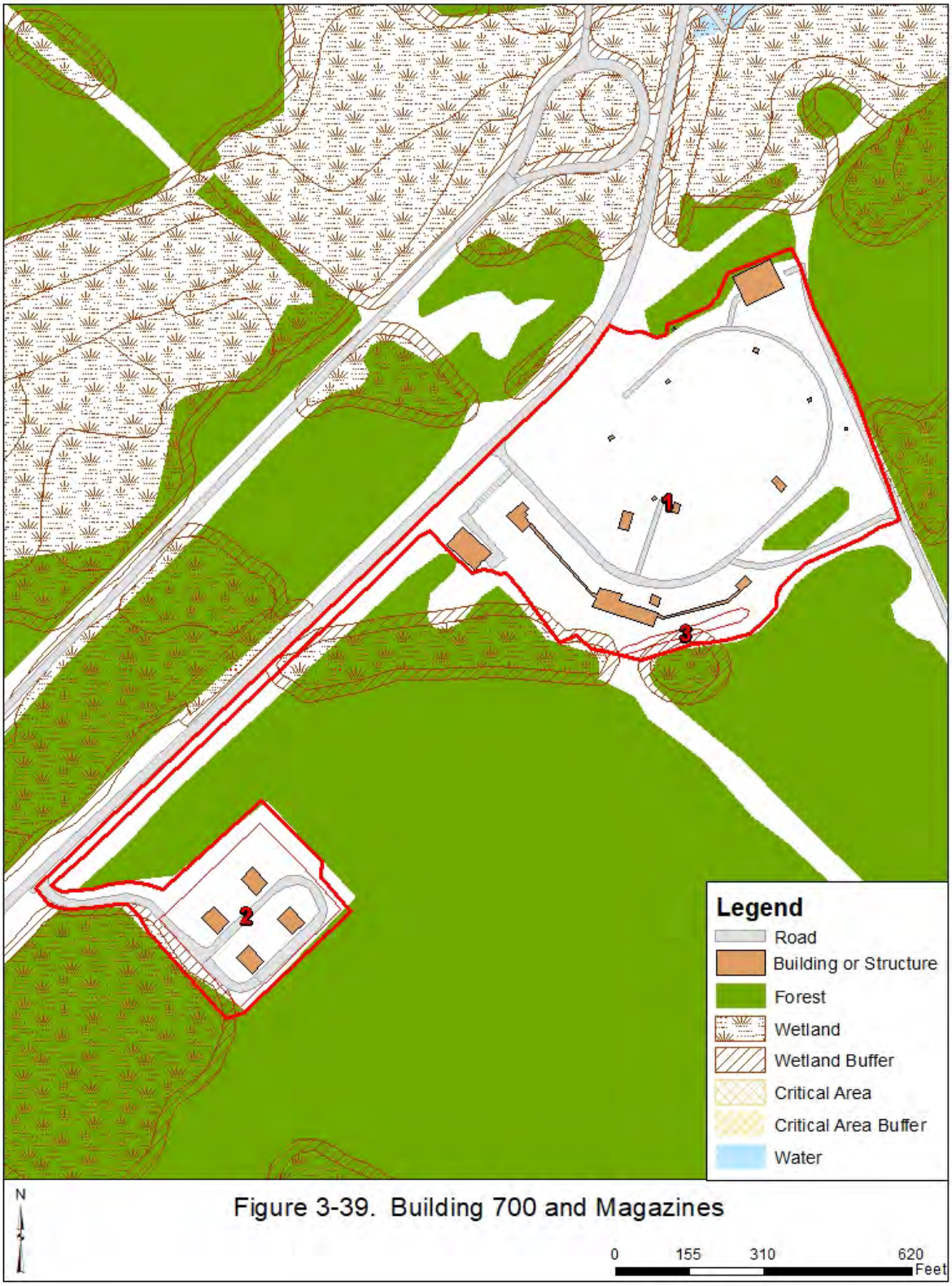

Figure 3-39. Building 700 and Magazines

3.2.21 Building 702 and Storage Yard

The Building 702 and Storage Yard are located in the Aberdeen Area. The range encompasses approximately 3 acres.

The Building 702 and Storage Yard are delineated into 3 areas (Figure 3-40) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	0.6
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	0.9 (A) 1.1 (B)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	0.5

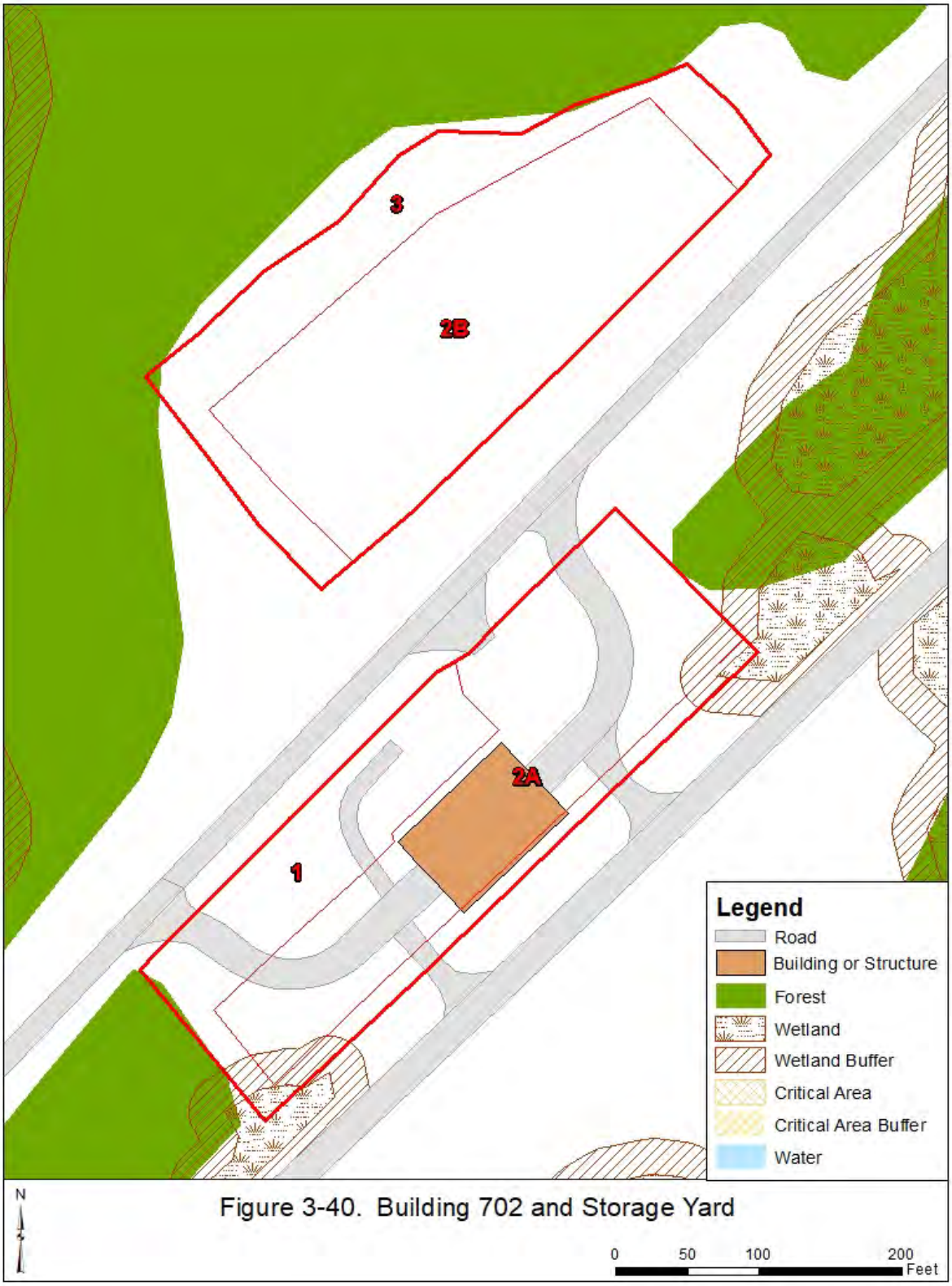

Figure 3-40. Building 702 and Storage Yard

3.2.22 C Field

The C Field range is located in the Edgewood Area. The range encompasses approximately 95 acres.

The C Field range is delineated into 7 areas (Figure 3-41) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	88
2	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	0.2 (A) 2.1 (B)
3	Berm	Mechanical, with or without herbicide spraying	Every 2 years	3.1
4	Natural Area	Conservation	Monitor for encroachment	0.5 (A) 0.5 (B) 1.2 (C) 0.6 (D)
5	Natural Area – Mitigation	Conservation	Monitor for encroachment	1.5
6	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	1.2

Figure 3-41. C Field

3.2.23 Chelsea Pond

The Chelsea Pond is located in the Aberdeen Area. The range encompasses approximately 5 acres.

The Chelsea Pond range is delineated into 4 areas (Figure 3-42) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area	Mechanical, with or without herbicide spraying	Every 2 years	1.6
2	Support Area (access trail to creek)	Mechanical, with or without herbicide spraying	Every 10 years	0.3
3	Support Area	Mechanical, with or without herbicide spraying	Every 10 years	1.5
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 10 years	0.8

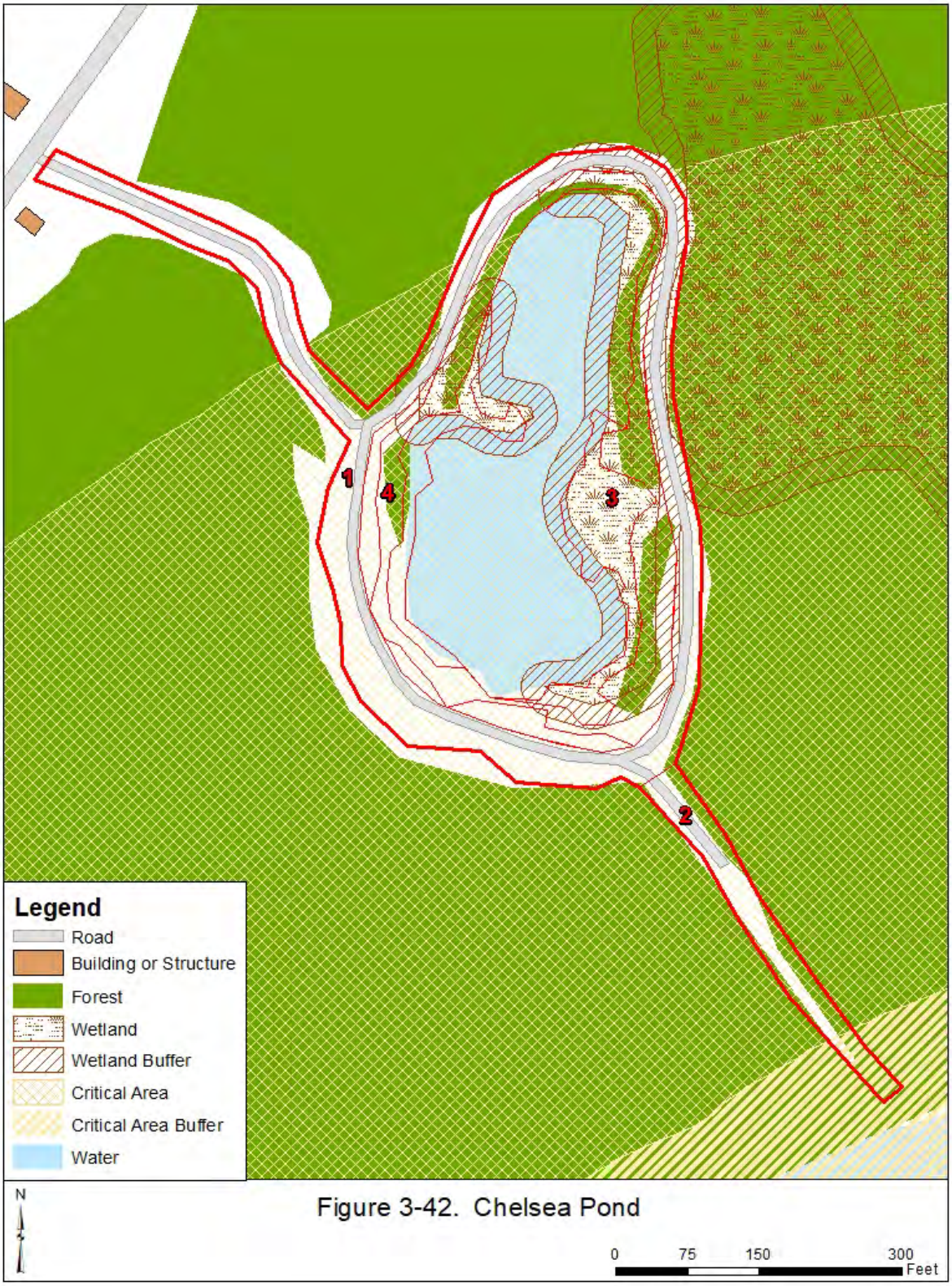

Figure 3-42. Chelsea Pond

3.2.24 Churchville Test Area

The Churchville Test Area is located in the Aberdeen Area. The range encompasses approximately 218 acres. The range is bordered to the north by Deer Creek.

The Churchville Test Area is delineated into 4 areas (Figure 3-43) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	79
2	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	2.1
3	Natural Area	Conservation	Monitor for encroachment	132
4	Shoreline, Beach, Riprap	Shoreline protection (Deer Creek)	Monitor, keep riprap clear	5

Figure 3-43. Churchville Test Area

3.2.25 Crash Pad (Rail Impact)

The Crash Pad (Rail Impact) range is located in the Aberdeen Area. The range encompasses approximately 7 acres.

The Crash Pad (Rail Impact) range is delineated into 3 areas (Figure 3-44) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	0.9
2	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	1.9 (A) 2.6 (B)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.5 (A) 0.1 (B) 0.5 (C) 0.03 (D)

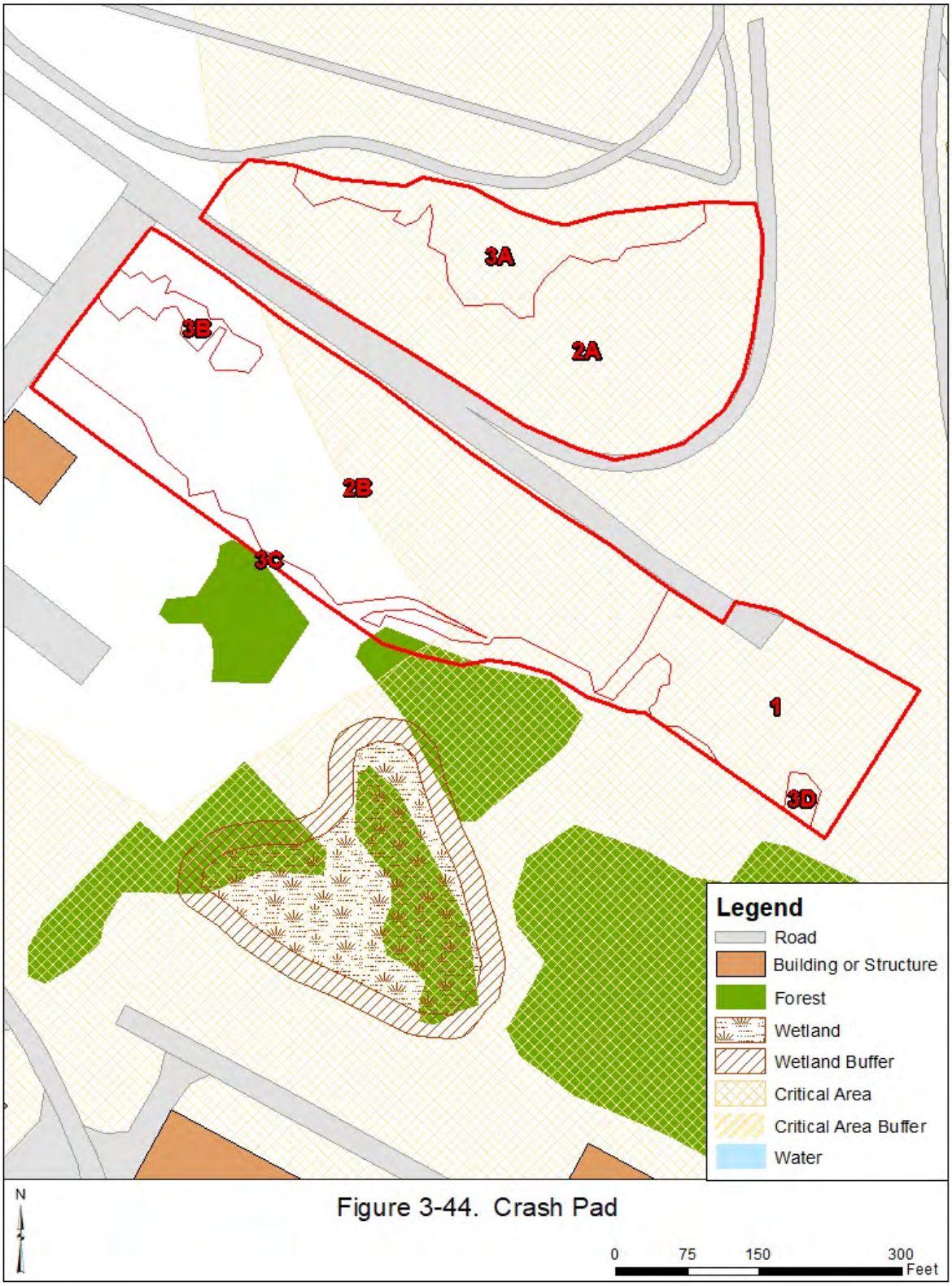

Figure 3-44. Crash Pad

3.2.26 D Field

The D Field range is located in the Edgewood Area. The range encompasses approximately 132 acres.

The D Field range is delineated into 3 areas (Figure 3-45) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area (access roads)	Mechanical	Once per year	6.8
2	Natural Area	Conservation	Monitor for encroachment	6 (A) 83 (B) 32 (C) 0.9 (D)
3	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.6 (A) 2.6 (B)

Figure 3-45. D Field

3.2.27 Dynamometer Course

The Dynamometer Course is located in the Aberdeen Area. The range encompasses approximately 16 acres.

The Dynamometer Course is delineated into 2 areas (Figure 3-46) with associated vegetation maintenance prescriptions. Areas 2A and 2B are two small vegetated areas within the turning loops at the north and south end of the course.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	15
2	Natural Area	Conservation	Monitor for encroachment	0.8 (A) 0.3 (B)

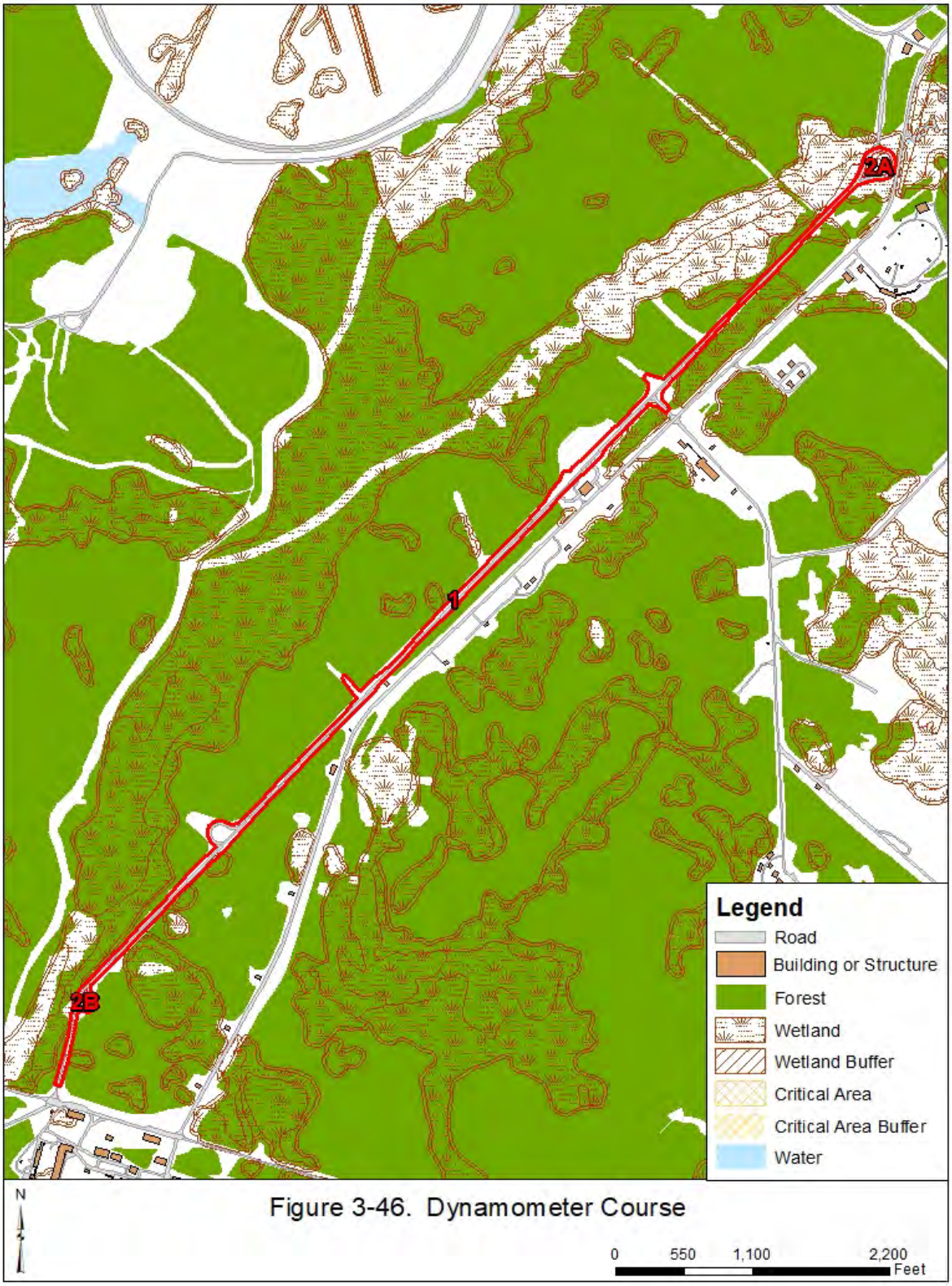

Figure 3-46. Dynamometer Course

3.2.28 Edgewood Ammo Plant

The Edgewood Ammo Plant is located in the Edgewood Area. The range encompasses approximately 7 acres.

The Edgewood Ammo Plant is delineated into 2 areas (Figure 3-47) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	3.8
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	1.9 (A) 0.9 (B)

Figure 3-47. Edgewood Ammo Plant

3.2.29 Fords Farm

The Fords Farm range is located in the Aberdeen Area. The range encompasses approximately 27 acres.

The Fords Farm range is delineated into 10 areas (Figure 3-48) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	15
2	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	1.6
3	Support Area	Mechanical	Once per year	0.4
4	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	0.08
5	Support Area	Mechanical, with or without herbicide spraying	Every 10 years	8.8
6	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Once per year	0.1
7	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.2 (A) 0.02 (B)
8	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	0.1
9	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 10 years	0.2 (A) 1.2 (B)
10	Natural Area	Conservation	Monitor for encroachment	1.2

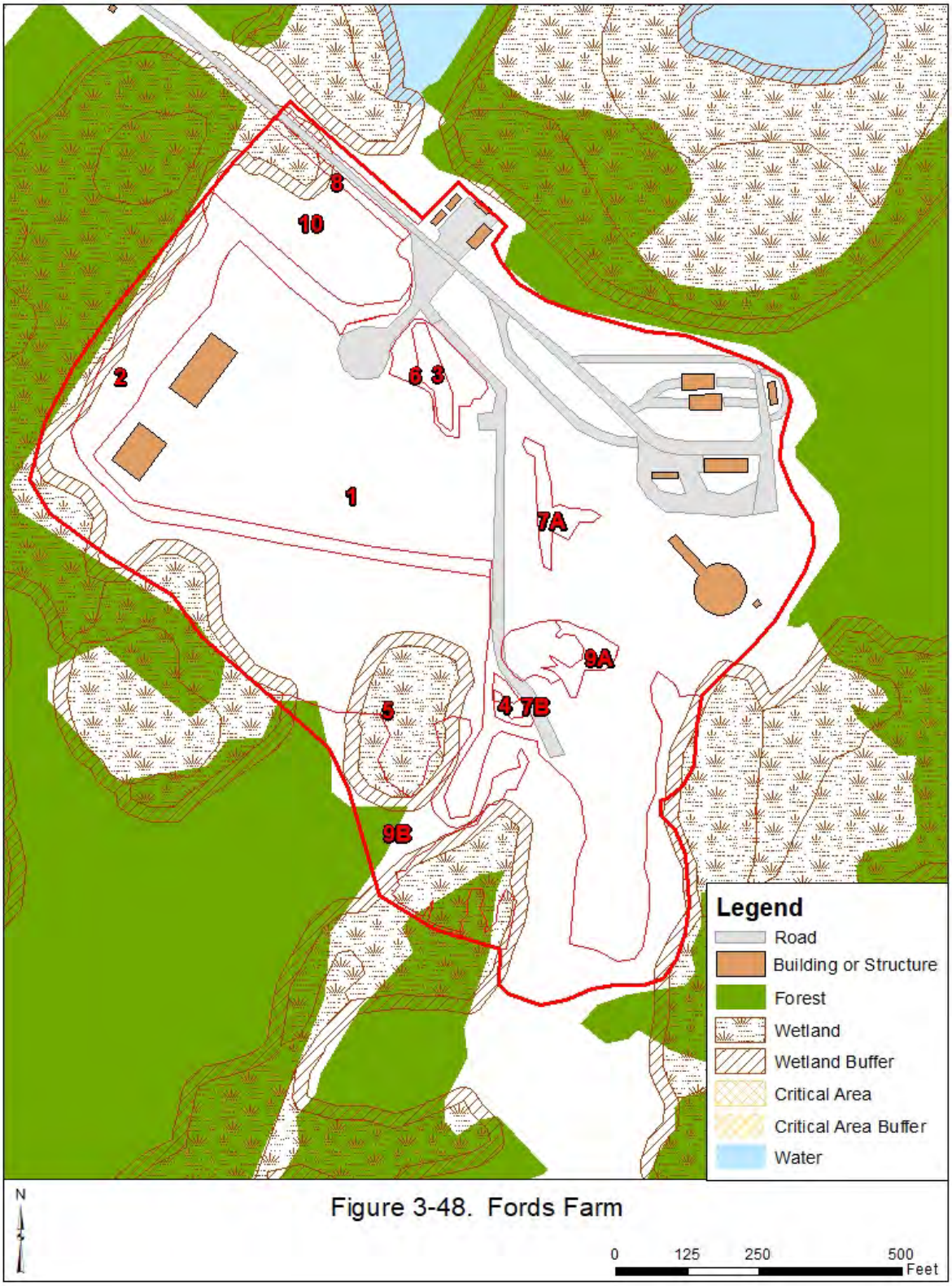

Figure 3-48. Fords Farm

3.2.30 Generator Test Facility

The Generator Test Facility is located in the Aberdeen Area. The range encompasses approximately 13 acres.

The Generator Test Facility is delineated into 2 areas (Figure 3-49) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	8 (A) 0.3 (B)
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	4.8

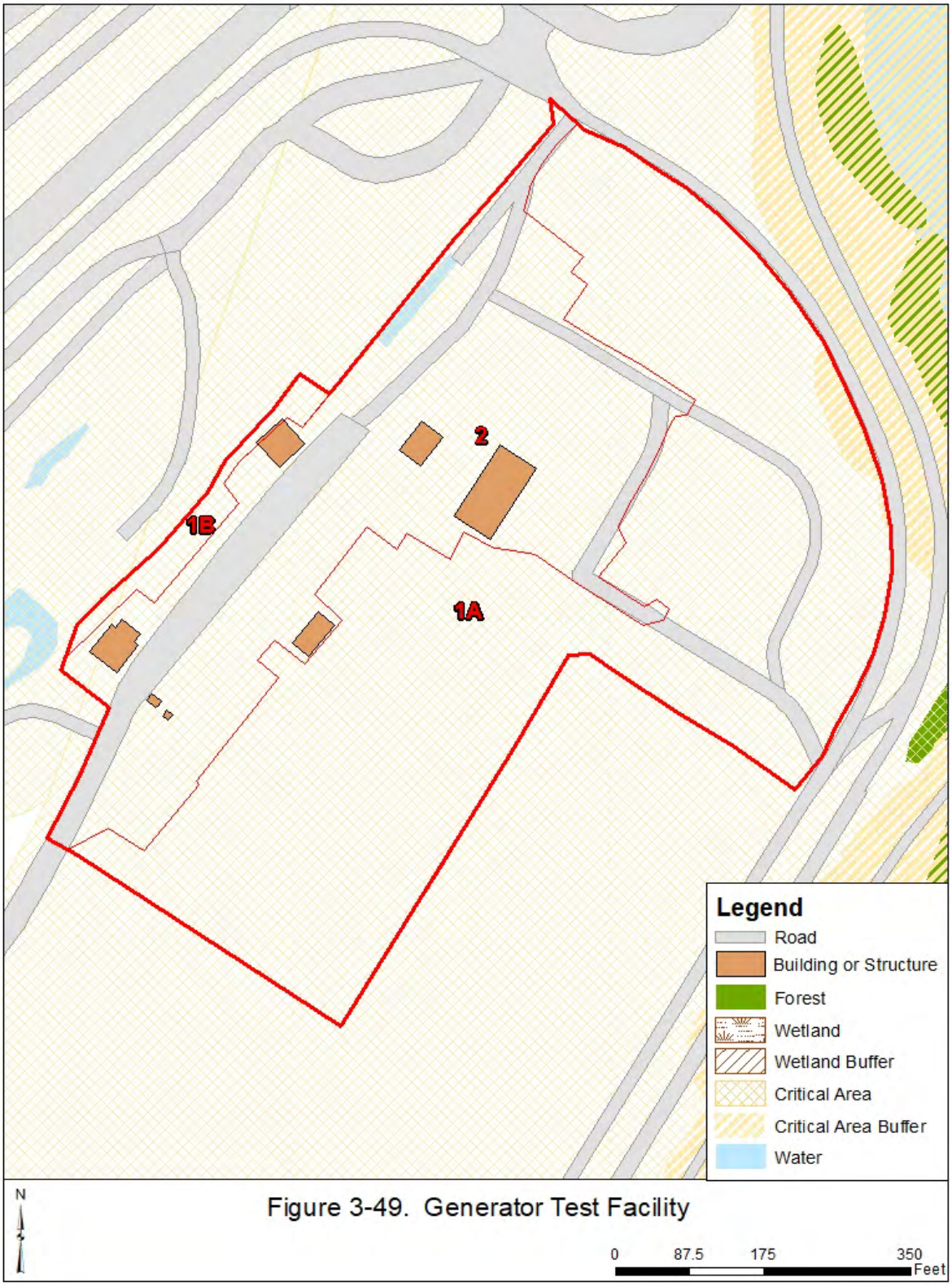

Figure 3-49. Generator Test Facility

3.2.31 Grenade Range

The Grenade Range is located in the Aberdeen Area. The range encompasses approximately 2 acres.

The Grenade Range is delineated into 2 areas (Figure 3-50) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area	Mechanical, with or without herbicide spraying	Once per year	0.7
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	1.3

Figure 3-50. Grenade Range

3.2.32 Henry Field (H Field)

The Henry Field (H Field) range is located in the Aberdeen Area. The range encompasses approximately 857 acres.

The Henry Field (H Field) range is delineated into 6 areas (Figure 3-51) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	214
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 2 years	55
3	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	62 (A) 172 (B) 28 (C) 60 (D) 25 (E) 195 (F) 33 (G)
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	2.2
5	Natural Area	Conservation	Monitor for encroachment	1.6 (A) 2.5 (B)
6	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	7.1

Figure 3-51. Henry Field

3.2.33 High Velocity

The High Velocity range is located in the Aberdeen Area. The range encompasses approximately 41 acres.

The High Velocity range is delineated into 6 areas (Figure 3-52) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (includes access roads)	Mowing	Twice per year	15
2	Support Area (0M to 1500M)	Mechanical, with or without herbicide spraying	Every 3 years	8.9
3	Support Area (creek to 3000M)	Mechanical, with or without herbicide spraying	Every 10 years	8.3
4	Support Area (3000M to 4000M)	Mechanical, with or without herbicide spraying	Every 20 years	8.5
5	Support Area (creek crossing)	Mechanical and/or controlled burn	Monitor for encroachment	0.5
6	Natural Area	Conservation	Monitor for encroachment	0.5

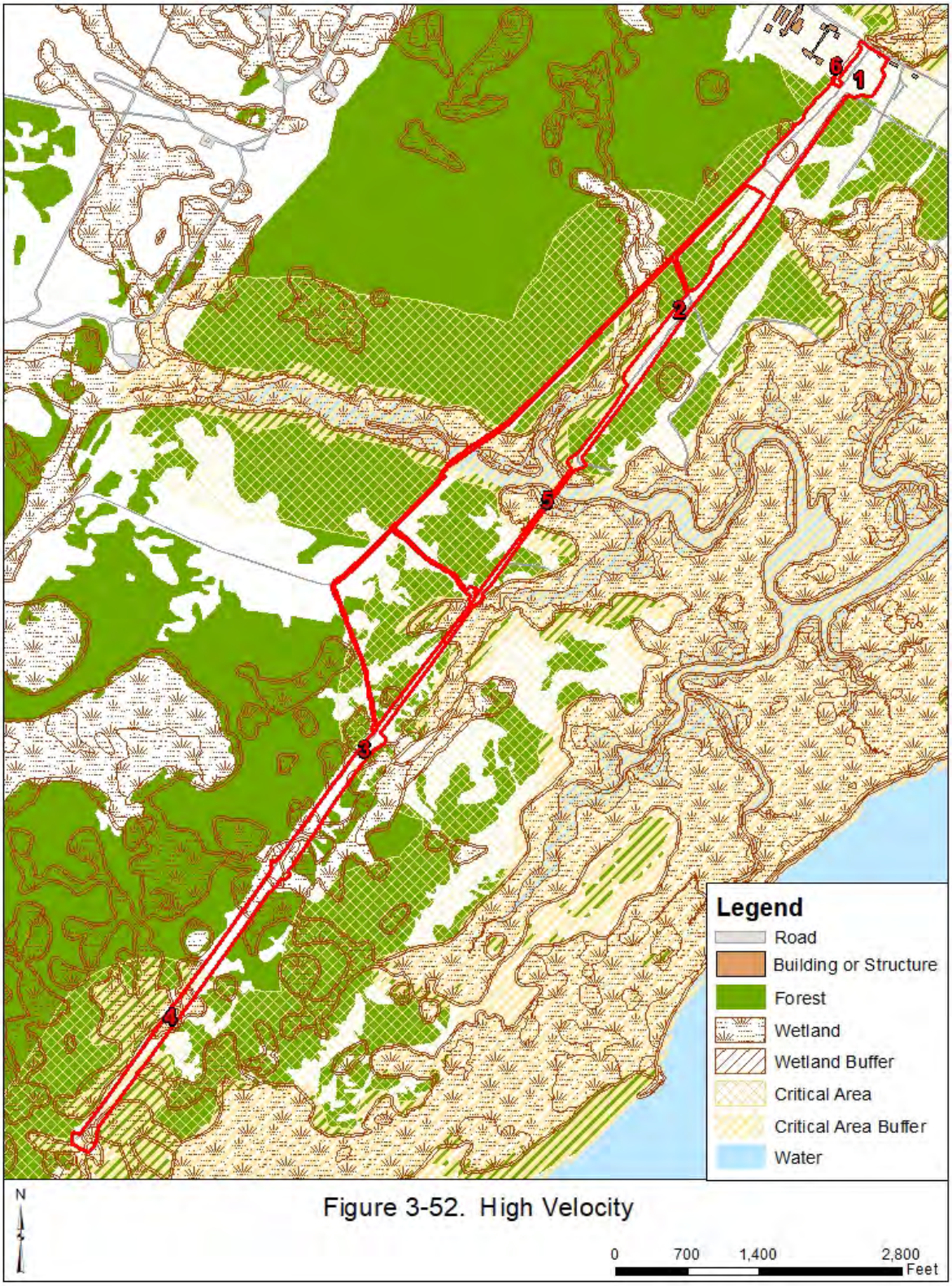

Figure 3-52. High Velocity

3.2.34 I Field

The I Field range is located in the Edgewood Area. The range encompasses approximately 83 acres.

The I Field range is delineated into 6 areas (Figures 3-53a and 3-53b) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	4.4
2	Support Area	Mechanical, with or without herbicide spraying	Once per year	0.5
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.3 (A) 0.1 (B)
4	Encroachment – Trees to Clear	Mechanical	Every 10 years	0.4
5	Bare Ground	Mechanical	As needed for testing and to keep clear of potential encroaching vegetation	13 (A) 40 (B)
6	Natural Area	Conservation	Monitor for encroachment	0.7 (A) 24 (B)

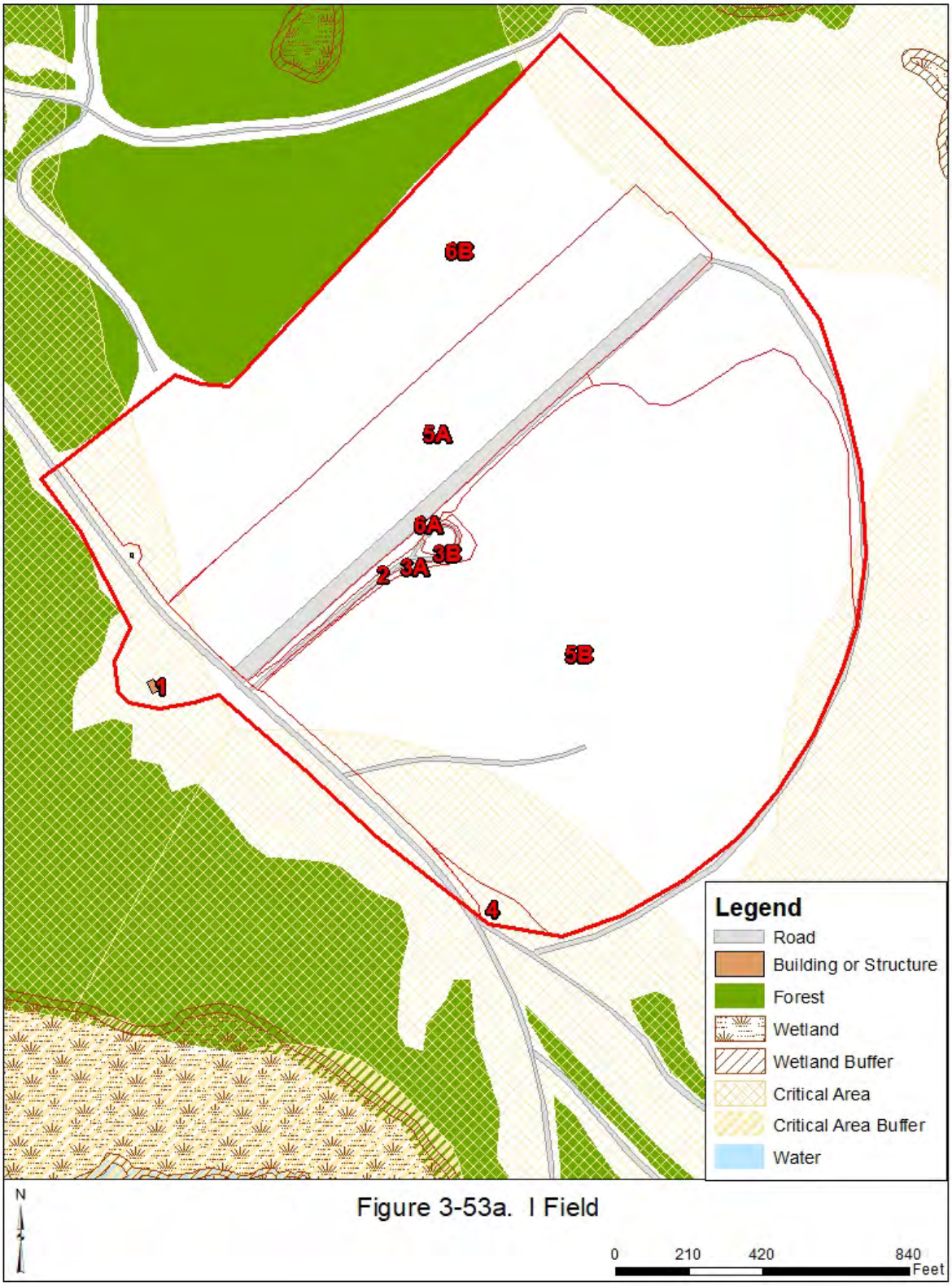

Figure 3-53a. I Field

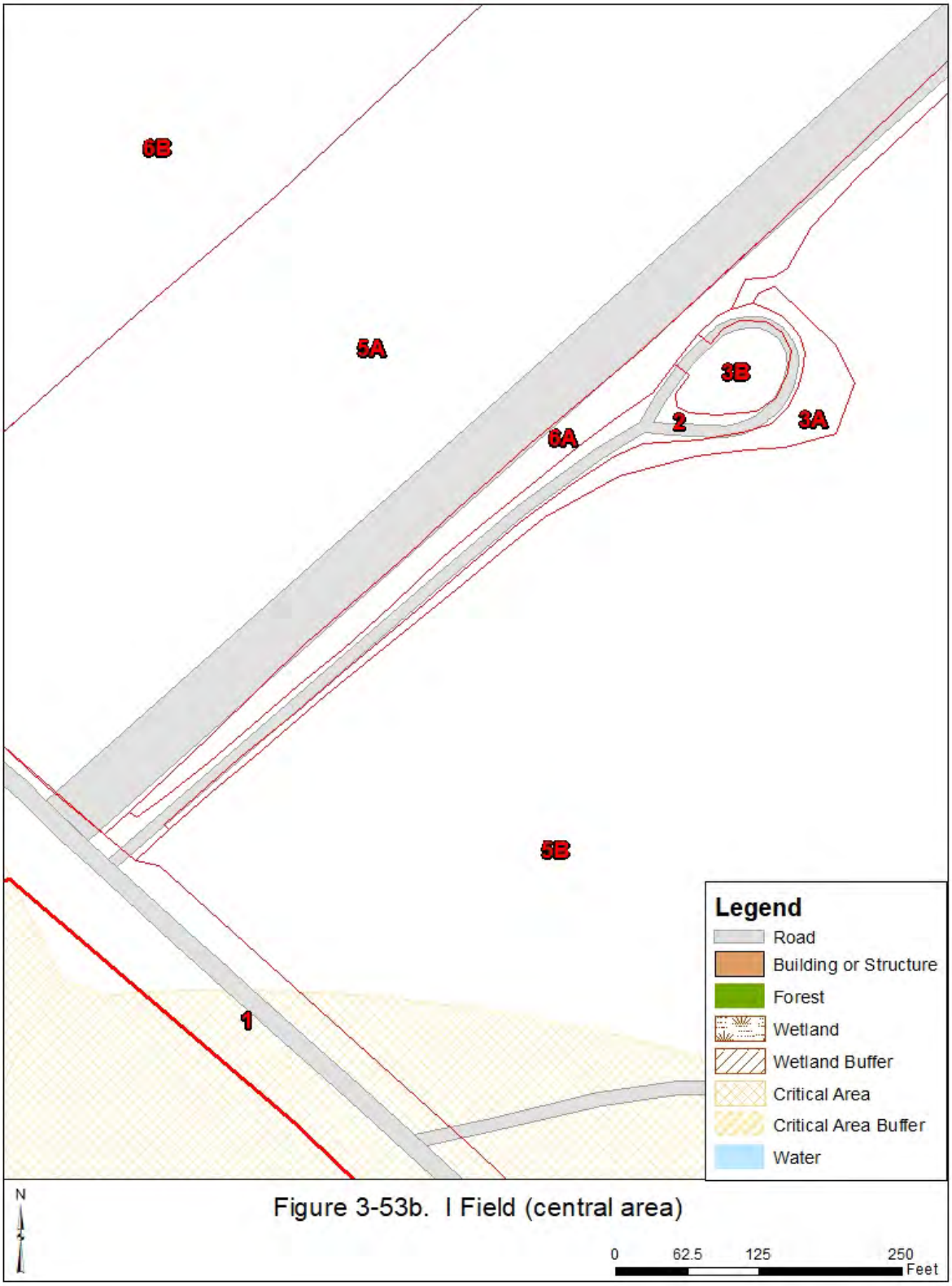

Figure 3-53b. I Field (central area)

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3.2.35 L Field

The L Field range is located in the Edgewood Area. The range encompasses approximately 27 acres.

The L Field range is delineated into 7 areas (Figures 3-54a and 3-54b) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	11
2	Support Area	Mechanical, with or without herbicide spraying	Every 2 years	1.2
3	Support Area (includes access trail to creek)	Mechanical, with or without herbicide spraying	Every 5 years	1.9
4	Support Area	Mechanical, with or without herbicide spraying	Every 10 years	3.2 (A) 2 (B)
5	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 2 years	0.2 (A) 0.02 (B) 0.01 (C)
6	Natural Area – Mitigation	Conservation	Monitor for encroachment	5.1
7	Natural Area	Conservation	Monitor for encroachment	1.7

Figure 3-54a. L Field

Figure 3-54b. L Field (central area)

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3.2.36 Laser Bubble (Moving Target Simulator)

The Laser Bubble (Moving Target Simulator) is located in the Aberdeen Area. The range encompasses approximately 3 acres.

The Laser Bubble (Moving Target Simulator) is delineated into a single area (Figure 3-55) with associated vegetation maintenance prescription.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	3.2

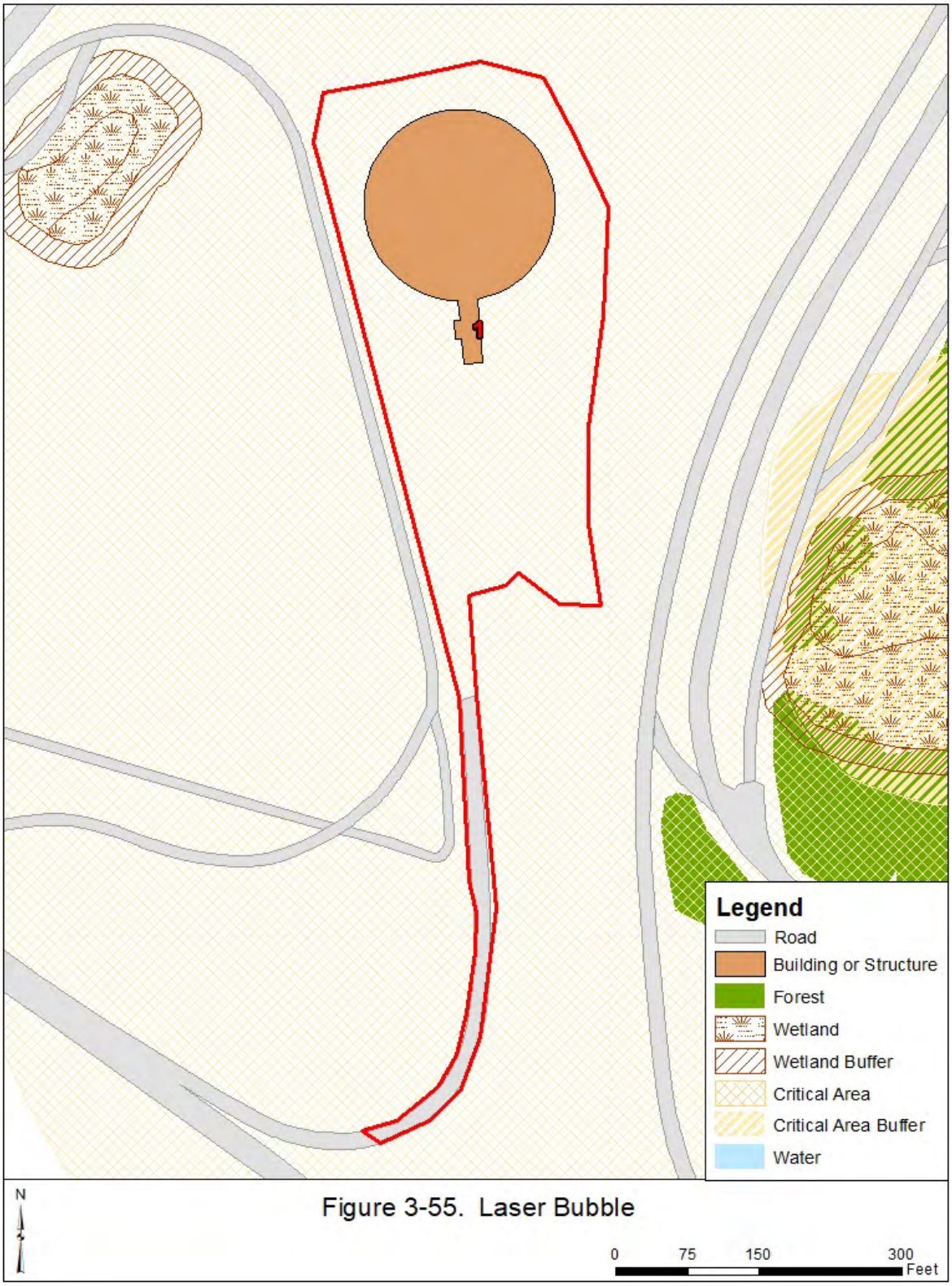

Figure 3-55. Laser Bubble

3.2.37 Light Armor

The Light Armor range is located in the Aberdeen Area. The range encompasses approximately 20 acres.

The Light Armor range is delineated into 2 areas (Figure 3-56) with associated vegetation maintenance prescription.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	20
2	Berm	Mechanical, with or without herbicide spraying	Every 3 years	0.2

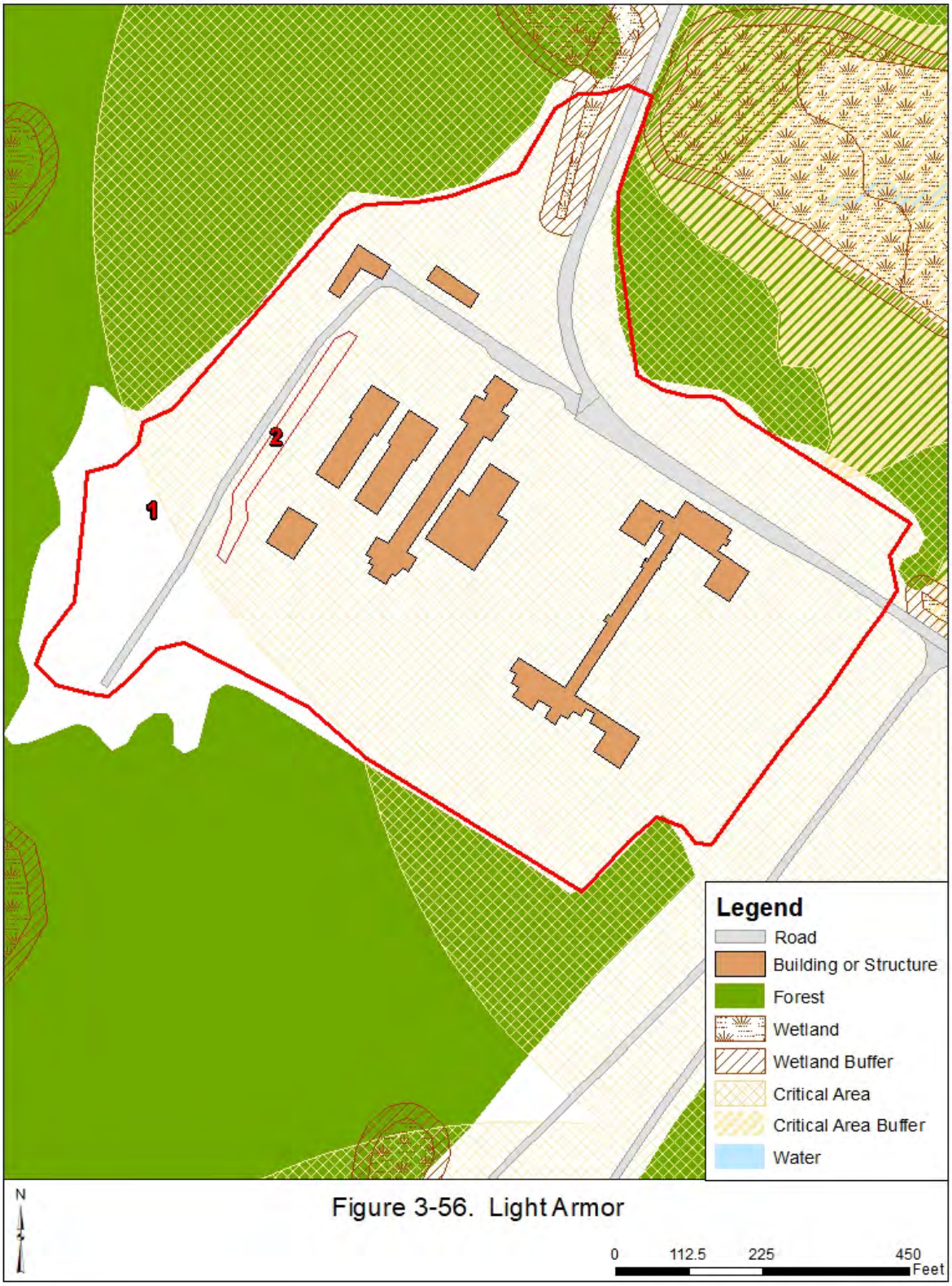

Figure 3-56. Light Armor

3.2.38 Light Rifle

The Light Rifle range is located in the Aberdeen Area. The range encompasses approximately 18 acres.

The Light Rifle range is delineated into 3 areas (Figure 3-57) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	4.1
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 2 years	11
3	Encroachment – Trees to Clear	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	2.5

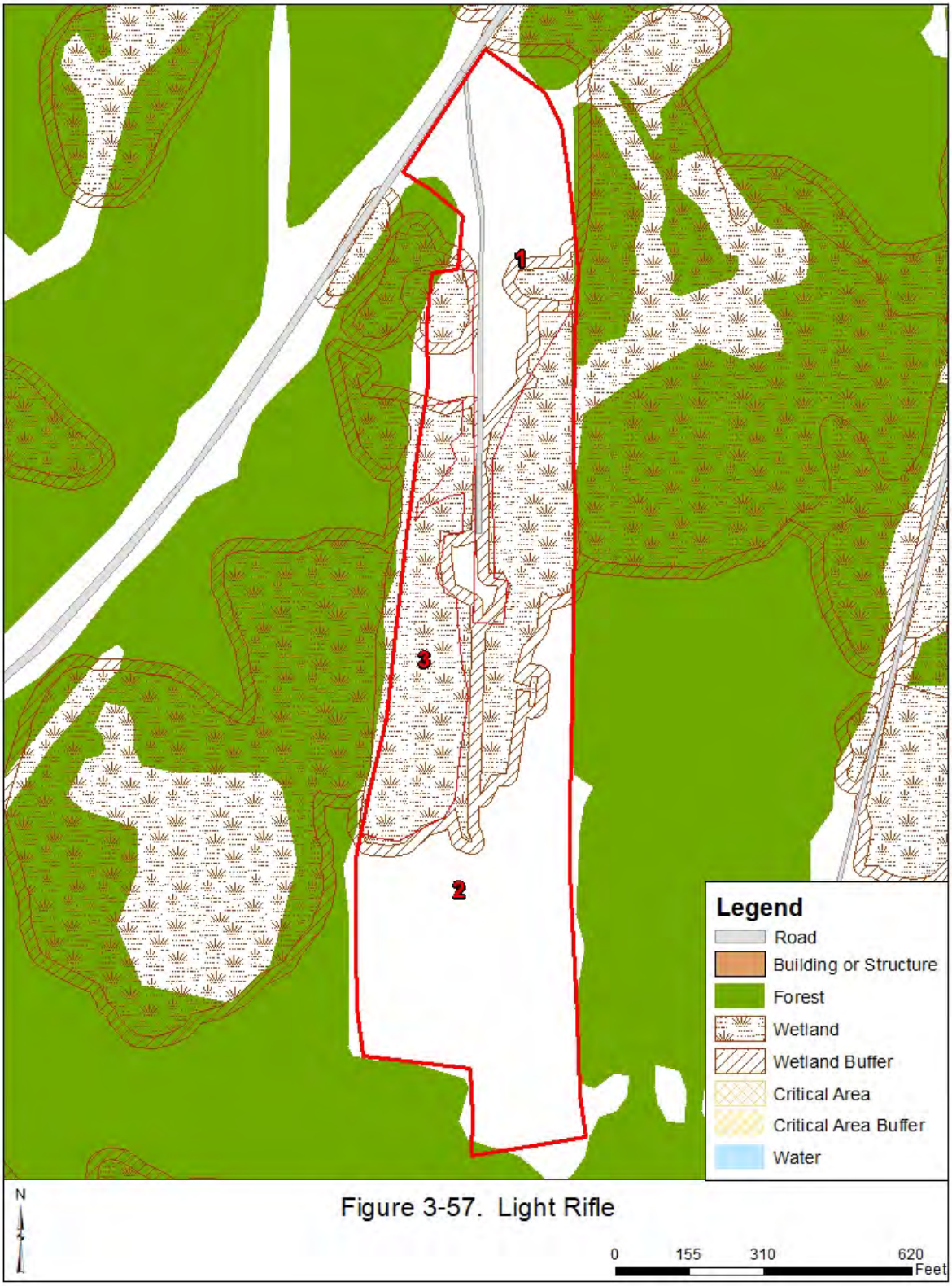

Figure 3-57. Light Rifle

3.2.39 Littoral Warfare Environment (LWE) and Annex

The LWE and Annex are located in the Aberdeen Area. The range encompasses approximately 31 acres.

The LWE and Annex are delineated into 6 areas (Figure 3-58) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	10
2	Berm	Mechanical, with or without herbicide spraying	Every 3 years	0.6 (A) 0.8 (B) 3.1 (C)
3	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	4.3 (A) 8.3 (B) 0.2 (C)
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 2 years	0.07 (A) 1 (B)
5	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.03 (A) 0.01 (B) 0.03 (C) 0.1 (D) 0.3 (E) 2.3 (F) 0.2 (G)
6	Natural Area	Conservation	Monitor for encroachment	0.5

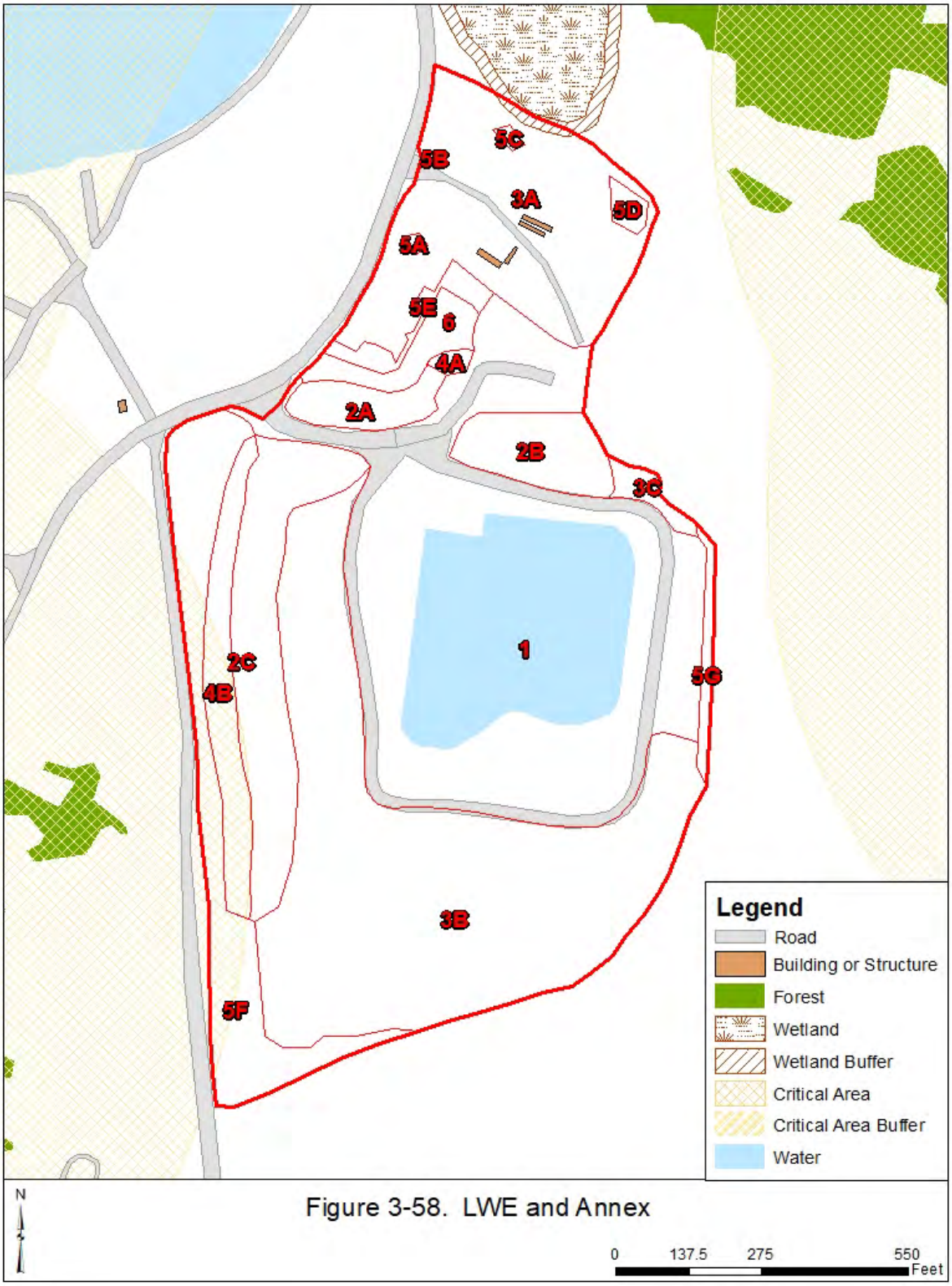

Figure 3-58. LWE and Annex

3.2.40 Main Front Complex

The Main Front Complex is located in the Aberdeen Area. The range encompasses approximately 355 acres.

The Main Front Complex is delineated into 5 areas (Figures 3-59a and 3-59b) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (includes access roads and pads)	Mowing, with or without controlled burn	Twice per year	183
2	Support Area (catch box)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	2.2
3	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	131 (A) 0.4 (B) 1.2 (C) 4.2 (D) 9.9 (E)
4	Encroachment – Trees to Clear (catch box)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	0.5
5	Encroachment – Trees to Clear	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	2.4 (A) 1.9 (B) 0.2 (C) 0.2 (D) 1 (E) 5.5 (F) 0.2 (G) 4.3 (H) 3 (I) 0.07 (J) 0.1 (K) 0.5 (L) 0.4 (M) 0.3 (N)

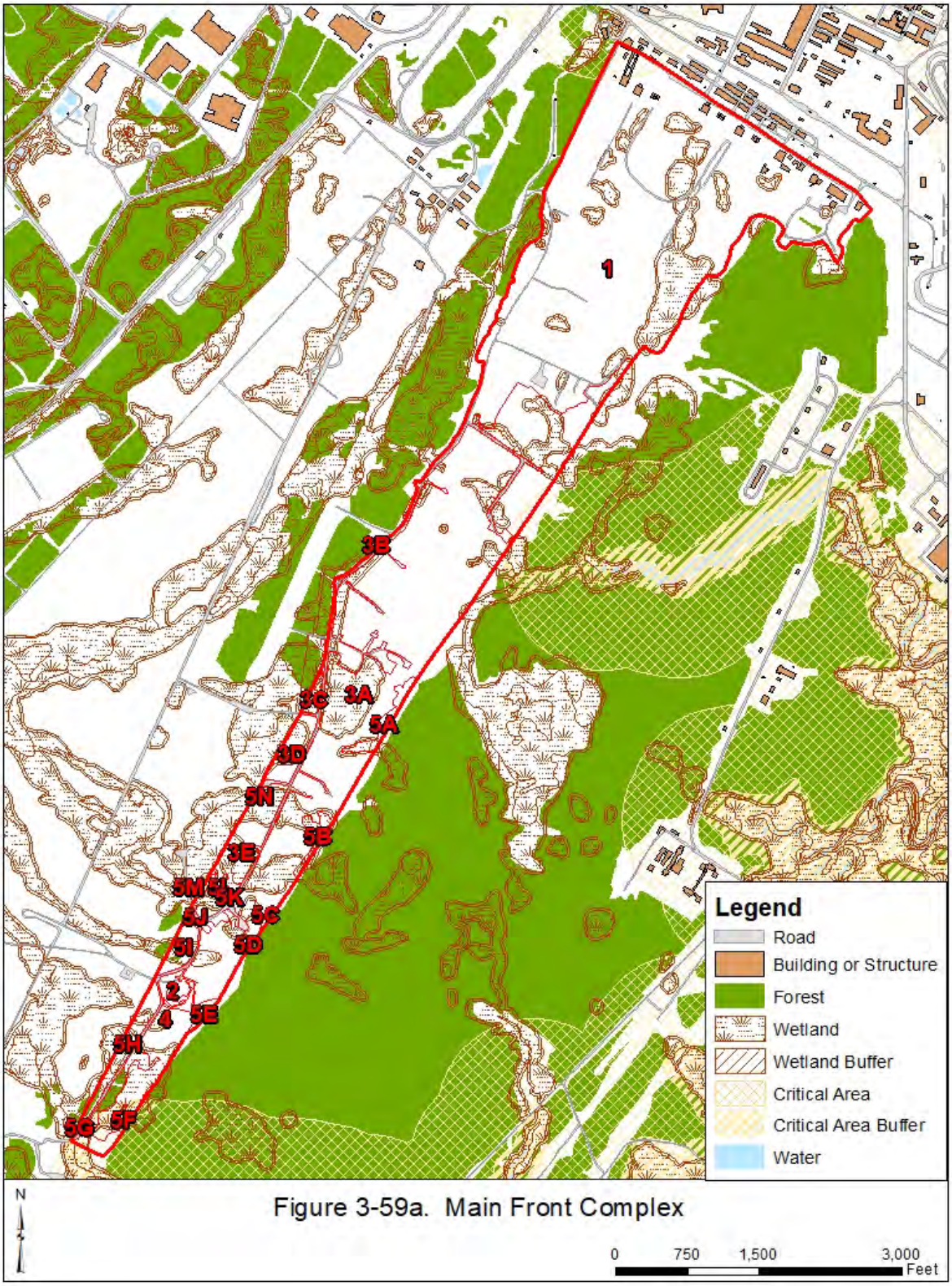

Figure 3-59a. Main Front Complex

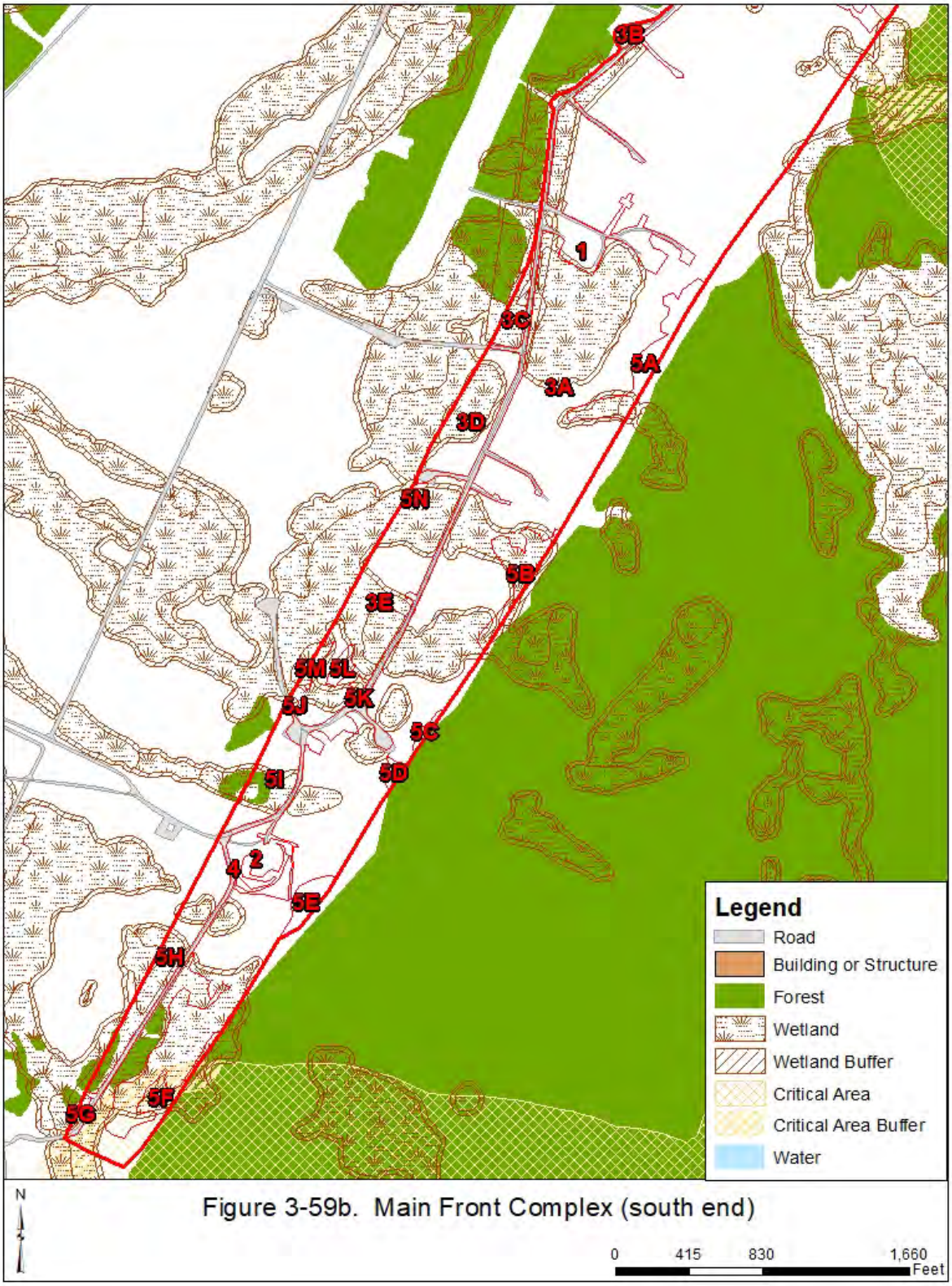

Figure 3-59b. Main Front Complex (south end)

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3.2.41 Material Handling Equipment Test Area (Heavy Equipment Test Area)

The Material Handling Equipment Test Area (Heavy Equipment Test Area) is located in the Aberdeen Area. The range encompasses approximately 14 acres.

The Material Handling Equipment Test Area (Heavy Equipment Test Area) is delineated into 2 areas (Figure 3-60) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	3.6 (A) 0.8 (B) 2 (C)
2	Gravel Stands, Pads	Mechanical, with or without herbicide spraying	Once per year	7.4
3	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	0.3

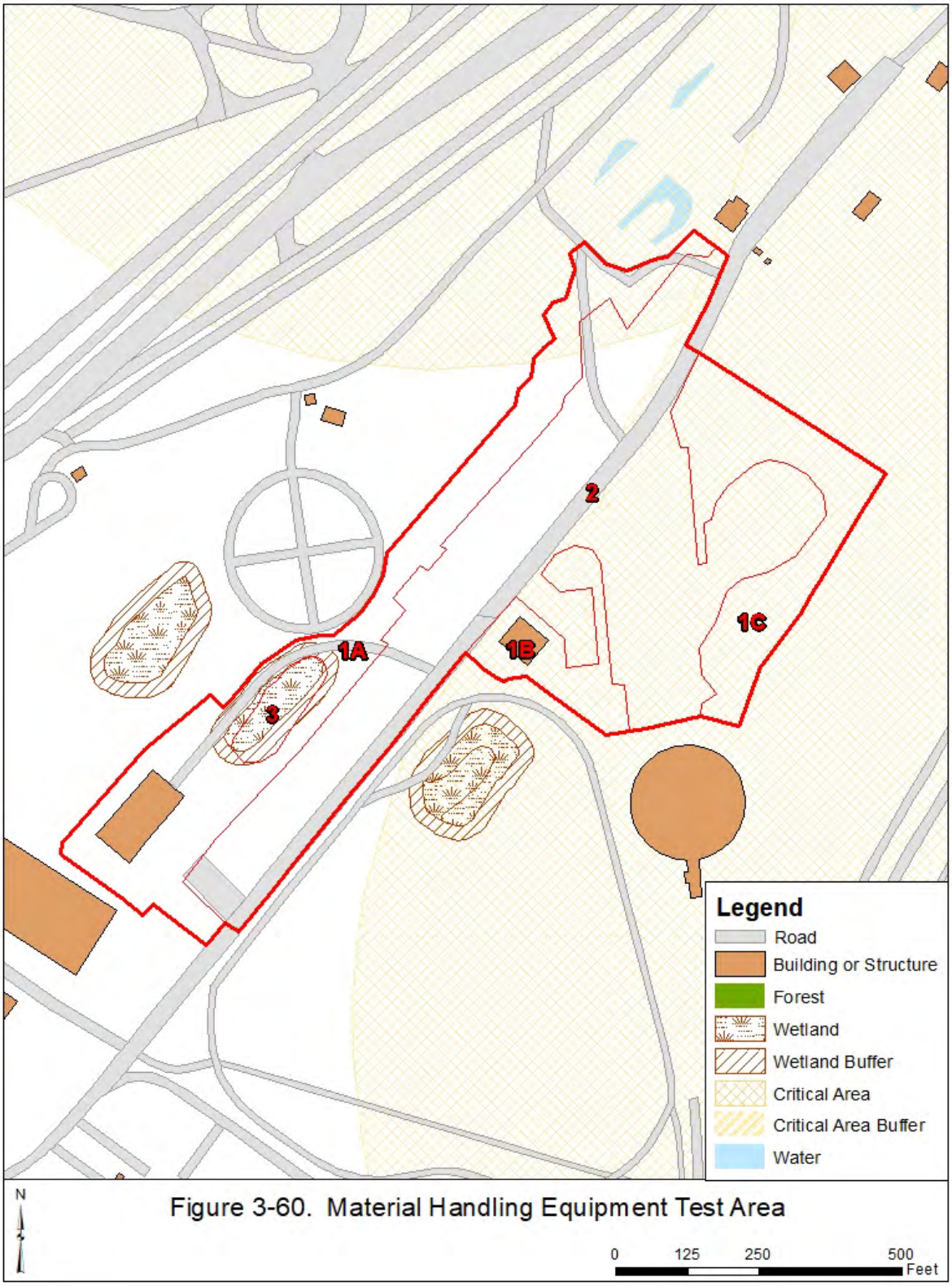

Figure 3-60. Material Handling Equipment Test Area

3.2.42 Meteorological Station

The Meteorological Station is located in the Aberdeen Area. The range encompasses approximately 4 acres.

The Meteorological Station is delineated into 3 areas (Figure 3-61) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	3
2	Natural Area	Conservation	Monitor for encroachment	0.9 (A) 0.1 (B)
3	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.3

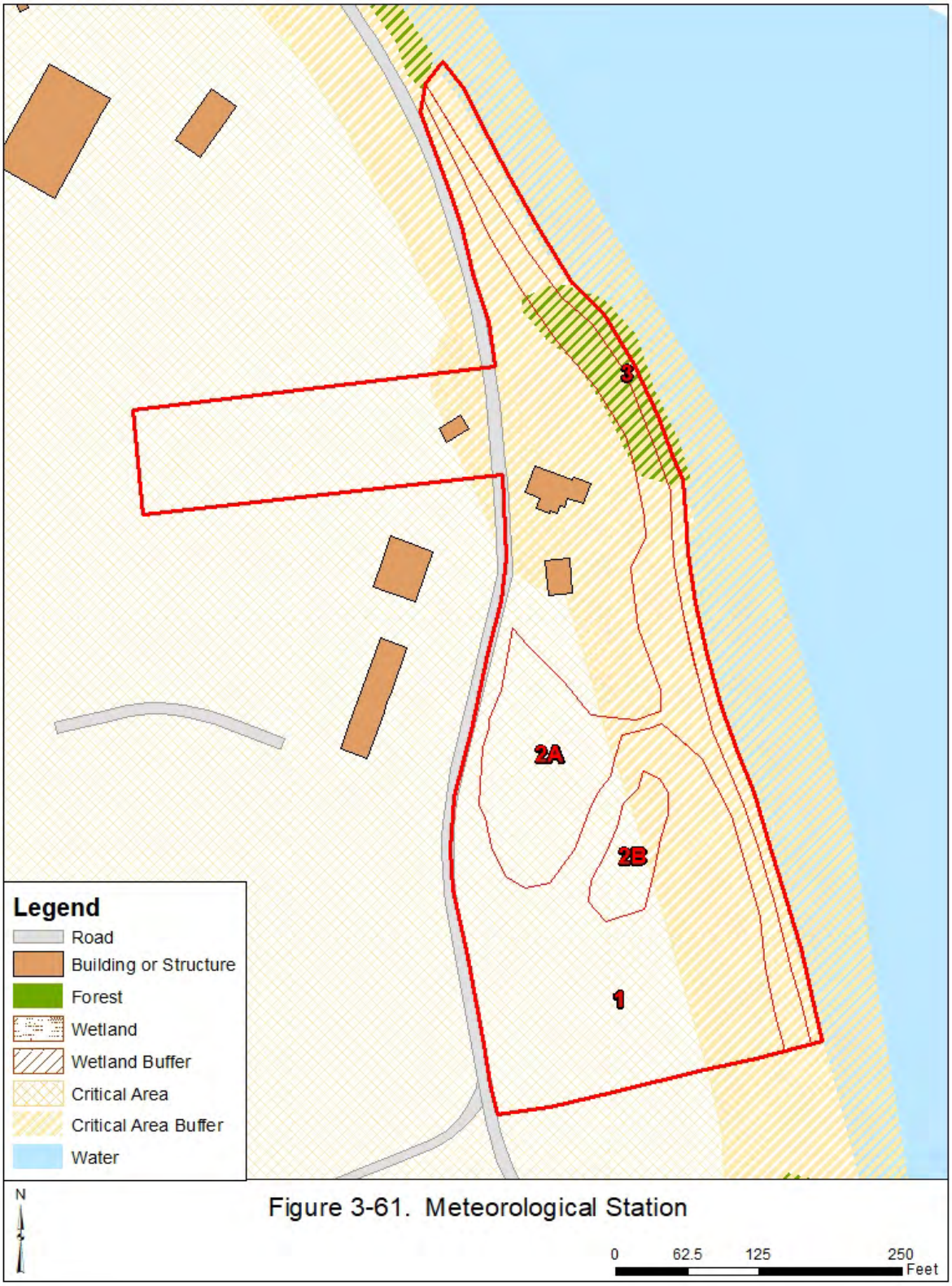

Figure 3-61. Meteorological Station

3.2.43 Michaelsville Complex

The Michaelsville Complex is located in the Aberdeen Area. The range encompasses approximately 357 acres.

The Michaelsville Complex is delineated into 5 areas (Figures 3-62a, 3-62b, and 3-62c) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (includes MICH5 tunnel, MICH 11 to 300M, MICH16/17 to 300M, MICH18/19 to 100M, Cold Room to 100M and firing pads for MICH20, MICH21, MICH22, MICH23)	Mowing	Twice per year	22
2	Support Area (A – Small Arms Range Road) (B – MICH20 to 100M) (C – MICH21 to 200M) (D – MICH22 to 450M) (E – MICH23 to 600M)	Mechanical, with or without herbicide spraying	Every 3 years	8 (A) 0.3 (B) 0.6 (C) 1.1 (D) 1.8 (E)
3	Support Area (A – MICH11, 300 to 3000M) (B – MICH16/17, 300 to 3000M) (C – MICH18/19, 100 to 3000M) (D – Cold Room, 100 to 3000M) (E – MICH20, 100 to 3000M) (F – MICH21, 200 to 3000M) (G – MICH22, 450 to 3000M and MICH23, 600 to 3000M)	Mechanical, with or without herbicide spraying	Every 20 years	6.2 (A) 6.3 (B) 6.7 (C) 6.8 (D) 6.6 (E) 6.4 (F) 11 (G)
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	0.5
5	Natural Area	Conservation	Monitor for encroachment	0.9 (A) 39 (B) 33 (C) 23 (D) 21 (E) 26 (F) 48 (G) 45 (H) 18 (I) 7.7 (J) 12 (K)

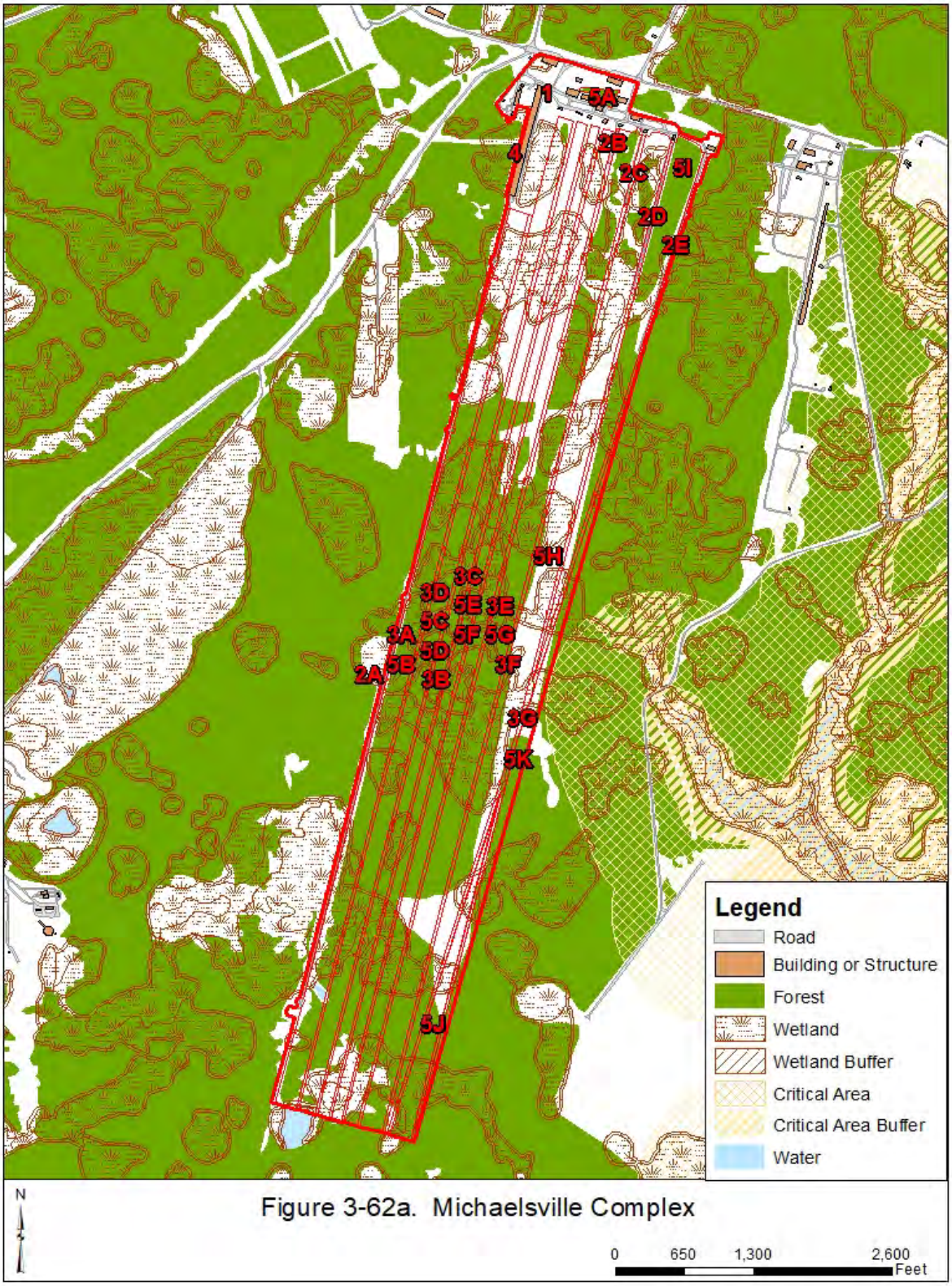

Figure 3-62a. Michaelsville Complex

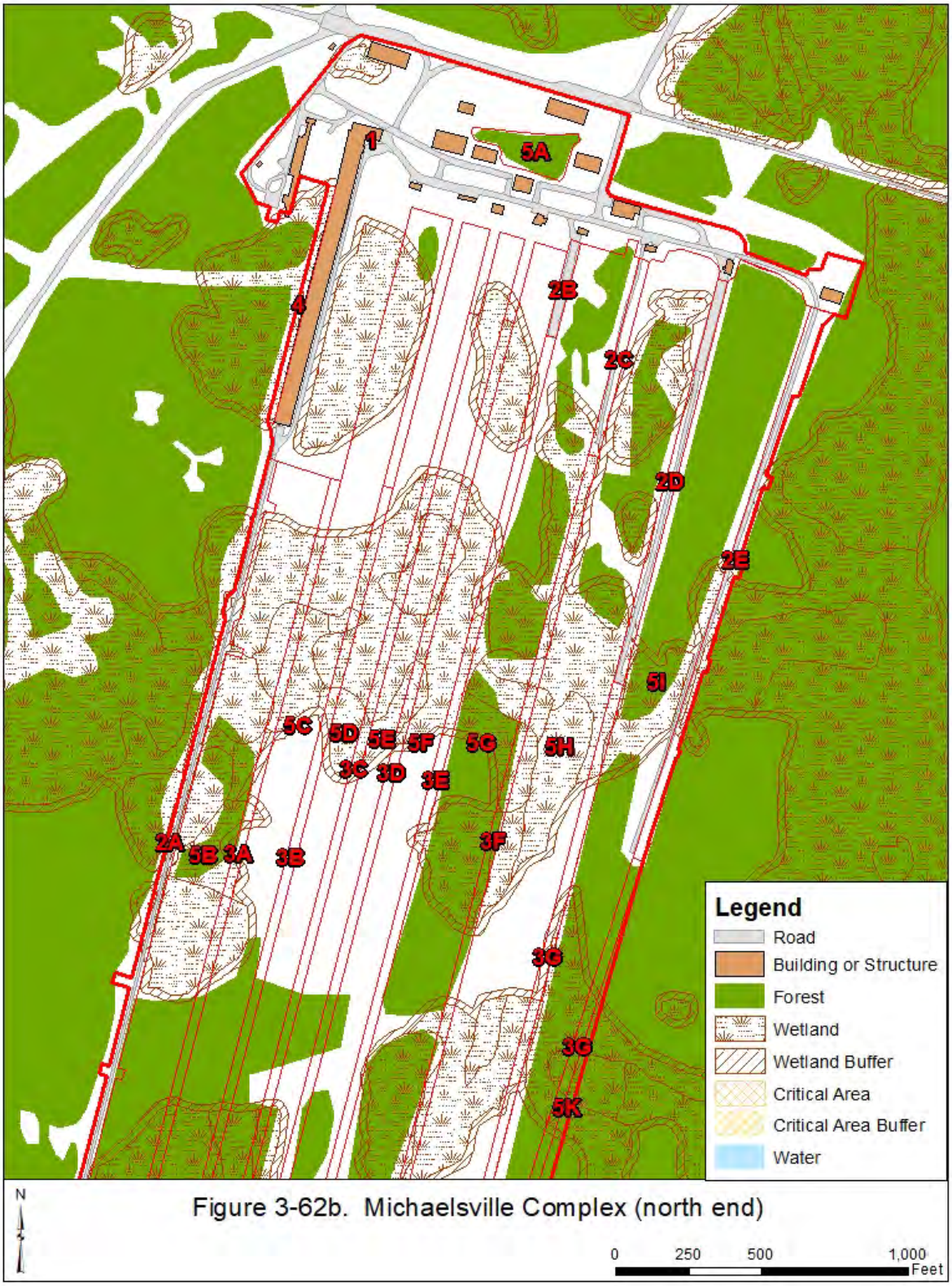

Figure 3-62b. Michaelsville Complex (north end)

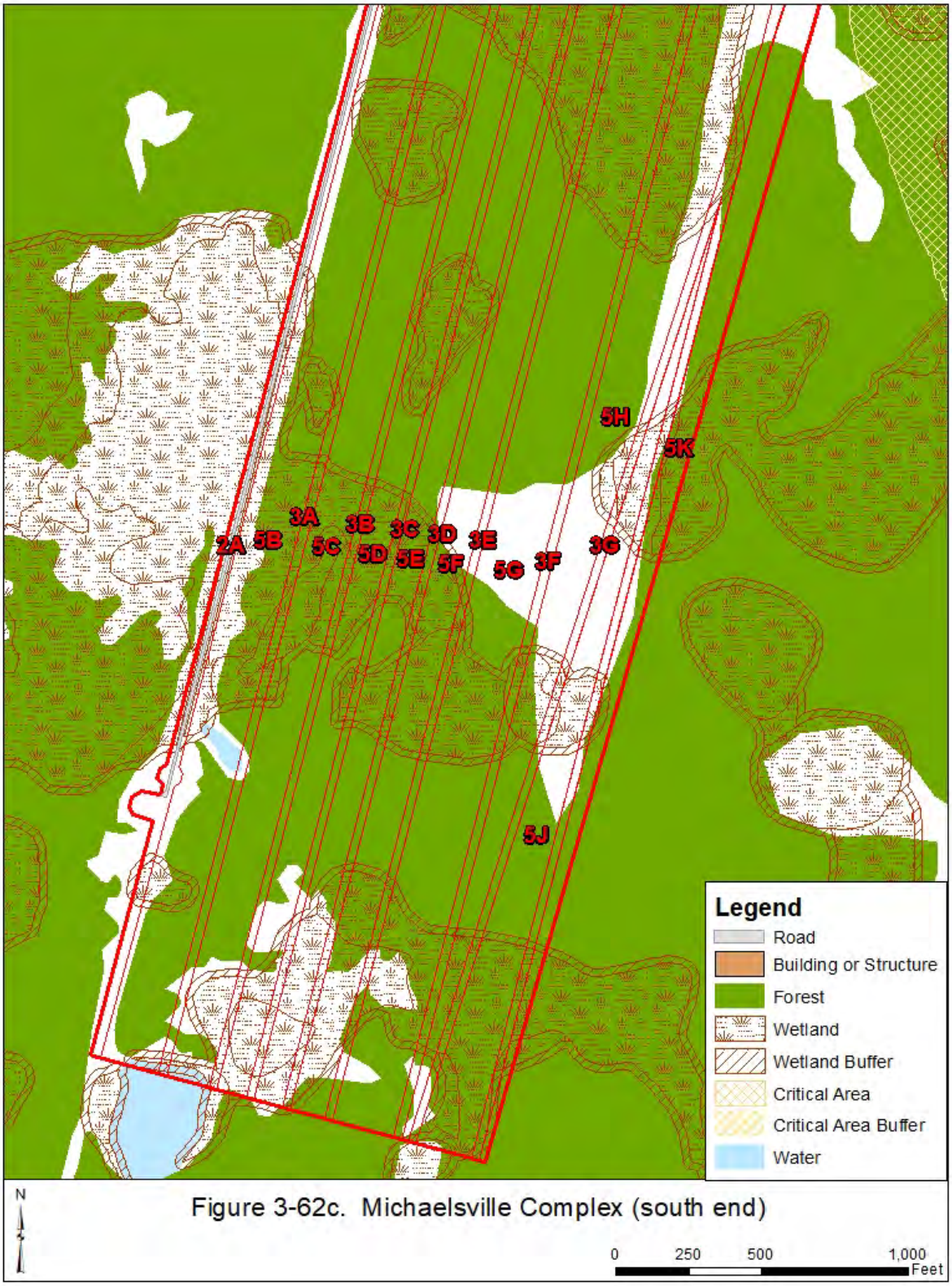

Figure 3-62c. Michaelsville Complex (south end)

3.2.44 Mile Loop

The Mile Loop is located in the Aberdeen Area. The range encompasses approximately 41 acres.

The Mile Loop is delineated into 3 areas (Figure 3-63) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	27
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	4.3
3	Natural Area	Conservation	Monitor for encroachment	9.5

Figure 3-63. Mile Loop

3.2.45 Mulberry Point Complex

The Mulberry Point Complex is located in the Aberdeen Area. The range encompasses approximately 69 acres.

The Mulberry Point Complex is delineated into 5 areas (Figure 3-64) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	63
2	Support Area (A – area around B635) (B – area around Arborvitae trees)	Mechanical, with or without herbicide spraying	Every 3 years	0.7 (A) 0.3 (B)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.8 (A) 1 (B) 0.2 (C) 0.07 (D)
4	Natural Area	Conservation	Monitor for encroachment	2.6
5	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.05

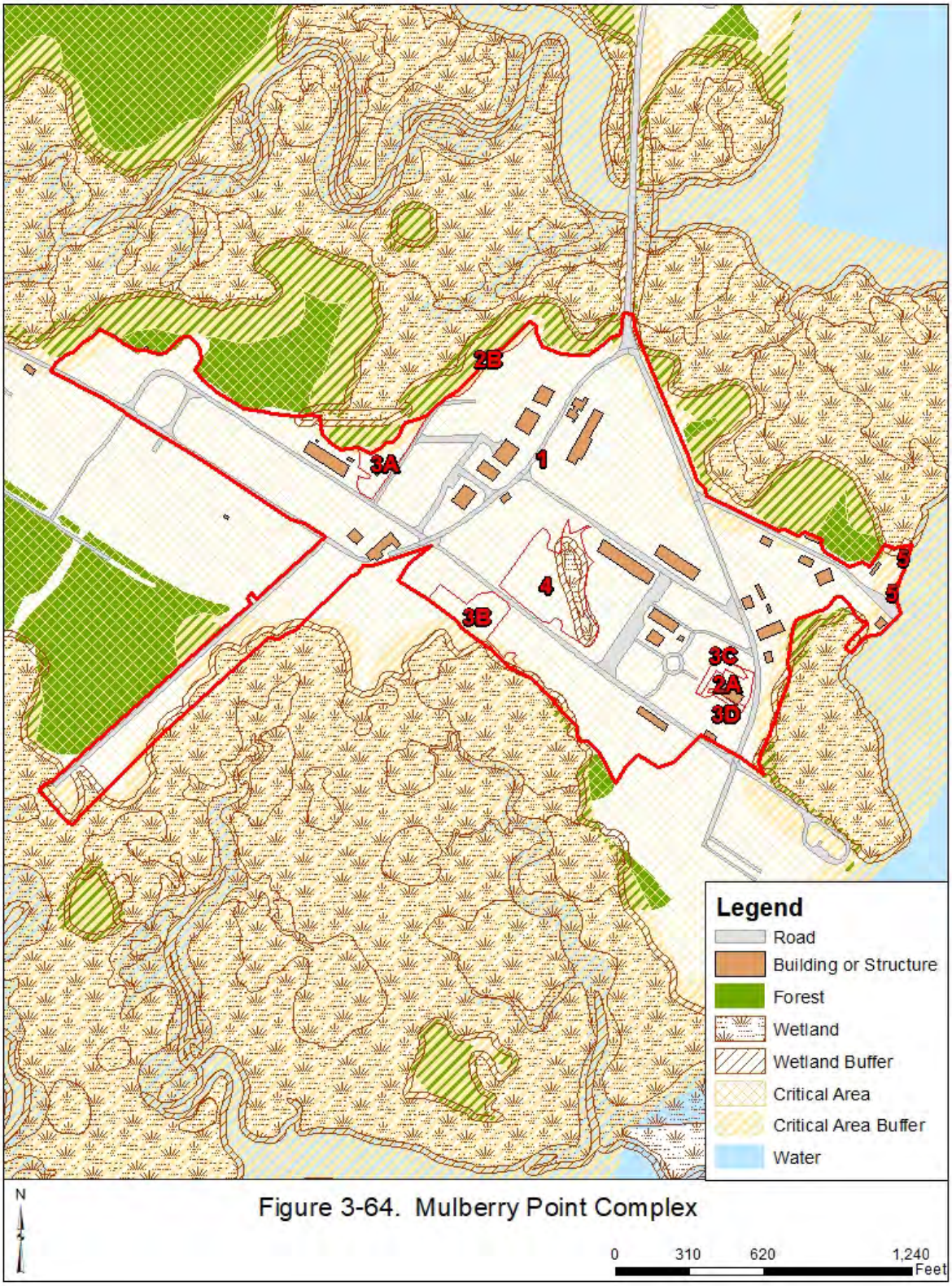

Figure 3-64. Mulberry Point Complex

3.2.46 Munson Test Area

The Munson Test Area is located in the Aberdeen Area. The range encompasses approximately 150 acres.

The Munson Test Area is delineated into 4 areas (Figure 3-65) with associated vegetation maintenance prescriptions. Area 4 represents a small stand of trees that encroach on a portion of the test course.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	136 (A) 0.6 (B) 1.1 (C)
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	3.2 (A) 4.1 (B) 1 (C) 3.1 (D)
3	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	0.02 (A) 0.09 (B) 0.06 (C) 0.03 (D) 0.2 (E) 0.3 (F) 0.09 (G)
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Once, then maintain as open (Area 1)	0.03

Figure 3-65. Munson Test Area

3.2.47 New Bombing Field

The New Bombing Field is located in the Aberdeen Area. The range encompasses approximately 319 acres.

The New Bombing Field is delineated into 9 areas (Figures 3-66a, 3-66b, and 3-66c) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (Cod Creek Road, access roads, pads)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 3 years	17
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 3 years	1.8
3	Support Area (A – field/marsh, Abbey Point Road to Tower Point Road) (B – field/marsh, west of Cod Creek Road) (C - field/marsh, east of Cod Creek Road)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	6.1 (A) 102 (B) 123 (C)
4	Support Area (A, B, C – utility right-of-way east of Cod Creek Road)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	0.6 (A) 0.4 (B) 0.05 (C) 7.8 (D) 5.1 (E)
5	Support Area (F3/F4 firing line)	Mechanical, with or without herbicide spraying	Every 20 years	7.1
6	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	0.2 (A) 2.6 (B) 3.5 (C)
7	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 10 years	0.3 (A) 1.7 (B) 2.5 (C) 2.8 (D)
8	Natural Area	Conservation	Monitor for encroachment	36 (A) 1.3 (B)
9	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	3.1

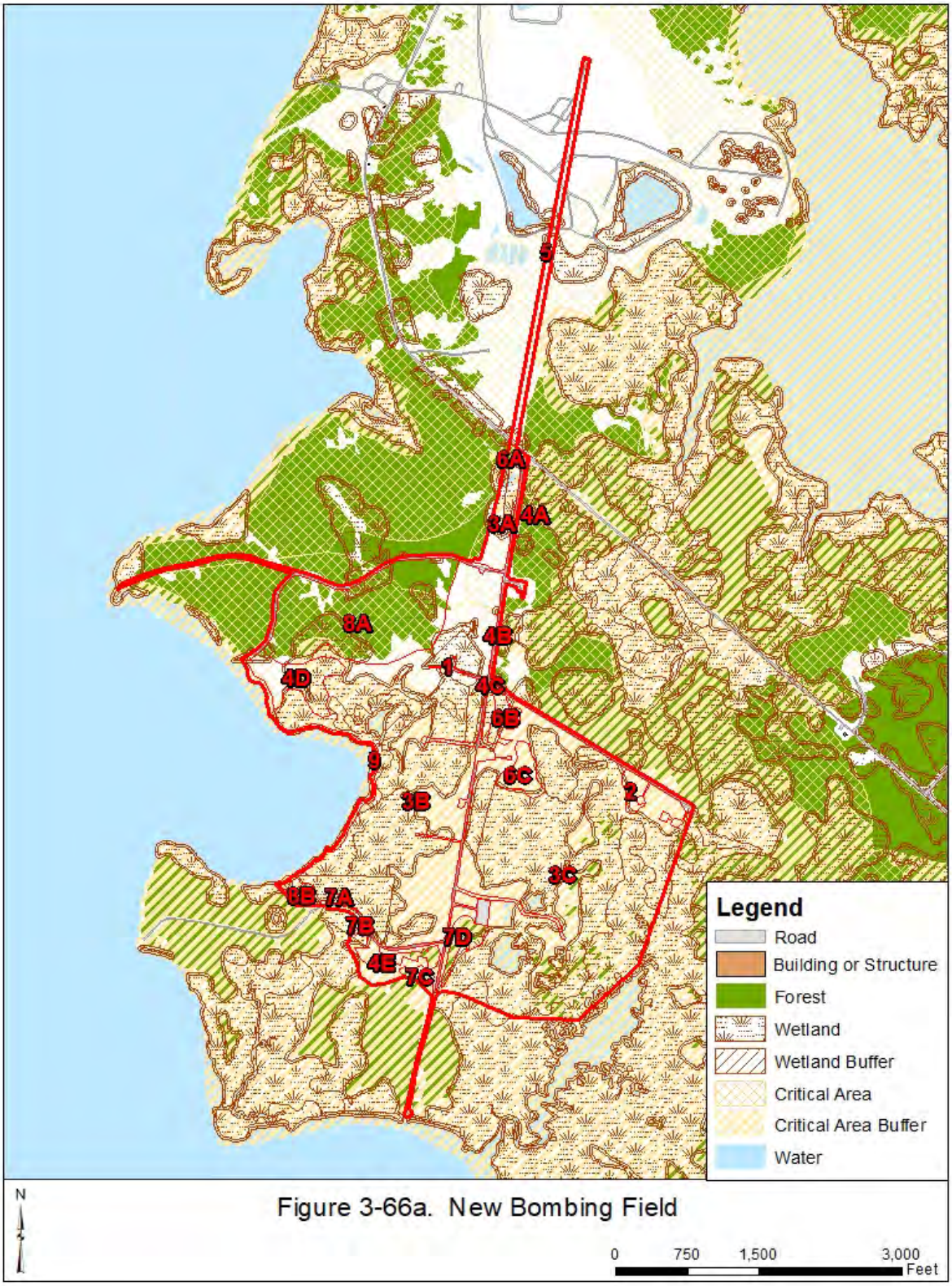

Figure 3-66a. New Bombing Field

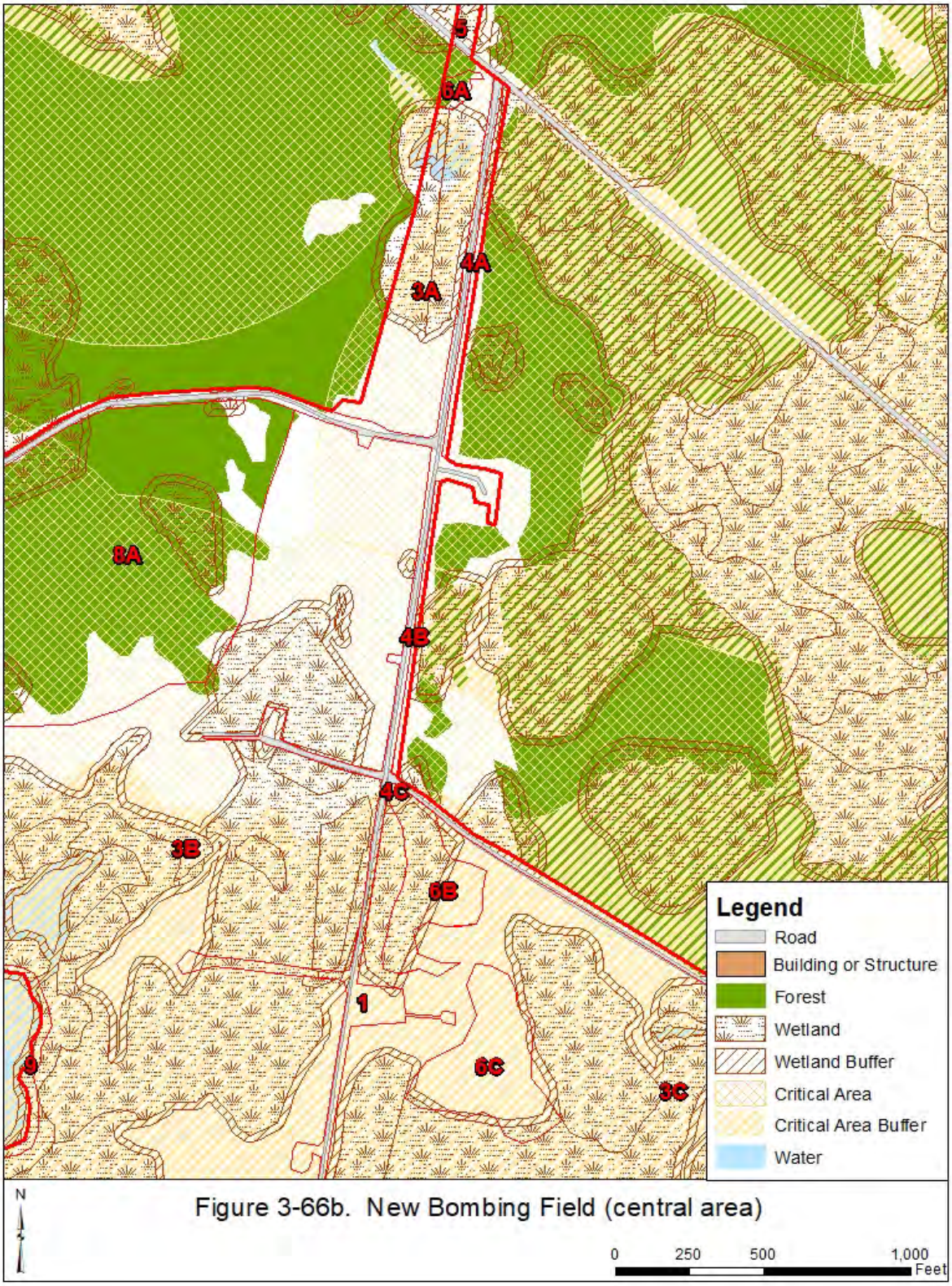

Figure 3-66b. New Bombing Field (central area)

Figure 3-66c. New Bombing Field (south end)

3.2.48 New Rough Handling Facility

The New Rough Handling Facility is located in the Aberdeen Area. The range encompasses approximately 16 acres.

The New Rough Handling Facility is delineated into 2 areas (Figure 3-67) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	15
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	1.2 (A) 0.06 (B)

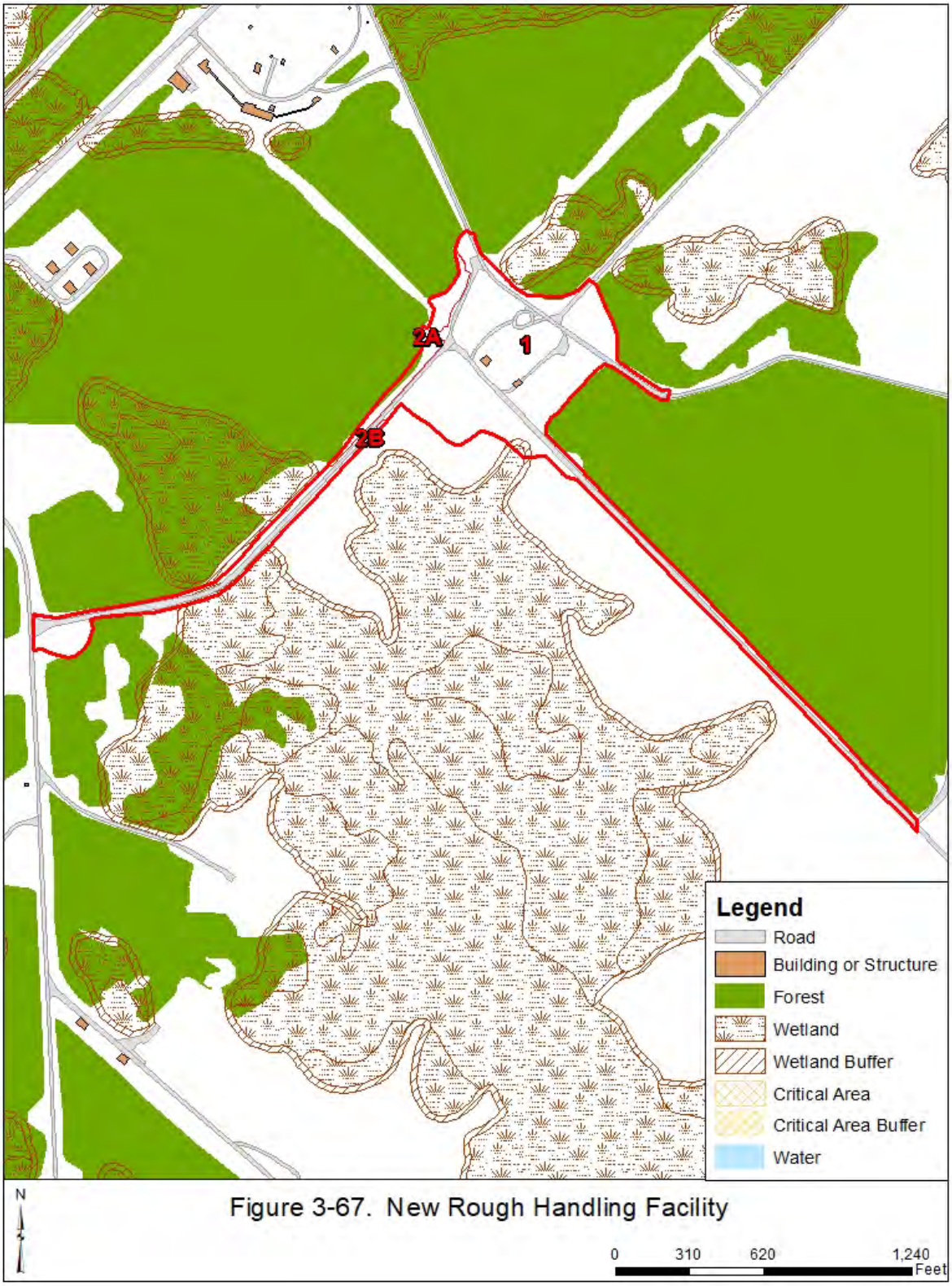

Figure 3-67. New Rough Handling Facility

3.2.49 Open Burning/Open Detonation (OB/OD) Area

The OB/OD Area is located in the Aberdeen Area. The range encompasses approximately 33 acres. There is a small berm (Area 4) around the north, east, and part of south end of the OD area (Area 1).

The OB/OD Area is delineated into 4 areas (Figure 3-68) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (OD area, equipment staging area)	Mowing, grading	Twice per year (mowing), small area grading conducted after each detonation to fill in large craters and limit ponding	19
2	Open (OB area, storage area)	Mowing	Twice per year	12
3	Stormwater management	Mechanical, with spot herbicide application on stone overflow weirs	Once per year (spot herbicide application on stone overflow weirs); every 7-10 years for mucking (or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	0.2 (A) 0.2 (B)
4	Berm	Mechanical, with or without herbicide spraying	Every 2 years	0.6

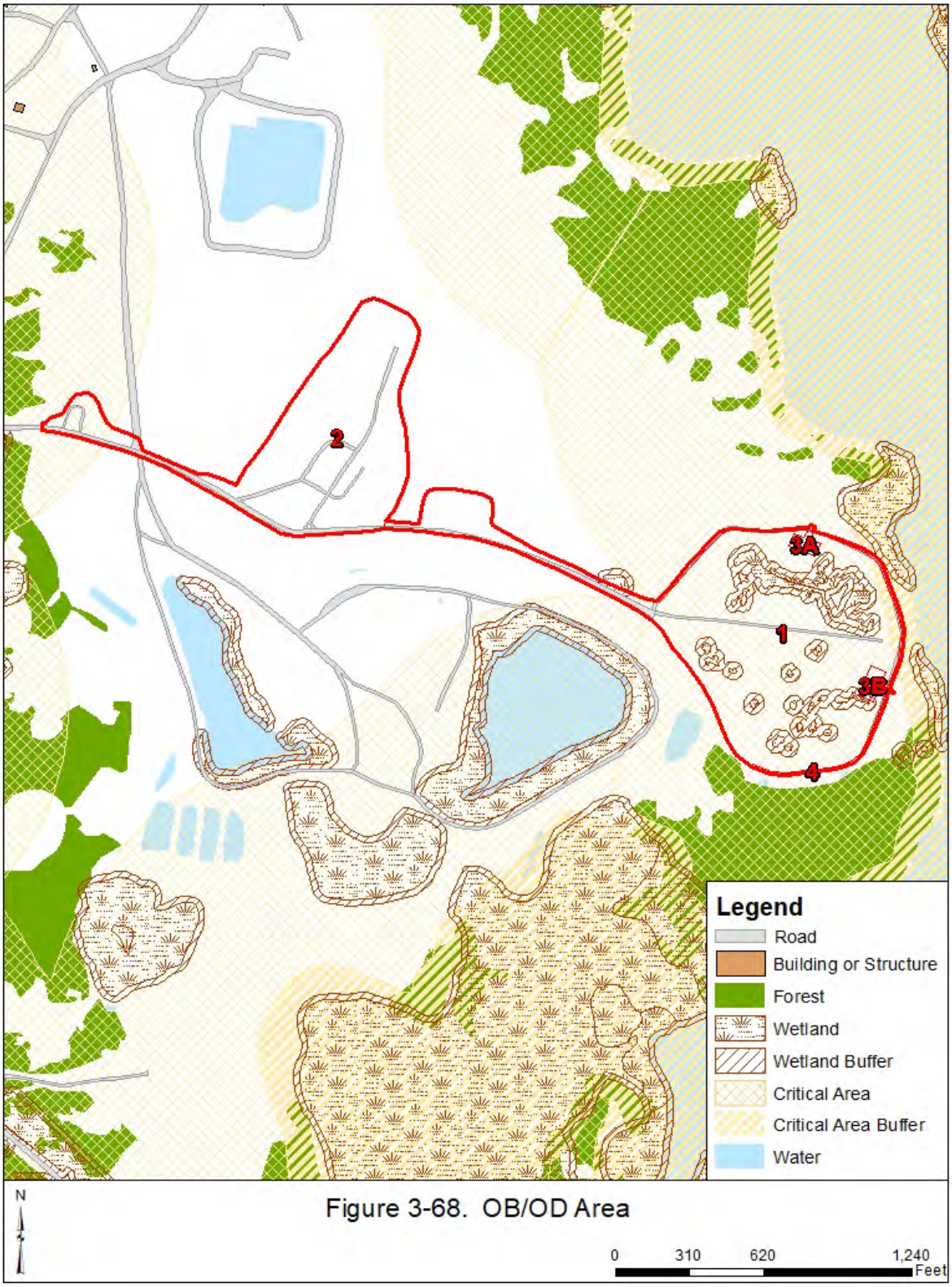

Figure 3-68. OB/OD Area

3.2.50 Perryman Test Area

The Perryman Test Area is located in the Aberdeen Area. The range encompasses approximately 853 acres.

The Perryman Test Area is delineated into 8 areas (Figures 3-69a, 3-69b, 3-69c, and 3-69d) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (A – tank access road) (B – 3mi Straight Away) (C – Cross Country #1) (D – Cross Country #2 and Bivouac Site #4) (E – Palmer Road) (F – Secondary A and Bivouac Site #3) (G – Cross Country #3 and Bivouac Site #2)	Mowing	Twice per year	12 (A) 109 (B) 94 (C) 38 (D) 22 (E) 46 (F) 82 (G)
2	Stormwater Management (stormwater pond)	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	7.3
3	Encroachment – Trees to Clear (stormwater pond)	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	1.3
4	Support Area (A – Dig Site #1) (B – Dig Site #2) (C – Dig Site #3) (D – Dig Site #4)	Mechanical, with or without herbicide spraying	Once per year	7.5 (A) 5.9 (B) 3.5 (C) 2.8 (D)
5	Support Area (Auxiliary Landing Field and Bivouac Site #1)	Mechanical, with or without herbicide spraying	Every 2 years	2.4
6	Support Area (A – access road to range tower) (B – Ride Quality) (C – Cross Country #4)	Mechanical (and/or controlled burn for C), with or without herbicide spraying	Every 5 years	0.5 (A) 3.6 (B) 82 (C)

7	Encroachment – Trees to Clear (A – access road to range tower) (B – Ride Quality)	Mechanical, with or without herbicide spraying	Every 5 years	0.06 (A) 1.4 (B)
8	Natural Area	Conservation	Monitor for encroachment	327

Figure 3-69a. Perryman Test Area

Figure 3-69b. Perryman Test Area (north end)

Figure 3-69c. Perryman Test Area (central area)

Figure 3-69d. Perryman Test Area (south end)

3.2.51 Phillips Army Airfield (PAAF)

The PAAF is located in the Aberdeen Area. The range encompasses approximately 650 acres.

The PAAF is delineated into 2 areas (Figures 3-70a, 3-70b, and 3-70c) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	30 (A) 620 (B)
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Once, then maintain as open (Area 1)	0.03 (A) 0.2 (B) 4.3 (C) 0.5 (D) 0.03 (E) 1.1 (F) 0.7 (G) 0.3 (H) 14 (I) 3.1 (J) 3.3 (K) 0.2 (L) 4.1 (M) 0.3 (N) 0.2 (O) 0.07 (P) 0.1 (Q) 0.1 (R)

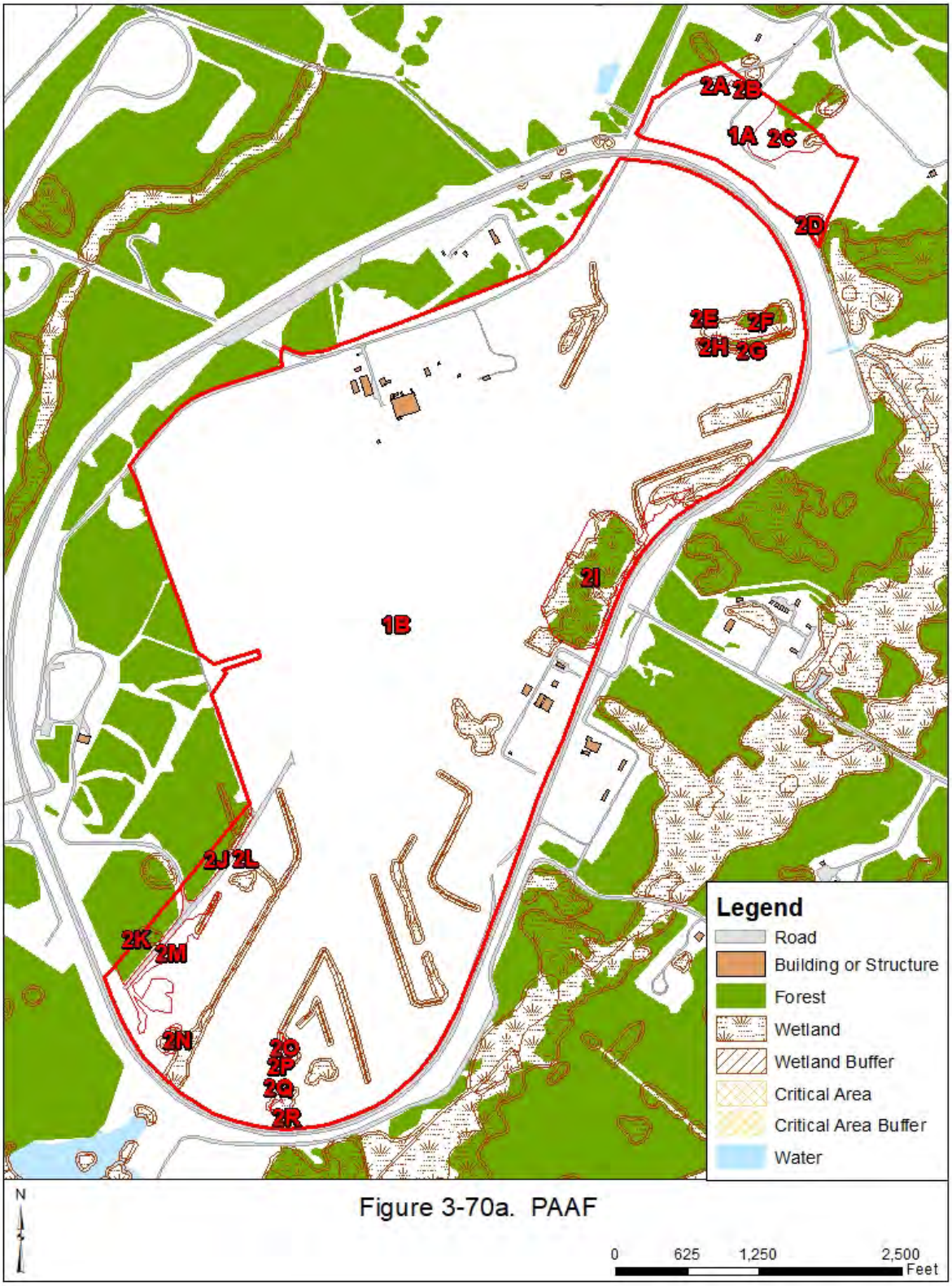

Figure 3-70a. PAAF

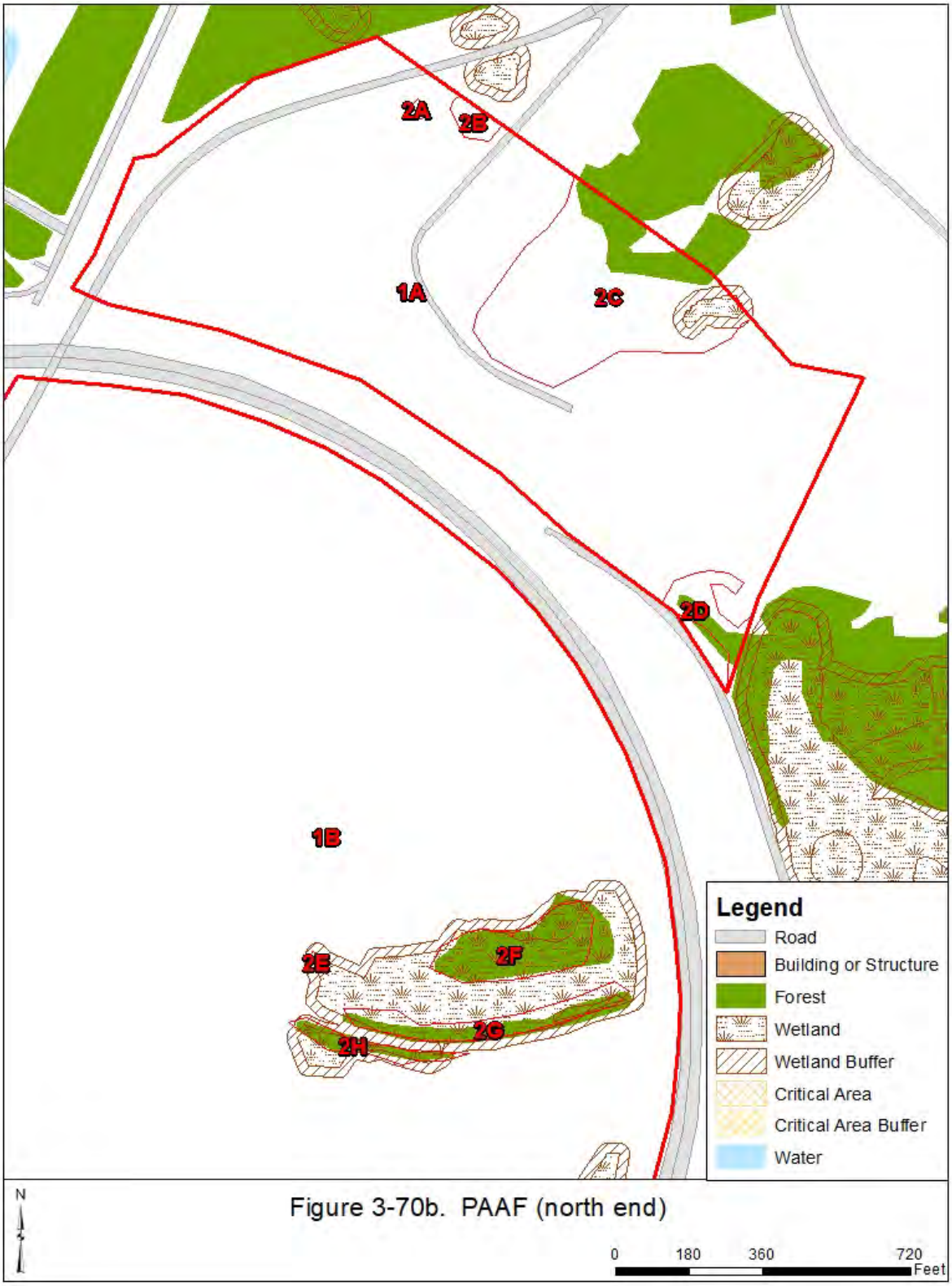

Figure 3-70b. PAAF (north end)

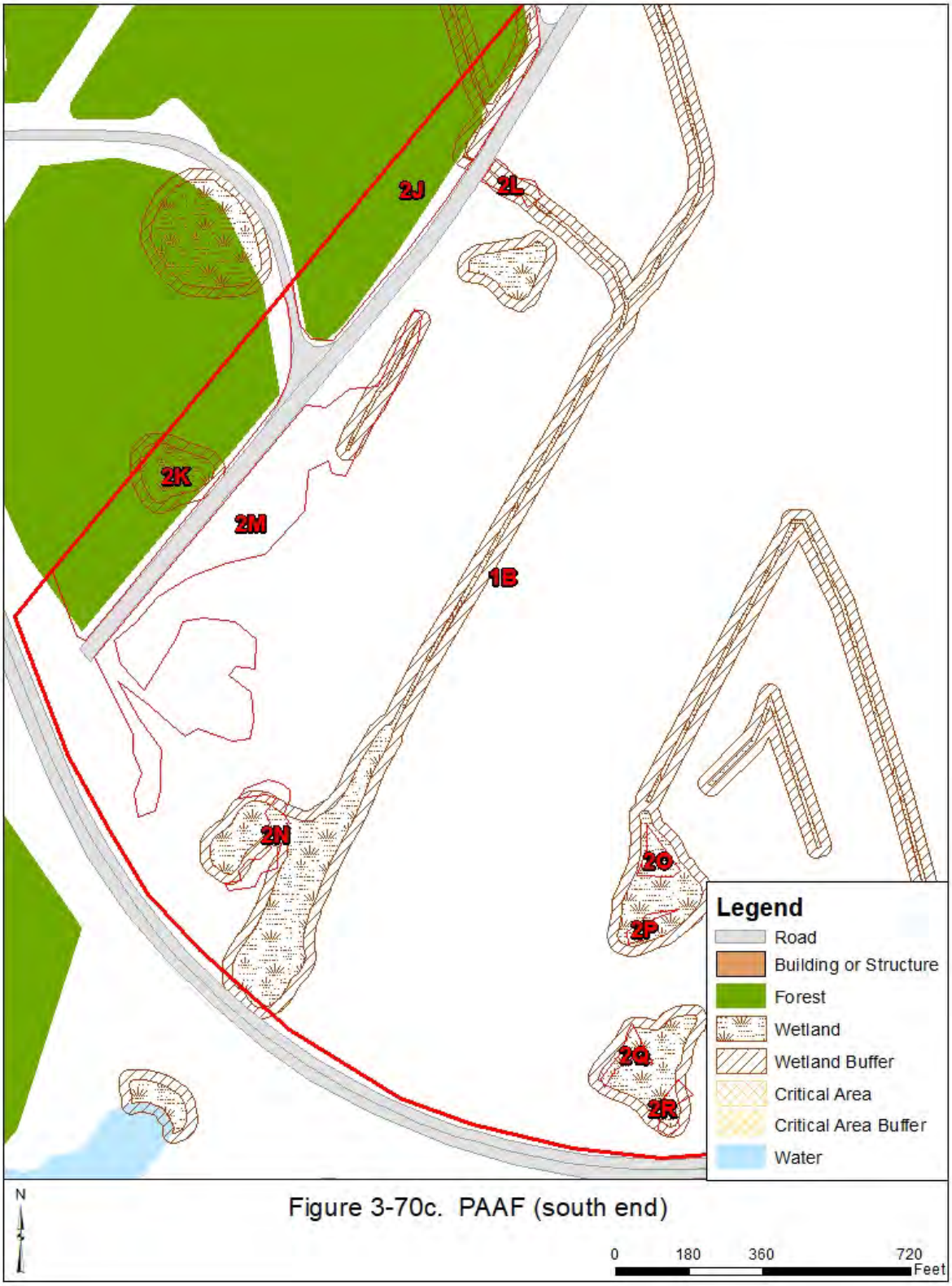

Figure 3-70c. PAAF (south end)

3.2.52 Poverty Island

The Poverty Island range is located in the Aberdeen Area. The range encompasses approximately 98 acres.

The Poverty Island range is delineated into 6 areas (Figure 3-71) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	91
2	Support Area (egress road)	Mechanical, with or without herbicide spraying	Every 5 years	0.3
3	Encroachment – Trees to Clear (B – fence line)	Mechanical, with or without herbicide spraying	Once, then maintain as open (Area 1)	0.2 (A) 0.6 (B)
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 2 years	1.4
5	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.1 (A) 0.05 (B) 0.9 (C)
6	Natural Area	Conservation	Monitor for encroachment	2.9 (A) 1 (B) 0.2 (C)

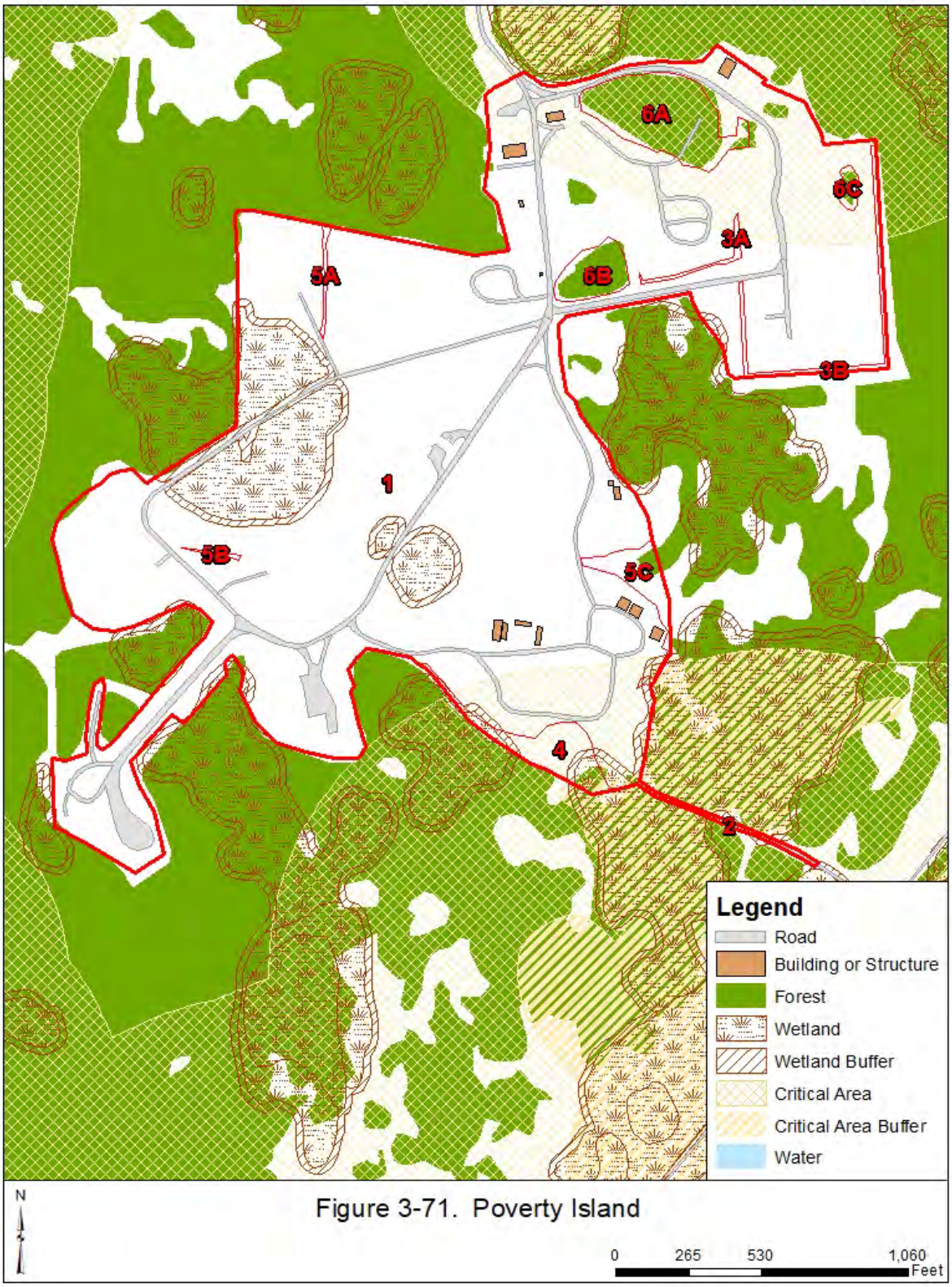

Figure 3-71. Poverty Island

3.2.53 Range 18

The Range 18 is located on Spesutie Island in the Aberdeen Area. The range encompasses approximately 38 acres.

Range 18 is delineated into 6 areas (Figure 3-72) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	16
2	Magazine	Mechanical, with or without herbicide spraying	Once per year	0.3
3	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	1.6 (A) 6.8 (B) 1.4 (C) 0.4 (D)
4	Natural Area – Mitigation	Conservation	Monitor for encroachment	0.3 (A) 0.2 (B)
5	Natural Area	Conservation	Monitor for encroachment	0.08 (A) 8.7 (B)
6	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	2.4

Figure 3-72. Range 18

3.2.54 Recoilless Range B (RRB)

The RRB range is located in the Aberdeen Area. The range encompasses approximately 20 acres.

The RRB range is delineated into 5 areas (Figure 3-73) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing, with or without controlled burn	Twice per year	12
2	Support Area	Mechanical and/or controlled burn, with or without herbicide spraying	Every 3 years	6
3	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	1.9
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.01 (A) 0.03 (B)
5	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 5 years	0.3

Figure 3-73. RRB

3.2.55 Recoilless Rifle

The Recoilless Rifle range is located in the Aberdeen Area. The range encompasses approximately 6 acres.

The Recoilless Rifle range is delineated into 4 areas (Figure 3-74) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	2.4
2	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	2.4
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.3 (A) 0.3 (B)
4	Natural Area	Conservation	Monitor for encroachment	0.4

Figure 3-74. Recoilless Rifle

3.2.56 Romney Creek

The Romney Creek range is located in the Aberdeen Area. The range encompasses approximately 72 acres.

The Romney Creek range is delineated into 5 areas (Figures 3-75a, 3-75b, and 3-75c) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (range road, Firing House to creek)	Mowing	Twice per year	17
2	Support Area (A – 1000M to egress road) (B – RC2)	Mechanical, with or without herbicide spraying	Every 5 years	4.3 (A) 0.3 (B)
3	Support Area (A – range road, RC13 to Firing House) (B – Firing House to egress road) (C – egress road to RC2) (D – RC2 to Elevation/Depression) (E – Elevation/Depression) (F – Elevation/Depression to creek)	Mechanical, with or without herbicide spraying	Every 10 years	6.9 (A) 2.6 (B) 11 (C) 3.6 (D) 0.6 (E) 6 (F)
4	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 10 years	0.06 (A) 0.08 (B) 0.02 (C) 0.2 (D) 0.5 (E) 0.05 (F) 0.02 (G) 0.8 (H) 0.4 (I) 0.05 (J) 0.03 (K)
5	Natural Area	Conservation	Monitor for encroachment	17 (A) 0.3 (B)

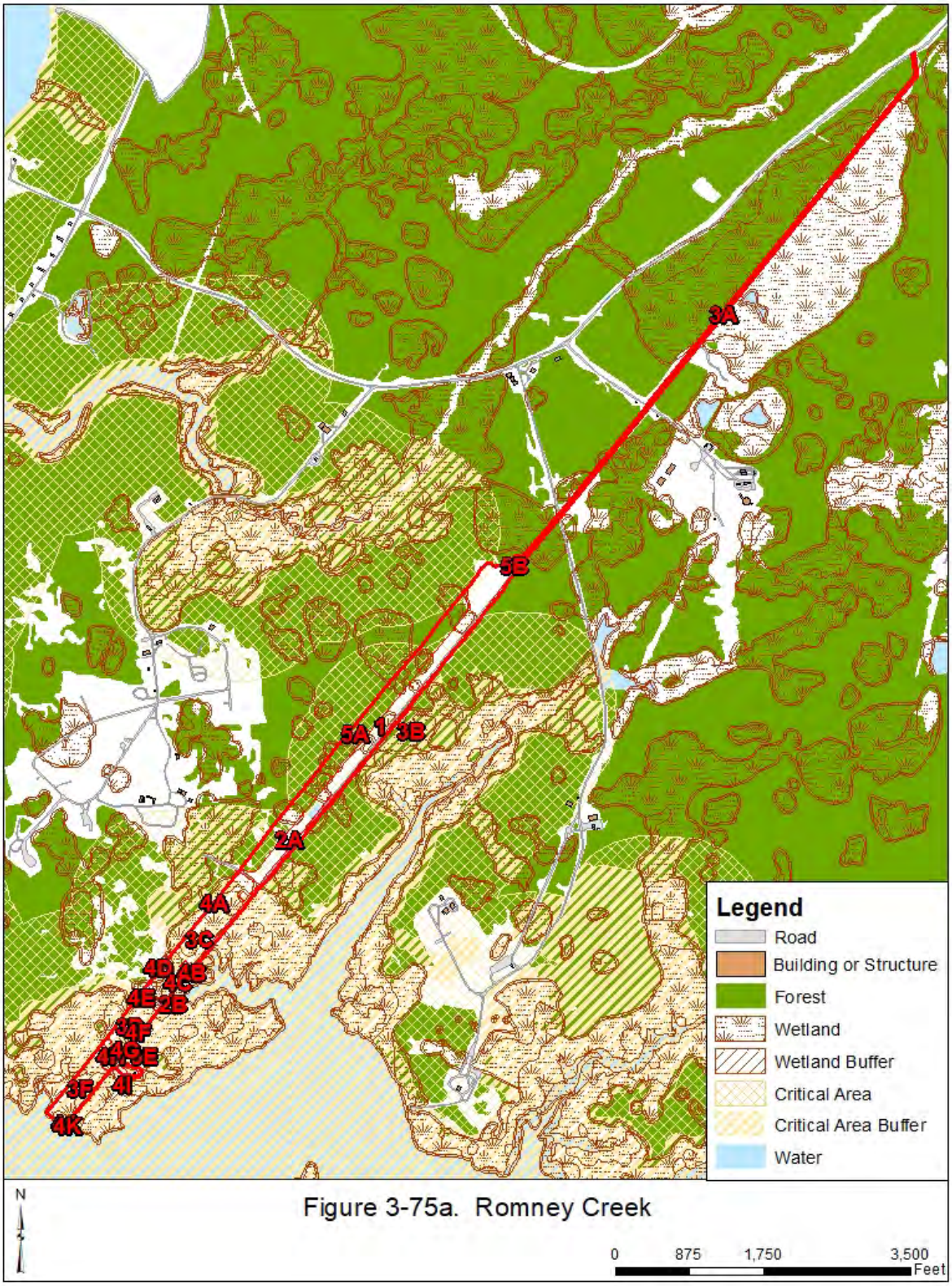

Figure 3-75a. Romney Creek

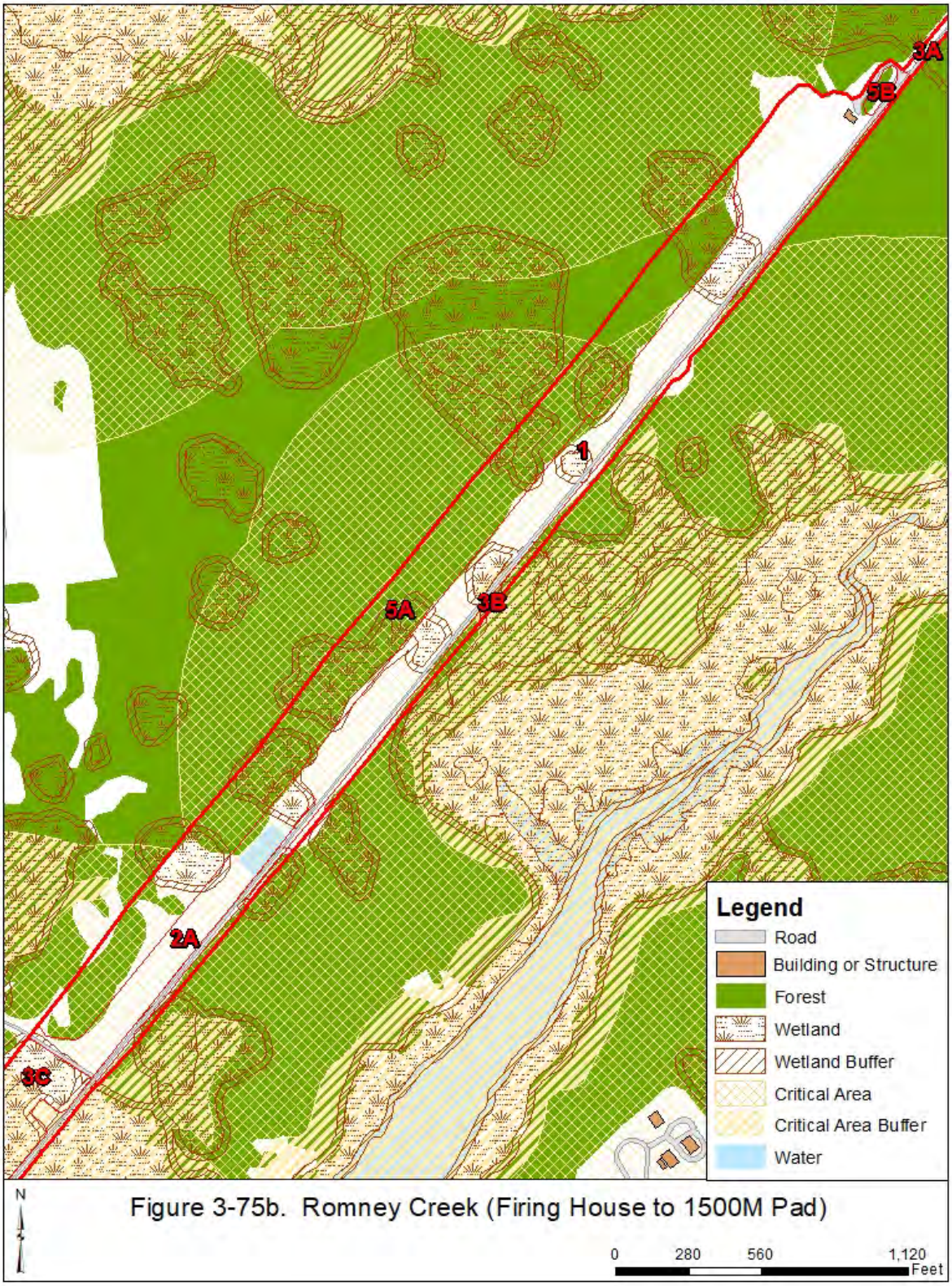

Figure 3-75b. Romney Creek (Firing House to 1500M Pad)

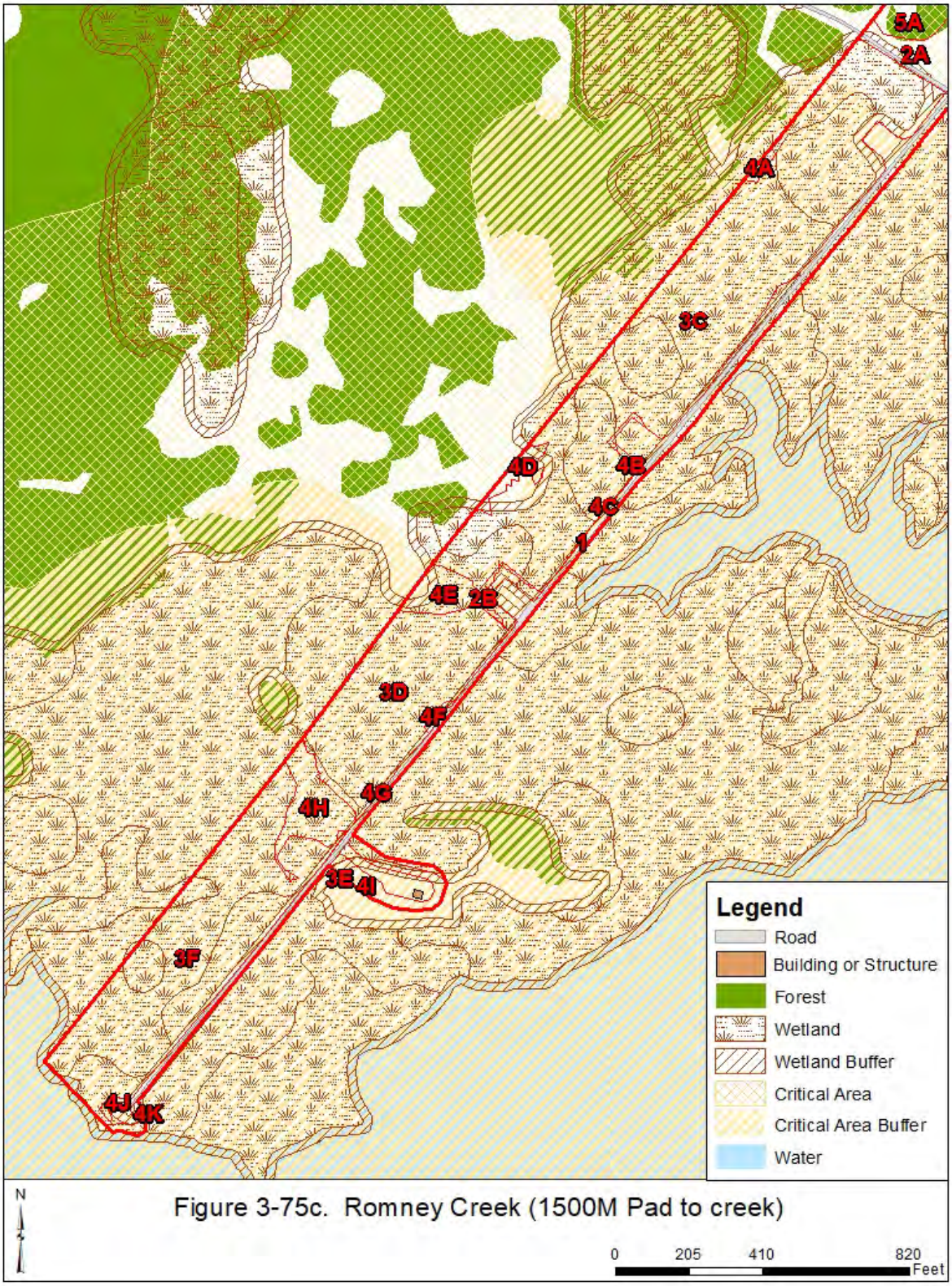

Figure 3-75c. Romney Creek (1500M Pad to creek)

3.2.57 Tilt Table

The Tilt Table is located in the Aberdeen Area. The range encompasses approximately 2 acres.

The Tilt Table is delineated into 2 areas (Figure 3-76) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	2.1
2	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.2

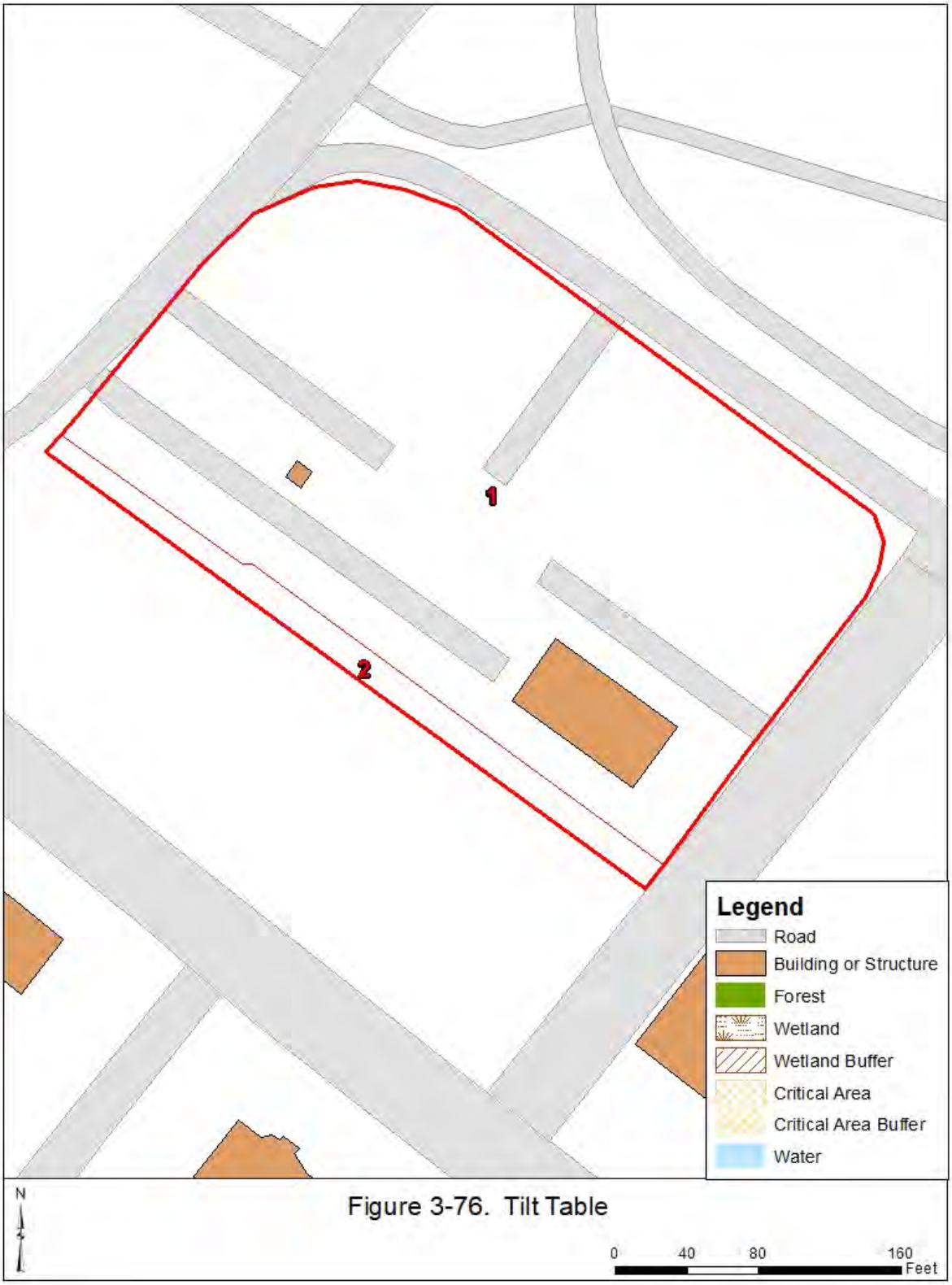

Figure 3-76. Tilt Table

3.2.58 Trench Warfare

The Trench Warfare range is located in the Aberdeen Area. The range encompasses approximately 686 acres.

The Trench Warfare range is delineated into 9 areas (Figures 3-77a, 3-77b, and 3-77c) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	26
2	Stormwater Management	Mechanical	Once per year, or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	1
3	Support Area (A – range roads, south of 1000M)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 3 years	15 (A) 90 (B) 67 (C) 48 (D)
4	Support Area (A – 1500M to laser board)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	51 (A) 2.4 (B) 1.7 (C)
5	Support Area (A – 1000M to laser board)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 10 years	114 (A) 27 (B) 1.6 (C) 18 (D)
6	Encroachment – Trees to Clear (1500M to laser board)	Mechanical and/or controlled burn, with or without herbicide spraying	Every 5 years	6.2 (A) 0.2 (B) 0.1 (C) 2.4 (D) 1.5 (E)
7	Encroachment – Trees to Clear (1000M to 3000M)	Mechanical, with or without herbicide spraying	Every 10 years	22 (A) 0.5 (B) 71 (C) 22 (D)
8	Support Area	Not applicable	None required	0.3
9	Natural Area	Conservation	Monitor for encroachment	5.4 (A) 1.2 (B) 46 (C) 44 (D)

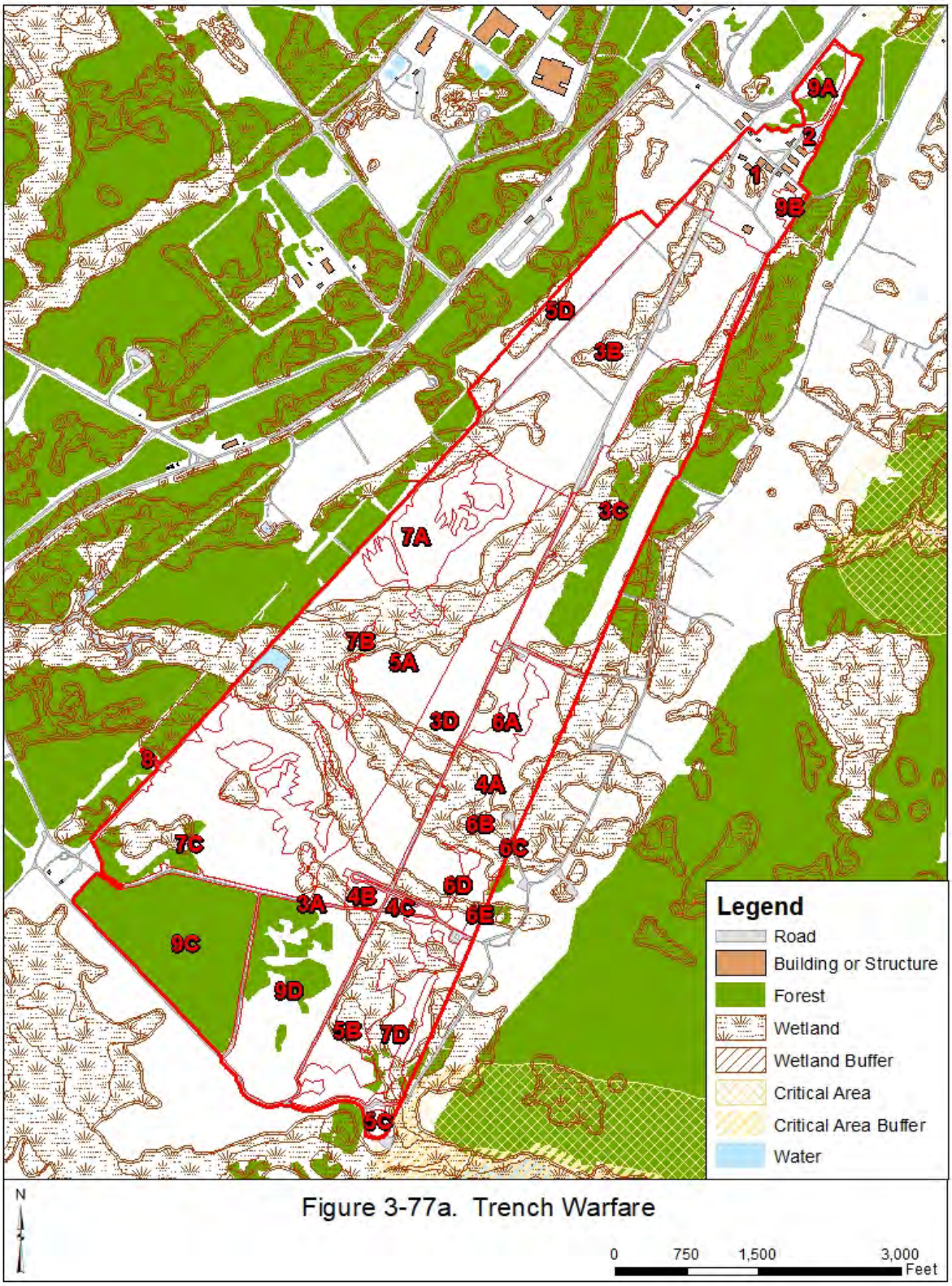

Figure 3-77a. Trench Warfare

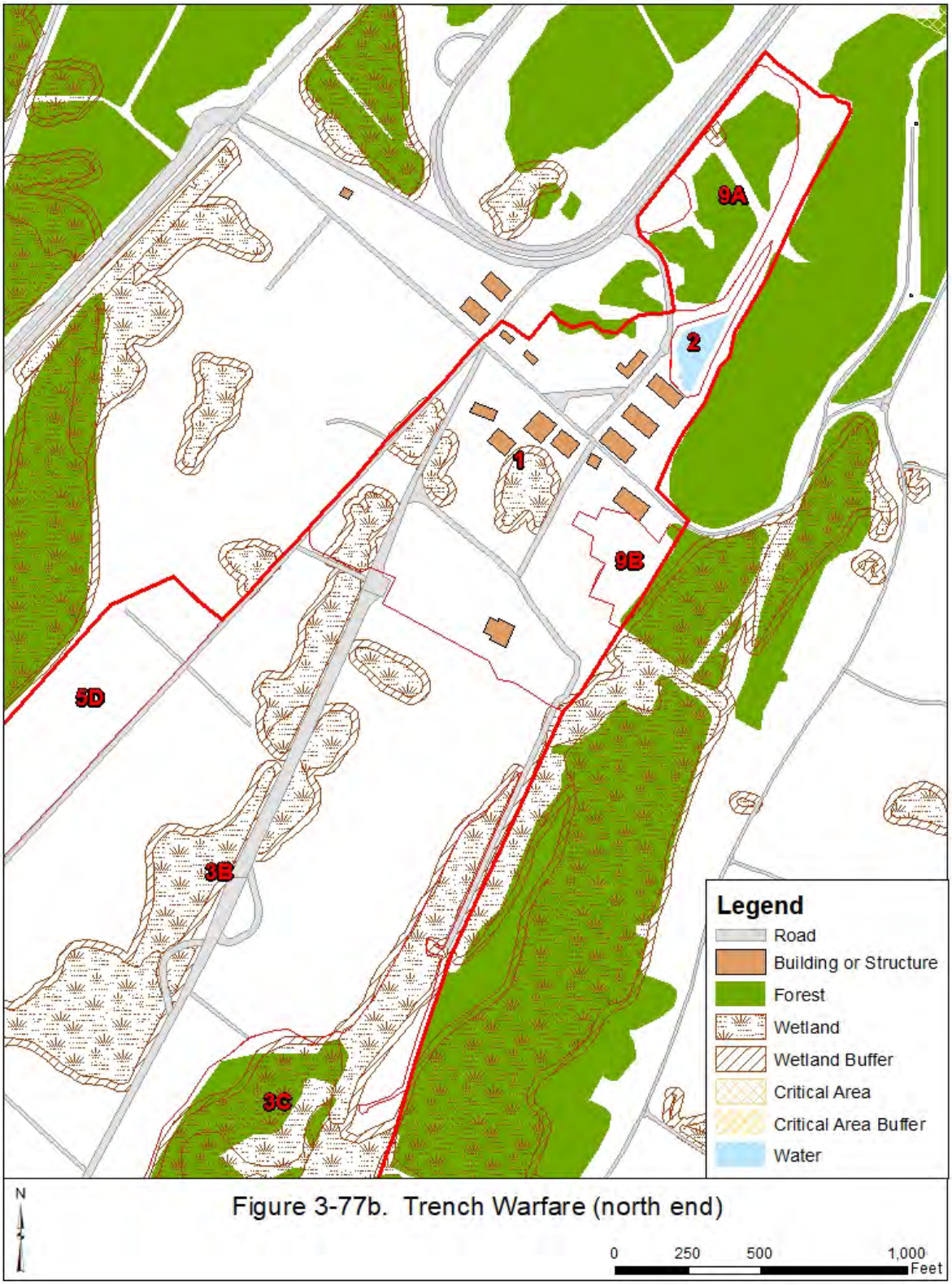

Figure 3-77b. Trench Warfare (north end)

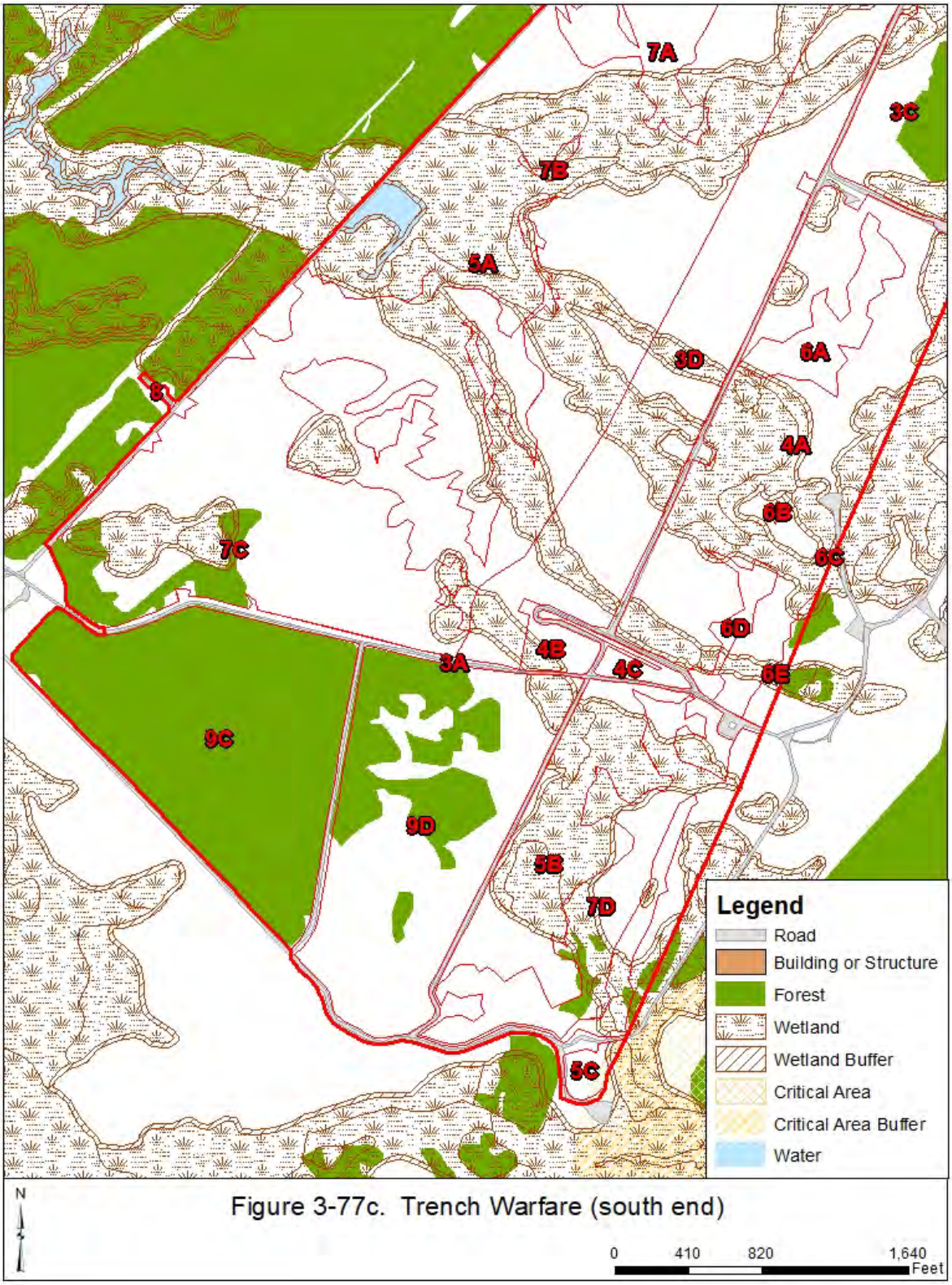

Figure 3-77c. Trench Warfare (south end)

3.2.59 Underwater Explosion Test Facility (UTF)

The UTF is located in the Aberdeen Area. The range encompasses approximately 65 acres.

The UTF is delineated into 4 areas (Figure 3-78) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	28
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	32
3	Natural Area	Conservation	Monitor for encroachment	2.6 (A) 0.9 (B) 0.5 (C)
4	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	1 (A) 0.1 (B)

Figure 3-78. UTF

3.2.60 Unmanned Ground Vehicle (UGV) and Small Unmanned Ground Vehicle (SUGV) Test Area

The UGV and SUGV Test Area is located in the Aberdeen Area. The range encompasses approximately 310 acres.

The UGV and SUGV Test Area is delineated into 4 areas (Figure 3-79) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open (Rifle Range Road to B861)	Mowing	Twice per year	31
2	Artificial Wetland	Mowing	Re-route discharge, then maintain as open (Area 1)	0.03
3	Support Area (A – perimeter course) (B – bypass course)	Mechanical, with or without herbicide spraying	Every 3 years	8.8 (A) 4.1 (B) 13 (C)
4	Natural Area	Conservation	Monitor for encroachment	42 (A) 11 (B) 185 (C) 14 (D)

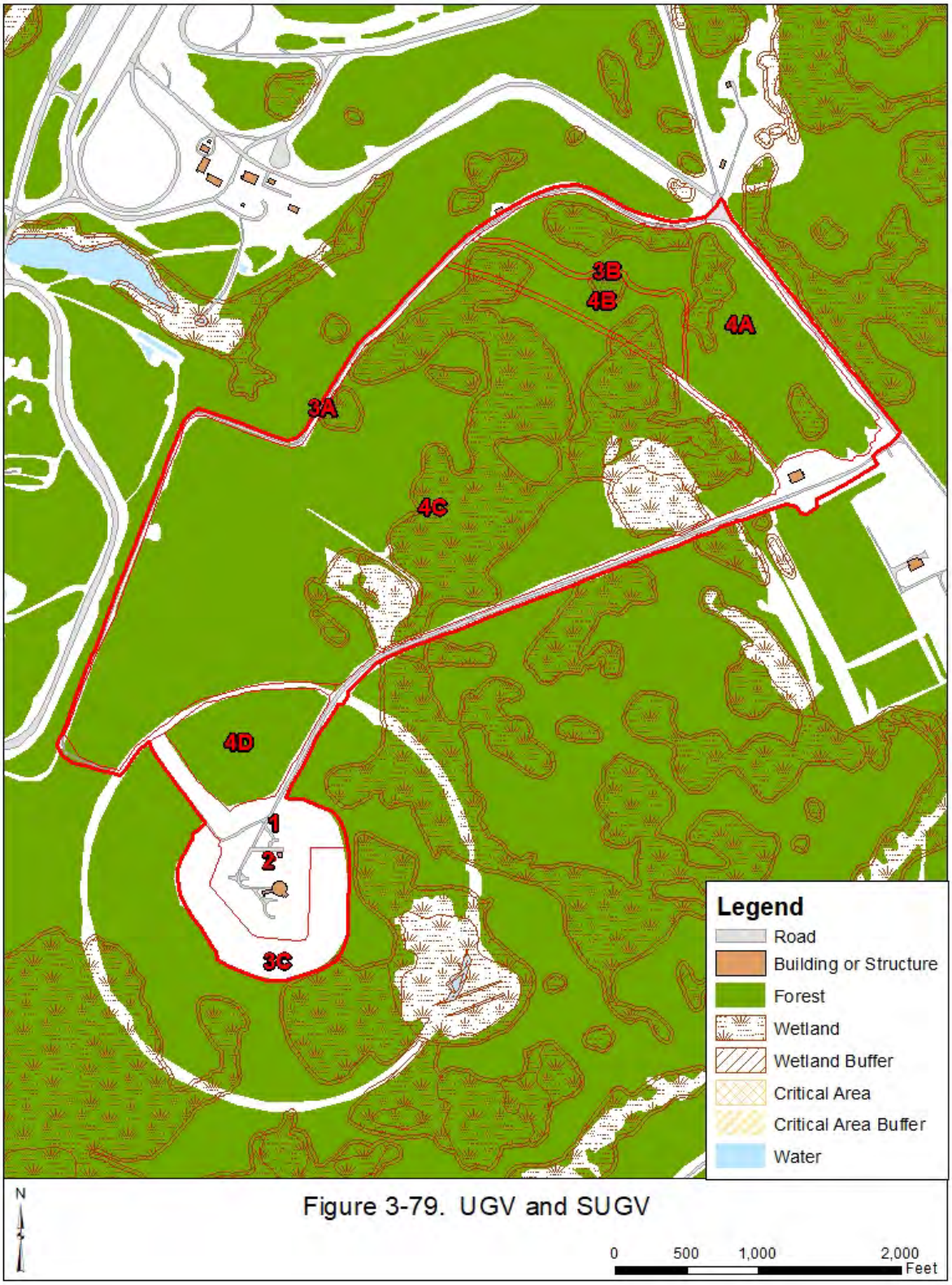

Figure 3-79. UGV and SUGV

3.2.61 Unexploded Ordnance (UXO) Detection Site

The UXO Detection Site is located in the Aberdeen Area. The range encompasses approximately 29 acres.

The UXO Detection Site is delineated into 3 areas (Figure 3-80) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	27
2	Berm	Mechanical, with or without herbicide spraying	Every 2 years	0.3 (A) 0.2 (B) 0.2 (C)
3	Natural Area	Conservation	Monitor for encroachment	0.4

Figure 3-80. UXO Detection Site

3.2.62 Vibration Facility

The Vibration Facility is located in the Aberdeen Area. The range encompasses approximately 15 acres.

The Vibration Facility is delineated into 3 areas (Figure 3-81) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	9.5
2	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	4.9 (A) 0.2 (B) 0.3 (C) 0.8 (D) 0.4 (E)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 3 years	0.08

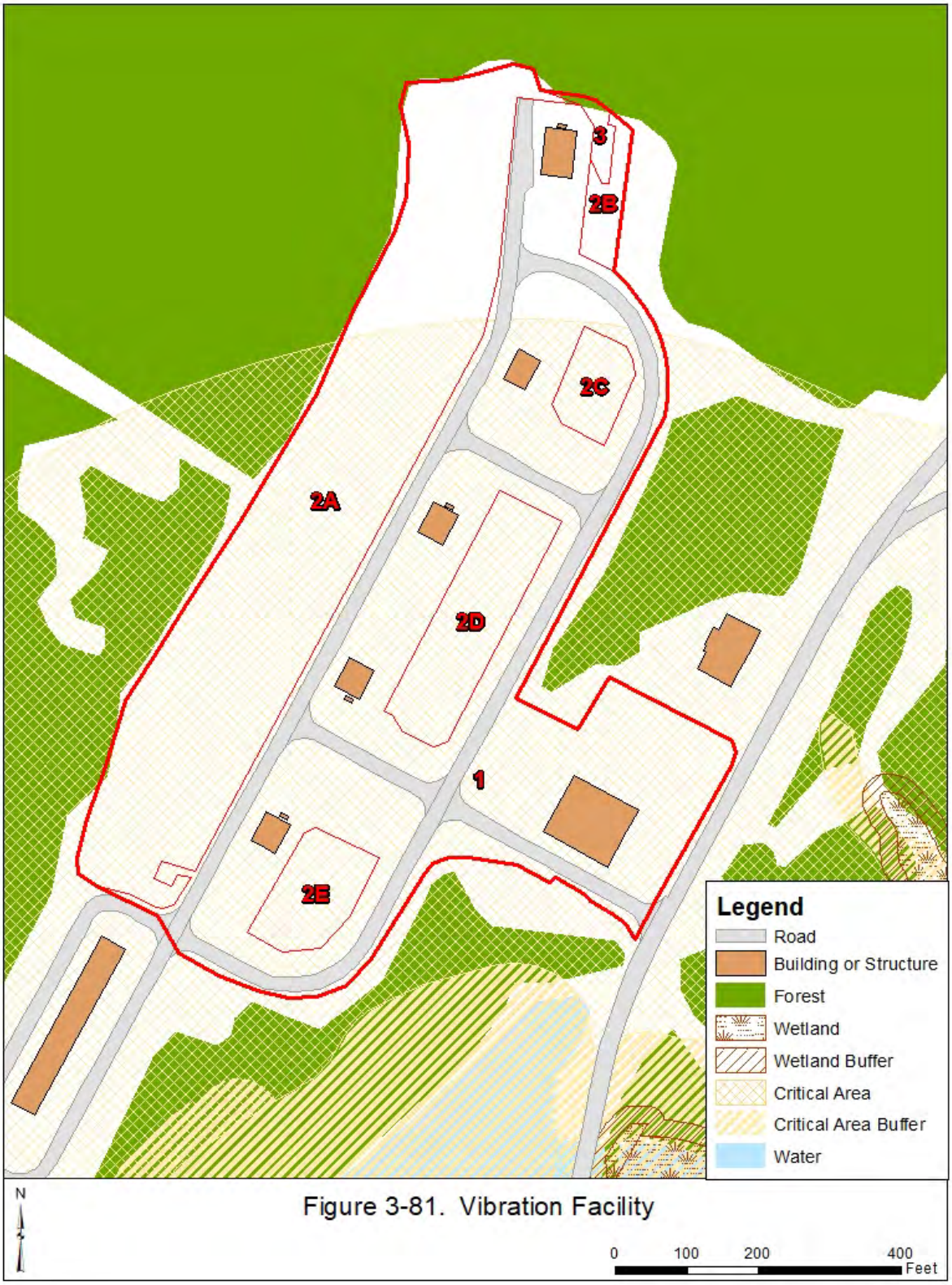

Figure 3-81. Vibration Facility

3.2.63 Wirsing Area

The Wirsing Area is located in the Aberdeen Area. The range encompasses approximately 51 acres.

The Wirsing Area is delineated into 4 areas (Figure 3-82) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	4.2 (A) 11 (B) 5.8 (C)
2	Support Area	Mechanical, with or without herbicide spraying	Every 10 years	8.2 (A) 9.2 (B)
3	Encroachment – Trees to Clear	Mechanical, with or without herbicide spraying	Every 10 years	1.8 (A) 0.02 (B) 0.003 (C) 3.7 (D) 1.1 (E)
4	Natural Area	Conservation	Monitor for encroachment	5.2 (A) 0.3 (B)

Figure 3-82. Wirsing Area

3.3 CBC RANGES

3.3.1 Building E1454 Bunker Yard

The Building E1454 Bunker Yard is located in the Edgewood Area. The range encompasses approximately 3 acres.

The Building E1454 Bunker Yard is delineated into a single area (Figure 3-83) with associated vegetation maintenance prescription.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	3.5

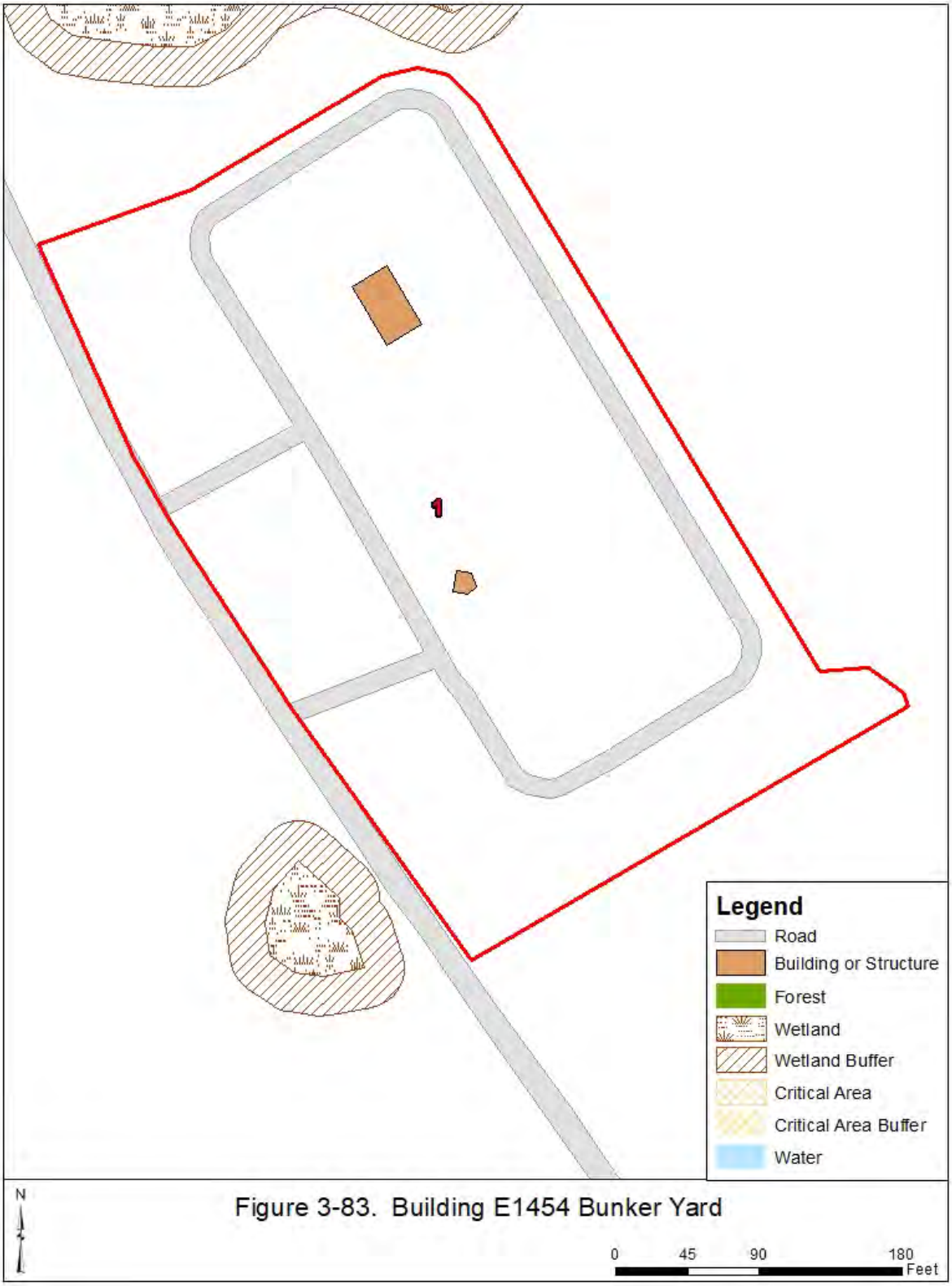

Figure 3-83. Building E1454 Bunker Yard

3.3.2 Building E7368

The Building E7368 is located in the Edgewood Area. The range encompasses approximately 0.2 acres.

The Building E7368 is delineated into a single area (Figure 3-84) with associated vegetation maintenance prescription.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	0.2

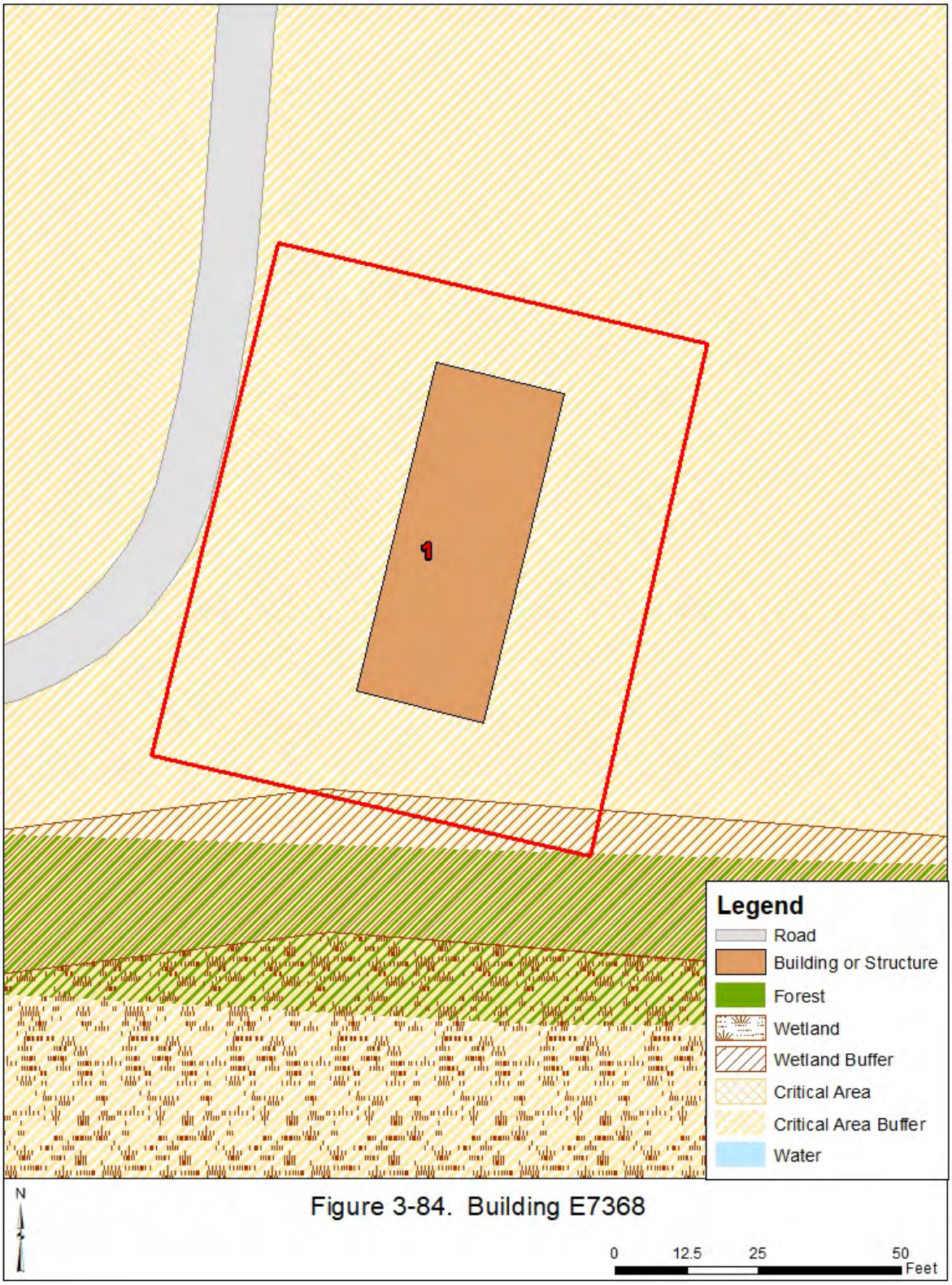

Figure 3-84. Building E7368

3.3.3 G Field

The G Field range is located in the Edgewood Area. The range encompasses approximately 16 acres.

The G Field range is delineated into 2 areas (Figure 3-85) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	4.5
2	Gravel stands, pads	Mechanical, with or without herbicide spraying	Once per year	11

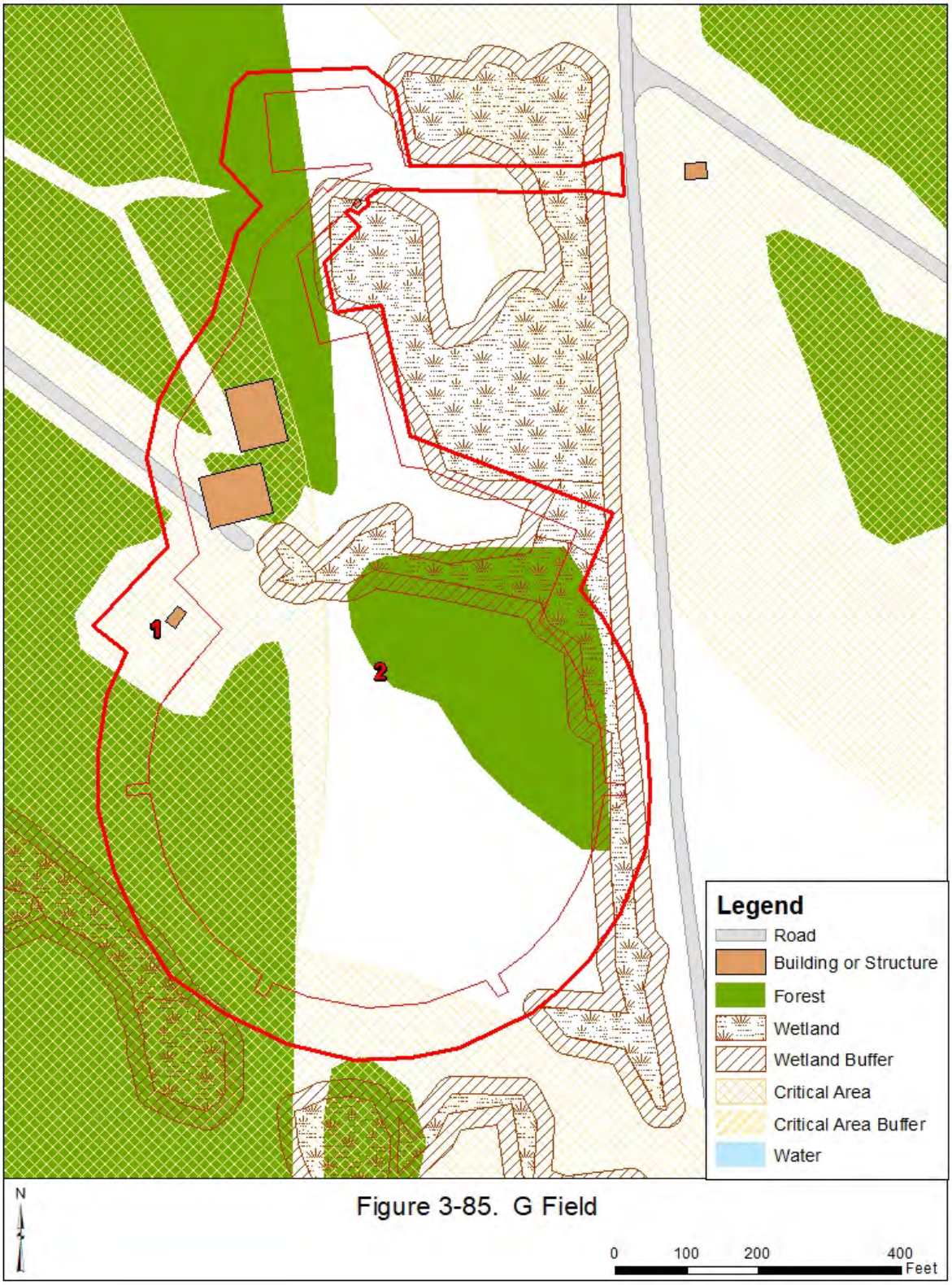

Figure 3-85. G Field

3.3.4 M Field

The M Field range is located in the Edgewood Area. The range encompasses approximately 231 acres.

The M Field range is delineated into 5 areas (Figure 3-86) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	224
2	Support Area	Mechanical, with or without herbicide spraying	Every 3 years	2.1
3	Support Area	Mechanical, with or without herbicide spraying	Every 10 years	0.4
4	Soil Stockpile	Not applicable	Not applicable	2.7
5	Building Demolition	Not applicable	Not applicable	1.9

Figure 3-86. M Field

3.3.5 MAPS

The MAPS range is located in the Edgewood Area. The range encompasses approximately 3 acres.

The MAPS range is delineated into a single area (Figure 3-87) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	3.3

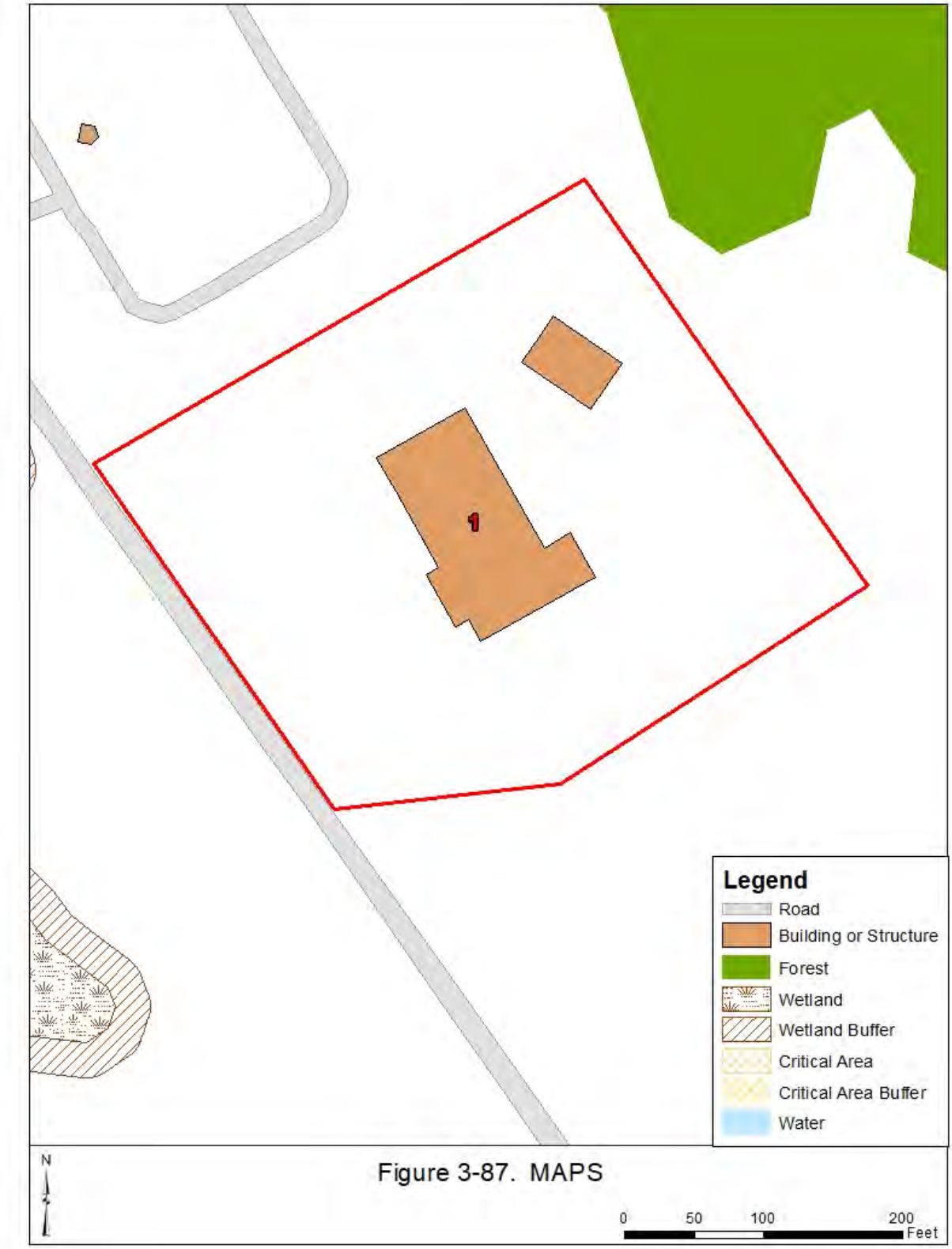

Figure 3-87. MAPS

3.3.6 Prototype Detonation Test and Destruction Facility (PDTDF)

The PDTDF range is located in the Edgewood Area. The range encompasses approximately 8 acres.

The PDTDF range is delineated into 3 areas (Figure 3-88) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing	Twice per year	6.4
2	Natural Area	Conservation	Monitor for encroachment	1.5
3	Shoreline, Beach, Riprap	Shoreline protection	Monitor, keep riprap clear	0.2

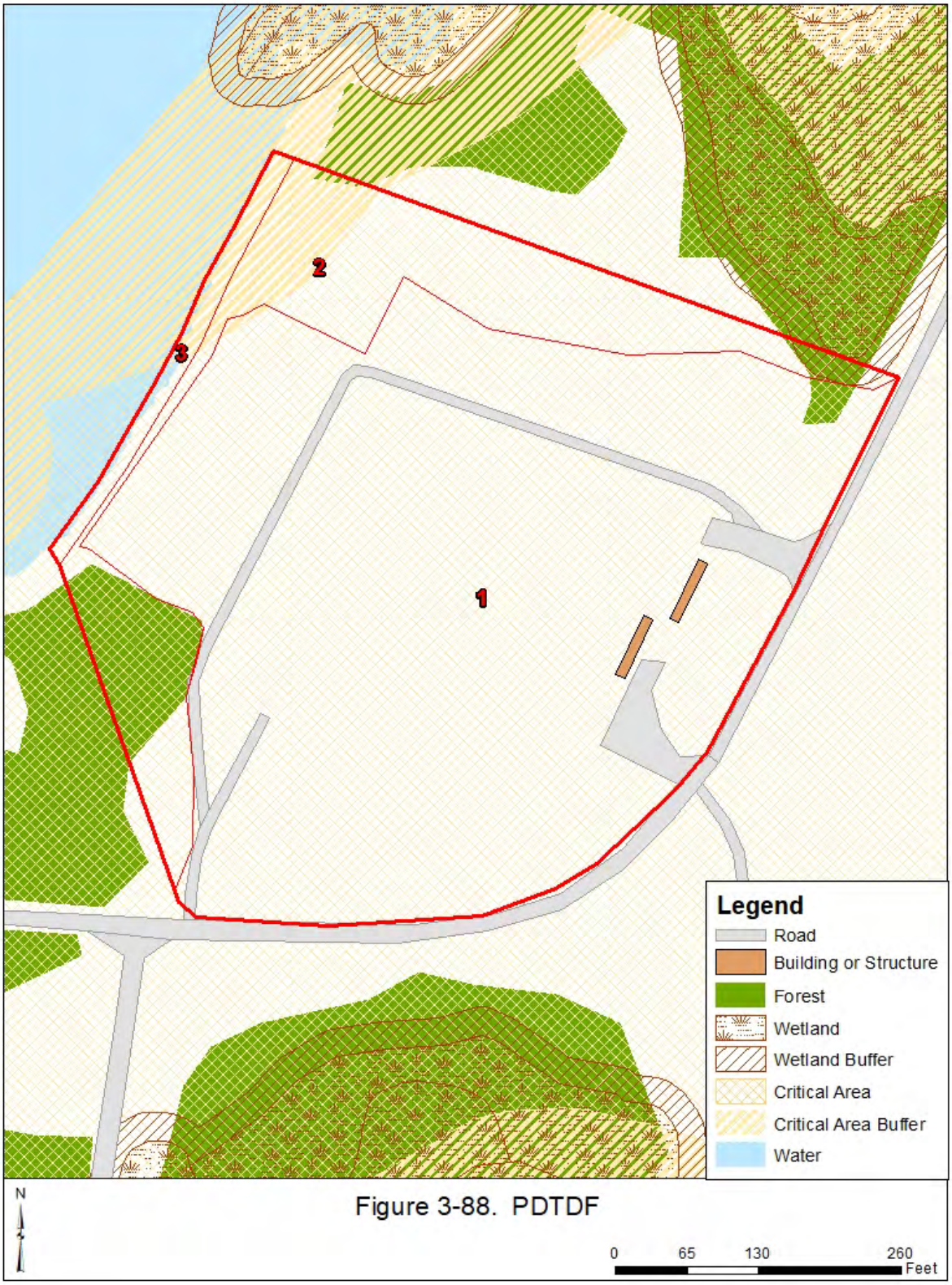

Figure 3-88. PDTDF

3.4 CARA RANGE

3.4.1 J Field OD Area

The J-Field OD Area is located in the Edgewood Area. The range encompasses approximately 6 acres. There is a flood protection berm (Area 3) around the north, east, and south end of the OD area (Area 1).

The J-Field OD Area is delineated into 3 areas (Figure 3-89) with associated vegetation maintenance prescriptions.

Area	Area Type	Maintenance Type	Frequency	Acres
1	Open	Mowing, tilling	Twice per year (late June and late August)	4.4
2	Stormwater management	Mechanical, with spot herbicide application on stone overflow weir	Once per year (spot herbicide application on stone overflow weirs); every 7-10 years for mucking (or as recommended in APG Stormwater BMP Maintenance Plan (Draft, June 2020 or as superseded)	0.14
3	Berm	Mechanical, with or without herbicide spraying	Every 2 years	1.2

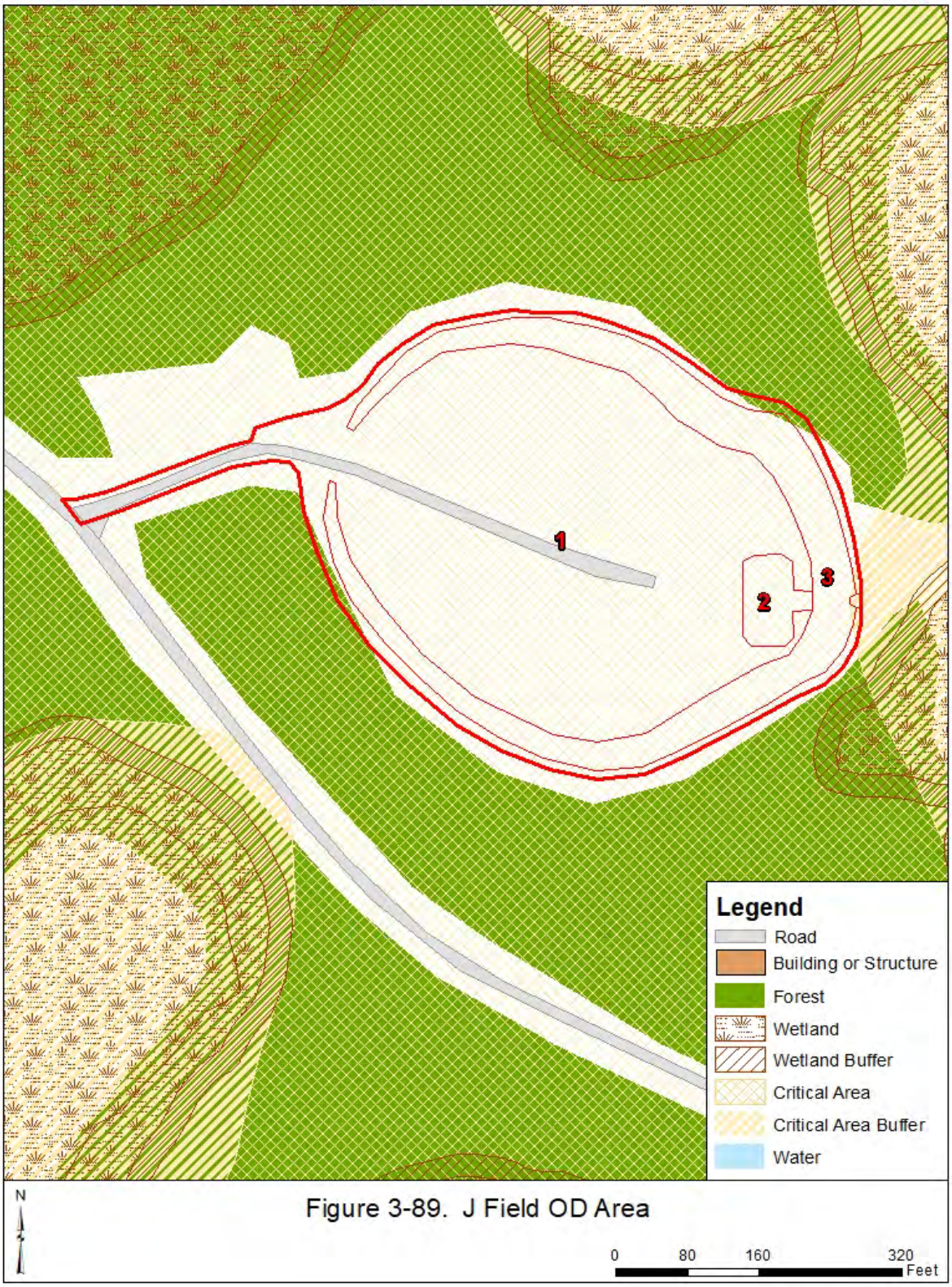

Figure 3-89. J Field OD Area

ATTACHMENT 1

General Consistency Determination
(to be added)

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APPENDIX K

Wildland Fire Management Plan

Wildland Fire Management Plan
is available for review at the office of:

DPW Environmental Division
Conservation Branch
Building E5183 Blackhawk Road, Room 213
Aberdeen Proving Ground, Maryland 21010
Phone: 410-436-0465

APPENDIX L

Installation Management Command Programmatic Consultation
for Northern Long-Eared Bat

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

IN REPLY REFER TO:

FWS/R3/ES

MAY 04 2015

Col. Robert Witting
Colonel, U.S. Army Commanding
U.S. Army Installation Management Command
U.S. Army Environmental Command
2450 Connell Road
Joint Base San Antonio Fort Sam Houston, TX 78234-7664

Re: Request for Concurrence on the Programmatic Informal Consultation on Impacts of Operations on Installation Management Command Installations on the Northern Long-eared Bat

Dear Col. Witting:

This responds to your April 24, 2015 request for our concurrence that select military mission operations of the Army's Installation Management Command (IMCOM), are not likely adversely affect the threatened northern long-eared bat (*Myotis septentrionalis*). Although you requested a conference report, the northern long-eared bat listing is effective as of today; therefore, the U.S. Fish and Wildlife Service (Service) is responding to your request under Section 7(a)(2) of the Endangered Species Act, as amended (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.; ESA).

As discussed in your letter, the U.S. Assistant Chief of Staff for Installation and staffs from the U.S. Army Environmental Command (USAEC), IMCOM, the U.S. Army National Guard and the Service have been coordinating on a programmatic informal consultation for select Army mission activities. This informal consultation includes conservation measures outlined in your April 24, 2015, Biological Evaluation (BE) entitled "Informal Conference & Management Guidelines on the Northern Long-eared Bat (*Myotis septentrionalis*) for Ongoing Operations on Installation Management Command Installations". The conservation measures will be incorporated into activities to avoid adverse effects to northern long-eared bats, thus achieving a "may affect, not likely to adversely affect" determination for Section 7 consultation for these projects. This programmatic informal consultation only addresses the consultation requirements for those projects that can implement the conservation measures and meet the project conditions and effect determinations described in the biological evaluation. The Service was a part of, and worked to help construct the biological evaluation, including all analysis and design of conservation measures. Therefore, based on the analysis in biological evaluation, we concur that all projects designed to fully meet the required terms

will only have effects on northern long-eared bat that are insignificant (unlikely to rise to the level of take), discountable (take is extremely unlikely to occur), or wholly beneficial.

Under the terms of this programmatic informal consultation, IMCOM is responsible for ensuring activities are within the scope of, and adhere to the criteria of the programmatic BE. Each IMCOM installation will screen applicable installation activities through an IMCOM/USFWS cooperatively generated checklist to ensure the activity is conducted as described in the BE. For each activity completed under the programmatic informal consultation, each installation will document their activities and compliance, and IMCOM will provide an annual report to the Service for all actions taken under this informal consultation.

The programmatic informal consultation agreement will be in effect for a period of three years, unless we receive information that indicates the consultation must be revised. To track and monitor the consultation, IMCOM and the Service will meet on an annual basis, or as needed, to: (1) discuss the annual report of covered projects, (2) evaluate and discuss the continued effectiveness of the programmatic consultation, and (3) update procedures, conservation measures, or project criteria, if necessary. If through this review process, IMCOM or the Service believes that this programmatic informal consultation is not being implemented as intended or is having unanticipated impacts on the species, they may request formal review and possible revision. IMCOM may also request revision if data endorses inclusion of new, or modification of established, measures in the BE that support a "may affect, not likely to adversely affect" determination.

We applaud your commitment to protect the northern long-eared bat and the collaborative approach of all of the participating divisions of the Army. With the completion of this programmatic informal consultation, we look forward to our continued collaboration on your conservation strategy and formal consultation approach for the northern long-eared bat. If the project description changes or new information reveals that the effects of the proposed action may affect listed species in a manner or to an extent not considered, further review pursuant to the ESA may be required. If you have any questions or need further information, please contact Karen Herrington of my staff at 850-348-6495.

Sincerely,

Lynn Lewis

Lynn Lewis
Assistant Regional Director, Midwest Region

cc: Paul Phifer, USFWS, ARD Ecological Services, Northeast Region
Leo Miranda, USFWS, ARD Ecological Services, Southeast Region
USFWS, Alabama Ecological Services Field Office, Daphne, AL
USFWS, Chesapeake Bay Ecological Services Field Office, Annapolis, MD
USFWS, Kansas Ecological Services Field Office, Manhattan, KS
USFWS, Kentucky Ecological Services Field Office, Frankfort, KY
USFWS, Michigan Ecological Services Field Office, East Lansing, MI

USFWS, Missouri Ecological Services Field Office, Columbia, MO
USFWS, New England Field Office, Concord, NH
USFWS, New Jersey Ecological Services Field Office, Pleasantville, NJ
USFWS, New York Ecological Services Field Office, Cortland, NY
USFWS, Pennsylvania Ecological Services Field Office, State College, PA
USFWS, Rock Island Ecological Services Field Office, Rock Island, IL
USFWS, Twin Cities Ecological Services Field Office, Bloomington, MN
USFWS, Virginia Ecological Services Field Office, Gloucester, VA

Informal Conference & Management Guidelines

on the

Northern Long-eared Bat (*Myotis septentrionalis*)

for

Ongoing Operations on Installation Management Command Installations

May 2015

Prepared By:
U.S. Army Environmental Command

Table of Contents

List of Tables:

I. General

A. *Purpose.* Pursuant to Section 7(a)(4) of the Endangered Species Act (ESA), federal action agencies are required to confer with the United States Fish and Wildlife Service (USFWS) if their proposed action is likely to jeopardize the continued existence of a listed species (50 CFR 402.10(a)). Action agencies may also confer with the USFWS if the proposed action may affect a proposed species or proposed critical habitat. Species listed as threatened or endangered under the ESA are afforded protection against "take". After the listing becomes effective, pursuant to Section 7(a)(2) of the ESA, federal action agencies are required to consult with the USFWS if their proposed action may affect the listed species (50 CFR 402.14(a)).

The intent of this informal conference and subsequent consultation is to evaluate military operations and sustainment/enhancement activities on Installation Management Command (IMCOM) installations and facilities that may affect, but are not likely to adversely affect (NLAA) the northern long-eared bat (*Myotis septentrionalis*; NLEB), a species to be listed as threatened under the ESA on 04 May 2015 (USFWS 2015). No additional species are addressed or covered within this action. IMCOM has determined effects and proposes conservation measures to avoid or minimize adverse effects to the NLEB. If USFWS concurs in the resulting conference report, this will be a programmatic informal conference and programmatic informal consultation. Any activities not included in this consultation will be subject to separate section 7(a)(2) consultation after the listing becomes effective.

This evaluation includes: 1) consultation requirements; 2) IMCOM structure; 3) distribution and status of the species; 4) description of Military Missions and Operations; 5) survey results; 6) proposed conservation measures to limit potential impacts from Military operations and activities; and 7) conclusions.

The resulting conference report will serve as guidelines that establish a programmatic baseline for managing the NLEB on applicable IMCOM installations and facilities to avoid likely future conflicts. It can be used in developing management and conservation goals and objectives for the NLEB as part of an installation's Integrated Natural Resource Management Plan (INRMP). An installation INRMP will supplement these guidelines with detailed measures to meet installation-specific NLEB conservation and unique military mission needs. The requirements established for the NLEB in the INRMPs will apply to all activities on the installation.

B. *Applicability.* The programmatic guidelines are applicable to IMCOM installations and areas of operations identified in this document. Some of these IMCOM installations have already completed an informal/formal conference/consultation with their local USFWS Field Office and will not be subject to this programmatic conference but instead retain the requirements within their specific document, unless the requirements are complimentary and/or the installation, in coordination with USFWS, chooses to adopt the conservation measures defined herein. The remaining IMCOM installations identified in this document with no prior USFWS coordination will be subject

to this programmatic conference and consultation. All IMCOM installations outside the known range of the NLEB are not considered in this programmatic document. The overarching intent is to facilitate IMCOM installations ability to utilize the most appropriate conservations measures in regards to NLEB though section 7conference/consultation.

C. *Timeline and Revision.* HQ IMCOM will revise these guidelines as necessary to be consistent with the listing rule of the NLEB, future Recovery Plans, or incorporation of the latest and best scientific data available. This informal conference will cover a period of three years but will be reviewed annually for applicability and continued concurrence between IMCOM & USFWS on its content. During the annual review if there is continued concurrence or if the document needs to be amended IMCOM and USFWS will coordinate according to the guidelines in the conference report. At any time, IMCOM or the USFWS may revoke or revise this programmatic consultation if it is determined that it is not being implemented as intended.

D. *Goal.* This documents intent is to provide programmatic coverage to all IMCOM installations for the training and land management activities and processes that are similar throughout. Additionally it is IMCOM's goal to implement management guidelines that will allow the accomplishment of military missions & sustainment while concurrently developing and implementing methods to assist in the conservation of the NLEB.

II. Additional Conference/Consultation

A. *Conference/Consultation Requirement.* In proposing actions that deviate from these guidelines that "may affect" the NLEB or for actions in which further consultation has been agreed to, IMCOM installations will comply with the conference/consultation requirements of section 7 of the ESA per the implementing regulations at 50 CFR part 402; and Army policies and guidance.

1. *Informal Conference/Consultation.* IMCOM recognizes that informal conference/consultation with the USFWS is critical to resolving potential problems and establishing the foundation to address issues in a proactive and positive manner. For any "may affect" determinations, IMCOM and IMCOM installations will seek to modify proposed actions and work with the USFWS to obtain concurrence on a "may affect, but not likely to adversely affect" (NLAA) determination. Issue resolution through informal conference/consultation is the preferred method.

2. *Formal Consultation.* If implementation of these guidelines is not possible or feasible for a proposed action and adverse affects cannot be avoided, the subject IMCOM installation will initiate formal Section 7 conference/consultation in accordance with the procedures in 50 CFR 402 and applicable Army policies and guidance. For formal consultations, the IMCOM installation will implement the reasonable and prudent measures (RPMs) identified in the Biological Opinion (BO) to ensure no impacts on mission implementation.

B. *Confirmation.* IMCOM will re-initiate consultation on these guidelines if (i) information arises indicating that implementation of the guidelines may not avoid adverse impacts on the NLEB for certain activities; (ii) data/new research endorses inclusion of new, or modification of established, measures in the guidelines that still support a NLAA determination; or (iii) a "take" occurs even though IMCOM is fully implementing the guidelines. IMCOM will notify USFWS within five business days if issues pertaining to (i) and/or (iii) arise, and work with the USFWS on addressing such issues through informal consultation. IMCOM will make the necessary changes to the guidelines, if any, and conduct the necessary internal staffing prior to submitting the revised document to USFWS for concurrence. During this period, the NLAA concurrence will still be valid for the conservation measures not subject to any scrutiny or concern.

C. *Programmatic Informal Consultation Process.* Each IMCOM installation will screen applicable installation activities through an IMCOM/USFWS cooperatively generated checklist to ensure the activity is conducted as described in this BE. For each activity completed under the programmatic informal consultation, each installation will document their activities and actions taken describing how compliance was maintained with the conservation guidelines within this document. IMCOM will collectively report annually to the USFWS on information collected in the annual Army Environmental Database Environmental Quality (AEDB-EQ) data call for actions taken in regards to NLEB at each installation. This informal conference will cover a period of three years but will be reviewed annually for applicability and continued concurrence between IMCOM & USFWS on its content. All other species that require Section 7 consultation or Migratory Bird Treaty Act compliance will be reported in separate documentation by the individual installation if applicable.

D. *Emergency Consultation*. Unpredictable catastrophes such as wildfires, tornados, or significant hurricane damage may present conditions that cannot be anticipated under these guidelines. In the case of a catastrophic event, IMCOM installations will implement these guidelines to the greatest extent possible, but imminent threat to life or property may take precedence. IMCOM installations will record impacts on NLEB habitat and any definitive impacts on bats resulting from the event, and document any actions that were necessary during the event such as creation of fire breaks, removal of hazardous trees, etc. The subject IMCOM installation(s) will initiate emergency consultation with their associated USFWS field office as soon as possible. IMCOM will reevaluate conservation and management requirements, if necessary, to better prepare for the conservation of the NLEB during such unanticipated events.

E. *Endangered Species Act 4(d) Rule*. With a 4(d) rule in place, any actions taken by an agency that are exempted in the 4(d) rule will not require an incidental take statement in a biological opinion. Therefore installations could drastically reduce the consultation timeframes and conservation measures required for forestry activities (including harvest & prescribed burning), prairie management, right of way expansion,

and other activities defined therein by conducting Section 7 Consultation only on activities contained within the 4d Rule.

F. *Other Listed Species*. Other ESA listed Threatened or Endangered species may occur on IMCOM installations listed in this BE. This BE only addresses the NLEB because consultation has already occurred for the other listed or, depending on the IMCOM installation, activities may have no effect on other listed species. Prior to implementing any Conservation Measure identified in this PBE, the IMCOM installation will address and assess impacts of such measures on applicable listed species. Conservation Measures and Reasonable and Prudent Measures of any relevant Biological Opinion(s) will continue to be implemented for listed species on sites subject to this consultation. If necessary, the IMCOM installation will informally consult with the USFWS to address a situation where implementation of a Conservation Measures may affect NLEB or other listed species.

III. Installation Management Command (Action Area).

Military installations particularly those managed by IMCOM have a demonstrated track record of sound natural resource stewardship and management. This demonstrated ability creates some of the most diverse natural resource areas supporting a multitude of rare and imperiled species while seamlessly blending that with the daily needs of advanced military training. It is the blending of these two seemingly contradictory things which continues to be the IMCOM goal as training capability is directly dependent on our ability to maintain the natural infrastructure of Army lands.

The primary purpose of IMCOM installations is to provide for the sustainment, enhancement, and readiness of the U.S. Military. Military training and enhancement activities are generally divided into the following categories: sustainment operations, engineering operations, air operations, water operations, field training operations, live munitions training, demolition, smokes/obscurants, and research, development, testing, and evaluation (RDTE). All of these activities occur in dispersed Training Areas; some of these activities occur in localized Training Areas year-round at all times of the day and night. Natural resource management activities also occur on most IMCOM installations which may include forest management, prairie management, wildlife management, recreation, erosion control, and other land management activities and uses as described in each installations INRMP.

The U.S. Army Command, IMCOM is a federal agency, and as such, must comply with Federal statutes and regulations. IMCOM supports active and reserve military installations worldwide. IMCOM is organized into four regions (Europe, Atlantic, Central, & Pacific), of which the Atlantic and Central Regions are within the range of the NLEB. There are 19 individual Army installations within the Atlantic Region and 6 installations within the Central Region that have the potential for NLEB's. Table 1 below lists each installation, its IMCOM Regions, the State in which it exists, and its approximate size. While there are approximately 809,000 million acres in total for these

installations only 453,000 of that is forested habitat which may or may not be suitable NLEB habitat.

Funding and policy guidance for natural resources management on installations are provided by IMCOM. IMCOM also provides natural resources technical support, and is responsible for tracking projects, quality assurance of compliance documents, and execution of funds. While IMCOM provides support across its installations, the individual installations are relatively autonomous in their completion of day-to-day management of the installation. Therefore some installations have conducted or are in the process of conducting individual Section 7 actions as it relates to their local situation and may not need the programmatic coverage provided by this document.

Table 1: IMCOM Installations Within the Range of the Northern Long-eared Bat.

IMCOM Region	Installation Name	State	Approx. Size (ac)	Approx. Forested (ac)	Indiana or Gray Bat	NLEB	Bat Surveys	Hibernacula <=5 miles	Consultation	WNS Decon
ATL	Aberdeen Proving Ground*	MD	72,500	18,000			scheduled FY15	No	No - poor habitat	NA
ATL	Carlisle Barracks*	PA	500	0						
CEN	Detroit Arsenal*	MI	341	0			None			
ATL (Reserve)	Devens Reserve Training Facility	MA	5,000	4,000	Verified absence	Historic presence	Occasional	No	No	NA
ATL	Fort AP Hill	VA	76,000	66,500	Out of Range	Historic presence	Occasional-in process	No	Informal	No
ATL	Fort Belvoir	VA	8,658	4,300	Indiana	Assumed	By project & Annual	No	Consultation in progress	Developing
ATL	Fort Campbell	KY	102,414	48,200	Indiana & Gray	Present	By project & Annual	Yes and on-site	Informal and Formal with INRMP	Yes
ATL	Fort Detrick*	MD	12,000	82			None	No Known	No	No
ATL	Fort Drum	NY	107,625	74,000	Indiana	Present	Annual	No	Informal and Formal BO	Yes
ATL	Fort George G. Meade	MD	5100	1,700	Out of Range	Assumed	None	No Known	Informal	N/A
ATL	Fort Hamilton*	NY	50	0			None			
ATL	Fort Knox	KY	109,000	81,000	Indiana	Present	Annual	Yes and on-site	Informal and Formal with INRMP	Yes
CEN	Fort Leavenworth	KS	5,600	3,500	Verified absence	Not Detected	Occasional	No Known	No	NA

IMCOM Region	Installation Name	State	Approx. Size (ac)	Approx. Forested (ac)	Indiana or Gray Bat	NLEB	Bat Surveys	Hibernacula <=5 miles	Consultation	WNS Decon
ATL	Fort Lee*	VA	5,376	2,300	Not Detected	Not Detected	Periodic (every 2-3 years)	No	No - poor habitat	Yes
CEN	Fort Leonard Wood	MO	61,000	44,500	Indiana & Gray	Present	Annual	Yes and on-site (Indiana)	Informal	
CEN (Reserve)	Fort McCoy	WI	60,000	45,400	Out of Range	Present	Periodic (every 2-3 years)	Yes	Informal	No
CEN	Fort Riley	KS	100,656	16,400	Out of Range	Verified absence	Annual	No	Informal	Yes
ATL	Joint Base Myer-Henderson Hall*	VA	270	0			None			
ATL	Natick Soldier System Center*	MA	124	0						
ATL	Picatinny Arsenal	NJ	6,400	4,000	Indiana	Present	Occasional	Yes	Informal	Yes
ATL	Redstone Arsenal	AL	38,000	23,900	Gray	Present	By project & Annual	Yes	Informal Consultation	Yes
CEN	Rock Island Arsenal	IL	946	200	Verified absence	Assumed	Periodic (every 2-3 years)	No	Informal Consultation	Developing
ATL	U.S. Army Adelphi	MD	200	120			scheduled FY15	No Known	No	Developing
ATL	U.S. Army Adelphi - Blossom Point*	MD	1,600	1,000			None	No	No - poor habitat	NA
ATL	West Point Military Reservation	NY	16,080	14,000	Possible Historic Presence	Present	Annual	Yes and on-site	Informal Consultation	Yes
Total			809,348	453,102						

* Indicates no habitat or highly unlikely to occur due to unsuitable habitat.

IV. Distribution and Status of the NLEB.

According to the NLEB final rule (USFWS 2015), the bat is known or believed to occur throughout or part of 37 States and the District of Columbia within the US. In Canada it is found from all Provinces from the Atlantic Coast westward to the southern Yukon Territory and eastern British Columbia. The northeast is considered to be the core range of the species and the area that has been hit hardest by white-nose syndrome. Based on hibernacula data, population numbers of NLEB have experienced a decline of approximately 99% in this core area (USFWS 2013). White-nose syndrome is the most severe and immediate threat to NLEB survival, and is the basis for the final listing of the species as threatened IAW ESA sections 3(6) and 4(a)(1) – Factor C: Disease or Predation. Currently, 12 IMCOM installations representing 9 States assume

NLEB presence or have recorded the NLEB potentially occurring on site (Table 1). A few other IMCOM installations have the potential for the NLEB to occur onsite, but surveys have not been completed to date. In general, the status of the species as a whole is declining and the status of the species on various installations ranges from declining in the east to stable in areas where effects of WNS have not yet occurred.

The active season of the NLEB is roughly April – October (USFWS 2015a). However, the spring staging and fall swarming periods can begin earlier in mid-March and extend to late November (USFWS 2014) (refer to Table 2). During the active season NLEBs roost singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and snags, typically ≥3 inches diameter at breast height (DBH) in over 35 different tree species. They are also known to roost in sheds and barns, but the overwhelming majority of roosts are in trees (USFWS 2014). NLEBs have been known or suspected of occurring on some of the installations listed in Table 1. Tree species such as black and red oak, silver and sugar maples, hickories, American beech, short-leaf pine, hemlock, birch, spruce, etc. ≥3 inches DBH are known to occur on IMCOM installations throughout the range of NLEB. Summer roosting habitat is available and possibly used on these sites.

Table 2: Active Season Dates for the Northern Long-eared Bat based on Table 1 of the Northern Long-Eared Bat Conference Guidance (USFWS 2014). Individual IMCOM installations should confirm dates with their local USFWS Field Office.

State/Region	Active Season
Alabama	Apr 1-Nov 30
Illinois	Apr 1-Nov 15
Kansas	Apr 1-Nov 1
Kentucky	Apr 1-Nov 15
Massachusetts	Contact FO
Maryland	Contact FO
Michigan	Apr 1-Oct 1
Missouri	Apr 1-Nov 15
New Jersey	Apr 1-Nov 15
New York	Apr 1-Oct 30
Pennsylvania	Contact FO
Virginia	Apr 1-Nov 15
Wisconsin	Apr 1 - Oct 15

As described in the final rule (USFWS 2015), NLEBs predominantly overwinter in hibernacula that include caves and abandoned mines. The hibernacula are typically large, with large passages and entrances, relatively constant, cooler temperatures (0 to 9 °C (32 to 48 °F), and with high humidity to such a large degree that droplets of water are often observed on their fur. The NLEB has also been found to overwinter in structures resembling mines and caves such as abandoned railroad tunnels and hydro-electric dam facilities, to name a few. There are only a few known NLEB hibernacula on

or within five miles of the IMCOM installations. Through development of the IMCOM INRMPs and the Army ACUB program, IMCOM installations have a very good knowledge base on hibernacula occurring on the installation or in the local region. This document addresses potential impacts on or conservation of hibernacula and associated swarming and staging areas for known hibernacula on or within 5 miles of an IMCOM installation. More specific information on NLEB seasons by state is depicted in Table 2.

IMCOM installations, described in Table 1, have conducted both project-level and installation-wide bat surveys to support the military mission. Installations will continue to survey at the level necessary to meet their mission requirements and comply with ESA. Installations that have not surveyed will conduct NLEB surveys to determine presence/absence in suitable habitat as funding allows.

More detailed information on the life history and habitat requirements of the NLEB can be found in the 2015 final rule (USFWS 2015).

As used in this BE, known roost trees are defined as trees that NLEBs have been documented as using during the active season (approximately April–October). Once documented, a tree will be considered to be a ‘‘known roost’’ as long as the tree and surrounding habitat remain suitable for NLEB. However, a tree may be considered to be unoccupied if there is evidence that the roost is no longer in use by NLEB (USFWS 2015).

Known, occupied hibernacula are defined as locations where one or more northern long-eared bats have been detected during hibernation or at the entrance during fall swarming or spring emergence. Given the documented challenges of surveying for northern long-eared bats in the winter (use of cracks, crevices), any hibernacula with northern long-eared bats observed at least once, will continue to be considered ‘‘known hibernacula’’ as long as the hibernacula and its surrounding habitat remain suitable for northern long-eared bat. However, a hibernaculum may be considered to be unoccupied if there is evidence (*e.g.,* survey data) that it is no longer in use by following the USFWS Indiana Bat Hibernacula Survey protocols (USFWS 2015).

Refer to the Glossary, Section X, for additional definitions.

V. Activities That Will Not Affect NLEB.

All activities at installations outside the range of the NLEB will result in no effect to the species. Within the range, all activities that occur in unsuitable habitat will result in no effects to the species and do not require the implementation of any conservation measures. The Northern Long-eared Bat Interim Conference and Planning Guidance (USFWS 14) states, “Trees found in highly-developed urban areas (e.g., street trees, downtown areas) are extremely unlikely to be suitable NLEB habitat.” Therefore, IMCOM considers that all sites within highly-developed urban areas that are not within 1000 feet of suitable forested/wooded habitat are excluded from these guidelines and

ESA conference/consultation requirements. Examples of highly-developed areas include but are not limited to: some cantonment areas, some housing areas, industrial areas, highly developed training sites, and developed testing facilities

IMCOM determines that all of the above proposed actions and sites will have "no effect" on the NLEB.

VI. Activities That May Affect NLEB.

For installations that contain habitat elements for the NLEB within its range, as identified in Table 1, IMCOM will adopt the below conservation practices, unless the installation has verified NLEB absence by utilizing the published USFWS Indiana bat (and NLEB) summer survey protocols.

A. Existing Military Training, Firing and Maneuver ranges: Military training activities are generally divided into the following categories: sustainment operations, engineering operations, air operations, water operations, field training operations (such as but not limited to: foot training, bivouacking, etc), live munitions training, demolition, smokes/obscurants, and research, development, testing, and evaluation (RDTE). All of these activities occur in dispersed Training Areas; some of these activities occur in localized Training Areas. Firing and maneuver ranges on IMCOM installations provide training and testing for the M16/M4 weapons family, M249 and M240 series machine guns, M9 and M1911 series pistols, M203 and MK19 grenade launchers, anti-tank weapons, helicopter gunnery, tank firing, 105 mm through 203 mm cannons, tracked and wheeled vehicles, live grenades, demolitions, and other military operations. The NLEB within these active ranges have been repeatedly exposed to loud noises associated with munitions, detonations, and training vehicles. Camp Atterbury (USFWS 2010), Fort Leonard Wood (USFWS 2010), and Fort Drum (USFS 2008) have assessed range and training noise impacts on Indiana bats (*Myotis sodalis*). Fort Leonard Wood monitored radio-telemetered Indiana bats and found that the bats did not avoid active ranges or alter foraging behavior during night-time maneuvers. A 2002 study on Camp Atterbury found that five of eleven Indiana bats tracked with radio transmitters periodically roosted in the impact area (Whitaker & Gummer 2002). Given these findings, along with the abundance and installation-wide distribution of the bats on the sites, they concluded, and USFWS concurred, that sound intensity and duration associated with past training events have not adversely affected Indiana bats due to the bats having become habituated to such stimuli. It is reasonable to believe that the NLEB have also become habituated to ongoing operational noise on existing IMCOM ranges.

Recent studies have indicated that anthropogenic noise can alter foraging behavior and success of bats, including some gleaning species like the NLEB (Bunkley et al., 2015; Schaub et al., 2008; Siemers and Schaub, 2011). Based on the potential that new sound stimuli may affect the NLEB by influencing foraging behavior and success, the relevant IMCOM installation will consult with the USFWS when new

activities are proposed that significantly differ in sound intensity, quantity/duration of noise events, from those described above.

Bats are vulnerable to mortality from vehicle strikes (Siebert and Connor, 1991; Glista and DeVault, 2008; Russell et al., 2009). Collisions with vehicles are documented for the endangered Indiana bat, as well as the NLEB (Russell et al., 2009). In this study, researchers monitored highway crossings of a roost of approximately 23,000 bats, mainly little brown bats (*Myotis lucifigus*). A total of 26,442 occurrences of bats crossing the highway during dusk (10 days) and dawn (six days) were recorded and 29 road-killed bats were found, one being an Indiana bat. In Glista and DeVault (2008), researchers surveyed 158.5 km of roads for mortality of vertebrates. A total of one road-killed bat (eastern red bat, *Lasiurus borealis*) was found during the road mortality detection surveys – travelling at speeds less than 40 km/h). Finally, Siebert and Connor recorded one road-killed bat during their 50 surveys of a 1.6km of highway (U.S. 33 NW of Athens, OH) spanning from June 1987 to August 1988. The Biological Opinion for Construction, Operation, And Maintenance of the U.S. 33 Nelsonville Bypass Road, OH (USFWS 2005), identified vehicle collision as an anticipated take of Indiana bat. Although we might expect bat mortality associated with vehicle collisions to diminish along with road size/traffic volume, the frequency at which bats attempt to cross roads, especially forest species like the NLEB, likely increases as road size and traffic decrease. Effects of vehicle collisions to bats are likely to be discountable regardless of road size, but should be considered that bats may respond differently to different types of roads. However, in contrast to the roads and maneuver sites on IMCOM installations, the stretches of road discussed above have a constant volume of traffic during times of bat activity, and vehicles are travelling at greater speeds than what typically occurs on IMCOM installations. The numbers and intensity of night time maneuvers and vehicle use on IMCOM installations, as well as operating speed of such vehicles, do not rise to the level associated with public highway use. Therefore, the likelihood of bat road mortality occurring during dusk to dawn on IMCOM installations is determined to be discountable.

In conclusion training activities at firing and maneuver ranges are not likely to adversely affect the NLEB.

B. Aircraft Operations. As with ranges, flight training has and continues to occur on multiple IMCOM installations within the range of the NLEB. Studies have shown that helicopters tend to elicit a heightened response compared to fixed-wing aircraft. Even though that may be the case, helicopter training on IMCOM installations usually occurs as hovering operations occurring over fields or other open areas, thus any impacts from noise or downdrafts would be temporary and minimal to roosting bats and trees. For ongoing night time operations, foraging bats will continue to be exposed to sound levels that have been shown not to alter foraging behavior (USFWS 2010). Given that NLEB forages in the canopy layer (USFWS 2013), collision during night time flight operations are very unlikely to occur. Based on the nature and implementation of air operations, and the assumed level of habituation to flight training stimuli, it is determined that sound generated by ongoing training activities at existing ranges is not likely to adversely

affect the NLEB. Similar conclusions were made at Fort Leonard Wood, (3D/I 1996), involving night-time maneuvers; air operations at Fort Drum, (USFWS 2009); and ongoing training activities at Camp Atterbury (USFWS 2010).

If there are any indications that flight training may be adversely impacting bats such as the observation of tree limbs and/or bark being blown off by helicopter downdraft, the applicable IMCOM installation will initiate consultation with their local USFWS field office. Consultation with the appropriate USFWS field office will also occur if flight training activities are introduced to new sites that have new impacts not discussed above, or if there is intensive low level hovering over forested areas during the active season (summer maternity season, and if applicable to the site, spring staging and fall swarming season), or if there is any other change to flight operations that may affect NLEB in a manner significantly different than those described above.

In conclusion, use of aircraft is not likely to adversely affect the NLEB.

C. Military Training Smoke and Obscurants: Smoke/obscurants are used to conceal military movements and help protect troops and equipment in combat conditions. They can be used throughout the Training Area as part of another military operation, or as part of an independent training scenario. Although they would be primarily used during the day, smoke/obscurants may be deployed at night. Training on some IMCOM installations may include, but is not limited to smokes and obscurants such as fog oil, colored smoke grenades, white phosphorous, and graphite smoke. The effects of these smokes and obscurants were assessed in the Fort Drum (USFS 2008;; Army 2014; USFWS 2009; USFWS 2013; USFWS 2015) and Camp Atterbury BAs and associated BOs (USFWS 2010). Research was cited indicating that prolonged dermal and respiratory exposures to these items, except for the graphite smoke, could have adverse effects on roosting and foraging Indiana bats. Given the similar roosting behavior and foraging locations of the NLEB, it is likely they will also be adversely affected by these smokes and obscurants. However, measures can be taken to avoid adverse effects of some smokes.

Camp Atterbury (USFWS 1998) conducted an ecological risk assessment (ERA) to assess which training materials and pesticides may cause adverse effects to Indiana bats. The ERA indicated that chemicals found in M18 colored smoke grenades may cause acute toxicological effects. They determined that Indiana bats roosting within 36 meters of the deployed grenades may inhale unsafe concentrations of M18 colored smoke during a one-minute period following release. To avoid the potential for adverse effects from colored smoke on NLEB, installations will not release M18 colored smoke grenades within 50 meters of forested suitable NLEB habitat during the active season if USFWS protocol surveys have not been completed. However, sites where surveys have been conducted and determined NLEB roost locations, M18 colored smoke grenades will not be used during the NLEB active season within 50 meters of known roost trees, which are described in Section IV of this document. Therefore, by implementing this measure, it is believed the effects of colored smoke on NLEB will be insignificant.

Citing data from a National Research Council's report on the toxicity of military smokes and obscurants, Fort Drum determined that based on the low toxicity on experimental animals, the use of graphite smoke may affect, but is not likely to adversely affect the known and undiscovered maternity colonies of Indiana bats. The USFWS concurred that any adverse effects associated with graphite smoke are discountable or insignificant (USFWS 2009).

In the 2012 Fort Drum BO (USFWS 2012), the USFWS included a table of a number of studies that provided estimates of fog oil concentrations from typical smoke screening operations. The highest level of fog oil recorded was 140 mg/m3, which was the upper level of a range for a 30 minute release that averaged a 51.8 mg/m3 concentration 200 meters from the source. A 120 min release recorded a maximum level of 105 and 102 mg/m3 at 200 and 100 meters, respectively, from the source of release. The COE Engineer Research and Development Center conducted a study to evaluate the health effects of fog oil aerosols in a surrogate species (Red-winged Blackbird) for the Red-cockaded Woodpecker (Driver et al. 2002). Based on the results of the study, they concluded that adult Red-winged Blackbirds can apparently sustain fog oil exposures of about 400 mg/m3 for 4 hours with no detectable adverse effects.

Table 3. 2012 Fort Drum BO of Estimates of Fog Oil Concentrations Resulting From Typical Smoke Screening Operations at Given Distances From the Source.

Study	Distance from source (meters)	Average (mg/m3)	Range (mg/m3)	Maximum (mg/m3)
Lilegren et al. 1988[A]	100	7.7		
	200	3.6		
	400	2.6		
Policastro et al. 1989[A]	25	116		
	100	8		
	200	3		
Driver et al. 1993[B] (30 min release)	100	64.3	27-120	
	200	51.8	7-140	
	400	27.9	1.8-93	
	1000	6.9	1.6-24	
Driver et al. 1993[B] (300 min release)	100	64		
	200	29		
	400	8.7		
	1000	1.6		
Getz et al. 1996 (120 min release)	100	64	25-102	
	200	56	8-105	
	500	46	1.3-90	
	1000	13	0.8-25	
U.S. Army 1997[B]	100	3.8		13.5
	250	3.5		12.7
	500	2.7		11.2
	1,000	1.2		4.3
Department of the Army 1997 (30 min release)	100		0-14	
	1000		0.1-1	

A- Results from studies conducted in the field
B- Results from modeling

Table is summarized from Getz et al. 1996 and ENSR 1999.

The Lethal Concentration (LC)50 of rats for inhalation of fog oil after 3.5 hours was 5,200 mg/m3. Less than 15% of the rats died at 4,000 mg/m3 (NRC 1999). Roosting NLEBs would most likely be exposed to fog oil levels well below those lethal to rats and having no detectable adverse effects on blackbirds. It would appear that release of fog oil at least 100 meter from any known or suspected roost sites would be sufficient to avoid impacts on NLEB. However, in a study conducted on Fort Leonard Wood, it was estimated that Indiana bats within 4,000 m of static smoke training and 7,000 m of mobile smoke training had the potential to inhale unsafe quantities of fog oil (USFWS 2009). To ensure that NLEB are not adversely affected by fog oil, IMCOM sites will not use fog oil during the NLEB active period, unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

White phosphorous (WP) ignites when it is exposed to air and may cause burns. Smoke typically lasts up to 15 minutes. Rats exposed to WP for 15 min/day, 5 days/week for 13 weeks at 1,740 mg/m3 (H_3PO_4) resulted in the death of 32% of the rats within 6 weeks. Rats produced clear signs of irritation when exposed to H_3PO_4 at a concentration of 525 mg/m3 for 60 minutes. Longer term exposure at concentrations of 884 mg/m3 (15 min per day, 5 days per week for 6 or 13 weeks), resulted in slight laryngitis and tracheitis. A similar exposure, but at higher concentrations (H_3PO_4 at 1,742 mg/m3), resulted in wheezing, dyspnea, moderate-to-severe laryngitis and tracheitis, and interstitial pneumonia. No such effects were reported for rats exposed for 15 min per day, 5 days per week for 13 weeks with H_3PO_4 at 280 mg/m3. Reproduction and development of rats showed that higher WP exposure (1,742 mg/m3 for 15 min/day, 5 days/week for 10 weeks) were associated with lower natal weights and had severe effects on survivability (NRC 1999).

It has been estimated that an exposure concentration of WP could reach 202 mg/m3 (H_3PO_4) 100 m downwind from deployment and about 1.4 mg/m3 (H_3PO_4) 5,000 m downwind. It was cited that the EPA does not expect community exposures to be severe at a distance of greater than 300 m; however, particularly susceptible individuals might experience respiratory irritation even at a distance of 5,000 m (NRC 1999).

To avoid the potential for adverse effects WP on NLEB, installations will not release WP within 200 meters of forested suitable NLEB habitat during the active season if USFWS protocol surveys have not been completed. However, sites where surveys have been conducted and determined NLEB roost locations, WP will not be used during the NLEB active season within 200 meters of known roost trees, which are described in Section IV of this document. Therefore, by implementing this measure, the anticipated level of WP at that distance should not expose NLEB to concentrations of H_3PO_4 that would be likely to adversely affect them.

For “other” smokes and obscurants, we cannot negate the potential for adverse affects on NLEB from exposure. Therefore, to avoid any potential for adverse affects, these items will not be employed during the NLEB active season. IMCOM installations will consult with the USFWS if any of these “other” smokes or obscurants are being

considered for release during the NLEB active season and there is scientific evidence to support that such substances can be released in a manner to avoid adverse effects or ensure such effects are insignificant or discountable.

Summary of Conservation Measures for Military Smoke & Obscurants:

1. M18 colored smoke grenades will not be used within 50m of forested suitable NLEB habitat during the NLEB active season (see Table 2) unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

2. M18 colored smoke grenades will not be used within 50m of known roost trees during the active season (see Table 2) after USFWS protocol surveys have been completed or site specific consultation has been completed with the local USFWS Field Office.

3. Fog oil will not be released within forested suitable NLEB habitat during the NLEB active season (see Table 2) unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

4. WP will not be released within 200 meters of forested suitable NLEB habitat during the NLEB active season (see Table 2) unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

5. WP will not be used within 200m of known roost trees during the active season (see Table 2) after USFWS protocol surveys have been completed or site specific consultation has been completed with the local USFWS Field Office.

6. Other smoke/obscurants will not be employed during the NLEB active season (see Table 2) unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

7. No smoke or obscurants will be released within 0.5 miles of known hibernacula outside of the active season as defined in Table 2.

In conclusion military smoke and obscurants may affect, but are not likely to adversely affect the NLEB by implementing the above conservation measures.

D. Construction: Construction projects can include new buildings, building additions, new or upgraded utilities, etc. As part of construction there may be multiple activities including tree removal, site preparation, equipment staging and maintenance areas, etc. On IMCOM installations where NLEB are known (or assumed – no P/A

surveys conducted to date but within range and suitable summer habitat) to roost, tree cutting and clearing for construction projects will occur during the NLEB inactive season (Table 2) or when verified absence has been determined utilizing the published USFWS protocols. If there is a need to remove a single or small cluster of trees during the active season, the installation will follow procedures listed in Section VI.G. below to determine if such removal can be done with insignificant or discountable effects on NLEB. Tree cutting and clearing may cause loss of habitat; however, inactive season tree removal effects would be discountable by following similar conservation measures to the Federal Highway Administration and Federal Railroad Administration's Range-wide Biological Assessment for Transportation Projects for Indiana Bat and NLEB (FHA 2015)

Other construction activities such as site grading, road construction, vertical and horizontal building, and other activities are likely to occur during the NLEB active season during day light hours. Noise and vibrations generated by heavy equipment within or directly adjacent to roosting trees could temporarily disturb roosting bats. For known roost sites, or areas of suitable habitat without verified absence, that are greater than 100m from the construction site, it is anticipated that the intensity of noise and vibration associated with the construction will diminish a sufficient amount to reduce the likelihood of disturbing bats that roost in these particular areas. Also High light levels may deter bats from areas as their nocturnal behavior may have evolved in response to predation risks (Speakman 1991, Sparks et al. 2005). By angling the light away from potential foraging and roosting areas, the area will be darker thus providing bats more protection from predators. By implementing 100 meter buffers around areas of suitable habitat without verified absence, IMCOM determines that such activities "may affect, but not likely to adversely affect" the NLEB in regards to disturbance activities related to construction. Additional coordination will occur for projects within 0.25 miles of known roosts.

Hibernacula may be affected by construction activities if the activity is conducted too close to or during the inactive season. Construction activities such as site grading, road construction, vertical and horizontal building, and other activities are likely to occur during the NLEB inactive season (Table 2) during day light hours. Noise and vibrations generated by heavy equipment within or directly adjacent to hibernacula could temporarily disturb roosting bats. Because all construction activities will occur >0.5 miles from hibernacula during the winter to be included as part of this informal consultation, no direct effects to NLEB will occur. Additional consultation is required for any construction activities <0.5 miles from hibernacula.

In addition, in areas where NLEBs are already subject to noise and vibrations associated with ongoing actions, construction activities occurring in such area would not likely have an adverse effect on NLEBs.

Additionally, site-specific consultation with the local USFWS field office will often be needed to adequately assess the potential direct and indirect effects associated with construction projects. However, across the range of the species no effects are anticipated if construction projects:

1) Are located entirely (including staging areas & construction footprint) beyond 100 m[1] of NLEB suitable summer habitat and 5 mi of hibernacula OR
2) Involve maintenance, alteration, or demolition of bridges/structures without any signs of bats as verified by a trained biologist, pest management specialist, or similar professional individual.

Some projects may occur near or within suitable NLEB habitat, but the project will result in no effects or discountable likelihood of effects even without the implementation of any avoidance or minimization measures, if the proposed project is based on the following:

1) Activities are completely within existing road surfaces (e.g., road line painting).
2) Activities are within existing ROWs or at existing facilities that contain suitable habitat but that do not remove or alter the habitat (e.g., mowing, brush removal).
3) Activities are wetland or stream protection associated with wetland mitigation without any tree removal.
4) Are located in areas with verified absence determined by USFWS protocol surveys[2]

Other projects may occur near or within NLEB suitable habitat which will require the implementation of conservation measures to avoid or minimize impacts to the point of insignificant/discountable for the projects to be included in this programmatic consultation. Construction projects that involve any of the features listed below are not likely to adversely affect NLEBs.

1) Structure Maintenance: during the active season (Table 2) that does not bother roosting bats in any way (e.g., activity away from roosts inside common rooms in structures, normal cleaning and routine maintenance).
2) Bridge Maintenance: during the active season (Table 2) that does not bother roosting bats in any way (e.g., road paving, wing-wall work, work above that does not drill down to the underside of the deck, some abutment, beam end, scour, or pier repair).
3) Structure or Bridge Maintenance: outside the active season that does not alter roosting potential for bats.
4) Tree Removal must occur outside the active season (Table 2) AND must not remove known roosts (as defined herein) AND
    - must be entirely within 100 feet of existing road surfaces in order to have no linear acreage limits; (this would include roads within cantonment , state, local roads, paved roads, and developed hard packed roads, but does not include trails or other travel corridors in training areas)

    OR

[1] Addresses potential for noise/disturbance adjacent to suitable habitat.
[2] See protocols for minimum number of years negative survey results are valid

- if located >100 feet of existing road surfaces, must be limited to no more than 10 acres per project (10 acres is 5% of a 200 acre home range)

The following additional conservation measures will be taken for all construction to further eliminate the potential to affect NLEB:

1. Roost Tree Protection. No known roost trees, as defined herein, will be felled, unless there is a human health and safety concern. If there is a need to remove a known roost tree, the installation will follow procedures listed in Section VI.G. below to determine if such removal can be done with insignificant or discountable effects on NLEB.

2. Construction activities outside of suitable habitat will not occur within 100 meters of any known roost trees without additional site-specific consultation.

3. Construction activities that remove suitable habitat within 0.25 miles of any known roost trees without additional site-specific consultation. Construction activities will also take into account factors such as the surrounding landscape, habitat connectivity, and distance to other roosts, distance to known foraging areas, and any other issue important NLEB.

4. Time of Year Restriction for Tree Falling. A time of year restriction for clearing trees (> 3 in DBH) has been established to protect known or potential roost trees during the active season (see Table 2), unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

5. Flagging or signs will be used to demarcate areas to be cleared vs. not cleared prior to any construction activities for a given project. Flagging will be removed upon completion of the project.

6. Via Scope of Works, Contracts, Briefings, etc., all personnel responsible for construction activities will be informed about the need to follow design plans, stay within flagging, and minimize impacts to wildlife and other environmental concerns.

7. Outdoor Lighting Minimization. For all future projects, IMCOM will evaluate the use of outdoor lighting and seek to minimize light pollution by angling lights downward or via other light minimization measures.

8. Demolition. If the building has pre-existing known NLEB colonies, then the appropriate environmental personnel of the IMCOM installation must be contacted before demolition is to occur. If during the course of demolition, NLEB are discovered, then all work must cease and USFWS must be immediately contacted. If the structure is safe to leave as is, then it will be left

until after October 15, or until bats have stopped using the structure. If the structure is unsafe and poses a risk to human health and safety, IMCOM will attempt to exclude the bats immediately. If this is not possible, or NLEB are found to be using the structure during the maternity season when pups are not volant, IMCOM will contact USFWS to discuss the most appropriate next course of action.

9. Water Quality BMPs will be established for each construction site in accordance with the appropriate federal laws and state permits.

In conclusion construction & maintenance activities may affect, but are not likely to adversely affect the NLEB by implementing the above screening criteria and conservation measures.

E. Forest management: Forest management includes both even-aged (e.g., clearcutting or shelterwood) and uneven-aged (single tree or group selection) harvest methods to manage forests to support military training, timber production/health, and wildlife habitat creation/enhancement. Environmental conditions (e.g., wet or rocky soils), training requirements, and stand characteristics dictate harvest methods. Forest management practices such as timber harvest and silviculture are essential to maintaining diverse quality forested habitat for both the NLEB and military training. A number of forest management practices occur on military installation such as but not limited to: harvest, thinning, and/or planting operations. Operations that require tree removal have the potential to alter NLEB habitat. In the final listing rule USFWS anticipates that habitat modifications resulting from forest management and silviculture will not significantly affect the conservation of the northern long-eared bat. However, timber harvest operations performed during the species' active season may directly kill or injure individuals.

Removal of trees could have an indirect effect from loss of potential roosting and foraging areas. The degree of potential impact would be dependent on whether the removal is temporary (i.e., timber harvest, to include clearcuts) or permanent (construction). As stated in the proposed listing rule for NLEB (USFWS 2013), studies to date have found that NLEBs show a varied degree of sensitivity to timber harvesting practices and the amount of forest removal occurring varies by State.

The following additional conservation measures will be taken for all forest management activities to further eliminate the potential to affect NLEB:

1. Time of Year Restriction for Tree Falling. A time of year restriction for clearing trees (> 3 in DBH) has been established to protect known or potential roost trees during the active season (see Table 2) unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office

2. Roost Tree Protection: No known roost trees, as defined herein will be felled, unless there is a human health and safety concern. If there is a need to

remove a known roost tree, the installation will follow procedures listed in Section VI.G. below to determine if such removal can be done with insignificant or discountable effects on NLEB. Clearcutting or similar harvest will not occur within 0.25 mi (250 m) and overstory roost tree removal within 100 meters of documented maternity roost trees without further consultation with the USFWS. Tree thinning/removal will also take into account factors such as the surrounding landscape, habitat connectivity, and distance to other roosts, distance to known foraging areas, and any other issue important to NLEB.

3. Forest Management will not be conducted within 0.5 miles from "known hibernacula" when bats are present during the inactive season. Forest management near hibernacula may affect swarming and staging areas through habitat loss around the hibernacula. Additional site-specific consultation will occur for forest management within 0.5 miles of hibernacula.

4. Tree Removal Acreage Limits:
   - if located >100 feet of existing road surfaces, must be limited to no more than 10 acres of clearcutting (or similar forest practice like seed tree or shelterwood harvest) per project (10 acres is 5% of a 200 acre home range). NOTE: There is no acreage limit for selective harvest practices conducted during winter, as roosting habitat will remain available.

   OR
   - must be entirely within 100 feet of existing road surfaces in order to have no acreage limits; (this would include roads within cantonment , state, local roads, paved roads, and developed hard packed roads, but does not include trails or other travel corridors in training areas)

5. Snag Retention. All snags will be left in silvicultural treatments unless there is a safety concern for the contractor or the military units training in the stands (e.g., maneuver corridors), or unless the treatment is a salvage harvest or clearcut. Snags should be distributed and retained throughout the landscape.

In conclusion forest management activities may affect, but are not likely to adversely affect the NLEB by implementing the above screening criteria and conservation measures.

F. Prescribed Burns: Prescribed fire is used to improve line-of-sight on ranges and observation points for direct and indirect firing, maintain grassland/open shrubland for open maneuver training, reduce fuel accumulation to minimize wildfire risk, and manage species habitat. It is also used as a tool to maintain ecological health of grassland and forested areas and regenerate oak ecosystems. The majority of natural and prescribed fires on IMCOM installations occur in impact or surface danger zone areas, due to live fire training and testing operations. The vegetation that occupy these areas are fire dependent. Other prescribed fires are generally conducted in grasslands

and forests, during the growing and dormant seasons, and all prescribed fires are implemented in accordance with the installation's Integrated Wildland Fire Management Program and State regulations.

Prescribed fire is gaining acceptance as a means of restoring and perpetuating oak (*Quercus*) dominated ecosystems in the eastern U.S. (Dickinson et al., 2010). As stated in the final listing rule (USFWS 2015), a U.S. Forest Service review of prescribed fire and its effects on bats generally found that fire had beneficial effects on bat habitat. Bats are resilient to fire and some species prefer burned areas for foraging and roosting (e.g. Boyles and Aubrey 2005, Loeb and Waldrop 2007). There is little scientific evidence to indicate that fire has adverse effects on NLEB. NLEB roost-switching frequency, distance between successive roosts, and duration of individual roost tree use were similar between fire and control treatment areas (Johnson et al. 2009). Following prescribed fires, NLEB benefit from increased abundance of insects and availability of roost sites (Lacki et al. 2009). During prescribed fire, NLEB have been shown to exit their roosts during the day and switch roosts as necessary to limit their exposure (Dickinson et al. 2009). In fact, most bats are quick and highly vagile so that escape and relocation to unburned areas easily can occur (Carter et al. 2009). However, neonatal bats that cannot fly would be at greater risk to smoke and fire effects than juveniles or adults. Although, exposure of tree roosting bats to carbon monoxide (CO) is unlikely to be a concern when fireline intensity is low (~1.5 m flame length) (Dickinson et al., 2010). In largely forested landscapes, there are infinite amounts of available roosts for alternate use (Carter et al. 2000). During the active season, bats frequently roost-switch but use torpor to conserve energy and extra arousals when bats are in deep torpor are a cause for concern. The maternity roosting season, from 01 June to 31 July when young pups are not Volant, and to a much lesser extent during the active season, is the only time NLEB might be directly affected by prescribed burns to elicit take. During all other times of the year research has shown that NLEB are not adversely affected by burns conducted under prescribed conditions.

Conservation Measures for Prescribed Burning:

1. Not within 0.5 miles from "known hibernacula" when bats are present during the inactive season (see Table 2 for active season).

2. Not within forested suitable NLEB habitat during the active season (see Table 2) unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

3. Prescribed burns will be conducted under a site specific burn plan per the Installation Integrated Wildland Fire Management Plan which is integrated with the ecosystem management goals and objectives of a tripartite approved (IMCOM, State, and USFWS) Integrated Natural Resource Management Plan (INRMP).

4. Time of Day Restriction. Fore prescribed burns not within forested suitable NLEB habitat, whenever possible, all efforts will be made to have all flames extinguished and smoke generation minimized by sunset to reduce potential direct impacts to foraging bats during the active season (see Table 2

5. Containment Measures. For prescribed burns within 100 meters of forested suitable NLEB habitat, make use of naturally occurring firebreaks or, if necessary, establish wet lines to preclude fire from entering the adjacent NLEB habitat during the active season (see Table 2), unless USFWS protocol surveys have been completed to verify absence or site specific consultation has been completed with the local USFWS Field Office.

In conclusion prescribed burning activities may affect, but are not likely to adversely affect the NLEB by implementing the above conservation measures. Additionally prescribed burning is determined to provide an overall beneficial effect to overall habitat quality.

G. Specific Single, Group, or Hazard Tree Removal: Removal of single, multiple, or cluster of trees during the active season in suitable habitat, trees that do not pose a risk to human life or property will be analyzed for signs of bats being present (emergence surveys) prior to removal according to USFWS Indiana bat (and NLEB) summer survey protocols. If NLEB are roosting in such tree(s), the applicable IMCOM installation will consult with their local USFWS field office. If bat species are determined present and immediate removal of the tree(s) is necessary, the tree(s) will be removed in a manner that will minimize impacts on the bats such as first disturbing the tree(s) to cause them to abandon the roost. If there are hazard trees that are considered an imminent threat to human life or loss of property and need to be removed during the active season, the IMCOM installation will remove such trees and inform the USFWS field office of the action only if NLEB are present on the installation and the IMCOM installation will initiate emergency consultation per the procedures in accordance with 50 CFR 402.05.

H. Pesticide Use: All pesticides will be applied in accordance with their label and applicable laws and regulations. All pesticides are also applied in accordance with the installation INRMP and the Integrated Pest Management Plan (IPMP).IMCOM installations will regularly check Protection Bulletins on EPA's Endangered Species Protection Program (ESPP) website to determine whether pesticide use in a certain geographic area may affect NLEB. Limitations on pesticide use will be implemented as required to protect NLEBs in all areas. Application of pesticides in and around buildings or other structures are not likely to have any effect on NLEB. If NLEBs are found roosting in a building, then pesticides will be used sparingly and no foggers will be used in and around the occupied building.

To minimize the exposure of NLEB to pesticide and to keep in from drifting into known roost tree areas or water bodies the following conservation measures will be followed:

Conservation measures for Pesticide use:

1. Only pesticides registered by the EPA and State of use may be applied and only in accordance with their label.

2. Aerial application of pesticide will only occur outside the active season unless additional consultation with the USFWS is accomplished. Aerial applications will occur between the hours of sunrise and one hour before sunset. This will protect foraging bats in undiscovered foraging areas from direct exposure.

3. Whenever possible, herbicides that have low toxicity to mammals will be utilized with the tow behind power blowers. Herbicides that may be somewhat toxic to mammals will be mixed and applied at a rate that should minimize any potential exposure concerns.

4. Application of pesticides from ground mounted vehicles (i.e., ATVs, tractors) that spray chemicals directly onto the ground and do not result in broad dispersal will be conducted at least 100 ft (30 m) from known roost trees during the active season (coordinate with local USFWS field office).

5. Application of pesticides that result in broad dispersal (e.g., tow behind power blowers) will be conducted at least 250 ft (76 m) away from known roost trees during the active season (coordinate with local USFWS field office). Pesticides will not be applied between sunrise and one hour before sunset. Location-specific applications (i.e. hatchet or stem injections of trees, individual application to specific plants) may be used within 50 ft (15 m) of known roosts. This measure minimizes the risk of exposure to bats and potential effects from pesticides.

6. Pesticides applied from tow behind power blowers will use appropriate nozzles and drift control additives, and will be applied using low pressure to reduce drift and potential swirling motion from the blower. All efforts will be made to only spray 10 feet from ground level or below.

7. Pesticides will not be applied outdoors when the wind speed exceeds 8 mi/hr for all applications except power mist blowers. Pesticides applied via power mist blower will only be applied with wind speeds <5 mi/hr. This is to reduce the risk of pesticide drift, which could impact water quality or non-target areas. Care will be taken to make sure that any spray drift is kept away from non-target areas and individuals. Additionally, aerial application utilizing helicopters should employ large droplet technology through special nozzles on drop tubes to ensure the herbicide stays on target.

8. If a bat colony is found roosting in a building, then insecticides will be used sparingly and no foggers will be used. This will minimize impacts to roosting northern long-eared bats if they are found within a building.

In conclusion by implementing these conservation measures IMCOM believes the effects on NLEB will be insignificant.

I. Pest Control: IMCOM facilities may have pest control complaints, such as but not limited to bats, moles (order Insectivora), raccoons (*Procyon lotor*), squirrels (order Rodentia), skunks (order Carnivora), woodchucks (order Rodentia), insects, and other such species. Each issue is handled on a case-by-case basis depending on the pest species and the situation. When possible, wildlife will be deterred from areas by removing features that are attractive to the species (e.g. eliminating potential food/nesting sources, plugging openings into buildings, etc.). If deterrence efforts are ineffective, then it may be necessary to set live traps and relocate or euthanize animals, or use lethal control methods such as trapping, shooting, and/ or chemical control. All pest control efforts are performed in accordance with the installation INRMP and the IPMP.

Lethal traps are primarily used for rodents and moles. Adhesive traps are allowable for rodent and insect control in buildings, however, if placed incorrectly, they may inadvertently capture bats. Both adult and juvenile bats are susceptible to capture in glue traps which could result in injury or mortality. To prevent accidental capture of bats, no adhesive traps can be placed in such a manner that they could capture bats. Glue traps will not be placed in any crawl space or attic compartment within buildings or in areas where bats are known to occur. If bats are present within the building, then live traps for rodents will be used instead of glue traps.

If there are large scale infestations of rodents and moles, chemical means may be necessary to effectively manage the outbreak. Bait stations will not be placed where it may be accessible to children or pets and must be monitored to prevent access to non-target animals.

Conservation Measures for Pest Control:

1. No Lethal Control. No lethal control methods are permitted for bats unless there is a suspected human health risk for exposure to rabies or other disease. If individual bats are in buildings and there is no evidence of maternity use, then all efforts will be made to safely capture and release individual bats. Or, the bats will be excluded by establishing one-way valves over the roost's exit (if feasible).

2. Time of Year Restriction for Exclusion. The exclusion will only be done during times of the year when pups are not present or when they are volant (i.e., August - early May). The time of year restriction will minimize the risk of separating mothers from non-volant young, so it will prevent potential pup mortality during exclusion activities. Sealing cracks and crevices in buildings will also be done during the late fall through early spring. Sealing cracks and

crevices prevents bats from entering a building and reduces human/bat conflicts.

3. Adhesive Trap Restrictions. No adhesive traps used for rodents or insects will be placed in such a manner that they could capture bats—glue traps will not be placed in any crawl space or attic compartment within buildings or in areas where bats are known to occur.

4. Chemical Measures. Any use of chemical or insecticides will be utilized in accordance with section "H" above.

In conclusion by implementing these conservation measures IMCOM believes the effects on NLEB will be insignificant in regards to pest control management activities.

J. Recreational Activities: Recreational activities on IMCOM installations typically consist of hunting, fishing, trapping, hiking, mountain biking, camping, horseback riding, wildlife watching, and other consumptive and non-consumptive activities. These activities whether dispersed or concentrated are low impact activities that do not alter the landscape or generate a disturbance that would be considered to affect the NLEB. Continued use of IMCOM installations for these or similar activities is expected to continue without restriction, in accordance with the Sikes Act (16 U.S.C. 670, et seq.). However development of new areas for these activities that would be considered construction or habitat alteration "may affect"; therefore those projects would utilize the conservation measures identified earlier in this document for those actions.

Hunting activities have the potential to directly affect roosting NLEB if a hunter should place a stand in a NLEB roost. Hunters are unlikely to place tree stands in snags due to the instability of snags and the risk that the tree may fall. Thus, NLEB roosting in standing dead trees are not likely to be adversely affected by tree stands during the non-hibernation seasons. Tree stands may disturb roosting NLEB or damage roosts that are located within crevices of live trees or are in a dead tree limb of a live tree. Installment of a tree stand may cause NLEB to abandon the roost. Hunting primarily occurs in the fall-winter when NLEB are moving to the hibernacula or are already in the hibernacula, so NLEB are more likely to roost alone or in small groups within trees or are within the hibernacula. But since hunting typically occurs in seasons when NLEB are less likely to be present, the use of tree stands may affect but is not likely to adversely affect roosting NLEB.

Hunting activities also have the potential to directly affect roosting NLEB if a hunter should shoot at game flying through the air or in a tree and the shot hits a tree containing roosting NLEB. The likelihood of this happening is expected to be extremely rare, given the combination of occurrences that need to come together (i.e., the hunter being in a location suitable for NLEB to be roosting and game birds or waterfowl to be flying, the hunter shooting at the right angle into a tree to hit and kill a NLEB, etc.).

Additionally, most NLEB would presumably be within the hibernacula when the majority of hunting is conducted (October-February).

There is potential that individuals hunting game may shoot into a forested area which has NLEB roosts. Fired projectiles may strike a NLEB roost and remove bark from the tree, rendering the roost unsuitable for future use. Snags are ephemeral in nature and frequently slough bark. NLEB are known to frequently switch roosts assumed because of the fleeting nature of snags. Since strikes of snags are expected to occur infrequently, NLEB are unlikely to be adversely affected by hunting. Thus effects are discountable.

Skeet shooting could potentially result in injury or mortality of a foraging NLEB if skeet shooting was conducted in extreme early morning or at sunset when NLEB may be active. Skeet ranges located adjacent to suitable NLEB summer foraging habitat have a likelihood that a NLEB could be struck during skeet shooting but is highly improbable.

Legal use of Off Road Vehicles (ORV) should have no known indirect effects to NLEB as ORV's will remain on the road at all times and will not damage vegetation in the area. However, unauthorized ORV use off-trail may damage vegetation which can expose the soil to the elements and could lead to increased soil erosion. Soil erosion may lead to declines in water quality. Lower water quality may reduce aquatic insect availability, which are prey for NLEB. In addition, streams/wetlands may be converted overtime into mud pits that are unsuitable for drinking by NLEB. Given the amount of ample water and natural habitat available on IMCOM installations, it is unlikely that ORV use will adversely affect NLEB. Thus, effects are discountable.

Recreational activities that occur in the vicinity of hibernacula are pass through in nature except possibly for stationary hunting. Stationary hunting would only create a disturbance when a shot or shots were fired but no different than the single unlikely instance as with pass through hunting. Additionally as in section "A" noise activities associated with the firing of weapons has been shown to not adversely affect NLEB.

In conclusion, the majority of recreational activities with the exclusion of ORV use, hunting, and skeet shooting, are expected to have no known effects on NLEB. Given the conservation measures for each and remote nature of potential effects, recreational activities may affect but are not likely to adversely affect NLEB.

VII. Additional General Conservation Measures

This section identifies the Conservation Measures (CM) proposed throughout this document that are considered necessary to either avoid adverse affects or to ensure the expected effects are beneficial, insignificant or discountable. Additional CMs are also proposed to promote the conservation of the NLEB.

- IMCOM will use the most current National WNS Decontamination Protocols approved by USFWS for planned activities that involve close or direct contact with bats, their environments, and/or associated materials.
- IMCOM will explore cooperative management efforts with adjacent landowners, if such efforts would complement installation NLEB conservation initiatives and/or support mission implementation.
- IMCOM will explore cooperative NLEB management strategies, solutions, and efforts with other federal, state, and private organizations and landowners in the region.
- IMCOM will seek funding opportunities to conduct USFWS presence/absence surveys on individual installations subject to the availability of funds.
- IMCOM installations will continue to manage their ecosystems to support and enhance military training, testing, & readiness in accordance with their INRMP to retain habitat and biological diversity, and long term sustainability.
- IMCOM & the USFWS will develop a screening criteria check list so individual installations may quickly and categorically apply the above listed measures described in the programmatic process.
- IMCOM will centrally report activities taken by individual installations under this programmatic opinion annually to the USFWS from data gathered through the annual AEDB-EQ installation data call.

VIII Conclusions

A. Northern Long-Eared Bat. Based on IMCOM's intent to follow USFWS guidance on NLEB management, carry out actions as described in Section V, and to implement the conservation measures identified in Section VI, IMCOM has determined that implementation of actions IAW with this document **"may affect, but not likely to adversely affect"** the NLEB as a threatened species listed under the ESA.

B. Request of Conference Report. IMCOM requests that the USFWS review our findings and determinations stated herein and provide a conference report that reflects IMCOM's proposed conservation measures for reducing adverse effects. If necessary, the applicable IMCOM installation(s) will initiate site specific consultation with their USFWS Field Office on activities that are not included in this BE or if there is additional site specific information to suggest alternate conservation measures.

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X. Glossary

Action area - all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action.

Active season – the time period when bats are not in hibernation. This includes spring emergence, young rearing, and breeding (swarming) and is typically from April through October (specific dates are defined by geographical area see Table 2).

Critical habitat - (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of the ESA, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the ESA, upon a determination by the Secretary that such areas are essential for the conservation of the species (defined in Section 3 of the ESA).

Emergency - An emergency is a situation involving an act of God, disasters, casualties, national defense or security emergencies, etc., and includes response activities that must be taken to prevent imminent loss of human life or property.

Exfoliating bark - tree bark that peels away from a trunk or a branch of a tree; when a tree dies, plates of bark spring away from the bole of the tree. Some living trees, such as shagbark hickory and white oak, have bark that peels back from the living cambium.

Hibernaculum (plural **hibernacula)** - a site, usually a cave or mine, where any bat species hibernates during the winter (see suitable habitat).

Is likely to adversely affect – the appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial.

Known hibernacula – a location where one or more northern long-eared bats have been detected during hibernation or at the entrance during fall swarming or spring emergence. Given the documented challenges of surveying for northern long-eared bats in the winter (use of cracks, crevices), any hibernacula with northern long-eared bats observed at least once, will continue to be considered ‘‘known hibernacula’’ as long as the hibernacula and its surrounding habitat remain suitable for northern long-eared bat. However, a hibernaculum may be considered to be unoccupied if there is evidence (*e.g.,* survey data) that it is no longer in use by northern long-eared bats (USFWS 2015).

Known roost tree – a tree that male or female NLEBs have been documented as using during the active season (approximately April–October). Once documented, a tree will

be considered to be a ‘‘known roost’’ as long as the tree and surrounding habitat remain suitable for NLEB. However, a tree may be considered to be unoccupied if there is evidence that the roost is no longer in use by NLEB (USFWS 2015).

May affect - the appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat.

No effect - the appropriate conclusion when the action agency determines its proposed action will not affect a listed species or designated critical habitat**.**

Not likely to adversely affect (NLAA) - the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. **Beneficial effects** are contemporaneous positive effects without any adverse effects to the species. **Insignificant effects** relate to the size of the impact and should never reach the scale where take occurs. **Discountable effects** are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

Snag - a standing dead (or mostly dead) tree, generally with <10 percent living canopy.

Staging - the departure of bats from hibernacula in the spring, including processes and behaviors that lead up to departure (see suitable habitat).

Suitable habitat - Summer and/or winter habitat that is appropriate for use by NLEB (may be known or unknown in terms of documented use). See most recent summer survey guidance)

- **Winter** (hibernacula) is restricted to underground caves and cave-like structures (e.g.,abandoned mines, railroad tunnels). These hibernacula typically have large passages with significant cracks and crevices for roosting; relatively constant, cooler temperatures (0-9 degrees C) and with high humidity and minimal air currents.

- **Summer** for NLEB consists of the variety of forested/wooded habitats where they roost, forage, and travel. This includes forested patches as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1000 feet from the next nearest suitable roost tree, woodlot, or wooded fencerow. May also include structures for roosting (e.g., barn).

- **Spring staging/fall swarming** for NLEBs consists of the variety of forested/wooded habitats where they roost, forage, and travel within 5 miles of a hibernaculum. This includes forested patches as well as linear features

such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1000 feet from the next nearest suitable roost tree, woodlot, or wooded fencerow.

Suitable roost tree - any tree in which bats roost when they emerge from the hibernacula. Females gather in maternity colonies and males may roost singly or in small groups. During summer NLEBs roost singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and snags, typically ≥3 inches dbh.

Survey - a method of sampling, such as mist netting, that provides data concerning the presence/absence of bats at a site; also, the act of enumerating the bats hibernating in a cave or mine. NLEB summer survey guidance can be found at http://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html

Swarming - A phenomenon in which, during late summer and autumn, numerous bats are observed entering and exiting entrances to caves and mines, but few, if any, of the bats may roost within the site during the day. Swarming probably is related to fall breeding activities and locating potential hibernation sites. (See suitable habitat).

Take - Take is defined in Section 3 of the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Torpor – a period of inactivity, with reduced body temperature and metabolism.

Volant - able to fly.

Verified absence - refers to known or suitable habitat determined to be unoccupied at the time of impact by utilizing USFWS approved protocols.

XI. Summary of IMCOM NLEB Programmatic Biological Evaluation Conservation Measures

A) Activities/Areas Not Subject to Conservation Measures:

- Any Activity that occurs outside the known range of the NLEB (see Section V for details)
- Any activity that occurs within the known range of the NLEB but does not contain suitable NLEB habitat. (see Section V for details)
- Any activity in a highly developed urban area that is <1000' from suitable NLEB habitat. (see Section V for details)
- Any area where NLEB absence has been verified by USFWS Protocol survey.
- Any activity that is conducted under a site specific consultation with the local USFWS Field Office.
- All military activities such as but not limited to: air operations, water operations, field training operations, live munitions training, demolition, and research, development, testing, and evaluation (RDTE). (see Section VI-A for details)
- All activities involving the use of aircraft such as but not limited to: fixed wing, rotary wing, drone, etc…(see Section VI-B for details)
- All categories of outdoor recreation such as but not limited to: hunting, fishing, trapping, hiking, mountain biking, camping, horseback riding, wildlife watching, and other consumptive/non-consumptive activities. (see Section VI-J for details)

B) Activities Subject to Conservation Measures:

- Military Training Smoke and Obscurants: (see Section VI-C for details)
  1. M18 colored smoke grenades will not be used within 50m of forested known/presumed occupied NLEB during the active season (see PBE Table 2 Below). Or within 50m of known roost trees during the active season if USFWS protocol surveys have been completed.
  2. Fog oil will not be released within forested known/presumed occupied habitat during the NLEB active season (see PBE Table 2 Below).
  3. WP will not be released within 200 meters of forested known/presumed occupied NLEB during the active season (see PBE Table 2 Below). Or within 200m of known roost trees during the active season if USFWS protocol surveys have been completed.
  4. Other smoke/obscurants will not be employed during the NLEB active season (see PBE Table 2 Below).
  5. No smoke or obscurants will be released within 0.5 miles of known hibernacula outside of the active season as defined in PBE Table 2 Below.

- Construction: (see Section VI-D for details)
  1. If there is a need to remove a single or small cluster of trees during the active season, the installation will follow procedures listed in that section below.
  2. Consult with USFWS for projects within 0.25 miles of known roost trees. Buffers may also take into account factors such as the surrounding landscape, habitat connectivity, and distance to other roosts, distance to known foraging areas.

3. Implement a 0.5 mile buffer around "known" hibernacula where additional consultation is required
4. Conduct structure, sign, utility, & bridge maintenance: during the active season that does not bother roosting bats in any way (e.g., activity away from roosts inside common rooms in structures, normal cleaning and routine maintenance)
5. Tree removal outside the active season (see PBE Table 2 Below), that is entirely within 100'of an existing road surface has no acreage limit. This would include roads within cantonment , state, local roads, paved roads, and developed hard packed roads, but does not include trails or other travel corridors in training areas)
6. Tree removal outside the active season (see PBE Table 2 Below), that is >100' of an existing road surface has a 10 acre per project limit.
7. Flagging or signs will be used to demarcate areas to be cleared vs. not cleared prior to any construction activities for a given project. Flagging will be removed upon completion of the project.
8. Via Scope of Works, Contracts, etc., all personnel responsible for construction activities will be informed about the need to follow design plans, stay within flagging, and minimize impacts to wildlife and other environmental concerns.
9. Outdoor Lighting Minimization. For all future projects, IMCOM will evaluate the use of outdoor lighting and seek to minimize light pollution by angling lights downward or via other light minimization measures.
10. Demolition. If the building has pre-existing known NLEB colonies, then the environmental contact of the IMCOM installation must be contacted before demolition is to occur. If during the course of demolition, NLEB are discovered, then all work must cease and USFWS must be immediately contacted. If the structure is safe to leave as is, then it will be left until after October 15, or until bats have stopped using the structure. If the structure is unsafe and poses a risk to human health and safety, IMCOM will attempt to exclude the bats immediately. If this is not possible, or NLEB are found to be using the structure during the maternity season when pups are not volant, IMCOM will contact USFWS to discuss the most appropriate next course of action.
11. Water Quality BMPs will be established for each construction site in accordance with the appropriate federal laws and state permits.

- <u>Forest management:</u> (see Section VI-E for details)
  1. IMCOM will screen projects that required tree removal for forest management activities the same as identified for construction.
  2. If there is a need to remove a single or small cluster of trees during the active season, the installation will follow procedures listed in that section below.
  3. Implement a 0.25-mile buffer around known roost trees where additional consultation is required for clearcutting or similar harvest. Buffers will be may also take into account factors such as the surrounding landscape, habitat connectivity, and distance to other roosts, distance to known foraging areas.

4. Implement a 0.5 mile buffer around "known" hibernacula where additional consultation is required.
5. Tree removal outside the active season (see PBE Table 2 Below), that is entirely within 100'of an existing road surface has no acreage limit. This would include roads within cantonment , state, local roads, paved roads, and developed hard packed roads, but does not include trails or other travel corridors in training areas)
6. Clearcutting or similar harvest outside the active season (see PBE Table 2 Below), that is >100'of an existing road surface has a 10 acre per project limit. No acreage limit on selective harvest.
7. Flagging or signs will be used to demarcate areas to be cleared vs. not cleared prior to any forest management activities for a given project. Flagging will be removed upon completion of the project.
8. Snag Retention. All snags will be left in silvicultural treatments unless there is a safety concern for the contractor or the military units training in the stands (e.g., maneuver corridors), or unless the treatment is a salvage harvest or clearcut.

- Prescribed Burns: (see Section VI-F for details)
  1. Will not be conducted within 0.5 miles from "known hibernacula" when bats are present during the inactive season (see Table 2 for active season).
  2. Will not occur within forested suitable NLEB habitat during the active season (see PBE Table 2 Below).
  3. Prescribed burns will be conducted under a site specific burn plan per the Installation Integrated Wildland Fire Management Plan
  4. Whenever possible, all efforts will be made to have all flames extinguished and smoke generation minimized by sunset to reduce potential direct impacts to foraging bats during the active season (see PBE Table 2 Below)
  5. Make use of naturally occurring firebreaks or if necessary, establish wet lines 100m around forested known/presumed occupied NLEB habitat during the active season (see PBE Table 2 Below), to preclude fire from entering, to the maximum extent practicable.

- Specific Single, Group, or Hazard Tree Removal (see Section VI-G for details)
  1. Removal of single, multiple, or cluster of trees during the active season, in areas where there are known roost trees, trees that do not pose a risk to human life or property will be analyzed for signs of bats being present (emergence surveys) prior to removal according to USFWS Indiana bat (and NLEB) summer survey protocols.
  2. If known roost tree removal is determined to be necessary, the applicable IMCOM installation will consult with their local USFWS field office.
  3. If such tree removal is preferred immediately, the applicable IMCOM installation will consult with their local USFWS field office.
  4. If non-ESA bat species are determined present and immediate removal of the tree(s) is necessary, the tree(s) will be removed in a manner that will minimize

impacts on the bats such as first disturbing the tree(s) to cause them to abandon the roost.

5. If there are hazard trees that are considered an imminent threat to human life or loss of property occurring in suitable NLEB habitat and need to be removed during the active season, the IMCOM installation will remove such trees and inform the USFWS field office of the action only if NLEB are present on the IMCOM installation will initiate emergency consultation per the procedures in accordance with 50 CFR 402.05.

- Pesticide Use: (see Section VI-H for details)
  1. Only pesticides registered by the EPA and State of use may be applied and only in accordance with their label.
  2. Aerial applications will occur outside the active season (see PBE Table 2 Below) and between the hours of sunrise and one hour before sunset. When utilizing helicopters for application they should employ large droplet technology through special nozzles on drop tubes to ensure the herbicide stays on target.
  3. Whenever possible, herbicides that have low toxicity to mammals will be utilized with the tow behind power blowers. Herbicides that may be somewhat toxic to mammals will be mixed and applied at a rate that should minimize any potential exposure concerns.
  4. Application of pesticides from ground mounted vehicles (i.e., ATVs, tractors) that spray chemicals directly onto the ground and do not result in broad dispersal will be conducted at least 100 ft (30 m) from known roost trees during the active season (see PBE Table 2).
  5. Application of pesticides that result in broad dispersal (e.g., tow behind power blowers) will be conducted at least 250 ft (76 m) away from known roost trees during the active season (see PBE Table 2 Below) and will not be applied between sunrise and one hour before sunset.
  6. Location-specific applications (i.e. hatchet or stem injections of trees, individual application to specific plants) may be used within 50 ft (15 m) of known roosts.
  7. Pesticides applied from tow behind power blowers will use appropriate nozzles and drift control additives, and will be applied using low pressure to reduce drift and potential swirling motion from the blower. All efforts will be made to only spray 10 feet from ground level or below.
  8. Pesticides will not be applied outdoors when the wind speed exceeds 8 mi/hr for all applications except power mist blowers. Pesticides applied via power mist blower will only be applied with wind speeds <5 mi/hr.
  9. If a bat colony is found roosting in a building, then insecticides will be used sparingly and no foggers will be used. This will minimize impacts to roosting northern long-eared bats if they are found within a building.

- Pest Control: (see Section VI-I for details)
  1. No Lethal Control. No lethal control methods are permitted for bats unless there is a suspected human health risk for exposure to rabies or other

disease. If individual bats are in buildings and there is no evidence of maternity use, then all efforts will be made to safely capture and release individual bats. Or, the bats will be excluded by establishing one-way valves over the roost's exit (if feasible).

2. Exclusion will only be done during times of the year when pups are not present or when they are volant (i.e., August - early May). Sealing cracks and crevices in buildings will also be done during the late fall or early spring.
3. No adhesive traps used for rodents or insects will be placed in such a manner that they could capture bats—glue traps will not be placed in any crawl space or attic compartment within buildings or in areas where bats are known to occur.
4. Chemical Measures. Any use of insecticides will be utilized in accordance with the conservation measure associated with "Pesticide Use".

C) Additional General Conservation Measures.

1. IMCOM will use the most current National WNS Decontamination Protocols approved by USFWS for planned activities that involve close or direct contact with bats, their environments, and/or associated materials.
2. IMCOM will explore cooperative management efforts with adjacent landowners, if such efforts would complement installation NLEB conservation initiatives and/or support mission implementation.
3. IMCOM will explore cooperative NLEB management strategies, solutions, and efforts with other federal, state, and private organizations and landowners in the region.
4. IMCOM will seek funding opportunities to conduct USFWS presence/absence surveys on individual installations subject to the availability of funds.
5. IMCOM installations will continue to manage their ecosystems to support and enhance military training, testing, & readiness in accordance with their INRMP to retain habitat and biological diversity, and long term sustainability.
6. IMCOM & the USFWS will develop a screening criteria check list so individual installations may quickly and categorically apply the above listed measures described in the programmatic process.
7. IMCOM will centrally report activities taken by individual installations under this programmatic opinion annually to the USFWS from data gathered through the annual AEDB-EQ installation data call.

IMCOM NLEB Programmatic Consultation
Screening Criteria

IMCOM NLEB Programmatic Consultation Screening Criteria

This document is intended to compliment and facilitate the implementation of the IMCOM Programmatic Consultation by allowing individual installations to screen areas or projects for applicable conservation measures for the NLEB. For all projects purposes screened with this criteria ensure you document the location, size, and disposition for annual reporting.

1) Does your area or activity occur within one of the following categories?

- **a.** Occurs outside the known range of the NLEB (see Section V for details)
- **b.** Occurs within the known range of the NLEB but does not occur within 0.5 miles of hibernacula or within 0.25 miles of suitable NLEB summer habitat. (see Section V and the Glossary in Section X for details)
- **c.** Occurs within a highly developed urban area that is <1000' from suitable NLEB habitat. (see Section V for details)
- **d.** An area with NLEB verified absence through USFWS Protocol survey(s).
- **e.** An activity that is conducted under a separate site specific consultation with the local USFWS Field Office.
- **f.** A military training activity such as but not limited to: air operations, water operations, field training operations, live munitions training, demolition, and research, development, testing, and evaluation (RDTE) that does not utilize smokes, obscurants, or gases. (see Section VI-A for details)
- **g.** Aircraft activities such as but not limited to: fixed wing, rotary wing, drone, etc…(see Section VI-B for details)
- **h.** Outdoor recreation such as but not limited to: hunting, fishing, trapping, hiking, mountain biking, camping, horseback riding, wildlife watching, and other consumptive/non-consumptive activities. (see Section VI-J for details)

NO
Continue to question 2 and all remaining questions.

YES
No further action is necessary to comply with Endangered Species Act protections for the Northern Long-eared Bat.

2) Does your activity utilize military smoke or obscurants?

NO
Continue to question 3 and all remaining questions.

YES
Implement the following applicable conservation measures (see Section VI-C for details), continue to question 3 and all remaining questions.

1. M18 colored smoke grenades will not be used within 50m of forested suitable NLEB during the active season (see PBE Table 2 Below). Or within 50m of

known roost trees during the active season if USFWS protocol surveys have been completed.
2. Fog oil will not be released within forested suitable NLEB habitat during the active season (see PBE Table 2 Below).
3. WP will not be released within 200 meters of forested suitable NLEB habitat during the active season (see PBE Table 2 Below). Or within 200m of known roost trees during the active season if USFWS protocol surveys have been completed.
4. Other smoke/obscurants will not be employed during the NLEB active season (see PBE Table 2 Below).
5. No smoke or obscurants will be released within 0.5 miles of known hibernacula outside of the active season as defined in PBE Table 2 Below.

3) Does your activity involve construction?

NO
Continue to question 4 and all remaining questions.

YES
Implement the following applicable conservation measures (see Section VI-D for details), continue to question 4 and all remaining questions.

1. If there is a need to remove a single or small cluster of trees during the active season, the installation will follow procedures listed question 6.
2. Will not occur within forested suitable NLEB habitat during the active season (see PBE Table 2 Below).
3. No known roost trees will be felled, unless there is a human health and safety concern. If there is a need to remove a known roost tree, the installation will follow procedures listed in Section VI.G. to determine if such removal can be done with insignificant or discountable effects on NLEB.
4. Consult with USFWS for projects within 0.25 miles of known roost trees. Buffers may also take into account factors such as the surrounding landscape, habitat connectivity, and distance to other roosts, distance to known foraging areas.
5. Implement a 0.5 mile buffer around “known” hibernacula where additional consultation is required.
6. For structure, sign, utility, & bridge maintenance: if needed during the active season, conduct in manner that does not bother roosting bats in any way (e.g., activity away from roosts inside common rooms in structures, normal cleaning and routine maintenance). If needed outside of the active season, conduct in manner that does not alter roosting potential for bats.
7. Tree removal outside the active season (see PBE Table 2 Below), that is entirely within 100’of an existing road surface has no acreage limit. This would include roads within cantonment , state, local roads, paved roads, and developed hard packed roads, but does not include trails or other travel corridors in training areas)

8. Tree removal outside the active season (see PBE Table 2 Below), that is >100' of an existing road surface has a 10 acre per project limit.
9. Flagging or signs will be used to demarcate areas to be cleared vs. not cleared prior to any construction activities for a given project. Flagging will be removed upon completion of the project.
10. Via Scope of Works, Contracts, etc., all personnel responsible for construction activities will be informed about the need to follow design plans, stay within flagging, and minimize impacts to wildlife and other environmental concerns.
11. Outdoor Lighting Minimization. For all future projects, IMCOM will evaluate the use of outdoor lighting and seek to minimize light pollution by angling lights downward or via other light minimization measures.
12. Demolition. If the building has pre-existing known NLEB colonies, then the environmental contact of the IMCOM installation must be contacted before demolition is to occur. If during the course of demolition, NLEB are discovered, then all work must cease and USFWS must be immediately contacted. If the structure is safe to leave as is, then it will be left until after October 15, or until bats have stopped using the structure. If the structure is unsafe and poses a risk to human health and safety, IMCOM will attempt to exclude the bats immediately. If this is not possible, or NLEB are found to be using the structure during the maternity season when pups are not volant, IMCOM will contact USFWS to discuss the most appropriate next course of action.
13. Water Quality BMPs will be established for each construction site in accordance with the appropriate federal laws and state permits.

4) Does your activity involve Forest Management, not including Prescribed Burning?

NO
Continue to question 5 and all remaining questions.

YES
Implement the following applicable conservation measures (see Section VI-E for details), continue to question 5 and all remaining questions.

1. IMCOM will screen projects that required tree removal for forest management activities the same as identified for construction.
2. If there is a need to remove a single or small cluster of trees during the active season, the installation will follow procedures listed in that section below.
3. Will not occur within forested suitable NLEB habitat during the active season (see PBE Table 2 Below).
4. No known roost trees will be felled, unless there is a human health and safety concern. If there is a need to remove a known roost tree, the installation will follow procedures listed in Section VI.G. to determine if such removal can be done with insignificant or discountable effects on NLEB.

5. Implement a 0.25-mile buffer around known roost trees where additional consultation is required for clearcutting or similar harvest. Overstory roost tree removal is also not authorized within 100 meters of documented maternity roost trees without further consultation with the USFWS. Tree thinning/removal will also take into account factors such as the surrounding landscape, habitat connectivity, and distance to other roosts, distance to known foraging areas.
6. Implement a 0.5 mile buffer around "known" hibernacula where additional consultation is required.
7. Tree removal outside the active season (see PBE Table 2 Below), that is entirely within 100'of an existing road surface has no acreage limit. This would include roads within cantonment , state, local roads, paved roads, and developed hard packed roads, but does not include trails or other travel corridors in training areas)
8. Clear cutting or similar harvest outside the active season (see PBE Table 2 Below), that is >100'of an existing road surface has a 10 acre per project limit. No acreage limit on selective harvest outside the active season.
9. Flagging or signs will be used to demarcate areas to be cleared vs. not cleared prior to any forest management activities for a given project. Flagging will be removed upon completion of the project.
10. Snag Retention. All snags will be left in silvicultural treatments unless there is a safety concern for the contractor or the military units training in the stands (e.g., maneuver corridors), or unless the treatment is a salvage harvest or clearcut.

5) Does your activity involve Prescribed Burning?

NO
Continue to question 6 and all remaining questions.

YES
Implement the following applicable conservation measures (see Section VI-F for details), continue to question 6 and all remaining questions.

1. Will not be conducted within 0.5 miles from "known hibernacula" when bats are present during the inactive season (see Table 2 for active season).
2. Will not occur within forested suitable NLEB habitat during the active season (see PBE Table 2 Below).
3. Prescribed burns will be conducted under a site specific burn plan per the Installation Integrated Wildland Fire Management Plan
4. Whenever possible, all efforts will be made to have all flames extinguished and smoke generation minimized by sunset to reduce potential direct impacts to foraging bats during the active season (see PBE Table 2 Below)
5. Make use of naturally occurring firebreaks or if necessary, establish wet lines 100m around forested known/presumed occupied NLEB habitat during the active season (see PBE Table 2 Below), to preclude fire from entering, to the maximum extent practicable.

6) Does your activity involve Specific Single, Group, of Hazard Tree Removal?

NO
Continue to question 7 and all remaining questions.

YES
Implement the following applicable conservation measures (see Section VI-G for details), continue to question 7 and all remaining questions.

1. Removal of single, multiple, or cluster of trees during the active season, in areas where there are known roost trees, trees that do not pose a risk to human life or property will be analyzed for signs of bats being present (emergence surveys) prior to removal according to USFWS Indiana bat (and NLEB) summer survey protocols.
2. If known roost tree removal is determined to be necessary, the applicable IMCOM installation will consult with their local USFWS field office.
3. If such tree removal is preferred immediately, the applicable IMCOM installation will consult with their local USFWS field office.
4. If non-ESA bat species are determined present and immediate removal of the tree(s) is necessary, the tree(s) will be removed in a manner that will minimize impacts on the bats such as first disturbing the tree(s) to cause them to abandon the roost.
5. If there are hazard trees that are considered an imminent threat to human life or loss of property occurring in suitable NLEB habitat and need to be removed during the active season, the IMCOM installation will remove such trees and inform the USFWS field office of the action only if NLEB are present on the IMCOM installation will initiate emergency consultation per the procedures in accordance with 50 CFR 402.05.

7) Does your activity involve Pesticide Use?

NO
Continue to question 8 and all remaining questions.

YES
Implement the following applicable conservation measures (see Section VI-H for details), continue to question 8 and all remaining questions.

1. Only pesticides registered by the EPA and State of use may be applied and only in accordance with their label.
2. Aerial applications will occur outside the active season (see PBE Table 2 Below) and between the hours of sunrise and one hour before sunset. When utilizing helicopters for application they should employ large droplet technology through special nozzles on drop tubes to ensure the herbicide stays on target.
3. Whenever possible, herbicides that have low toxicity to mammals will be utilized with the tow behind power blowers. Herbicides that may be

somewhat toxic to mammals will be mixed and applied at a rate that should minimize any potential exposure concerns.

4. Application of pesticides from ground mounted vehicles (i.e., ATVs, tractors) that spray chemicals directly onto the ground and do not result in broad dispersal will be conducted at least 100 ft (30 m) from known roost trees during the active season (see PBE Table 2).
5. Application of pesticides that result in broad dispersal (e.g., tow behind power blowers) will be conducted at least 250 ft (76 m) away from known roost trees during the active season (see PBE Table 2 Below) and will be applied between sunrise and one hour before sunset.
6. Location-specific applications (i.e. hatchet or stem injections of trees, individual application to specific plants) may be used within 50 ft (15 m) of known roosts.
7. Pesticides applied from tow behind power blowers will use appropriate nozzles and drift control additives, and will be applied using low pressure to reduce drift and potential swirling motion from the blower. All efforts will be made to only spray 10 feet from ground level or below.
8. Pesticides will not be applied outdoors when the wind speed exceeds 8 mi/hr for all applications except power mist blowers. Pesticides applied via power mist blower will only be applied with wind speeds <5 mi/hr.
9. If a bat colony is found roosting in a building, then insecticides will be used sparingly and no foggers will be used. This will minimize impacts to roosting northern long-eared bats if they are found within a building.

8) Does your activity involve Pest Control?

NO
Continue to question 9.

YES
Implement the following applicable conservation measures (see Section VI-I for details), continue to question 9 and all remaining questions.

1. No Lethal Control. No lethal control methods are permitted for bats unless there is a suspected human health risk for exposure to rabies or other disease. If individual bats are in buildings and there is no evidence of maternity use, then all efforts will be made to safely capture and release individual bats. Or, the bats will be excluded by establishing one-way valves over the roost's exit (if feasible).
2. Exclusion will only be done during times of the year when pups are not present or when they are volant (i.e., August - early May). Sealing cracks and crevices in buildings will also be done during the late fall or early spring.
3. No adhesive traps used for rodents or insects will be placed in such a manner that they could capture bats—glue traps will not be placed in any crawl space or attic compartment within buildings or in areas where bats are known to occur.

4. Chemical Measures. Any use of insecticides will be utilized in accordance with the conservation measure associated with “Pesticide Use”.

9) If your activity was not identified through the previous screening questions or cannot be completed within the identified conservation measures, contact your local USFWS Field Office for additional guidance or site specific consultation.

Table 2: Active Season Dates for the Northern Long-eared Bat based on Table 1 of the Northern Long-Eared Bat Conference Guidance (USFWS 2014). Individual IMCOM installations should confirm dates with their local USFWS Field Office.

State/Region	Active Season
Alabama	Apr 1-Nov 30
Illinois	Apr 1-Nov 15
Kansas	Apr 1-Nov 1
Kentucky	Apr 1-Nov 15
Massachusetts	Contact FO
Maryland	Contact FO
Michigan	Apr 1-Oct 1
Missouri	Apr 1-Nov 15
New Jersey	Apr 1-Nov 15
New York	Apr 1-Oct 30
Pennsylvania	Contact FO
Virginia	Apr 1-Nov 15
Wisconsin	Apr 1 - Oct 15

APPENDIX M

Eagle Conservation Plan;

APG Standing Operating Procedures

- Eagle Monitoring Surveys
- Response to Eagle Injuries and Mortalities

EAGLE CONSERVATION PLAN

U.S. Army Garrison
Aberdeen Proving Ground, Maryland

Final

August 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
ACP	Advanced Conservation Practice
ACUB	Army Compatible Use Buffer
APG	Aberdeen Proving Ground
APLIC	Avian Power Line Interaction Committee
BGEPA	Bald and Golden Eagle Protection Act
BRAC	Base Realignment and Closure Act
CFR	Code of Federal Regulations
ECP	Eagle Conservation Plan
ESA	Endangered Species Act
MDDNR	Maryland Department of Natural Resources
U.S.	United States
USFWS	United States Fish and Wildlife Service

1. STAGE 1 – SITE ASSESSMENT

Stage 1 of the Eagle Conservation Plan (ECP) consists of a site evaluation and characterization. This stage is used to evaluate broad geographic areas with regards to important eagle use areas. Potential impacts to resident breeding and non-breeding eagles, and to migrant and wintering eagles are broadly identified. Existing information from literature, databases, and other sources is utilized to judge the appropriateness of potential project sites, taking into account suitability for project development and potential risk to eagles.

1.1 Site Evaluation

The project site is Aberdeen Proving Ground (APG) located in Harford and Baltimore Counties, Maryland. APG is a United States (U.S.) Army installation that encompasses approximately 72,500 acres (113 square miles) of land and water in the northern Chesapeake Bay. The expanse of the installation property allows for research, development, engineering, and testing of all Army materiel including ordnance, weaponry, vehicles, soldier systems, and communication systems. APG is the U.S. Army's oldest active proving ground, and was established in 1917 shortly after the U.S. entered World War I. Since its inception, countless Army systems have been tested for performance and durability at APG including various weaponry systems and all tracked and wheeled vehicles utilized by the U.S. Forces. In addition, APG has served as a center for chemical warfare research and development. From the trenches of France and Belgium in World War I to the desert battlefields of Iraq nearly 80 years later, the research and testing conducted at APG has contributed to the performance, defense, and safety of the U.S. Forces. Because of the Base Realignment and Closure Act (BRAC) of 2005 and other factors, APG has evolved into a major hub of research, development, test and evaluation activity for the joint services. The Army mission at APG is vital to national security. Sustainment of APG's military mission ensures that today's soldiers have the most advanced equipment, systems, and technology possible to succeed at home and abroad.

The installation is geographically divided into two areas, separated by the Bush River (Figure 1). The Edgewood Area is to the west of the river, and the Aberdeen Area lies to the east. The Edgewood Area consists of the Edgewood peninsula, Pooles Island, Carroll Island, and Graces Quarters. The Aberdeen Area consists of the Aberdeen peninsula and Spesutie Island. Additionally, there are several small APG properties that are not connected to the main installation: Churchville Test Area, Atkisson Dam and Reservoir, Van Bibber Water Treatment Plant (WTP), Hanson Reservoir, and Eastern Shore Towers.

This ECP was developed by APG in coordination with the U.S. Fish and Wildlife Service (USFWS), in support of a programmatic permit for take of bald eagles at APG. The proposed activity is not defined as a single action, but rather all the activities that occur at APG that have the potential to disturb or take eagles. Incidental take of bald eagles

Figure 1 Aberdeen Proving Ground, Maryland

at APG is most likely to occur due to collisions with electrical and other man-made infrastructure, and disturbances to nesting eagles from air, land, and water mission activities. In accordance with its 2006 Endangered Species Act (ESA) Section 7 Biological Opinion for bald eagles, APG has implemented a number of conservation measures to reduce eagle mortalities and disturbances. However, due to the on-going military mission and the increasing population of bald eagles, it is unlikely that the incidence of eagle take at APG can be entirely eliminated despite the implementation of minimization measures. Therefore, APG is applying for a programmatic permit for take of eagles under the Bald and Golden Eagle Protection Act (BGEPA). The programmatic permit will authorize incidental eagle take (lethal and nest disturbance), and also potential removal of eagle nests under specific conditions. Therefore, APG's programmatic permit will be a combination permit authorized under Title 50 Code of Federal Regulations (CFR) Part 22.26 (incidental take) and Part 22.27 (nest removal). The programmatic permit will supersede APG's 2006 Biological Opinion, terms and conditions, and ESA incidental take allowance.

1.2 Site Characterization

Located on the western shore of Maryland in the northern Chesapeake Bay, over half of APG is comprised of water or wetlands. With approximately 135 miles of shoreline, much of it forested, APG has played a significant role in the regional recovery of bald eagles. APG is located within the Upper Bay Bald Eagle Concentration Area, one of several concentration areas for bald eagles in the Chesapeake Bay (Watts and Mojica 2009a). This concentration area supports resident breeding and non-breeding eagles, and also migratory eagles from the northeastern and southeastern territories of the U.S. and Canada. At least 1,500 breeding pairs of eagles inhabit the Chesapeake Bay (Craig Koppie, USFWS, pers. comm.). APG attracts a disproportional number of eagles within the concentration area, because the installation has largely undeveloped forested shorelines with abundant food resources in the surrounding rivers and Bay. In addition, many of these shoreline areas have restricted access with little human activity. These shorelines provide optimal habitat for foraging, roosting, and nesting bald eagles. Eagles can be expected to utilize other small pockets of less developed areas in the northern Bay, such as the Sassafras River to the east of APG (3 miles from installation eastern boundary) and the lower Susquehanna River to the north of APG (5 miles from installation northern boundary). However, residential and commercial development of surrounding shorelines in the northern Chesapeake Bay continues to drive an increasing number of eagles to APG.

2 STAGE 2 – SITE SPECIFIC SURVEYS AND ASSESSMENTS

Stage 2 of the ECP consists of the collection of site specific quantitative data through scientifically-based surveys and assessments. The data identify any important eagle use areas or migration concentration sites that fall within or close to the project footprint. In addition, the data allow for an estimation of the eagle exposure rate within the project footprint.

2.1 Important Eagle Use Areas

APG has monitored the bald eagle population on the installation since the mid-1970s utilizing population surveys, roost surveys, and nest surveys. These surveys have been supplemented with an extensive three-year eagle movement study using satellite telemetry. These efforts have resulted in a comprehensive database of eagle movement, population dynamics, and productivity on APG that also provides a broader understanding of eagle dispersal/movement and roost behavior throughout the Chesapeake Bay.

2.1.1 Foraging and Loafing Areas

Bald eagles generally use shoreline areas with suitable trees for perching, as areas for daytime foraging and loafing. The size of a local eagle population can be roughly estimated by surveying the shorelines. To this end, APG conducts an annual Mid-Winter Bald Eagle Survey as a cooperative effort with the Maryland Department of Natural Resources (MDDNR). The mid-winter survey is part of a national survey, and is typically conducted during a two-week window in early January. APG's annual survey route is conducted by helicopter and includes the shoreline and tributaries of APG, and also the off-Post shoreline of the Susquehanna River north to the Exelon Peach Bottom (Pennsylvania) power plant. The data collected from the survey help to identify long-term population trends and distributions of eagles. This information is critical to effectively implementing APG's bald eagle management and compliance program. APG provides the annual data to the MDDNR, who then compiles all the data collected within the state to estimate the region-wide bald eagle population. These mid-winter counts are only a "snap shot" and are dependent on a number of factors including annual productivity, and local, regional, and broader weather conditions which can trigger earlier or later migrations of northern eagles from Canada and the northeastern U.S. In addition, the survey route is limited to the major shorelines and does not extend inland; therefore, eagles loafing along smaller inland creeks may not be counted.

APG developed a standardized protocol for the mid-winter count to allow for year-to-year comparisons of data. APG's database (1986-present) is one of only two historic collections of mid-winter bald eagle population data in Maryland. APG's data have indicated an increase in the population of eagles on APG and the surrounding areas since the early 1980s, but a general stabilization of numbers in recent years (Table 1). The mid-winter surveys continue to confirm large numbers of eagles utilizing

Table 1: Cumulative Mid-Winter Bald Eagle Survey Data

Year	Day	Number of Bald Eagles Counted						Total Number of Bald Eagles
		Aberdeen Proving Ground			Susquehanna River			
		Adult	Subadult	Total	Adult	Subadult	Total	
2013	6-Jan	144	59	**203**	24	1	**25**	**228**
2012	8-Jan	104	53	**157**	27	12	**39**	**196**
2011	9-Jan	88	51	**139 (+1 GE)**	13	10	**23**	**162 (+1 GE)**
2010	10-Jan	117	80	**197**	25	17	**42**	**239**
2009	Survey not conducted (helicopter not available)							
2008	12-Jan	93	39	**132**	20	7	**27**	**159**
2007	7-Jan	71	29	**100**	19	7	**26**	**126**
2006	8-Jan	106	58	**164**	45	19	**64**	**228**
2005	9-Jan	145	61	**206**	23	9	**32**	**238**
2004	11-Jan	73	54	**127**	33	21	**54**	**181**
2003	12-Jan	135	91	**226**	16	7	**23**	**249**
2002	13-Jan	60	14	**74**	27	16	**43**	**117**
2001	26-Jan	103	85	**188**	30	21	**51**	**239**
2000	9-Jan	57	25	**82**	40	31	**71**	**153**
1999	10-Jan	67	58	**125**	13	13	**26**	**151**
1998	11-Jan	60	19	**79**	30	29	**59**	**138**
1997	12-Jan	80	43	**123**	17	12	**29**	**152**
1996	21-Jan	92	47	**139**	19	8	**27**	**166**
1995	15-Jan	70	31	**101**	16	5	**21**	**122**
1994	9-Jan	26	36	**62**	22	9	**31**	**93**
1993	17-Jan	40	23	**63**	14	4	**18**	**81**
1992	12-Jan	49	40	**89**	15	8	**23**	**112**
1991	13-Jan	26	20	**46 (+1 GE)**	12	7	**19**	**65 (+1 GE)**
1990	14-Jan	111	67	**178**	2	2	**4**	**182**
1989	15-Jan	61	40	**101**	not surveyed due to fog			**101**
1988	10-Jan	27	24	**51**	18	18	**36**	**87**
1987	11-Jan	24	13	**37**	6	8	**14**	**51**
1986	11-Jan	35	29	**64**	0	0	**0**	**64**
1985	13-Jan	19	28	**47**	not surveyed			**47**
1984	7-Jan	30	62	**92**	not surveyed			**92**
1983	9-Jan	11	28	**39**	not surveyed			**39**

GE=Golden Eagle

nearly all forested shorelines of APG. The densest concentrations of eagles are routinely observed along the shorelines of the Bush River, Spesutie Island, and Pooles Island.

2.1.2 Roosting Areas

Non-breeding eagles are typically gregarious and establish communal roosts (areas where eagles gather and perch overnight). Communal roosts are typically isolated from human disturbance, contain sustainable substrate for roosting, positioned in areas protected from harsh weather, and have a clear movement corridor between the roost and primary foraging areas. A number of communal roost areas have been identified on APG through ground surveys and satellite telemetry data. APG has identified several core (year-round) roosts as shown in Figure 2. These core roosts are located further inland than the shoreline foraging and loafing areas, and include Coopers Creek, Mosquito Creek, Woodrest Creek, and three roosts along Romney Creek. Numerous ancillary (seasonal) roosts also exist along the wooded shorelines of the installation. The satellite telemetry data indicated that eagles at APG move in and out of roost areas throughout the day, and may not utilize the same nighttime roost area from night to night (Watts and Mojica 2009b). This network of core and seasonal communal roost areas is dynamic and can change over time depending on factors such as distribution of prey, loss of perch trees, or other changes to the habitat.

2.1.3 Nesting Areas

Bald eagles exhibit high nest fidelity and nesting territories are often used year after year. The majority of the nests on APG are located in large trees with a clear view of shoreline foraging areas, or if located further inland, within one mile of a suitable foraging area.

APG conducts a series of nest surveys by helicopter each breeding season. These surveys identify new nests, fallen nests, numbers of eggs and chicks, and confirm fledging. The aerial surveys are supplemented by ground observations. APG conducts the nest surveys in accordance with a standardized protocol developed by APG and following recommendations from the USFWS's Chesapeake Bay Field Office. The surveys have documented a tremendous increase in the number of breeding pairs of eagles on APG. In 1977, APG had only one known nesting pair of eagles. The number of breeding pairs increased to five by 1991. In 2013, APG had close to 50 active nests that fledged a total of 90 chicks (Figure 3). Since 2006, the APG nesting population (measured as number of active nests) has nearly doubled. The productivity (measured as total number of chicks fledged) has more than doubled in the same time period. Increased productivity is due in part to an increased frequency of "triplets" (three chicks in nest), from 0 percent in 2005 to an average of 19 percent of active nests in the past three years (2011-2013) (see Table 2 below). Overall, the number of chicks per active nest at APG has increased from 1.17 in 2005 to 1.76 in 2013. This increased fecundity is indicative of a robust breeding population at APG that is benefitting from the abundantly available food resources.

Figure 2 (APG Bald Eagle Nests and Roosts) is available for review at the office of:

DPW Environmental Division
Natural Resources Branch
Building E5183 Blackhawk Road, Room 213
Aberdeen Proving Ground, Maryland 21010
Phone: 410-436-0465

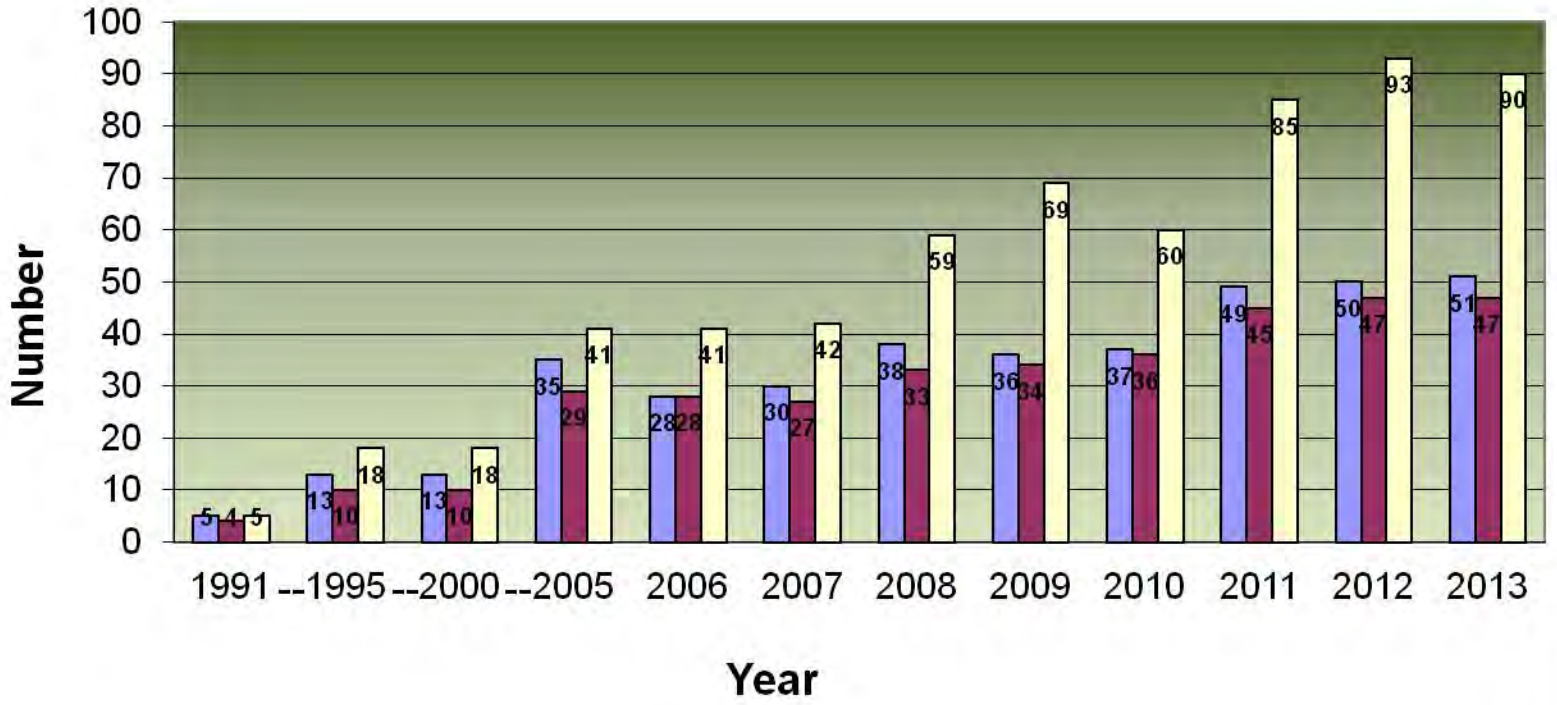


Figure 3 APG Bald Eagle Nest Productivity

Table 2: Number of Triplet Bald Eagle Nests Per Season at APG

Year:	2005	2006	2007	2008	2009	2010	2011	2012	2013
Active Nests:	35	28	30	38	36	37	49	50	51
Sets of Triplets[(a)]:	0	2	1	3	7	3	9	11	8
Triplet Frequency[(b)]:	0%	7%	3%	8%	19%	8%	18%	22%	16%
Chicks/Active Nest:	1.17	1.46	1.40	1.55	1.92	1.62	1.73	1.86	1.76

(a) Documented triplets, regardless if one or more chicks lost
(b) Triplet Rate = (# Sets of Triplets) / (# Active Nests)

On APG, nesting habitats which for many years contained only a single active nesting pair are now known to contain two or more pairs in very close proximity (USFWS 2006). In 2006, the mean inter-nest distance (that is, the mean nearest-neighbor distance between simultaneously occupied nests) was 1,560 meters (0.97 miles) (APG 2007). As of 2013, the mean distance for APG nests is 1,277 meters (0.79 miles). APG has several overlapping nesting territories each with a pair of nests only 300 to 600 meters apart (less than 0.5 miles). Inter-nest distances are likely much shorter at APG than for other nests in the region. With the establishment of more compressed territories, many eagle pairs at APG have developed a tolerance to routine and on-going mission activities and noise, with some pairs building nests and raising young within 200 meters of active range areas. Locations of eagle nests at APG for the 2013 nesting season are shown in Figure 2. APG currently tracks approximately 70 nests (active and inactive).

2.2 Eagle Exposure Rate

The available data indicate that APG supports a convergence of three populations of bald eagles: year-round residents, northern migrants, and southern migrants. It is estimated that a few hundred eagles are on APG at any one time, and that at least several hundred eagles utilize the installation throughout the year. The number of eagles on the installation is estimated to be highest during the winter months (January-March) and the summer months (June-July) due to influx of northern and southern migrants, respectively (Watts and Mojica 2009b). The downrange areas of the installation generally have the highest eagle activity. The downrange areas are less developed than the cantonment areas and support the majority of the nests and roosts. However, with the expanding population of eagles, there is potential for interactions between eagles and military mission throughout the installation. It is worthy to note that wintering golden eagles are seen in the northern Chesapeake Bay region, including APG, but not in any large numbers.

An eagle exposure rate is not readily calculable (or applicable) given the size of the installation, the varied land uses by the Army, and the dynamics of an expanding eagle population. It is expected that incidental take of eagles will continue at APG in the form of lethal take and nest disturbance, despite the implementation of conservation measures. The number of historic takes at APG will be used in Stage 3 of this ECP to predict an annual take level for the next five years.

Due to the expanding eagle population and limiting habitat, it is expected that new eagle pairs will continue to pursue less than optimal habitats (including man-made structures) to establish nest territories. Some of these new nests may directly conflict with mission operations and/or pose a risk to human or eagle safety. For this reason, it is likely that APG may require removal of a nest or nests within the next five years in accordance with Title 50 CFR Part 22.27.

Based on the information gathered in Stages 1 and 2, the mortality/disturbance risk to eagles at APG is considered to fall within Category 2. As defined by the USFWS, Category 2 is high or moderate risk to eagles with opportunity to minimize/mitigate impacts.

3 STAGE 3 – PREDICTED EAGLE FATALITIES AND DISTURBANCES

Stage 3 of the ECP uses the data from Stage 2 to predict eagle risk, as average number of fatalities per year, extrapolated for the duration of the permit. Risk of disturbances to eagles is also determined in Stage 3.

3.1 Predicted Eagle Fatalities

In compliance with APG's 2006 Biological Opinion, APG implemented a number of conservation measures to reduce eagle mortalities and disturbances (see discussion of existing conservation measures in Section 4). However, incidental take of eagles has not been entirely eliminated due to the on-going military mission and the increasing population of bald eagles at APG (Figure 4). Since issuance of the Biological Opinion, APG has had an average of 4.4 bald eagle takes (mortalities) per year (2006-2013). Nearly all of these takes (91 percent) were line strikes where the eagle flew into an overhead power line and was killed outright, or died later, due to electrocution and/or blunt force trauma. The remaining takes consisted of a collision with an aircraft, an impalement on a lightening rod, and a drowning in a containment structure/box.

Since 2009, the annual number of takes at APG has increased. There were three takes in 2009, seven takes in 2010, and eight takes in 2011. While the number of takes decreased to two in 2012, the number of takes increased again to eight in 2013.

The number of eagles removed from the population (takes) can be compared to the number of eagles added to the population (chicks fledged), by expressing takes as a percentage of the fledgling population. From 2006 to 2013, percentage of takes ranged from 0 percent in 2008 to 11.7 percent in 2010 (Figure 5). An extrapolation of this take data (2006-2013) estimates a gradual increase in takes, with an annual take of 7.2 percent by 2019 (80 percent confidence interval of 5.0-9.5 percent, see Appendix). Take data prior to 2006 was excluded from the prediction model, because APG had not fully implemented protective measures for eagles until 2006.

In order to predict the number of eagles equating to 7.2 percent of the population, a regression is performed on the population data. An extrapolation of the population data (expressed as number of chicks fledged) from 2006 to 2013 predicts 142 fledglings (80 percent confidence interval of 139-146, see Appendix) added to the population in 2019. A predicted take of 7.2 percent of 142 fledglings equates to 10.2 birds, or 13.9 birds as a worst case scenario using the 80 percent upper confidence limits (9.5 percent of 146 fledglings).

These extrapolations assume a linear increase in takes and productivity over the next five years. This may prove to be an over-estimation of predicted take/productivity, especially if the population of eagles at APG reaches a stable carrying capacity within the next five years. Currently, there is no evidence to support that APG has reached its carrying capacity for breeding bald eagles. While the population has appeared to

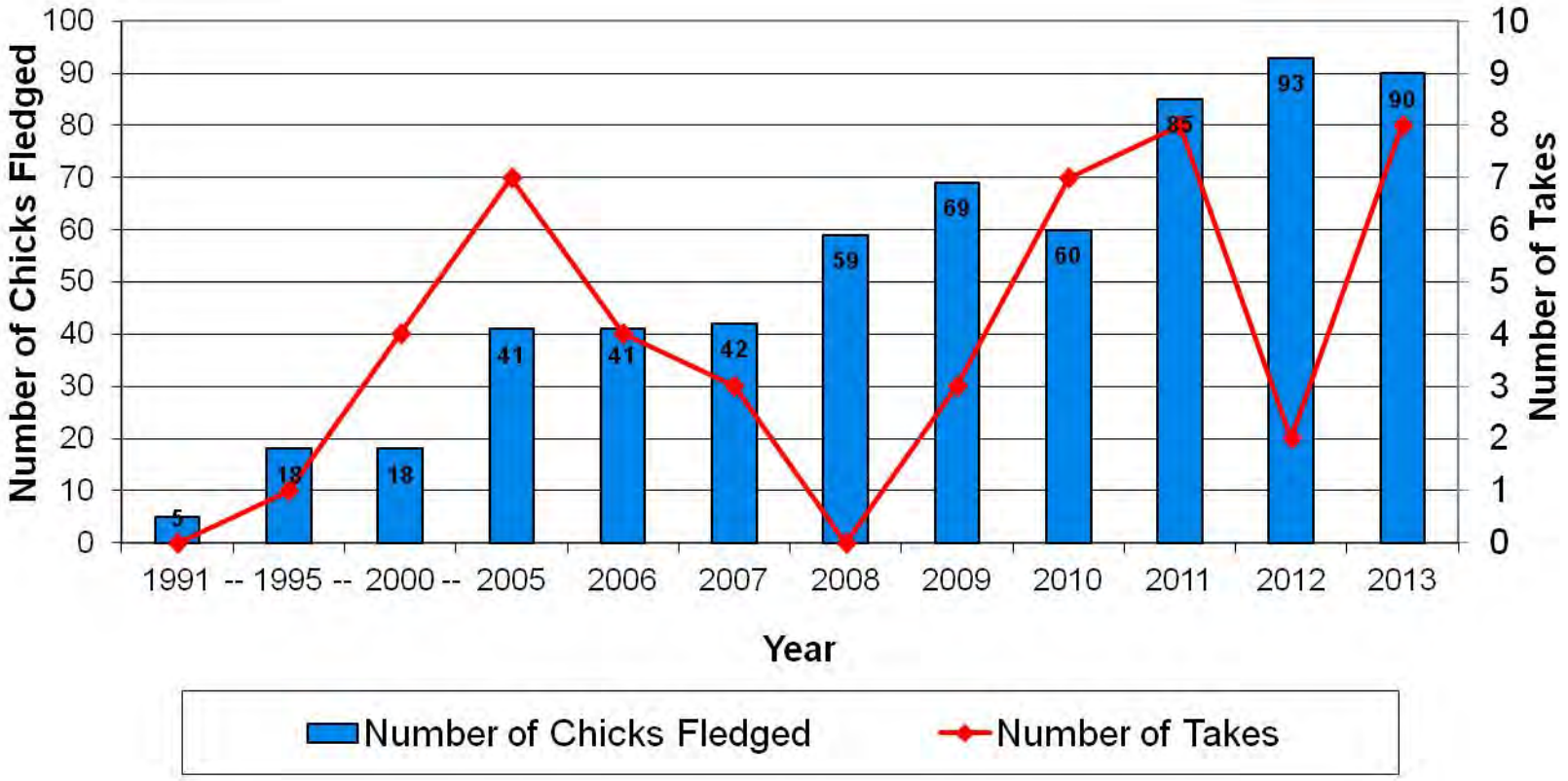


Figure 4 APG Bald Eagle Productivity and Take

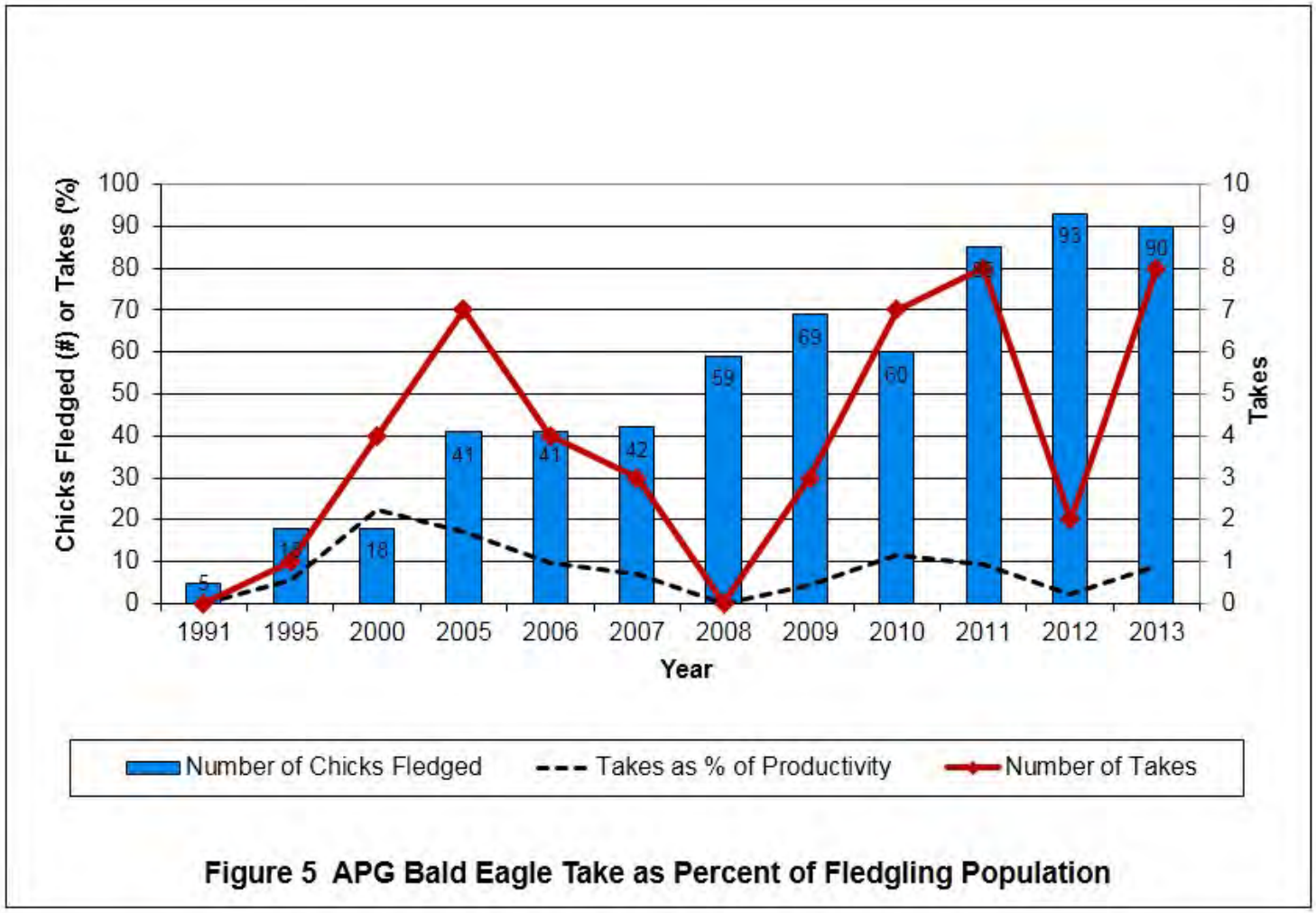


Figure 5 APG Bald Eagle Take as Percent of Fledgling Population

plateau for the last 3 years (2011-2013), a similar plateau was observed in 2005-2007 and in 2008-2010, with each 3-year time period followed by a significant increase in the nesting population. Even if the number of nests does not substantially increase over the next five years, it is still possible that the number of chicks per nest will continue to increase.

An increasing number of line strikes is believed to have resulted from intraspecies interactions (fights between eagles over prey items or territory). For example in 2011, a dead immature eagle was found under an overhead power line. The eagle had puncture wounds on the toes and feet, and feathers clinging to one of the talons. Similarly in August 2013, two dead immature eagles were found under overhead power lines with the remains of a fish in the talons of one of the eagles. APG has also documented increased aggression between eagles and ospreys, which can result in one or both birds striking an overhead line. APG has an expanding population of ospreys. Ospreys are seasonal inhabitants of APG and the Chesapeake Bay area, returning to the region in early March and remaining into October when they begin their migration south for the winter. Though the breeding seasons of the two species are slightly off-set, APG has seen increasing frequencies of interspecies aggression related to nesting and foraging territories. APG has noted instances of ospreys harassing eagle pairs that have a nest in close proximity to an osprey nest. Additionally, ospreys often harass foraging eagles, swooping down to try to dislodge a prey item from the eagle's talons. In 2010, APG captured an injured eagle on the ground that was being harassed and chased by a nearby pair of nesting ospreys. The frequency of both intra and interspecies aggressive incidents will likely continue to increase as the two populations compete for eventually limiting food resources and territory.

3.2 Predicted Nest Disturbances

Under the 2006 Biological Opinion, APG was granted a nest disturbance allowance of up to three nests per year, each nest containing up to three eggs or chicks, due to incidental disturbance. Since 2006, APG has had no nest disturbances. However, new eagle pairs continue to construct new nests in close proximity to installation activities. In addition, APG's military mission continues to evolve due to immediate in-theatre needs, BRAC, and other factors.

3.3 Summary of Proposed Incidental Take

Based on the predicted levels of take discussed above, APG proposes the following incidental take allowance for the programmatic permit:

1. Incidental Lethal Take – Up to 12 bald eagles per calendar year due to collisions with electrical and other man-made infrastructure, collisions with ground and aerial vehicles (both manned and un-manned), and other unforeseen impacts resulting incidentally to mission activities, that result in death of the eagle or its permanent removal from the wild population
    - Proposed take is mid-point between predicted take (10 eagles) and worst case scenario (14 eagles) and is justified by the fluctuation of takes from year to year, continued competition with other raptors (ospreys), and the

uncertainty if the eagle population will continue to increase. Proposed take is higher than previous allowance under 2006 Biological Opinion, and is justified because APG's eagle population has nearly doubled since 2006.

2. Incidental Nest Disturbance – Up to 3 bald eagle nests per calendar year with minimization measures, due to incidental harassment of adults leading to abandonment of nest and loss of productivity for the given year, inclusive of eggs and young
    - Proposed take is unchanged from previous allowance under 2006 Biological Opinion.

Mortalities, injuries, and nest disturbances that are attributable to natural causes will not count against the permitted incidental take allowance. APG will report all eagle mortalities, injuries, and nest disturbances (incidental take and natural causes) to the USFWS, as discussed in Section 5.

3.4 Nest Removals

No eagle nest has ever been removed at APG. However, due to the expanding eagle population and the on-going military mission, APG may have a need in the next five years to remove an eagle nest or nests. As eagle density continues to increase, eagle pairs are moving towards less optimal habitat to establish new nesting territories. In 2007, an eagle pair constructed a nest on the top of a man-made tower that was located in a near direct line of fire. In 2011, an eagle pair constructed a nest in the direct flight path utilized by an airfield. Both of these nests negatively impacted mission activities, and reduced mission capabilities. Both nests have since fallen from the trees naturally, and the eagle pairs have not returned to the sites. Should either of these sites become occupied again by an eagle pair, APG will coordinate with the USFWS for the removal of the nest. Other nests may arise in unforeseen locations which may also require removal in the next five years.

All nest removals will be coordinated in advance with the USFWS, and all removals will be in accordance with Title 50 CFR Part 22.27. A nest requested for removal will fall into one of the following categories (Title 50 CFR Part 22.27):

1. An active or inactive nest where removal is necessary to alleviate a safety emergency
    - For example, a nest located in a flight path that increases the risk of collision between aircraft and eagles, and jeopardizes the safety of aircraft, pilot, and crew
    - Chicks and viable eggs from an active nest must be immediately transported to a qualified rehabilitation facility permitted to care for eagles
2. An inactive nest where removal is necessary to ensure public health and safety

3. An inactive nest that is built on a man-made structure and creates a functional hazard that renders the structure inoperable for its intended use
4. An inactive nest where removal protects a local interest and the activity necessitating the removal, or the mitigation for the removal, with reasonable certainty provides a clear and substantial benefit to eagles
    - For example, removing a nest in order to bury overhead power lines, or removing a nest located in the only feasible site for a new testing or training range (with mitigation)
    - Mitigation measures could include securing an off-Post conservation easement in documented eagle nesting habitat

Each proposed nest removal will be evaluated by APG, in coordination with the USFWS, to ensure that all reasonable avoidance measures have been implemented and that the nest removal will not adversely impact the installation's breeding population. For the purpose of this discussion on nest removals, an "inactive" nest is defined as a nest not currently being used by eagles as determined by the continuing absence of any adult, egg, or dependent young at the nest for at least ten consecutive days immediately prior to, and including, at present. A nest removal action must include trimming of suitable nest supporting limbs in the nest tree, or altering of the man-made structure, to prevent attempts by eagles to re-build the nest. APG will report all eagle nest removals to the USFWS, as discussed in Section 5.

4 STAGE 4 – AVOIDANCE AND MINIMIZATION OF RISK AND COMPENSATORY MITIGATION

Stage 4 of the ECP is development of proposed advanced conservation practices (ACPs) to avoid or minimize predicted eagle risks at the project site. A cumulative effects analysis is conducted by the USFWS in Stage 4 to determine if local and regional thresholds for eagle take are exceeded. The cumulative effects analysis is based on impacts from all permitted take within the locality/region. Compensatory mitigation may be warranted at the end of Stage 4, if projected take exceeds the local and/or regional thresholds.

4.1 Existing Conservation Measures

As a requirement of APG's 2006 Biological Opinion, APG implemented a number of conservation measures to avoid and minimize eagle mortalities and disturbances. These measures included:

- Line Burial – APG spent $11.6 million to bury nearly six miles of overhead power lines on Spesutie Island from 2006 to 2014. This portion of the installation had the highest frequency of eagle mortalities as a result of line strikes. Spesutie Island (located in the northeastern portion of APG, see Figure 1) is surrounded by the Chesapeake Bay and has dense eagle activity including foraging, nesting, and sheltering sites. Line burial has also been incorporated into new projects that are located close to shoreline foraging areas. Line burial has been the most effective measure to eliminate line strikes at APG, but also the most expensive. Due to the very high costs of implementation, it is not feasible to bury all overhead lines at APG.

- Avian Deterrents/Protective Devices – APG spent $3.6 million to retrofit electrical infrastructure with avian deterrents and protective devices following the Avian Power Line Interaction Committee (APLIC) best practices guidelines (APLIC 1994; 2012). The retrofits included installing perch excluders on cross arms; insulating covers on wires, conductors, jumper wires, cutouts, and bushings; and spinning reflective flight diverters and high-visibility spheres on overhead power lines. Eagles are killed by exposed electrical lines in two functionally different ways. The first (pole electrocution) occurs when an eagle perches on a utility pole cross arm and is electrocuted when different body parts touch elements that complete the electrical circuit. The second (line strike) occurs when eagles fly into exposed wires and are either killed by the trauma of striking the wires or are electrocuted when their wings complete a circuit between two wires. The installation of avian deterrents and protective devices on electrical infrastructure has been a cost effective measure that significantly reduces the number of eagle mortalities on APG. The deterrents and devices are nearly maintenance-free, except for the spinning flight diverters which need periodic replacement as the swivel assemblies fail. Several versions of the diverters have been field tested at

APG, and the latest version (FireFly™ FF) with a large stainless steel ball bearing swivel has proven to be the most durable.

- Movement Study – APG spent $2.2 million to conduct a three-year eagle movement study using satellite telemetry. Satellite transmitters were deployed on 63 bald eagles trapped on APG between 2007 and 2009. The transmitted data (collected between 2007 and 2011) were used to further understand movement patterns of eagles (including resident and migrating eagles) that utilize APG. Foraging areas and core and seasonal roost areas were delineated, along with movement corridors. This information is critical to a successful management program for bald eagles on APG. Telemetry data combined with traditional ground monitoring allows APG to evaluate effects of mission activities on eagle movement and behavioral patterns.

- Nest Cameras – APG spent $200,000 on the installation of remote cameras on six bald eagle nests on APG. Video footage combined with ground observations is used to monitor the eagles during nesting season. The live-feed video footage is used to evaluate, in real-time, the effects of mission activities on the nesting eagles.

- Nest Study – APG conducts comprehensive annual bald eagle nest studies. A standardized protocol was developed by APG and is used to conduct nest surveys. The use of a standardized protocol ensures consistent collection of data that allows for year to year comparisons of nest productivity. The nest studies incorporate both aerial (overflight) and ground observations. The results of the nest studies confirmed a continued increase in the annual productivity of eagles at APG.

- Monitoring During Mission Activities – In addition to population and nest surveys, APG conducts ground observations to monitor eagles during mission activities. Biologists are able to observe eagle behavior, communicate directly with activity coordinators, and if needed, immediately halt potentially disturbing mission activities. Monitoring is an effective protective measure at APG that also ensures the success of various mission activities including range firing, shoreline training, and environmental remediation.

- Restrictive Buffers – APG implemented 500-meter protective buffers around bald eagle nests. Within these buffers, human activity is restricted during nesting season, and habitat altering activities (land clearing, construction, and/or development) are limited year-round. Similar buffers are also implemented around core communal roosts. Maintaining protective buffers minimizes direct impacts of mission activities on eagles.

- Revised Management Plan – APG revised the eagle management component of its Integrated Natural Resources Management Plan (INRMP) to incorporate the avoidance and minimization measures required by the 2006 Biological Opinion.

The plan outlines management strategies, coordination, reporting requirements, and employee training.

All of the above mentioned conservation measures have proven to be successful at reducing mortalities and minimizing disturbances to bald eagles at APG. These measures represent the best available management practices. The value of these conservation measures is evident in the thriving eagle population at APG.

Additionally, APG has an Army Compatible Use Buffer (ACUB) program. This program establishes buffer areas around Army installations to limit effects of encroachment and maximize land inside the installation that can be used to support the installation's mission. By working in partnership with conservation organizations, ACUBs can greatly enhance habitat conservation planning at the ecosystem level to ensure that greater benefits are realized towards species and habitat protection. APG's ACUB targets land conservation along shorelines of the northern Chesapeake Bay. These shorelines (particularly the eastern shorelines of Cecil and Kent Counties) are areas of high bald eagle activity, as supported by the data generated from the eagle movement study. APG is working with its conservation partners to encumber off-site land adjacent to, or ecologically adjacent to, the installation to limit development pressures, protect forested shoreline habitat, and ultimately benefit the bald eagle population.

4.2 Proposed Conservation Measures (ACPs)

ACPs are defined as scientifically supported conservation measures that avoid or minimize eagle risks to the maximum extent achievable, so that remaining take is unavoidable. Currently, the USFWS has no approved advanced conservation practices. Therefore, any advanced conservation practices proposed at this stage will be termed "experimental."

APG proposes a tiered application of experimental ACPs under the programmatic permit. The experimental ACPs would avoid or reduce eagle take to the maximum extent possible where remaining take is unavoidable, include adaptive management strategies, and promote conservation benefits. Tier 1 experimental ACPs are considered required measures to be implemented immediately. Tier 2 experimental ACPs are optionally implemented for proactive conservation benefits. The proposed experimental ACPs are listed below.

TIER 1: APG will implement the following five experimental ACPs immediately. Implementation of these measures is expected to reduce take to a level where remaining take is unavoidable.

1. **<u>Management Plan</u> – APG will continue to operate in accordance with its eagle management component of the INRMP.**
   - APG will revise the eagle management component of its INRMP to reflect the programmatic permit and experimental ACPs.

2. **<u>Adaptive Management</u> – APG will adaptively manage the eagle population on the installation to address allowable activities in the vicinity of eagle use areas.**

    - Adaptive management promotes flexible decision making that can be evaluated and adjusted based on outcomes of management actions and other events. APG will utilize its standard operating procedures for environmental reviews of all installation projects and adaptively manage project details to address allowable activities based on information obtained from existing eagle monitoring measures.

3. **<u>Avian Deterrents/Protective Devices</u> – APG will continue to periodically inspect and replace (if needed) the avian deterrents and protective devices on the electrical infrastructure.**

    - Avian deterrents and protective devices include spinning reflective deterrents (FireFly™ FF) on wires; elevated perches or perch excluders on cross arms; and insulating covers on wires, conductors, cutouts, and bushings. Inspections and replacements (as needed) would occur at least annually as addressed in the eagle management component of the INRMP. Alternative marking devices for the power lines may be employed as long as the alternatives are as or more effective than the FireFly™ FF units in reducing line strikes.

4. **<u>Line Burial</u> – APG will bury overhead power lines, where feasible and as funds allow, to reduce the potential of eagle mortalities due to line strikes.**

    - Sections of existing overhead lines that can be feasibly buried will be prioritized for burial based on areas of densest eagle activity, occurrence of line strikes, and availability of funding. Additional eagle movement and mortality data have been collected by APG since 2006; therefore, the selected areas may not necessarily correspond to those areas identified in the 2006 Biological Opinion. Priority areas will be identified in the eagle management component of the INRMP. Given the very high costs associated with burying overhead lines, line burial will only be considered after other minimization measures such as avian deterrents/protective devices have proven ineffective.

5. **<u>Biological Studies</u> – APG will continue to conduct annual population and seasonal nest surveys to monitor the stability and productivity of the installation's eagle population. Surveys will include a population overflight in early January (to coincide with the national Mid-Winter Eagle Count) and nest overflights in late January, early March, early April, and early May. If necessary, an additional nest overflight may be conducted in mid-May.**

- Surveys will follow standardized protocols developed by APG to allow for year-to-year comparisons of data. These surveys will incorporate both ground and aerial observations. The data collected will contribute to the long-term research at APG to help identify regional and long-term population trends, distributions, and nesting success.

TIER 2: At the Army's discretion, APG would optionally implement the following two experimental ACPs for proactive conservation benefits.

6. **<u>Forest Stand Improvements</u> – APG will conduct forest stand improvements to help ensure the sustainability of habitat for bald eagles, while sustaining the testing and training landscape required by the military mission.**

    - In 2012, APG lost over ten percent of the nest trees due to storms and natural degradation, occurrences indicative of declining forest health. It is important to the long-term sustainment of the breeding eagle population that these large canopy trees be replaced (either through natural re-generation or plantings). Unfortunately, deer pressure and invasive Japanese stiltgrass have limited the natural regeneration of oak, hickory, beech, and tulip poplar at APG.

    - The forest stand improvements would target existing forest stands that show degraded habitat quality, that exhibit high eagle activity, and that do not directly conflict with existing range mission activities. The forestry work would not establish new habitat which could potentially attract even more eagles to APG. Improvements would be made in areas unlikely to create additional risk to eagles from potential line strikes or other mission conflicts. The forest stand improvements would be conducted in eagle use areas, defined as having a documented nesting, roosting, and/or foraging area. The forest stand improvements would enhance native species diversity (oak, hickory, beech, and tulip poplar), decrease invasive species, and provide for long-term forest sustainability.

    - APG's forest management component of the INRMP outlines silvicultural prescriptions implementing forest improvement for each of its 580 forest stands. This landscape-level planning specifies annual actions designed for improving overall forest health, eagle habitat, and mission landscape by increasing natural regeneration, reducing the impact of invasive species, "jump starting" desired species composition through tree plantings, increasing biodiversity in existing monocultures, and moving towards uneven-aged forest structure. Silvicultural prescriptions include using tree planting in existing or created canopy gaps and/or individual tree planting within existing stands with no natural regeneration, mechanical removal of invasive species and vines in concert with pinpoint herbicide application, tree girdling, overstocked stand thinnings to increase crown size on mature trees, duff and soil disturbance to increase natural regeneration, and tubing natural regeneration of desirable species until above deer browse line.

- These proactive efforts to improve forest stands would be credited towards APG's conservation efforts for eagles. Potential conservation credit from a forest stand improvement effort will include: 1) enhancement of nesting habitat as mitigation for a nest removal, and 2) enhancement of roosting habitat as mitigation for a roost disturbance. APG would develop a Memorandum of Agreement (MOA) with the USFWS to specify how forest stand improvements would be credited towards eagle conservation. APG and the USFWS would work towards a MOA within the first year of the permit.

7. **<u>ACUB Program</u> – Through its ACUB program, APG will work with its conservation partners to encumber off-site land adjacent to, or ecologically adjacent to, the installation to limit development, protect forested shoreline habitat, and ultimately benefit the bald eagle population.**

    - The implementation of the ACUB program is dependent on available Army/Department of Defense funding, available partner funding, and willing landowners. When funding and parcels become available, APG will contribute funds to the partner's purchase of easements or properties from willing landowners, without acquiring any new land for Army ownership. Further details on this ACUB program, including priority areas, are provided in APG's approved proposal (APG 2012).

    - An ACUB conservation easement or purchase which is attained and which is associated with eagle habitat (as identified by a satellite telemetry study or confirmed by site investigation) will be credited towards APG's conservation efforts for eagles. Potential conservation credit from an ACUB easement or purchase will include: 1) off-site nest productivity counting towards APG's eagle productivity, 2) conservation of off-site nesting territory as mitigation for an on-site nest removal, and/or 3) conservation of off-site roosting territory as mitigation for an on-site roost disturbance. APG will develop a MOA with the USFWS to specify how ACUB efforts will be credited towards eagle conservation. APG and the USFWS will work towards a MOA within the first year of the permit. The MOA will serve as the vehicle for ensuring that mitigation credit is approved in encumbering the land parcel. Monitoring requirements of the ACUB parcel for meeting conservation and mitigation commitments will be addressed in the easement.

4.3 Cumulative Effects Analysis

The purpose of a cumulative effects evaluation is to identify conditions where take of eagles is assessed at the individual project level in combination with other similar projects in a defined geographic area. As part of the permit application review process under Title 50 CFR Part 22.26 (f)(1) and Final Rule (USFWS 2009b), the USFWS must evaluate and consider effects of take permits on eagle populations at three levels. These levels are: (1) eagle management unit or regional area, (2) local area, and (3) project area. The cumulative effects analysis also incorporates other biological

resource information such as annual nest productivity and mortality levels for each of these areas.

4.3.1 Geographic-Scope Take Thresholds

Regional Area Population

To ensure that any authorized take of eagles does not exceed the BGEPA's preservation standard, the USFWS has set thresholds for take limits of eagles based on regional eagle management units. These thresholds were developed using past State nesting surveys. The USFWS also incorporated measures to ensure that local area eagle populations are not severely impacted or depleted by take that could be otherwise be acceptable at the regional (eagle management unit) scale. An eagle management unit-wide area population index was developed by the USFWS with an assumption that eagle numbers are equally distributed across the landscape. APG falls within the USFWS's Mid-Atlantic bald eagle management unit. The estimated population size for the Mid-Atlantic bald eagle management unit is 14,021 eagles encompassing 237,687 square miles of landscape (USFWS 2009a). As shown below, the unit density is approximately 0.059 eagles per square mile.

Mid-Atlantic Management Unit Eagle Density = (Population) / (Management Unit Size)

= (14,021 eagles) / (237,687 square miles)

= 0.059 eagles per square mile

Local Area Population

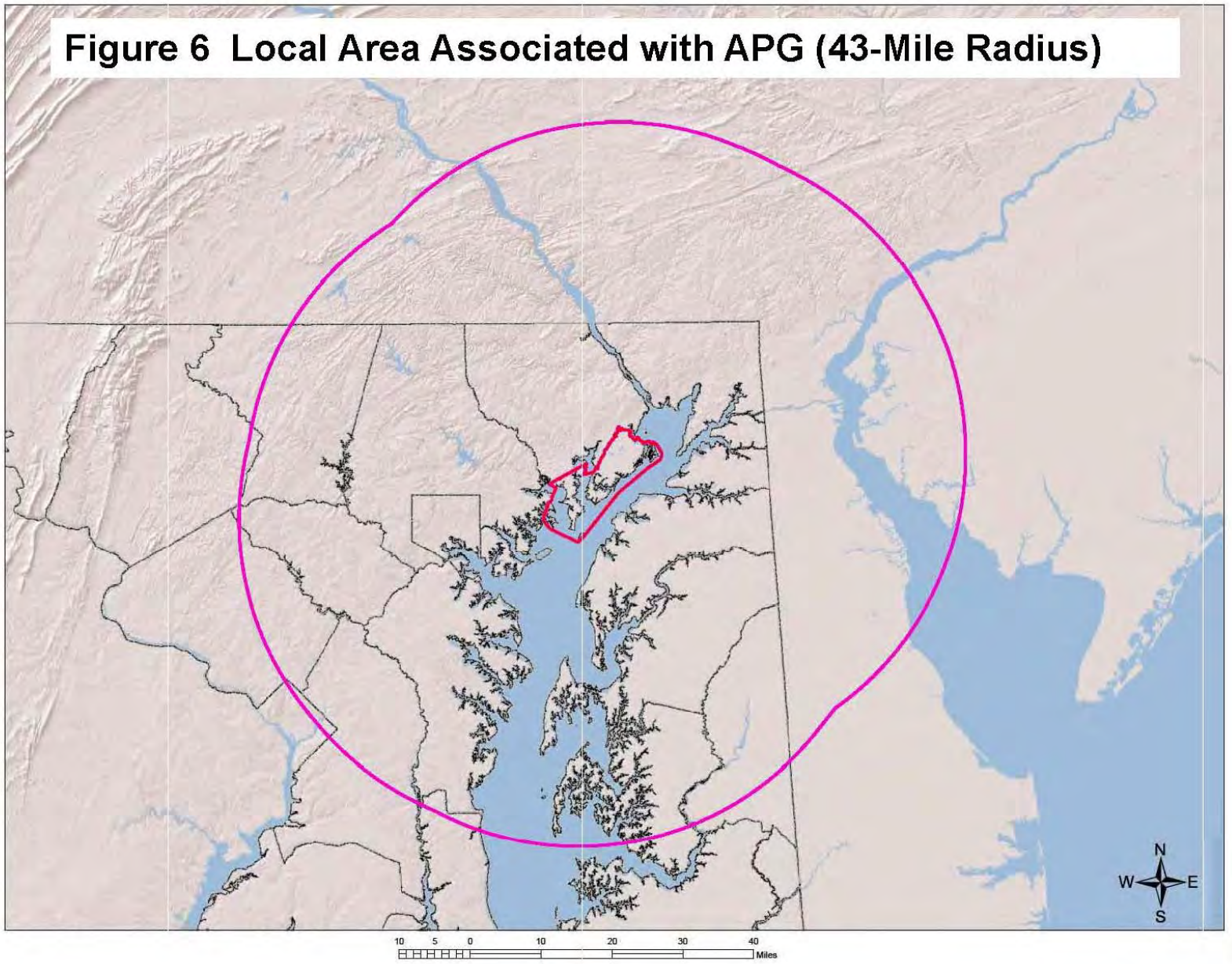
The local area bald eagle population is calculated based on the regional eagle density and an area extending 43 miles outward of the project boundary. Forty-three miles is the mean natal dispersal range for bald eagles as determined by the USFWS. For APG, this defined local area encompasses the entire northern Chesapeake Bay area, the southern Susquehanna River area, and portions of the Delaware River and Delaware Bay (Figure 6). This local dispersal area is approximately 4,913 square miles of habitat (exclusive of open waters of the Gunpowder River, Bush River, and Chesapeake Bay). Therefore, as shown below, the local area bald eagle population is approximately 290 eagles.

Local Eagle Population = (Regional Eagle Density) * (Local Area Size)

= (0.059 eagles per square mile) * (4,913 square miles)

= 289.9 eagles

Figure 6 Local Area Associated with APG (43-Mile Radius)



Based on data for the Mid-Atlantic bald eagle management unit and using the equation below (USFWS 2009a), the five percent benchmark for eagle take in this local area is 15 eagles per year.

Local Area 5% Threshold = (Local Area) * (Regional Eagle Density) * 0.05

= (4,913 square miles) * (0.059 eagles per square mile) * 0.05

= 14.5 eagles

The USFWS quantified take rates of between one and five percent of estimated local area eagle population as benchmarks, with five percent being at the upper end and still compatible with maintaining healthy local eagle populations. Under this methodology, permitting take of more than 15 eagles per year should be carefully considered to ensure that it is consistent with the BGEPA's preservation standard and the requirements of the regulations at Title 50 CFR Part 22.26.

4.3.2 Environmental Baseline

Nest Surveys and Population Monitoring

A comprehensive bald eagle nest monitoring survey in the Chesapeake Bay region was first conducted in the late 1970s and continued through 2004, by the Maryland Department of Natural Resources, the Delaware Division of Fish and Wildlife, and the Virginia Commission of Game and Inland Fisheries. The total number of occupied territories by the end of the 2004 nesting season was approximately 800 eagle pairs. In 2007, the USFWS delisted the bald eagle under ESA, and the States soon followed thereafter. Currently, only Virginia and Delaware continue to conduct annual nest surveys for their watershed areas.

Following the delisting of the bald eagle, smaller scale nest surveys resulted with only a portion of the population being sampled, making it difficult to quantify actual numbers of eagles for a local area population. Despite this reduced survey effort, nest monitoring continued, albeit as a necessity to meet ESA post-delisting requirements and eagle permit issuance criteria for development projects. Department of Defense installation managers, National Wildlife Refuges, and National Parks also continued to conduct annual nest monitoring. Proposed residential and commercial development projects, including land-based wind energy projects, were also required to assess potential impacts of their projects to nesting and wintering eagles.

APG Population Assessment

Since 1991, eagle nest surveys have been routinely conducted by APG environmental staff. Between 2005 and 2013, APG documented an increase in the breeding population to 51 pairs. Nest productivity also increased, with the highest yield occurring during the past consecutive three years (2011-2013). Nest production in 2011, 2012, and 2013, resulted in 85, 93, and 90 chicks, respectively.

Local Area Population Assessment

Productivity and population data collected by APG were combined with other data sources to estimate the 2013 local area eagle population (43-mile radius from APG). Other data sources included State agency nest surveys and a limited number of nest surveys conducted by private project consultants. A total of 645 eagles were estimated in 2013 (Table 4). This total includes chicks fledged from APG nests; however, only 50 percent of the chicks produced at APG in 2013 were conservatively included, in order to account for potential naturally-occurring fledgling mortality. In addition, the total does not include chicks that fledged from other nests in Maryland, Pennsylvania, Delaware, and New Jersey. The population calculation also does not include the significant number of subadult eagles in the local area (except those counted by APG during the mid-winter count). Therefore, the total number of eagles (645) is an under-estimation of the actual local area population.

Table 3. Local Area Bald Eagle Population

2013 Surveys	Count
Maryland (northern Bay segment)	58 nests
Pennsylvania (southeastern border)	21 nests
Lower Susquehanna River	12 nests
Delaware (western border)	25 nests
New Jersey (western border)	19 nests
APG	51 nests
Total Nests:	186
Breeders (Total Nests x 2):	372
Mid-Winter Survey (APG plus Lower Susquehanna):	228
APG Nest Production (50% of 90 chicks):	45
Total Population:	645

4.3.3 Stressors

Land clearing for commercial and residential construction activities has incrementally reduced natural habitat and land cover along rivers and Chesapeake Bay shorelines. Eagles have responded by either abandoning nest sites, adapting to fragmented territories with associated human activity, or relocating altogether to other forested areas with greater buffers such as those found at APG. APG's ACUB program (included as an experimental ACP under the proposed programmatic permit) would off-set development pressures by conserving potential eagle habitat on adjacent off-post property, thereby contributing to long-term benefits to the APG, local, and regional populations of bald eagles. Additional analyses of environmental impacts of the ACUB

program will be performed in the future as exact locations of ACUB parcels are determined.

Although APG supports extensive habitat for foraging, nesting, and roosting eagles, the military testing and training operations have the potential to be disruptive to eagles either through habitat encroachment or noise. However, eagles at APG have become adjusted to reduced territories, and acclimated to military activities and associated noise from vehicular traffic, detonations, and various weapon firings.

Man-made infrastructure, particularly power lines and other electrical infrastructure, are of primary concern for risk of injury or death to eagles and other large birds. Commercial and residential development can increase the risk of power line collisions and electrocutions if the infrastructure is situated between eagle roosting areas and shoreline foraging areas. APG has an extensive electrical grid that connects power to many buildings through suspended pole-to-pole electrical lines. To minimize impacts to eagles, APG buried segments of overhead lines that posed the greatest risks to eagles from mid-line collisions. For the remaining overhead lines and electrical infrastructure, APG installed protective equipment to reduce the potential for avian electrocutions.

Other stressors to eagles in the local and regional area include poisoning, lead contamination, shooting, silt-pond entrapments, and collision with vehicles, aircraft, trains, towers, and wind turbines. Territorial fighting and competition between eagles and with ospreys have also led to injury or mortality. In 2013, over 39 eagles were recovered in the local area requiring treatment from a variety of injuries (Sallie Welte, Tri-State Bird Rescue and Research, pers. com.).

4.3.4 APG Take Assessment

From 2005 to 2013, APG documented 42 eagle mortalities (takes) due to line strike, electrocution, or other collision. It is probable that a greater proportion of mortalities affected non-breeding individuals from wintering and summering populations at APG and not the local resident eagles. This probability is based on the assumption that resident eagles are acclimated to routine mission activities and noise and are therefore, less likely to flush. Regardless, mortalities represented both adult and sub-adult age classes at a ratio of nearly 50:50 throughout all four seasons (Lynda Hartzell, APG, pers. com.).

Since 2005, eagle mortalities resulting in take have averaged 4.7 eagles per year at APG. The number of takes increased most recently to a high of eight eagles in both 2011 and 2013. A projection model was used to estimate potential take by APG into the near future (five years). A Linear Regression Model takes into account previous take and using mathematical variables can output a predictable annual take at the 80 percent confidence level (see Appendix A). Based on the model, approximately ten eagle mortalities are projected annually over the next five years (up to 14 eagles as a worst case scenario using the 80 percent confidence limit). At this level, APG's projected take would meet the USFWS's permit issuance criteria without exceeding the five percent local area population take threshold (5% of 645 eagles = 32 eagles).

4.3.5 Other Permitted Take Within Local and Regional Populations

To ensure that local and regional eagle populations remain stable or increasing, the USFWS requires an assessment of the effects of past authorized take, those projects currently under review, and all sources of documented eagle mortalities including those naturally occurring on the landscape. The assessment also considers the level of uncertainty when using models to predict future eagle take associated with mid-line strikes or large-scale commercial wind farms.

A commercial wind energy project consisting of up to 50 turbines is proposed approximately 15 miles southeast of APG, and will overlap APG's local area bald eagle population designation by approximately 70 percent. The proposed wind energy project and APG have an estimated combined projected take between 18 and 26 eagles. According to USFWS methodology (2009a), permitting multiple projects within the same local area population that will potentially take greater than five percent of the local area population should be given careful consideration. The 2013 eagle nest surveys indicate an increase in the number of eagles in the local area population from the 2009 population estimate developed by the USFWS (2009a). The overall increasing population trend suggests that the local area population in the vicinity of APG could withstand take greater than five percent of the local area population without negatively impacting stability of the local or regional (eagle management unit) bald eagle populations.

The take threshold for issuing permits in the Mid-Atlantic eagle management unit allows for take of up to 65 individuals and the loss of 45.5 individuals through nesting pair disturbances yearly. Each nest disturbance equates to the loss of 1.4 chicks per nest. Under the proposed programmatic take permit for APG, yearly take of up to 12 eagles through injury or mortality and 4.2 eagles as a result of three nest disturbances will be subtracted from the current threshold. The additional permitted take will not exceed the maximum threshold of 65 individuals or disturbance loss of 45.5 for the Mid-Atlantic eagle management unit.

Therefore, based on the current local area population trends, the USFWS believes that in the next five and possibly ten years, eagle populations will remain stable or with increasing numbers even with the combined stressors associated with APG, climate change, and other limited projects in the local area and regional eagle management unit that may be permitted for incidental take of bald eagles.

4.3.6 Conclusion

Before the USFWS may issue a bald eagle programmatic take permit under Title 50 CFR Part 22.26, it must be determined that: 1) the direct and indirect effects of the take and required mitigation, together with the cumulative effects of other permitted take and additional factors affecting eagle populations, are compatible with the preservation of bald eagles; 2) the taking is necessary to protect a legitimate interest in a particular locality; 3) the taking is associated with, but not the purpose of, the activity; 4) the taking is unavoidable; 5) the applicant has avoided and minimized impacts to eagles to the extent practicable, and the taking will occur despite application of advanced

conservation practices; and 6) issuance of the permit will not preclude issuance of another permit necessary to protect an interest of higher priority as set forth in paragraph (e)(4) of Title 50 CFR Part 22.26. Based on information provided in this ECP, APG's proposed programmatic take of bald eagles is consistent with these issuing criteria.

4.4 Compensatory Mitigation

Additional compensatory mitigation is not required, because APG's experimental ACPs sufficiently reduce the potential for take to the maximum extent possible, and the projected take does not exceed calculated thresholds for the regional and local populations.

5 STAGE 5 – MONITORING

In Stage 5 of the ECP, a monitoring plan is developed to assess eagle mortalities and disturbances within the project area. The monitoring data are used to determine if conservation measures and/or compensatory mitigation are adequate, excessive, or deficient at reducing or off-setting observed take. The results of the monitoring may indicate if operational changes in the project are needed to reduce observed eagle mortality and/or disturbance.

5.1 Population Surveys

APG will continue to conduct an annual Mid-Winter Bald Eagle Survey as a cooperative effort with the MDDNR. The survey will include two routes: APG shoreline and Susquehanna River shoreline (north to approximately the Pennsylvania state line). The Susquehanna River shoreline will continue to be included in the survey, because past satellite telemetry data have indicated that resident eagles of APG regularly utilize the southern portion of the Susquehanna River, especially in the area of the Conowingo Dam just south of the Pennsylvania state line. The mid-winter count is merely a snap shot of the installation's bald eagle population. However, by following APG's standardized protocol, data from the survey can be compared from year to year to identify long-term trends in the population size and high eagle use areas. The survey is an aerial survey conducted from a helicopter or small fixed-wing aircraft in early January. Data collected from the survey will include the number of adult and immature bald eagles observed on each survey route, general weather conditions, and prevalence/absence of ice on open water.

5.2 Productivity Surveys

APG will continue to conduct seasonal nest surveys to monitor the productivity of the installation's resident bald eagles. These surveys will follow APG's standardized protocol, and will include aerial surveys supplemented by ground observations. Given the number of nests and the expanse of land to survey on APG, aerial surveys are a labor and cost efficient method to collect productivity data. Additionally, aerial surveys are necessary, because many nests are inaccessible on foot due to risks from unexploded ordnance. The aerial surveys will be conducted by helicopter or small fixed-wing aircraft in late January, early March, early April, and early May (an additional mid- to late-May survey may be added). Four to five flights per season promote efficiency in the surveys, because the results of each flight are used to guide the next flight. Specifically, the early January flight identifies new or fallen nests; the early March flight identifies early eggs and chicks; the early April flight determines "active" nest status; the early May flight generates initial productivity numbers and chick ages, and the last May flight confirms fledge dates for nests that are inaccessible to ground observations. Data collected from the surveys will include the condition of each nest, presence of adults in the nest or area, and number of eggs and/or chicks in each nest.

5.3 Mortality Monitoring

APG will continue to investigate each eagle injury and mortality in order to determine if injury/mortality is attributable to incidental take or natural causes. The investigations will be conducted in accordance with APG's standardized protocol for field responses and post-mortem examinations. Information collected during the field response will include photographs, global positioning system coordinates, surrounding habitat characteristics, proximity of electrical and other infrastructure, physical description of eagle, and evidence of trauma. Post-mortem examinations, if needed, will be conducted by the U.S. Army Public Health Command at APG. Information collected during the necropsy will include basic external measurements, external body condition, internal body cavity inspection, estimated time of death, and likely cause of death. Eagle carcasses and remains will be frozen and shipped to the National Eagle Repository (Denver, Colorado) in accordance with APG's standardized protocol.

Injured eagles that can be safely captured will be transported by APG personnel to Tri-State Bird Rescue (Newark, Delaware) or to an appropriate wildlife veterinarian.

5.4 Disturbance Monitoring

APG will continue to monitor, as necessary, mission activities that have the potential to disturb eagles, particularly nesting eagles. Monitoring of activities and observations from productivity surveys will be used together to determine if a nest disturbance has occurred. A summary of the monitoring will include type of activity monitored, number of eagles observed, type of eagle activity observed, minimization measures employed by activity to reduce eagle impacts, and any evidence of disturbance. Areas where a nest disturbance occurred will be monitored to document any new nest construction.

5.5 Habitat Conservation

APG will summarize habitat conservation efforts that benefit bald eagles conducted through forest stand improvements and/or the ACUB program. Summarized information will include location of project site with map, total acreage, description of site, description of eagle habitat and usage, type of conservation activities, and dates of project work.

5.6 Nest Removal Monitoring

For one year following the permitted removal of a nest, APG will monitor the area surrounding the affected nest tree for signs of nest re-building by eagles.

5.7 Reporting

The results of the monitoring and habitat conservation efforts will be summarized and provided by APG to the USFWS's Chesapeake Bay Field Office (Annapolis, Maryland) and Migratory Bird Management Office (Hadley, Massachusetts) according to the following schedules:

- Annual population survey results will be reported by January 31
- Annual productivity survey results will be reported by August 31

- Eagle injury/mortality will be reported within one business day of incident
- Annual summary of eagle injuries/mortalities (USFWS Form 3-202-15) will be reported by February 28
- Annual summary of eagle nest disturbances (USFWS Form 3-202-15) will be reported by February 28
- Annual summary of habitat conservation efforts will be reported by March 31
- Permitted removal of an eagle nest will be summarized within ten days after the removal; annual summary of eagle nest removals (USFWS Form 3-202-16) will be reported by January 31

Prior to renewal of the programmatic permit, the results of the monitoring will be reviewed by APG and the USFWS to determine if adjustments to monitoring, implementation of additional ACPs and/or compensatory mitigation, or reduction in ACPs are warranted.

6 REFERENCES

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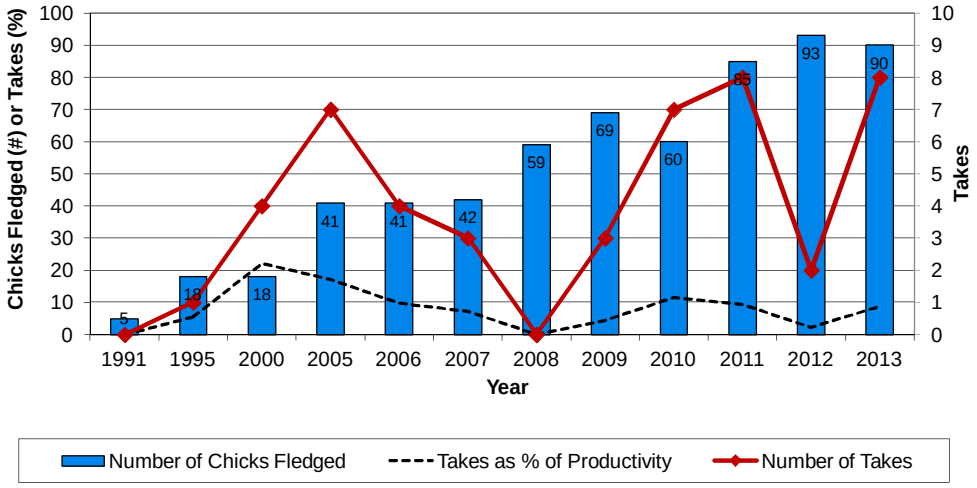
APPENDIX

APG Bald Eagle Cumulative Data

- Cumulative Raw Data
- Take Expressed as Percent of Population
- Regression (Take)
- Regression (Productivity)

Year	Number_Active_Nests	Number_Successful_Nests	Number_Chicks_Fledged	Number_Lethal_Takes	Number_Mortalities_Naturally_Caused
1991	5	4	5	0	0
1992	5	4	8	1	0
1993	8	7	11	1	0
1994	9	7	10	0	0
1995	13	10	18	1	0
1996	16	14	23	2	0
1997	13	5	9	0	1
1998	8	5	6	0	1
1999	19	11	20	2	1
2000	13	10	18	4	0
2001	20	19	32	0	1
2002	18	12	20	6	4
2003	23	23	35	15	2
2004	25	22	32	9	6
2005	35	29	41	7	0
2006	28	28	41	4	2
2007	30	27	42	3	3
2008	38	33	59	0	2
2009	36	34	69	3	2
2010	37	36	60	7	4
2011	49	45	85	8	4
2012	50	47	93	2	1
2013	51	47	90	8	0

Year	1991	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of Chicks Fledged	5	18	18	41	41	42	59	69	60	85	93	90
Number of Takes	0	1	4	7	4	3	0	3	7	8	2	8
Takes as % of Productivity	0.0	5.6	22.2	17.1	9.8	7.1	0.0	4.3	11.7	9.4	2.2	8.9



Year	Lethal Takes*	Predicted Lethal Takes*	Lower 80% CI	Upper 80%CI
2006	9.8	6.48	4.22	8.73
2007	7.1	6.53	4.28	8.79
2008	0	6.59	4.34	8.84
2009	4.3	6.65	4.39	8.90
2010	11.7	6.70	4.45	8.96
2011	9.4	6.76	4.51	9.01
2012	2.2	6.82	4.56	9.07
2013	8.9	6.88	4.62	9.13
2014		6.93	4.68	9.19
2015		6.99	4.74	9.24
2016		7.05	4.79	9.30
2017		7.10	4.85	9.36
2018		7.16	4.91	9.41
2019		7.22	4.96	9.47

REGRESSION:

slope	0.057142857	-108.1535714	b	t value	1.439756
SE (m)	0.683298074	1373.088373	SE (b)	delta m	0.983782
R2	0.00116425	4.42827764	SE (y predicted)	delta b	1976.912
	0.006993644	6	DF	delta y	2.254128
	0.137142857	117.6578571			
	#N/A	#N/A			
	#N/A	#N/A			
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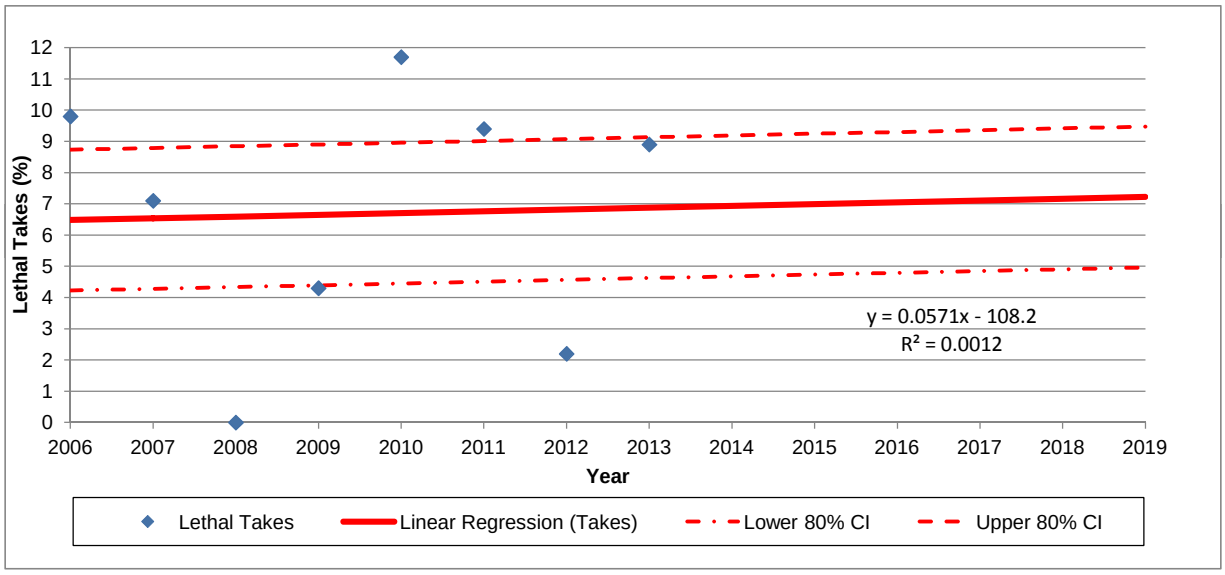

* Lethal takes expressed as percentage of same year's productivity (number of chicks fledged)

Year	Chicks Fledged	Predicted Chicks Fledged	Lower 80% CI	Upper 80%CI
2006	41	39.58	36.00	43.17
2007	42	47.52	43.94	51.11
2008	59	55.46	51.88	59.05
2009	69	63.40	59.82	66.99
2010	60	71.35	67.76	74.93
2011	85	79.29	75.70	82.87
2012	93	87.23	83.64	90.81
2013	90	95.17	91.58	98.75
2014		103.11	99.52	106.69
2015		111.05	107.46	114.63
2016		118.99	115.40	122.57
2017		126.93	123.34	130.51
2018		134.87	131.28	138.45
2019		142.81	139.22	146.40

REGRESSION:

slope	7.94047619	-15889.0119	b	t value	1.439756
SE (m)	1.086946704	2184.220821	SE (b)	delta m	1.564938
R2	0.898934547	7.04421974	SE (y predicted)	delta b	3144.744
	53.36746771	6	DF	delta y	3.585723
	2648.14881	297.7261905			
	#N/A	#N/A			
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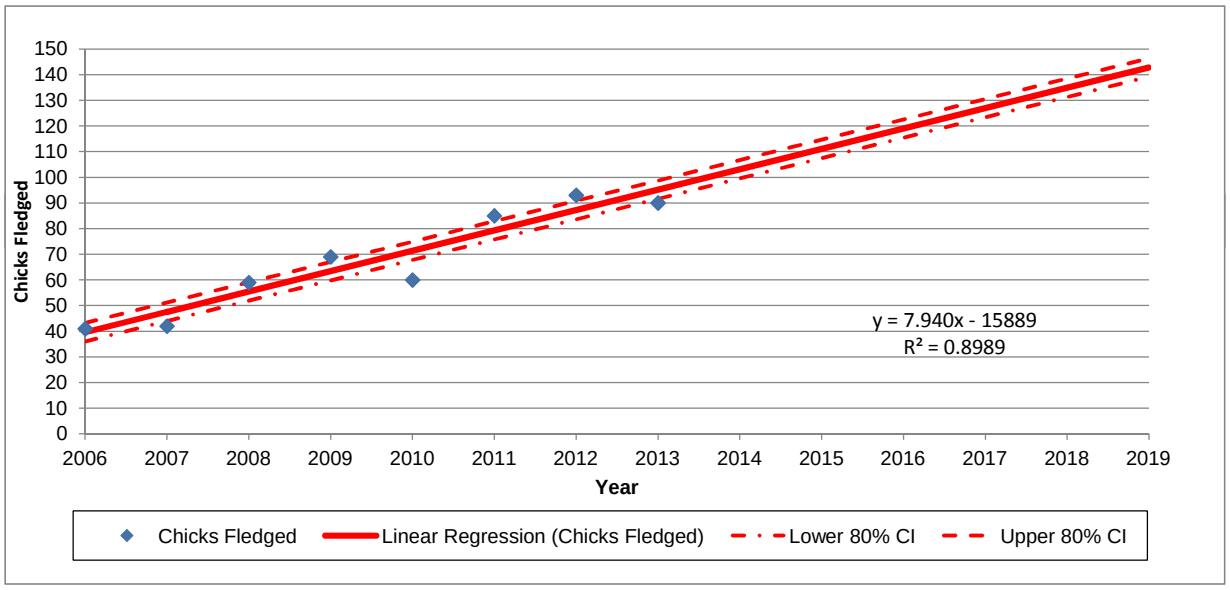

APG Standing Operating Procedures

U.S. Army Aberdeen Proving Ground
Directorate of Public Works
Environmental Division
15 October 2020

Standing Operating Procedure
EAGLE MONITORING SURVEYS

Summary. This Standing Operating Procedure (SOP) describes the procedures for conducting bald eagle monitoring surveys.

Applicability. The procedures described in this SOP apply to mid-winter bald eagle population surveys and seasonal bald eagle nest monitoring surveys conducted at Aberdeen Proving Ground (APG), exclusive of Adelphi Laboratory Center and Blossom Point Research Facility.

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1. Purpose. Adherence to this SOP will ensure: 1) consistent collection of data that will allow for year to year comparisons of bald eagle population size and nest productivity, and 2) monitoring is conducting in a manner that avoids incidental take or disturbance.

2. References.

a. Integrated Natural Resources Management Plan (INRMP), U.S. Army APG, October 2020.

b. Bald and Golden Eagle Protection Act (BGEPA), 16 USC 668-668c.

3. Definitions.

a. Bald Eagle	*Haliaeetus leucocephalus*; year-round species that utilizes APG lands and waters for nesting, foraging, and sheltering
b. Golden Eagle	*Aquila chrysaetos*; transient species that is infrequently sighted foraging and sheltering on APG lands during winter
c. Incidental Take	any take that results from, but is not the purpose of, carrying out an otherwise lawful activity

4. Scope. This SOP shall apply to mid-winter bald eagle population surveys and seasonal bald eagle nest monitoring surveys.

5. General. Monitoring is an essential component of wildlife management, and helps to identify population trends, distributions, and effectiveness of conservation measures. APG has a high density of bald eagles throughout the year. It is estimated that a few hundred eagles are on APG at any one time, and that at least several hundred eagles utilize the installation throughout the year, coming and going across the northern Chesapeake Bay region. Bald eagles remain protected by multiple federal laws, but specifically the BGEPA that is enforced through regulations written by the U.S. Fish and Wildlife Service (USFWS). The BGEPA prohibits take

of eagles (including but not limited to injuring and disturbing) without a permit issued by the USFWS. APG has a USFWS-issued permit that authorizes (under the BGEPA) take of bald eagles that occurs incidental to mission operations and activities. APG's permit includes requirements for monitoring of bald eagles as discussed in APG's INRMP. This SOP outlines the procedures for conducting bald eagle population and productivity surveys as part of the monitoring requirement.

6. Responsibilities. It is the responsibility of the U.S. Army Garrison APG to carry out this SOP. All bald eagle surveys are coordinated by the Directorate of Public Works (DPW) Environmental Division ("survey coordinator").

7. Procedures. The mid-winter population survey and seasonal nest monitoring surveys are aerial surveys usually conducted from a helicopter, but sometimes from a light plane. Currently, the helicopter and pilots are provided by the U.S. Army Aberdeen Test Center (ATC) through cooperation with Phillips Army Airfield (PAAF) Flight Operations. All eagle monitoring surveys require coordination with both PAAF Flight Operations and ATC Range Operations (scheduling and control tower) as detailed below in Section 4.a.

a. Flight Request and Coordination.

(1) The survey coordinator shall complete a flight manifest (i.e., list of passengers) for the flight. This manifest is submitted to PAAF Flight Operations. All passengers must have valid permission to fly on U.S. Army aircraft.

(2) The survey coordinator shall contact PAAF Flight Operations with the proposed flight date, at which time PAAF will identify any known pilot scheduling conflicts. Once a date is agreed to by PAAF, the survey coordinator shall submit a flight request to ATC Range Operations (scheduling). The survey coordinator must ensure the flight is confirmed by ATC Range Operations.

(3) The survey coordinator shall notify the flight passengers of the scheduled flight date and time. This notification shall include the survey coordinator's after-hours phone number, in the event of passenger or flight cancellation.

(4) The morning prior to the scheduled flight, the survey coordinator shall contact PAAF Flight Operations and ATC Range Operations (scheduling) to confirm the flight.

(5) On the day of the flight, all passengers shall arrive at PAAF 30 minutes prior to the scheduled departure time to allow for a pre-flight briefing. The pre-flight briefing is conducted by the survey coordinator, the pilot, and/or the flight crew chief. The following are included in the briefing:

- Survey route (map provided by survey coordinator)
- Helicopter seating (assigned by pilot and/or flight crew chief)
- Ear protection and headsets for communication (addressed by pilot and/or flight crew chief)
- General safety (addressed by pilot and/or flight crew chief)

(6) During flight, pilots maintain communication with ATC Range Operations (control tower). Flying over range areas is permissible only if ranges are cold (not firing), as directed by the range control tower operator.

b. Mid-Winter Population Survey. A yearly mid-winter population survey is conducted to estimate the number of bald eagles on APG and the surrounding area. The date of this aerial survey is coordinated through the Maryland Department of Natural Resources (MDDNR). The MDDNR designates a time frame for conducting the bald eagle survey in order that the data collected by APG can be compiled with data collected by other observers within the state to estimate the regional bald eagle population. The mid-winter population survey is typically conducted in early January. After the flight is requested and coordinated (Section 4.a), the procedures listed below shall be followed for the mid-winter survey.

(1) The helicopter shall maintain an altitude sufficient to accommodate counting of eagles while minimizing potential disturbance to the eagles. Other factors, including weather and discretion of the lead observer, may impact the flight altitude. Generally, an altitude of 300 to 500 feet is maintained.

(2) The survey route follows the shorelines of the installation and includes Spesutie Island, the Aberdeen and Edgewood Area peninsulas, Graces Quarters, Carroll Island, and Pooles Island. The flight also includes a survey of the Susquehanna River north to the Pennsylvania state line (just south of Exelon Peach Bottom power plant) and then back south to the mouth of the river.

(3) During the flight, the locations and age classes (adult, sub-adult, unknown) of bald eagles are noted on data sheets/maps. Any observations of golden eagles are also noted.

(4) The total numbers of eagles (by age class) are tallied for APG and the Susquehanna River.

(5) The survey coordinator shall report the results of the mid-winter survey to the MDDNR within seven business days of the survey. Survey results are reported to the USFWS as part of the annual reporting requirement under the BGEPA permit.

c. Seasonal Nest Monitoring Surveys. Nest surveys are conducted periodically during nesting season to determine activity status of all known bald eagle nests, and to locate any new nests, on APG. These aerial nest surveys are conducted in late January, late February/early March, late March/early April, and late April/early May. After the flight is requested and coordinated (Section 4.a), the procedures listed below shall be followed for each nest monitoring survey.

(1) The pilot shall maintain an altitude sufficient to accommodate nest observations while minimizing potential disturbance of the eagles. Other factors, including weather, location of the nest, and discretion of the lead observer, may impact the flight altitude. Generally, an altitude of 300 to 500 feet is maintained. Passes directly over the nest, as well as hovering over the nest, should be avoided.

(2) Observations are recorded on datasheets provided by survey coordinator.

(3) For any new eagle nest discovered during the flight, the general location of the new nest is noted on the datasheet. Coordinates of the new nest are recorded from the air using a global positioning system (GPS) unit.

(4) The survey coordinator shall revise the installation nest map, and provide changes to nest locations and activity status to the DPW GIS Office within seven business days of the survey. Distribution of the nest map includes appropriate Garrison personnel, contractors, and relevant tenant organizations.

d. Ground Observations. Aerial nest monitoring surveys are supplemented by ground observations, particularly for new nest confirmations and end of season fledge confirmations. Range operations, weather, eagle activity, vegetation and other complicating issues may hinder ground observations.

(1) New Nest Confirmations.

(a) For a new nest discovered on an aerial survey, ground verification of the new nest (and recording of GPS coordinates) should be conducted as soon as possible after discovery of the nest. This verification may be accomplished by walking to the nest tree with coordination as needed through ATC Range Operations (scheduling and control tower), or by triangulating using known points.

(b) For a new active nest discovered between aerial nest surveys, the survey coordinator shall submit the new nest coordinates to DPW GIS Office, and revise and provide the installation nest map as soon as possible after discovery.

(c) At the conclusion of the nesting season, the survey coordinator shall coordinate with MDDNR to assign MDDNR nest designations to all new nests discovered during the nesting season.

(2) End of Season Fledge Confirmations.

(a) After the late April/early May aerial survey, ground observations are needed to confirm that young have fledged from the nests. In the event that ground observations are hindered, nests with young that are close to fledging at the time of last observation will be presumed to be successful, unless there is evidence to the contrary.

(b) Once all nests are confirmed or assumed fledged (inactive), the survey coordinator notifies the DPW GIS Office so that appropriate changes can be made to eagle nest status data layer. At the conclusion of the nesting season, the survey coordinator shall report the yearly nest productivity to the MDDNR. Nest productivity is reported to the USFWS as part of the annual reporting requirement under the BGEPA permit.

U.S. Army Aberdeen Proving Ground
Directorate of Public Works
Environmental Division
15 October 2020

Standing Operating Procedure
RESPONSE TO EAGLE INJURIES AND MORTALITIES

Summary. This Standing Operating Procedure (SOP) describes the procedures for responding to an injured or dead eagle.

Applicability. The procedures described in this SOP apply to all incidents of injured or dead eagles at Aberdeen Proving Ground (APG), exclusive of Adelphi Laboratory Center and Blossom Point Research Facility. This SOP applies to both bald eagles and golden eagles.

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1. Purpose. Adherence to this SOP will ensure: 1) proper personnel notification, 2) collection of appropriate field and post-mortem data, and 3) reporting of information and data for eagle injuries and mortalities.

2. References.

a. Integrated Natural Resources Management Plan (INRMP), U.S. Army APG, October 2020.

b. Bald and Golden Eagle Protection Act (BGEPA), 16 USC 668-668c.

3. Definitions.

a.	Bald Eagle	*Haliaeetus leucocephalus*; year-round species that utilizes APG lands and waters for nesting, foraging, and sheltering
b.	Golden Eagle	*Aquila chrysaetos*; transient species that is infrequently sighted foraging and sheltering on APG lands during winter
c.	Incidental Take	any take that results from, but is not the purpose of, carrying out an otherwise lawful activity
d.	Necropsy	a post-mortem examination on an animal

4. Scope. This SOP shall apply to all injured or dead eagles discovered on the installation.

5. General. APG has a high density of bald eagles throughout the year. It is estimated that a few hundred eagles are on APG at any one time, and that at least several hundred eagles utilize the installation throughout the year, coming and going across the northern Chesapeake Bay region. Bald eagles remain protected by multiple federal laws, but specifically the BGEPA that is enforced through regulations written by the U.S. Fish and Wildlife Service (USFWS). The BGEPA prohibits take of eagles (including, but not limited to, injuring and disturbing) without a permit issued by the USFWS. APG has a USFWS-issued permit that authorizes take of bald

eagles that occurs incidental to mission operations and activities. APG's permit includes requirements for investigating and reporting injured and dead bald eagles, in accordance with the USFWS Office of Law Enforcement protocols and as discussed in APG's INRMP. This SOP outlines the procedures for responding to injured or dead eagles discovered on the installation.

6. Responsibilities. It is the responsibility of the U.S. Army Garrison APG to carry out this SOP. Specific responsibilities are detailed below.

7. Procedures for Responding to an Eagle Injury or Mortality.

a. Initial Notification. The person or organization that discovers the injured or dead eagle shall immediately notify by telephone the APG Police. The APG Police shall dispatch a Directorate of Emergency Services (DES) – Conservation Law Enforcement Officer (CLEO) to the site. The CLEO shall immediately notify the DPW Environmental Division – Eagle Program Subject Matter Expert (SME).

b. Field Investigation. The CLE and SME shall report to the scene as soon as possible after notification. When possible, the eagle carcass should not be moved until all parties have arrived at the scene. However, certain circumstances (safety, roadway blockage, delays in reporting to the scene, etc.) may necessitate the moving of the carcass to a safe area. All personnel handling dead eagles should wear rubber or latex gloves.

(1) At the scene, the following shall be collected:

(a) Photographs to include at a minimum

- Broad angle of scene
- Power lines configuration (if applicable)
- Carcass with power lines in view (if applicable)
- Close up of carcass upon discovery (before moved)
- Close up of any trauma areas on carcass
- Identifying marks, traits for species/age determination

(b) GPS location

(c) Description of location and carcass to include at a minimum

- Date and time of discovery
- Surrounding landscape (habitat, buildings, roads)
- Distance to, and description of, nearby electrical infrastructure
- Physical description of carcass including rigor mortis, insects, obvious trauma, missing body parts, missing feathers, leg bands, age class

(2) The collection of the above data may be facilitated by the use of a standard data sheet developed by the SME. Additional data may be collected by the CLEO for the police report (e.g., name of person reporting incident, names of personnel present at scene, weather conditions, etc.).

(3) The CLEO or SME shall take possession of the injured or dead eagle. The SME shall make the determination of final disposition of the eagle.

(a) Injured Eagles – Attempts to capture an injured eagle are made at the discretion of the CLEO and the SME. Injured eagles that can be safely captured are immediately transported by SME (or delegated person) to Tri-State Bird Rescue or to an appropriate wildlife veterinarian:

Tri-State Bird Rescue
110 Possum Hollow Road
Newark, DE 19711
Phone 302-737-9543 (after hours 302-737-9513)

(b) Dead Eagles – Depending on the condition of the carcass, the SME may collect basic biological data from the carcass:

- Weight
- Wing (chord) length
- Tail length
- Culmen length
- Tarsus length
- Talon (hallux) length

i. If the SME determines that a necropsy is required, then the dead eagle is loosely bagged and placed immediately into refrigerated storage (if possible). If a necropsy is not required, then the dead eagle is carefully bagged and placed immediately into locked frozen storage for subsequent shipment to the USFWS National Eagle Repository. A shipping box and pre-paid label can be obtained from the Repository:

National Eagle Repository
6550 Gateway Road, RMA, Bldg. 128
Commerce City, CO 80022
Phone 303-287-2110
Email repository@fws.gov

ii. When bagging the carcass and placing into refrigerator or freezer, care should be taken to avoid bending wing or tail feathers. An identification tag or label accompanies the bagged carcass. A USFWS toe tag shall be used on final disposition of the carcass to the National Eagle Repository.

c. Necropsy. A necropsy may be conducted at the discretion of the SME. The necropsy shall be conducted and documented in accordance with the U.S. Army Public Health Command (USAPHC) SOP "Eagle Mortality Post Mortem Examination" which is on file at the USAPHC. Coordination and transfer of the eagle carcass to the USAPHC shall be conducted in accordance with the USAPHC SOP. The carcass shall be double-bagged when transported to the USAPHC.

(1) Biological data (as permitted by condition of carcass) shall be collected to include:

(a) External inspection

- Missing parts, scavenger damage
- Burns
- Broken bones
- Eye condition (clear, sunken, cloudy, missing)
- Discharge from orifices
- Abrasions
- Missing feathers
- Insects
- Muscle mass condition
- Other abnormalities or conditions

(b) Sample for DNA analysis (two breast contour feathers) if requested

(c) Body cavity inspection

- Signs of internal hemorrhage
- Contents of gizzard and crop
- External appearance of organs
- Presence of macro parasites

(d) Estimated time of death

(e) Tissue samples for histopathology (if requested)

- Liver
- Kidney
- Brain
- Eyes (both – whole)
- Heart
- Lungs
- Spleen
- Pancreas
- Gonads

(f) Tissue samples for chemical analyses (if requested)

- Muscle
- Adipose
- Liver
- Kidney
- Brain

(2) All remains of the carcass shall be returned to the SME and placed in locked frozen storage for subsequent shipment to the USFWS National Eagle Repository (except tissue samples retained for analyses).

(3) Tissue samples, if collected, shall be contracted out by DPW Environmental Division for analysis by an outside contractor or by the USAPHC.

(4) The USAPHC shall prepare a summary report detailing the findings of the necropsy and forward to the SME.

d. Reporting.

(1) The SME shall notify the USFWS within seven days of collection of an injured or dead eagle. Notification shall be made using the USFWS on-line Injury and Mortality Reporting (IMR) system.

(2) The SME shall download from the IMR a yearly summary of injuries and mortalities and submit by email to the USFWS by 31 January of the following year, as part of annual reporting requirements under the BGEPA permit.

APPENDIX N

Outdoor Recreation Plan

Installation Outdoor Recreation Planning

The purpose of the Installation Outdoor Recreation Planning document is primarily to promote and maintain outdoor recreation activity for the mental and physical well-being of Soldiers, Civilians, Families, and contractors, specifically active duty military personnel, while at the same time protecting and improving the installation's natural resources. To this aim, this document will provide general guidance regarding outdoor recreational opportunities and activities at Aberdeen Proving Ground (APG). This document includes:

- Objectives – Identify objectives of outdoor recreation
- Recreational Resources – Catalogue outdoor recreational resources
- Resource Management – Describe resource management
- Future Planning – Discuss the methodology for proposed outdoor recreation development

1. Objectives

The goal for outdoor recreational management is to provide sustaining DFMWR facilities, activities and programs to the Soldiers, Civilians, Families, and contractors of APG. The objectives of recreational management planning are:

a. Assuring that planning for outdoor recreation is included as part of the Installation Master Plan

b. Improving the quality and quantity of leisure experiences for the Soldier, his/her family and where possible, members of the Department of the Army (DA) work force and the public

c. Providing an optimum variety, mix and location of recreational opportunities

d. Preserving and developing outdoor recreation resources to serve their highest and best use

e. Evaluating the effectiveness of existing and proposed outdoor recreation

f. Relating outdoor recreation plans to other installation plans

g. Promoting at all levels of the installation organization, understanding and support for more effective outdoor recreation planning

h. Encourage Army personnel to use their time constructively and creatively by taking part in programs to develop and maintain talent and skills

i. Promote and maintain the mental and physical fitness and well-being of DA personnel with emphasis on active duty military personnel

j. Maintain a high level of spirit, job proficiency, military effectiveness, and educational achievement

k. Assist in providing a community support environment to DA personnel and their families, especially important for military spouses' unaccompanied tours, missions or involved in conflicts

l. Create a vital, self-sustaining military community

m. Aid recruitment and retention by making service careers more attractive

n. Assist new personnel in adjusting from civilian life to a military environment

o. Provide programs that will appeal to the team work concept of the military

p. Bear in mind at all times the importance of establishing, maintaining and improving community relations

2. Recreational Resources

The outdoor recreation program at APG offers a wide variety of facilities, activities and special programs. Programs are open to active duty military personnel and their families, all active duty APG civilian employees and their dependents, and DOD contractors.

a. Facilities

Outdoor recreation facilities are located throughout both the Aberdeen Area (APG-AA) and Edgewood Area (APG-EA). Facilities include pools, golf courses, marinas, stables, picnic areas, and recreation centers (see Tables 1a and 1b). Facilities are either openly available to the APG community or obtainable by reservation.

b. Activities and Services

DFMWR provides a selection of activities and services for both the betterment of the mind and body of the target populations. These activities and services are for the populations as a whole or targeted for youth or seniors. Routine activities planned may include:

i) Physical education classes such as golf, kayaking, yoga, boot camp, etc.

ii) Mental welfare and betterment classes, such as career workshops and finance classes

iii) Trips to local destinations and discounted tickets to local venues

iv) Outdoor activities such as golf outings, organized runs and other organized sports

v) Equipment rentals for various activities are available (see Table 2)

c. Programs

i) Hunting Program

Hunting has been a popular activity on what is now APG since the early 1800s. The hunting program at APG has evolved over the years and still

provides a popular source of recreation to the APG community. A successful program is run as a coordinated effort by DFMWR, tenant range control, Conservation Law Enforcement Officers, and DPW Environmental Division.

The installation has an abundant and diversified population of game, including deer, ducks, geese, and furbearers such as raccoon, fox, rabbit, and muskrat. Hunting is allowed using shotgun, muzzleloader, or bows. Trapping is allowed for nuisance pest control only, as determined by the DPW Biologist.

With a large game population and a large number of hunters, safety becomes a prime concern. There are mandatory hunter safety requirements, field of fire zone in the hunting areas, and strict enforcement of all regulations. The Conservation Law Enforcement Officers patrol the hunting areas to enforce the regulations.

The management of the wildlife natural resources at APG is administrated by the DPW Biologist.

Regulations and guidance on the Hunting Program can be found in APG DFMWR website.

The prime objective of the program is to allow the hunters to maintain stable game populations in a safe manner without hindering the mission of APG.

ii) Fishing Program

Being located in the northern Chesapeake Bay and the mouth of the Susquehanna River, APG offers ideal conditions and opportunities for fishing. Many species are found in the local waters including catfish, carp, perch, bass, and blue crabs.

Fishing at APG is controlled by two sets of regulation, APGR 210-26 “Recreational Fishing and Crabbing Rules” and APGR 210-10 “Use and Navigation of Restricted Waters of APG.”

DFMWR is responsible for administering the fishing access at APG. They issue all permits, supply copies of regulations to fisherman, and maintain and rent boats and other equipment to fishermen. Two boat rental facilities are located on APG: the APG-AA issue point located at Swan Creek and the APG-EA rental facility located at the Sportsman Center on the Gunpowder River.

To take part in recreational fishing in restricted areas at APG, a fisherman must be an Installation Identification Card holder with an Installation restricted area access badge. Qualified anglers will apply for access for a specific area and date through DFMWR.

Non-Secured designated areas for fishing are:

- Swan Creek – easterly from installation perimeter to Building 2403
- Spesutie Island Marina – 100 feet from launch ramp, easterly to secure area
- Woodpecker Point – causeway to Dipper Creek
- Spesutie Island – west shore from causeway to 200 meters south
- Gunpowder River – east shore from northern installation boundary to secure area
- Lauderick Creek – southerly from Skippers Point to secure area

Fishing from DFMWR boat dock and piers is prohibited.

iii) Trap and Skeet (Shooting Sports)

The skeet and trap range has shotgun and muzzle loader shooting opportunities for all skill levels. The range is located at Building E4737 on Hoadley Road in the APG-EA. League and open shooting is available throughout the year. The Skeet and Trap Range may only be opened by a range control officer. Patrons must bring their own shotguns and ammunition.

iv) Hiking

There are very few hiking trails at APG due to the long history of testing and training on its ranges, minimizing the availably for hiking. The trails/nature walks in the cantonment areas for recreation in APG-AA are located behind the Maryland Gate Picnic Area. APG-EA trails are located on the southern shore of Lauderick Creek near the Skipper's Point Picnic Area.

v) Camping / Recreational Vehicle Park

There are camps site available in APG-EA, located at Skippers Point at the head of Lauderick Creek, and there is an RV park in APG-AA (see Table 3). For those desiring to camp but have limited equipment, DFMWR offers many items for rent (see Table 2).

vi) Intramural Sports

The Intramural Sports Program offers the opportunity to enhance individual morale and team esprit de corps through individual and team competition. Team sports have included softball, soccer, flag football, volleyball, basketball and ultimate frisbee. Tournaments are also offered throughout the year in sports such as dodge ball, kickball, tennis, racquetball, 3-on-3 basketball, and disc golf.

vii) Golfing

APG maintains two golf course – Ruggles Golf Course in APG-AA and Exton Golf Course in APG-EA. Outing and tournaments are offered throughout the year.

Amenities include:

- 9 and 18-hole Championship golf courses
- Driving Range with natural and artificial tees
- Putting Green
- Short Game Chipping Area
- Cart Rentals
- Fully Stocked Pro Shop
- Computerized Handicap System
- Golf Lessons
- Locker Rental
- Indoor and Outdoor Dining

3. Resources Management

APG occupies a prime portion of real estate at the northern section of the Chesapeake Bay. Included within its boundaries are numerous creeks, rivers, woodlands, wetlands and estuaries, and a large military and civilian work force. These resources must be managed thoughtfully and diligently to ensure that they continue to thrive while simultaneously providing optimal outdoor recreational opportunities for the APG community. Necessary action includes evaluation of existing conditions, identification of potential recreation areas, determination of outdoor recreation needs, selection of appropriate outdoor recreation activities, and implementation of physical improvements.

Natural resources will be maintained for recreation while not interfering with the mission of APG. Using appropriate management techniques, future generations will have equal or better areas for outdoor recreation.

a. Cooperative Agreement of Fish and Wildlife Resources

The Department of Defense, the Department of the Interior, and the state of Maryland in accordance with Title 10, US Code Section 2671, through their designated representatives have approved and implemented a cooperative plan for the protection, development, and management of the Fish and Wildlife Resources on APG. The purpose of the cooperative plan being to protect and enhance existing fish and wildlife at APG through land and water conservation programs and utilization of sound management practices. These practices will be conducive to healthy fish and wildlife populations. Assistance may be

obtained from either state or federal fish and wildlife biologists within their finding and personnel limits. The purpose of the cooperative plan also being to provide public recreational fishing, hunting and trapping opportunities and for commercial fishing operations, consistent with adequate military security and optimum public safety.

b. Surveys

Surveys will be made periodically to determine abundance and distribution of fish and wildlife populations. The information obtained from these surveys will be compared to existing data to determine population trends and manage the hunting and fishing programs accordingly.

c. Funds

Because of the high usage of many areas of the program, Outdoor Recreation becomes self-supporting for many programs. Significant funds are raised from the sale of hunting permits, which are deferred to the APG Conservation Subcommittee. This committee is responsible for administration and support of conservation efforts at APG.

4. Future Planning

Outdoor Recreation program planning is dependent on planning of use of installation resources and management of natural resources. This is accomplished with a combination of efforts from the DPW Environmental, DFMWR, and Master Planning:

- DPW Environmental manages natural resources through the implementation of the Integrated Natural Resources Management Plan and its accompanying plans.
- DFMWR routinely evaluates all outdoor recreational facilities and opportunities within APG, planning for new recreational prospects.
- Master Planning, as part of the Installation Master Plan, identifies new areas to be available for use as outdoor recreational areas.

The outdoor recreation planning process has three principle steps:

a. Identification

This step involves the acquisition of data pertaining to on- and off-Post conditions which influence outdoor recreation use and development. This information is available in the Installation Master Plan (i.e., climate, geology, hydrology, land use, vegetation, wildlife, conservation areas, Installation Restoration Program areas, transportation systems, climate, etc.)

b. Evaluation

An evaluation is made by DFMWR of the potential effects of both on- and off-Post conditions upon outdoor recreation. The principle opportunities and

constraints are summarized and the recreation needs and requirements of the installation are determined. There are numerous approaches to analyzing recreation supply and demand. Data to consider include:

- Resources available
- Record of activity participation
- Fiscal resources available
- Behavioral indices

c. Implementation

Based upon information gathered and the determination of opportunities and constraints, needs and requirements evaluation, implementation begins. Conceptual alternatives for future development are presented. Selection of the most feasible alternative results in a long-range plan for future development.

Tables.

Table 1a. Aberdeen Area Outdoor Recreation Facilities

FACILITY NAME
COMMUNITY/CONFERENCE CENTER
PVT/ORG CLUB
UOQ MILITARY
EXCHANGE BRANCH
REC SHELTER
REC EQ CHECKOUT
BOWLING CENTER
AUTO SKILL CENTER
CHAPEL/CHILD CARE CENTER
CHILD DEVELOPMENT CENTER
YOUTH CENTER
AUDITORIUM GP
PHYSICAL FITNESS CENTER
OLYMPIC POOL - OD SWIM POOL
RECREATION CENTER
ENLISTED UPH
ENLISTED UPH
ENLISTED UPH
TRANS UPS AIT
REC SHELTER - WOODPECKER PT PARK
REC SHELTER - WOODPECKER PT PARK
REC SHELTER

Table 1b. Edgewood Area Outdoor Recreation Facilities

FACILITY NAME
REC SHELTER
REC SHELTER
CHILD DEVELOPMENT CENTER
YOUTH CENTER
RECREATIONAL SHELTER
PLAYGROUND
PLAYGROUND
BOAT HOUSE
BOAT HOUSE
STR SED GP INS
RECREATIONAL SHELTER
RANGE OPERATIONS BLDG
RECREATIONAL SHELTER - EA
EDGAR STARK SVC CLUB – RECREATIONAL CENTER
COURT AREA
ELI HOYLE GYM 6 FLD ART REG
BAYSIDE OD POOL
RECREATIONAL SHELTER
ROD/GUN TRAP SHOOTING
SKEET TRAP BLDG - PVT/ORG CLUB
SKEET STOR BLDG - PVT/ORG CLUB
SKEET STOR BLDG - PVT/ORG CLUB
EGBERT BULLENE BLDG - ARMY LODGING
RAY AVERY BLDG - ARMY LODGING
ARMY LODGING
EDGEWOOD AREA RECREATIONAL SHELTER
EDGEWOOD AREA RECREATIONAL SHELTER
EDGEWOOD AREA RIDING STABLES
SOFTBALL FIELDS - ABERDEEN
SOFTBALL FIELDS - EDGEWOOD
MULTI ATHLETIC FIELD - EDGEWOOD

Table 2. Outdoor Recreation Rental Equipment

PARTIES	GAMES	WATERCRAFT	CAMPING
BOUNCE HOUSES	BASKETBALL, FOOTBALL, SOCCER, VOLLEYBALL	CANOES	TENTS
CANOPIES	RING TOSS	KAYAKS	SLEEPING BAGS
TABLES	TUG OF WAR ROPE	ALUMINUM BOATS	CAMPING COT
ICE CHESTS	CORNHOLE SET	BOAT TRAILERS	CAMPING CHAIR
WATER COOLERS	HORSESHOE SET	BOAT MOTORS	COOK SET, CAMP STOVE
TOWABLE GRILLS	VOLLEYBALL SET	LIFE VESTS	GENERATOR
CANOPY		PADDLEBOARD	LANTERN
			VEHICLE LUGGAGE RACK
			BACKPACK
			UTILITY TRAILERS

Table 3. Camping Facilities

Aberdeen North Campground has 11 RV slots; each concrete pad has full utility service. Each site also includes fire pit and picnic table.

APG NORTH CAMPING FEES	DAILY	WEEKLY
ACTIVE DUTY	$20	$100
RETIRED	$25	$125
DOD CIVILIAN / CONTRACTOR	$30	$150

Aberdeen South Campground has tent camping. There are port-a-pots within walking distance of the facility.

APG SOUTH CAMPING FEES	DAILY
ALL SITES	$5

Abbreviations.

APG ..... Aberdeen Proving Ground

APG-AA ..... Aberdeen Proving Ground-Aberdeen Area

APG-EA ..... Aberdeen Proving Ground-Edgewood Area

APGR ..... Aberdeen Proving Ground Regulation

DA ..... Department of the Army

DFMWR ..... Directorate of Families, Morale, Welfare and Recreation

DOD ..... Department of Defense

DPW ..... Directorate of Public Works

References.

Installation Master Plan (2012).

Technical Manual Planning of Outdoor Recreation Areas, TM-5-803-12, 3 September 1986.

Army Regulation 215-1, Military Morale, Welfare and Recreation Programs and Nonappropriated Fund Instrumentalities.

APG Regulation 200-6 Hunting, Trapping and Wildlife Control on APG.

APG DFMWR Hunting Program Policy Memo.

APG Regulation 210-26, Recreational Fishing and Crabbing Rules.

APG Regulation 210-10, Use and Navigation of Restricted Waters of APG.

APPENDIX O

Project List

LIST OF INRMP PROJECTS

The following is not an inclusive list of all projects. The projects are presented in no particular order. Costs are estimated.

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PROJECT: Unexploded Ordnance (UXO) Support for Environmental Field Work

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

UXO avoidance support for execution of natural resources projects (including but not limited to habitat restorations, stream surveys, sediment and benthic sampling, wetlands regulatory site visits, shoreline post-storm surveys and clean-up efforts, and sign installation). Partial funding is acceptable.

Deliverable:

UXO sweeps to include scans and avoidance. Letters of completion to include UXO swept GIS layer maps indicating UXO completion by specific contractor letter, technician, anomalies found and UXO work dates. Each site geographic area will be GPS captured for APG's GIS.

Cost and Cost Basis:

$75,000 (total)

30 days UXO support @ $2,500 per day

Justification:

Failure to fund prevents implementation of many INRMP projects. APG regulation requires UXO support for any intrusive operations.

Class:

0 - Recurring

Legal Driver:

Sikes Act

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PROJECT: Water Quality Monitoring

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Approximately half of APG is open water of the Chesapeake Bay or tributaries of the Chesapeake Bay. This is a valuable resource deemed a "National Treasure" by President Obama in EO 13508. As the receiving water for all land based activities on APG, water quality monitoring is a significant aspect is determining the overall health of APG's ecosystems. Water quality monitoring is also important in determining viability of the water for survivability and restoration potential for submerged aquatic vegetation (SAV). SAV is important habitat for fish and blue crabs, while reducing the suspended sediment load and stabilizing shorelines. Monitoring water quality on a regular basis can also help identify the presence of Harmful Algal Blooms (HABs), so the appropriate notification can be given to people working or recreating on the Chesapeake Bay and its' tributaries. Candidate for Work Plan Integration through Public Health Command.

Deliverable:

Monthly data analysis in spreadsheet form

Cost and Cost Basis:

$40,000

58 samples per month for Nitrogen series, Phosphorus series, Solids series, Other

Justification:

If not funded approximately half of APG will continue to be unmonitored from an ecological perspective. Data gaps will continue to grow, between the outside community and APG and unsafe conditions could occur in the waters of APG without being identified.

Class:

0 – Recurring

Legal Driver:

EO 13508, Sikes Act

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PROJECT: Wetland Hydrologic Monitoring to Assess Impact of Sea Level Rise

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Dynamic changes in shallow groundwater elevations as a result of surface-water elevation changes and wetland vegetation loss will be a large factor in the impact of sea level rise (SLR) on bordering areas including upland forested habitat, buildings, roads, testing ranges and test facilities. As wetland inundation increases, increases in shallow groundwater levels will likely cause waterlogging and die-off in forested areas. Increases in salinity of shallow groundwater from surface-water encroachment can add to the stress and die-off in upland forested areas, adding to the threat to protected species, such as the bald eagle, that rely on the wetlands and forested areas. The scope of this study is to establish water-level monitoring transects in two wetlands with bordering forested areas to provide an assessment of their response and vulnerability to changes in surface-water levels. Both a disturbed and relatively undisturbed wetland will be assessed and compared.

Shallow ground-water wells (piezometers), nested with surface water-level monitors, will be installed manually, with at least one transect from shore to forested upland, consisting of about 10 piezometers (in nests of 2 to 3 piezometers at a site) in the Monks Creek wetland area. Surveying will be completed to obtain piezometer elevations and transducers will be used to continuously record water levels. Temperature, pH, and specific conductance (which will provide salinity) will be measured with hand-held tapes and probes in monthly synoptic events. In addition to the monthly samples, a pre- and post-storm event will be selected and data will be collected in an event in both winter and summer months. Measurements will provide data that will be critical to informing the relation between groundwater and surface-water dynamics and predicting future response and effects of SLR.

Deliverable:

Data will be provided to environmental staff and stored in USGS supported databases. Available local tide and precipitation data will also be provided and used to interpret results. APG environmental staff will be briefed on results and application of data.

Cost and Cost Basis:

$99,580 (total)

$67,645 for labor (includes administrative and technical support personnel)

$17,000 for equipment and supplies

$14,935 for indirect costs

Justification:

Accurate data are critical for planning to protect the wetlands that make up a significant portion of APG. Lack of place-based measurements will result in reliance on models not calibrated to site conditions, leaving habitat, mission assets, and restoration remedies in place at risk. This study will provide data to support DOD resiliency planning and to develop site-specific climate change vulnerability assessments.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act, Clean Water Act

PROJECT: Wetland Elevation Monitoring to Assess Potential for Sea Level Rise (SET Installation and Monitoring)

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

This project addresses priorities and needs outlined by the Army (USACE Climate Change Adaptation Plan, 2014) to prepare for changing sea levels and provides information for developing climate change vulnerability assessments as specified in the INRMP. This includes the collection of timely data, information, and decision support tools for climate preparedness and resilience by addressing sea level rise (SLR) and storm effects on wetlands and low-lying areas. Wetland ecosystems, and the forested areas that often border them, not only provide habitat for protected species but are important buffers for military testing facilities and ranges, historic waste disposal areas, buildings and roads at APG.

Project will install 3 additional permitted surface elevation tables (SETs) for a total of 6 SETs, and monitor SETs and co-located marker horizons at least 4 times at all locations during a 12 to 18-month period. Additional surveying may be initiated following storms. Continuous data downloads will be conducted at least every 2 months through the duration of the project. Monitoring data will be collected from tide gauge installed for previous USGS project.

Deliverable:

Surface elevation, SET, and tide gauge data will be collected, quality assured, and maintained in electronic format and provided as data deliverable. Tide gage data will be maintained in the USGS National Water Information System (NWIS) database. Up to three meetings or briefings per year will be provided, as requested by APG staff.

Cost and Cost Basis:

$86,000 (total)

$66,700 for 252 hours of one Senior Scientist (project management, planning, data compilation and interpretation) and 576 hours of two Technicians (field work and data processing); Labor estimate also includes administrative and technical support personnel

$3,900 for UXO support

$2,500 for equipment and supplies

$12,900 for indirect costs

Justification:

Accurate predictive models are critical for planning to protect the wetlands that make up a significant portion of APG. Failure to plan for SLR impacts puts at risk the ability of wetlands to function as protection for important habitat (such as for the bald eagle, driving eagles further inland and more susceptible to disturbance) and the surrounding testing ranges and installation infrastructure. This study will provide data to support DOD resiliency planning and to develop site-specific climate change vulnerability assessments.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act, Clean Water Act

PROJECT: Extreme Event Monitoring to Assess Wetland Vulnerability

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Documenting the height, extent, and timing of storm surge and understanding how overland storm tide and waves evolve and dissipate when they move across natural and man-made landscapes is critical for storm preparedness and prediction. Up to four monitoring sites will be selected for bracket installation to measure differences from the Bay-frontage surge (near the river mouth) and surge potentially occurring in the upper river systems. Brackets will be deployed on existing infrastructure, such as a tide gate, sea wall, pier, or other structures. A survey of the bracket location will be conducted so that accurate water elevation can be determined when the data is downloaded from the sensor. When a severe storm is forecasted, water level sensors will be mounted to the installed brackets 24 to 48-hours in advance of the storm. Typically, the recording period lasts for 1 to 3 days depending on the magnitude of the storm and post-storm access to the sensor sites. In a typical year, sensors may be deployed on average three times. If more events occur, sensors will be deployed as many times as required to capture the event.

Deliverable:

Site specific data will be provided within a week of each monitored storm (approximately 3 times per year). A summary briefing of the storm information will be delivered to environmental staff and those involved in emergency preparedness planning before the end of the project period.

Cost and Cost Basis:

$24,940 (total)

$14,700 for labor (salary and benefits)

$6,500 for equipment and supplies

$3,740 for indirect costs

Justification:

Data from this project will provide insight into coastal flooding during extreme events. In addition, the project will provide valuable information including duration and extent of inundation during flood or surge events that can be used for preparedness planning, increasing resilience of local coastal assets and to develop site-specific climate change vulnerability assessments.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act, Clean Water Act

PROJECT: Monitoring of SETS and Hydrology, Extreme Event Modeling and Synthesis, and Product Development

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Continued collection, interpretation, and synthesis of place-based measurements in two tidal creeks to better understand wetland elevation, sea level rise, vulnerability to extreme events, and near wetland hydrology and potential for sea level rise.

Deliverable:

Surface elevation, SET, and tide gage data will be collected (at least 4 additional monitoring events), quality assured, and maintained in an electronic format and provided to the Army as a data deliverable (USGS data release).

Up to 3 meetings or briefings per year are expected, as requested by the Army.

In the case of a storm in which SWaTH monitoring will occur as part of the larger regional northeast corridor network, a web link will be provided to site-specific data within one week of storm. Otherwise, if a storm is assessed without regional network, a summary briefing of the storm information will be delivered before end of project period.

An interpretive product (e.g., story map, administrative report, interactive mapper), synthesizing the multiple monitoring efforts, is proposed to provide a tool to understand and visualize results of the study of wetland elevation, vulnerability, and connection to hydrology at APG.

Cost and Cost Basis:

$144,374 (total)

Justification:

Accurate predictive models are critical for planning to protect the wetlands that make up a significant portion of APG, though effective place-based monitoring is required to inform these predictive models. Failure to plan for sea level rise impacts puts at risk the ability of wetlands to function as important habitat for protected species and as protective buffer for the surrounding military buildings and training areas. The care of wetlands at APG is also paramount to the military mission of environmental stewardship. Significant unexploded ordnance and environmental contamination exists at the installation at many sites in or near wetlands, where natural processes in the wetlands act to remediate contaminants and prevent their release to surface water, groundwater, and the air. This study will provide a complete monitoring program to evaluate sea level rise impacts at a range of spatial and temporal scales to support DoD

resiliency planning. Impacts of sea level rise have already been mentioned in 5-year reviews of sites with current RODs. Lack of place-based measurements will result in reliance on models not calibrated to site conditions, leaving habitat, mission assets, and restoration remedies in place at risk.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

PROJECT: Wetlands Mitigation Monitoring

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Annual monitoring of wetland mitigation sites, not currently under contract for initial 5 years of long-term monitoring to ensure compliance with the terms of the wetland permits. Candidate for Workplan Integration through USACE Baltimore District.

Deliverable:

Report on the status of the mitigation sites

Cost and Cost Basis:

$7,972 (total)

$4,372 for labor

$3,600 for UXO support

Justification:

Failure to fund will result in non-compliance with terms of wetland permits

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Clean Water Act

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PROJECT: Evaluation of C4ISR and ATEF Wetland Mitigation Sites

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Evaluate current status of C4ISR and ATEF wetland mitigation sites. Assess success of each site and make recommendations for path forward to include planting plan and schedule for permit close-out.

Deliverable:

Report on current status of mitigation site, planting plan, and recommendations for permit close-out and timeline.

Cost and Cost Basis:

To be determined (estimated $50,000)

Justification:

Fifth and final year of monitoring under contract for C4ISR and ATEF wetland mitigation sites is complete. Due to circumstances beyond contractor's control, sites have not achieved permit required success criteria by 5th year of monitoring. Contracts have been closed out. In order to comply with terms of wetland permits, the sites need to meet success criteria and be evaluated for close-out. Failure to fund will result in non-compliance with terms of the wetland permit.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Clean Water Act

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PROJECT: Wetlands Planning Level Survey

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.1 –** Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Project Description:

Determine tidal reach (head of tide) by aerial photographic interpretation and conduct field delineation as needed on various creeks on APG to include Romney Creek. Candidate for Work Plan Integration through USACE Baltimore District.

Deliverable:

Report and GIS data on the tidal reach.

Cost and Cost Basis:

$20,550

> $7,840 for field work (Environmental Scientist for 80 hours @ $98 per hour)
>
> $7,840 for aerial photos and report (Environmental Scientist for 80 hours @ $98 per hour)
>
> $800 for GIS support (16 hours @ $50 per hour)
>
> $320 for administrative support (8 hours @ $40 per hour)
>
> $3,750 for UXO support (40 hours @ $93.75 per hour)

Justification:

Determination of the tidal reach will define the tidal versus nontidal floodplain and provide more definitive data on the Maryland defined critical area boundary.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: Wetland Delineation

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Wetland delineation and functional assessment of project areas on APG. Candidate for workplan integration through USACE Baltimore.

Deliverable:

Wetland delineation report, functional assessment report, and GIS data for each project area.

Cost and Cost Basis:

$29,350 (total)

$14,230 for labor

$15,120 for UXO support

Justification:

Failure to fund will result in potential delays in mission operations due to inability to support permit application for DPW projects.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act, Clean Water Act

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PROJECT: Wetland Mitigation Site Development Under DoD Umbrella Mitigation Banking Instrument

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Using the established DoD Umbrella Mitigation Banking Instrument, establish a single user wetland mitigation bank site. This includes: mitigation site search; site selection; conceptual mitigation plan development; preliminary regulatory approval; NEPA coordination; baseline data collection; hydrologic and hydraulic (H&H) modeling and water budget; 65% design plan development; mitigation site plan development; state and federal permit applications and approvals; final bank site approvals; permits and authorizations; final design plan development; and mitigation site plan approval.

Deliverable:

Environmental Assessment, Environmental Baseline Survey of proposed sites, baseline data collection, H&H Modeling & Water Budget, Conceptual Mitigation Plan, 65% Design Plan, Mitigation Site Plan, permit applications and approvals, 90% Design Plans and supporting documents. Final Bank Site approvals, permits and authorizations.

Cost and Cost Basis:

To be determined (estimated $1,360,000)

Justification:

10 USC 2694 allows DoD installations to develop wetlands bank to pro-actively manage compensatory mitigation measures as required by Federal and State permits issued under the Clean Water Act. Developing an off-post bank will reduce internal encroachment caused by the permanent loss of mission landscape and will reduce the liability and risk to the Army due to the criteria used to measure success of the project. Currently in the State of Maryland, mitigation design and funding is required prior to a permit being issued for projects on the Installation.

Failure to fund will increase internal encroachment caused by permanent loss of mission landscape to mitigation and will increase liability and risk to Army due to criteria used to measure success of mitigation project

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act, Clean Water Act

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PROJECT: Wetland Restoration

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Implementation of the recommendations in the Wetland Functional Analysis: Romney Creek Watershed. Wetland restoration of 8 acres of forested wetland in Forest Stand 38-18.

Deliverable:

Project will include invasive species removal and tree planting

Cost and Cost Basis:

$202,044.80 (total)

8 acres @ $25,255.60 per acre

Justification:

Failure to fund will perpetuate decline of wetlands in Romney Creek watershed due to invasive plants and heavy deer pressure. The forested wetlands are showing no signs of regeneration or future sustainability.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act, Clean Water Act

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PROJECT: Wetlands Program Support

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Wetland delineation, permit application development, meetings and site visits with the regulators.

Deliverable:

Wetland delineation report and mapping

Cost and Cost Basis:

$17,520

4 acres @ $4,380 per acre

Justification:

Failure to fund could potentially result unauthorized wetland impacts that may result in non-compliance with Clean Water Act if sites are not field delineated.

Class:

0 - Recurring

Legal Driver:

Clean Water Act

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PROJECT: Wetlands Permit Database

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.1 –** Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act
>
> **Objective 2.4 –** Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

This project is to develop a simple, shareable system (e.g., database) for managing and maintaining APG's wetlands permit data and records. An inventory/catalog will be made of all existing wetland data/reports, including subject, format, location, etc. This would include scanning paper reports, identifying spreadsheet formats that could be used to log raw/notational data, and designing a database into which scanned reports, spreadsheets, individual records, etc. could be uploaded.

Deliverable:

Inventory of all wetlands data/reports and a database for wetlands permits/reports

Cost and Cost Basis:

To be determined (estimated $20,000)

Justification:

APG will continue to have wetlands permit files in vulnerable paper formats, and in non-centralized locations. This information will continue to be unsearchable and virtually inaccessible to persons beyond the immediate individual with the data.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Culvert Inventory

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.2 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Locate and GPS all culverts and headwalls at APG to include all range areas, Churchville Test Area, Graces Quarters, and Carroll Island. Culverts will be located at all roadway, rail, driveway or sidewalk crossings. Headwalls will be identified and recorded in any instance where they are part of the culvert. Use GPS data to update and populate APG's existing "StormwaterUtilitySegmant_Clvrt" GIS layer and "StormwaterUtilitySegmant_Hdwll" GIS layers. Field check all data in the existing layers; gather and populate any missing data from the layers; identify any references to culverts and/or headwalls that no longer exist; locate and collect all culverts and headwalls that are not identified in the existing layer; and populate all required data as specified in the latest Army Geospatial Data Layer Quality Assurance Plans.

Deliverable:

Geodatabase with fully compliant, complete data layers containing all required attributes. The horizontal accuracy of the data shall be less than or equal to 1 foot.

Cost and Cost Basis:

To be determined (estimated $25,000)

Justification:

Culvert failure has been addressed on an emergency basis. In order to develop a programmatic wetland permit for culvert replacement and streamline the regulatory process, an inventory of the culverts is required.

Class:

1 – Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: Beaver Management

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.2 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Identify locations where beaver activity (dams, culvert blockages) has the potential for causing negative impacts to built and natural infrastructure and identify future potential problem areas. Develop site-specific strategies for each of these locations to mitigate negative beaver impacts based on the most current research and techniques available. Clean and monitor existing flow devices to maintain function.

Deliverable:

Maintenance and repair of existing flow devices and installation of additional flow devices and other beaver impact mitigation strategies as needed.

Report detailing maintenance activities, site-specific strategies undertaken to mitigate negative beaver impacts (e.g. flow device installation, tree protection). Spatial data for inclusion in the installation GIS should be part of the report.

Cost and Cost Basis:

To be determined (estimated $22,700)

Justification:

The beaver population at APG has increased as suitable habitat surrounding the installation has diminished and participation in recreational trapping has declined. As a result, beavers are causing significant negative impacts to culverts, roads, test ranges, wetland and stream mitigation acreage, forest stands and other military assets.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Regulatory Credit Ratio Analysis

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

This task is aimed at completing a small study to analyze the complexity of credit ratios for various mitigation types including streams, wetlands, and trees for compliance with multiple state and federal permitting requirements. Mixing mitigation types may prove more cost effective when mission requirements require regulatory mitigation.

Deliverable:

The primary project deliverable associated with this activity is a report analyzing current state and federal regulations, types of regulatory mitigation and various methodologies of mixing mitigation types to meet permit requirements.

Cost and Cost Basis:

To be determined (estimated $50,000)

Justification:

Construction projects on APG often affect various state and federal laws, regulations and policies. Often times, mitigation is required for each of these and sometimes mitigation requirements are contradictory. An in depth analysis of mitigation ratios and types would benefit planning and budgeting operations in order to maximize financial resources while also maximizing mitigation survivability.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Plant Community Map and Rare Plant Survey

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

AR 200-1 specifies that planning level surveys (PLSs) and data analyses shall be conducted as the foundation for effective planning and decision making. APG has not completed a PLS of vegetation communities, one of the baseline surveys required by AR 200-1.

The goal of the proposed project is to develop a detailed Federal Geographic Data Committee (FGDC) compliant vegetative communities map of APG and to identify and map the distribution of rare plants associated with these communities.

Deliverable:

1. Three CDs containing an FGDC compliant vegetative communities map (ArcMap compatible) and all associated GIS layers used to develop the map. All layers will have appropriate metadata and be SDSFIE compliant.
2. Three large format hardcopy maps of the final product.
3. Five hardcopy and bound technical reports that describe in detail the methods used to produce the vegetation map. In addition, the technical report will have detailed descriptions of each association identified and used to develop the vegetation map of Aberdeen Proving Ground. A digital copy of the final product will be provided on CD in Microsoft word and PDF format.

Cost and Cost Basis:

$93,899.81 (total)

$43,656.25 for 1,015 hours of project management, planning, data compilation and interpretation field work

$43,656.25 for per diem, lodging, mileage, fuel, tolls

$9,632 for CESU indirect costs

$7,421.56 for USACE Fort Worth District fee

$22,440 for UXO support

Justification:
Failure to fund will result in lack of required installation-wide data on vegetation communities and populations of RTE plants. Accurate, up-to-date data on RTE plants is necessary for project planning to support and sustain the mission. Lack of data on rare plant populations will limit the conservation management of sensitive and rare species to prevent future state and federal listings.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Spotted Turtle Population and Habitat Study

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

In order to effectively protect, manage, and monitor at-risk species, APG requires current information on where these species occur on the installation. This project will survey for spotted turtles and habitat at Carroll Island. Spotted turtle is currently under review for potential federal listing under ESA.

Deliverable:

Project will collect, measure, sex, mark, age and release the Spotted Turtle population on Carroll Island and assess the habitat at the collection points.

Cost and Cost Basis:

$35,100 (total)

$20,500 for labor

$2,000 for supplies

$12,600 for support

Justification:

Failure to fund could result in restrictions on mission activities. If spotted turtles are listed under ESA and baseline data on species' occurrence are not available, APG will be required to implement appropriate spotted turtle protection guidance across the installation, even if the species is not present. Proactive conservation of species at risk and their habitats can help preclude the need for federal listing and protect significant biological diversity, while enabling APG to continue providing a high quality testing environment.

Class:

1 – Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: Spotted Turtle Signage

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.2 –** Conserve threatened and endangered species in compliance with federal, DoD, and Army regulations and policies

Project Description:

Design and purchase signs to mark spotted turtle habitat in areas where unmanned ground vehicles and other test activities have the potential to impact turtles, nests, and habitat.

Deliverable:

10, 12” x 18” weatherproof signs with mounting hardware
10, 6 ft U-channel sign posts

Cost and Cost Basis:

$497.50 (total)

Justification:

Placement of spotted turtle signs will provide test planners easily visible markers for areas to avoid during test activities. This will facilitate test planning and execution while protecting a species-at-risk.

Class:

1 – Statutory Requirement (Non-Recurring)

Legal Driver:

ESA; Recommended BMPs for the Spotted Turtle on DoD Installations; Sikes Act

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PROJECT: Northern Long-eared, Tri-colored, and Little Brown Bat Acoustic Survey

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Conduct acoustic presence/absence survey for northern long-eared, tri-colored, and little brown bats on approximately 40,000 acres of the installation. Survey will consist of 60 stationary survey locations monitored for two nights each and 10 mobile survey transects to cover areas of the installation where it is not feasible to set up stationary monitors. Federal installations are required by law to have their properties surveyed for distribution and abundance of listed species. The northern long-eared bat is a federally listed species, and the tri-colored bat and little brown bat are currently under review for potential federal listing under Endangered Species Act (ESA).

Deliverable:

Detailed report to include methodology, species detected at each sampling location/transect, total number of pulses recorded of each species, and comparisons to 2011 and 2017 survey results. Raw data, shape files, and analysis outputs will be provided for incorporation into APG's GIS.

Cost and Cost Basis:

$86,660 (total)

$45,360 for 280 hours of sampling, 7 days in July, 7 days in September (USACE Senior Biologist @ $162 per hour)

$22,400 for 280 hours of sampling, 7 days in July, 7 days in September (USACE Junior Biologist @ $80 per hour

$9,200 for travel (14 days)

$2,480 for equipment

$2,000 for materials and supplies

$1,220 for report production

Justification:

We are required to conduct ESA consultations with USFWS prior to mission activities that have potential to affect listed species or their habitats. Data from this project will minimize potential for delays that would occur if required individual surveys were conducted in potential bat habitat prior to each mission activity. Additionally, proactive

conservation of species at risk (tri-colored and little brown bats) can help preclude need for ESA federal listing.

Class:

1 – Statutory Requirement (Non-Recurring)

Legal Driver:

ESA; Sikes Act

PROJECT: Bald Eagle Aerial Surveys

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act (BGEPA)

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Aerial surveys conducted by helicopter to monitor bald eagle population, identify new nests, count numbers of eggs and chicks, and confirm fledging. Eagle monitoring data are used to identify mission impacts on eagle population, as required by BGEPA and APG's Bald Eagle Incidental Take Permit.

Deliverable:

1. Mid-Winter Bald Eagle Count report
2. Annual Bald Eagle Productivity report
3. Annual Bald Eagle Take report

Cost and Cost Basis:

$17,822.52 (total)

27 flight hours for UH-60 Blackhawk aircraft

Flight rate = $802.51 for first hour + $546.16 per each additional hour

One (1) 4-hr flight = $802.51 + 3($546.16) = $2,440.99
Ten (10) 2-hr flights = 10($802.51 + $546.16) = $13,486.70
One (1) 3-hr flight = $802.51 + 2($546.16) = $1,894.83

Direct charge to Aberdeen Test Center

Justification:

Permit compliance. Knowing and willful failure to comply with conditions of permit is cause for suspension of permit, denial of permit renewal, restrictions on mission operations, fines and imprisonment. Fines of $100,000 ($200,000 for organizations), imprisonment for 1 year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation is a felony.

Class:

0 – Recurring

Legal Driver:

BGEPA (16 USC 668; 50 CFR 22.26)

PROJECT: Eagle Protection Devices for Power Lines

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act (BGEPA)

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Replacement of failed avian protection devices (including flight diverters/flappers and insulating covers) on overhead power lines to reduce bald eagle mortalities due to line strikes, as required by APG's Bald Eagle Incidental Take Permit. These efforts will reduce the potential for power outages caused by eagles colliding with power lines, causing mission delays. Partial funding is acceptable.

Deliverable:

Removal and replacement of avian protective devices

Cost and Cost Basis:

$52,500 (total)

Replacement of 700 flappers @ $75 ea

Modification to existing contract with City Light & Power with MIPR to DLA

Justification:

Permit compliance. Knowing and willful failure to comply with conditions of permit is cause for suspension of permit, denial of permit renewal, restrictions on mission operations, fines and imprisonment. Fines of $100,000 ($200,000 for organizations), imprisonment for 1 year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation is a felony.

Class:

1 – Statutory Requirement (Non-Recurring)

Legal Driver:

BGEPA (16 USC 668, 50 CFR 22.26)

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PROJECT: Fatality Monitoring for Eagle Incidental Take Permit

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.1 –** Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act (BGEPA)

Project Description:

Develop and implement a bald eagle fatality monitoring protocol that includes: 1) quantification of incidental carcass finds through a standardized carcass detection (searcher efficiency) trial, and 2) carcass persistency trial. Data collected from implementation of protocol will support creation of a legally and scientifically defensible take estimate in support of issuance of eagle permit, and verify compliance with terms of BGEPA take authorization. This project will be developed and implemented with input from the U.S. Fish and Wildlife Service.

Deliverable:

Protocol for incorporation into APG Integrated Natural Resources Management Plan.

Data sheets for collecting monitoring data.

Data report that meets requirements of U.S. Fish and Wildlife Service.

Cost and Cost Basis:

To be developed and implemented in-house (labor only)

Justification:

APG must demonstrate compliance with the terms of the BGEPA take authorization. Compliance with the take authorization requires periodic monitoring in order to provide data needed by the U.S. Fish and Wildlife Service regarding the impacts of the activity on eagles for purposes of adaptive management. APG must coordinate with the U.S. Fish and Wildlife Service to develop specific monitoring protocols.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

BGEPA (16 USC 668, 50 CFR 22.26)

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PROJECT: Fisheries Planning Level Survey

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

APG has a large commercial and recreational fishery as well as the highest graded waters in the Chesapeake Bay. At this time, we know very little about the populations and abundances of fish in our waters. We rely on catch reports from commercial fishermen and receive no data from recreational fishermen. A comprehensive survey is needed to better regulate and manage our fisheries. With an influx of BRAC personnel, an even greater recreational fishery pressure is expected. Furthermore, recent poaching activity in the Chesapeake Bay and changes in fishing regulations have put the spotlight on fishing activity in Maryland. We need to determine an accurate estimation of health of our fisheries. Magnuson-Stevens Fishery Conservation and Management Act requires fisheries to be sustainably managed. We currently have very little reliable data to be used for management purposes. Recreational and commercial fisheries heavily impact various fish populations in APG's waters. Rebounds and changes in fish and crab population in the Chesapeake Bay have sparked changes on State regulations and we need data to support changing APG regulations.

Deliverable:

A comprehensive report detailing the current populations and abundances of important commercial and recreational finfish and shellfish in APG waters.

Cost and Cost Basis:

$81,287 (total)

$32,400 for UXO support (3 locations to be sampled 3 seasons, 3 days per location @ $1,200 per day)

$46,487.52 for sample collection, identification, and data analysis (one 2012 GSA Biologist III @ $102 per hour and one 2012 GSA Biologist IV @ $113.22 per hour; 8 hours per day for 27 days)

$2,400 for supplies (3 nets @ $800 each)

Justification:

Maryland's Coastal Management Program's Enforceable policies state that fisheries shall be sustainably harvested. APG has regulatory jurisdiction over its waters and its fisheries (APGR 210-10) but limited knowledge on the value of its resource. If this project is not funded, APG would be inconsistent with Maryland's enforceable coastal policy and would not have a scientifically defendable position for APGR 210-10.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

PROJECT: MBTA Avian Management for Nesting Raptors

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Install artificial nesting structures to encourage raptors such as ospreys and barn owls to nest in locations that will not impact installation infrastructure and constrain mission activities. Nesting platforms for ospreys will reduce the potential for power outages which significantly impact mission due to power interruptions to range areas and surety buildings. Nesting boxes for barn owls will minimize the potential for mission interruptions/delays caused by birds nesting in structures used for test programs.

Deliverable:

Installation of nesting platforms and boxes

Cost and Cost Basis:

$16,500 (total)

$15,300 for 9 osprey platforms installed @ $1,700 per platform

$1,200 for 3 barn owl boxes installed @ $400 per box

Justification:

Failure to fund will result in continued potential for mission delays due to power outages when birds and and/or their nesting material contact electrified equipment. Continued potential for mission interruptions due to birds nesting in active test structures. Potential for incidental take of eggs/nestlings/fledglings during mission activities.

Class:

3 – Best Management Practice

Legal Driver:

Migratory Bird Treaty Act, Sikes Act

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PROJECT: Habitat Management for Migratory Waterbirds

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Replacement of two non-working water control structures to maintain water levels for migrating and wintering waterfowl. Project includes design, permitting (as required), UXO support, and construction.

Deliverable:

Replacement of water control structures

Cost and Cost Basis:

$150,000 (total)

2 water control structures @ $75,000 each

Justification:

If the water control structures are not replaced, upstream areas will continue to flood, reducing the amount of shallow water habitat available to migrating and wintering waterfowl, encroaching on upland forested areas, and killing trees. Additionally, the current water control structures are not in compliance with a Memorandum of Agreement with Ducks Unlimited to provide routine rehabilitation, annual operation and maintenance necessary to maintain the continuing viability and functioning of the waterfowl management ponds

Class:

3 – Best Management Practice

Legal Driver:

Migratory Bird Treaty Act, Sikes Act

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PROJECT: Mute Swan Aerial Surveys

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Conduct aerial surveys for mute swans, an invasive species managed under Maryland law. The Maryland Department of Natural Resources (DNR) tracks the numbers and locations of wild mute swans in the state for targeted control efforts. APG's extensive wetlands provide ideal mute swan breeding habitat while its restricted access limits the ability of the DNR to count and control mute swans on APG. Aerial surveys coordinated with DNR biologists will allow location of active mute swan nests for egg addling in the spring and location of adult swans during the summer molt for population control.

Deliverable:

Numbers and locations of mute swans and mute swan nests in APG wetlands identified on two flights (spring and mid-summer).

Cost and Cost Basis:

$3,243.50 (total)

5 flight hours for UH-60 Blackhawk aircraft

Flight rate = $802.51 for first hour + $546.16 per each additional hour

Two (2) 2.5-hr flights = 2($802.51 + $546.16 + $273.08)

Direct charge to Aberdeen Test Center

Justification:

If mute swan numbers and locations are not tracked for targeted control efforts, APG has the potential to become a source for mute swans in the upper Chesapeake Bay. This would negatively affect coordination with the State Wildlife Action Plan and Chesapeake Bay Program goals of managing populations of waterbirds through understanding the impacts of exotic species.

Class:

0 – Recurring

Legal Driver:

Sikes Act

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PROJECT: Prescribed Burn for Wildland Fire Management

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Prescribe burn to reduce fuel load, sustain mission, and promote habitat for species diversity

Deliverable:

Reduced fuel load for 16 acres

Cost and Cost Basis:

$32,000 (total)

> 16 acres @ $2,000 per acre

Justification:

Loss of missionscape and habitat due to uncontrolled fires from high fuel load

Class:

0 - Recurring

Legal Driver:

Sikes Act

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PROJECT: Riparian Buffer Forest Management

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Project targets rehabilitation of 30 acres of unhealthy riparian areas along Romney Creek and Canal Creek. Maintenance of these riparian buffer forest stands is critical to sustaining the necessary APG testing and training natural infrastructure. Healthy forest riparian buffers are critical to the overall health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Inspection and maintenance of riparian buffer forest stands in the Aberdeen and Edgewood areas in a manner that sustains 80% survivability of the original stand establishment with the species.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$246,000 (total)

> $136,000 for UXO support, site prep, tree planting (8 acres @ $17,000 per acre)
> $110,000 for UXO support, forest scrub removal (22 acres @ $5,000 per acre)
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: Forest Stand 6-11 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 25 acres (forest stand 6-11) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$176,041 (total, FY16)

> 25 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 6-12 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 23 acres (forest stand 6-12) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$161,958 (total, FY16)

> 23 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 6-13 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 13 acres (forest stand 6-13) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$91,541 (total, FY16)

> 13 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 6-14 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 37 acres (forest stand 6-14) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$260,541 (total, FY16)

> 37 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 37-9 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 27.9 acres (forest stand 37-9) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$196,462 (total, FY16)

> 27.9 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 37-10 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 35.2 acres (forest stand 37-10) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$247,866 (total, FY16)

> 35.2 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 37-11 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 42.6 acres (forest stand 37-11) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$299,974 (total, FY16)

> 42.6 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 40-7 Timber Stand Improvement

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

The ongoing decline of APG's overall forest health is impacting the required testing mission buffer and wildlife habitat. APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement and timber stand improvement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Timber stand and habitat improvement on 34 acres (forest stand 40-7) in the Edgewood Area. Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal. Planned timber stand and habitat improvement projects are in the Forest Management component plan of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining testing and training natural infrastructure and improving the health of the Chesapeake Bay. Project will also reduce wildland fire fuel load. Partial funding is acceptable.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$239,416 (total, FY16)

> 34 acres at $7,041.64 per acre
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only further increase wildland fire fuel load and the rapid decline of APG's forests and mission testing/training landscape.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 3-5

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 15.56 acres (forest stand 3-5). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$96,481.31 (total)

15.56 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 3-6

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 14.5 acres (forest stand 3-6). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$89,908.70 (total)

14.5 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 3-9

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 56.86 acres (forest stand 3-9). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions that will implement requirements in the Forest Management Plan component of the INRMP that improves testing and training landscape required to sustain the military mission at APG. The ongoing decline of APG's overall forest health is impacting the required testing mission buffer. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest management that will reverse the current trend.

Cost and Cost Basis:

All project costs bases on projected new forestry contract currently in development for award (costs based on historical pricing plus). See pricing per acre used for FY21 project costs.

$404,521.38 (total)

Forest enhancement and invasive removal:
56.86 acres @ $2,009.03 per acre=$114,233.45

UXO:
56.86 acres @ $5,105.31 per acre=$290,287.93

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Failure to fund will only further the degradation of APG's overall forest health required for APG's testing and training mission and increase wildland fire fuel load.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 12-3

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 42.3 acres (forest stand 12-3). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$251,017 (total)

42.3 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 12-5

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 57.19 acres (forest stand 12-5). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$354,612.32 (total)

57.19 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 13-4

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 5.36 acres (forest stand 13-4). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$33,235.22 (total)

5.36 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 14-3

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 30.71 acres (forest stand 14-3). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions that will implement requirements in the Forest Management Plan component of the INRMP that improves testing and training landscape required to sustain the military mission at APG. The ongoing decline of APG's overall forest health is impacting the required testing mission buffer. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest management that will reverse the current trend.

Cost and Cost Basis:

All project costs bases on projected new forestry contract currently in development for award (costs based on historical pricing plus). See pricing per acre used for FY21 project costs.

$218,481.38 (total)

Forest enhancement and invasive removal:
30.71 acres @ $2,009.03/acre = $61,697.31

UXO:
30.71 acres @ $5,105.31/acre=$156,784.07

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Failure to fund will only further the degradation of APG's overall forest health required for APG's testing and training mission and increase wildland fire fuel load.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 15-21

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 14.25 acres (forest stand 15-21). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$88,494 (total)

> 14.25 acres
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 17-7

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 56.9 acres (forest stand 17-7). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$369,555.76 (total)

56.9 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 18-3

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 46.43 acres (forest stand 18-3). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$287,893.86 (total)

46.43 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 18-5

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 47.37 acres (forest stand 18-5). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions that will implement requirements in the Forest Management Plan component of the INRMP that improves testing and training landscape required to sustain the military mission at APG. The ongoing decline of APG's overall forest health is impacting the required testing mission buffer. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest management that will reverse the current trend.

Cost and Cost Basis:

All project costs bases on projected new forestry contract currently in development for award (costs based on historical pricing plus). See pricing per acre used for FY21 project costs.

$337,006.29 (total)

Forest enhancement and invasive removal:
47.37 acres @ $2,009.03/acre = $95,167.75

UXO:
47.37 acres @ $5,105.31/acre=$241,838.54

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Failure to fund will further degrade the overall health of APG’s forests required for APG's testing and training mission and increase wildland fire fuel load.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 18-7

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 89.35 acres (forest stand 18-7). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions that will implement requirements in the Forest Management Plan component of the INRMP that improves testing and training landscape required to sustain the military mission at APG. The ongoing decline of APG's overall forest health is impacting the required testing mission buffer. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest management that will reverse the current trend.

Cost and Cost Basis:

All project costs bases on projected new forestry contract currently in development for award (costs based on historical pricing plus). See pricing per acre used for FY21 project costs.

$635,666.28 (total)

Forest enhancement and invasive removal:
89.35 acres @ $2,009.03/acre = $179,506.83

UXO:
89.35 acres @ $5,105.31/acre=$456,159.45

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Failure to fund will further degrade the overall health of APG’s forests required for APG's testing and training mission and increase wildland fire fuel load.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 29-11

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 31.12 acres (forest stand 29-11). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$192,962.67 (total)

31.12 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 41-2

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.3 – Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 21.1 acres (forest stand 41-2). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$169,703.53 (total)

21.1 acres

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Enhancement, Stand 41-13

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

APG's overall forest health and adequate natural regeneration continue to decline because of intense deer pressure and invasive species such as Japanese stilt grass. APG military mission and ecosystem sustainability requirements drive the need for aggressive forest enhancement that will reverse the current trend while developing and maintaining desirable future forest conditions.

Forest enhancement on 45.9 acres (forest stand 41-13). Enhancement requirements include UXO sweep on the entire area prior to forest scrub and invasive species removal as outlined in the APG forest management plan. Planned timber stand and habitat improvement projects are in the Forest Management Plan component of the APG INRMP and focus on improving the forest ecosystem while creating and sustaining the testing and training natural infrastructure and improving the health of the Chesapeake Bay. Partial funding is acceptable. Project will also reduce wildland fire fuel load.

Deliverable:

Develop, map, and mark silvicultural prescriptions as required in the Forest Management component of the INRMP.

Reduction of wildland fire fuel load.

Cost and Cost Basis:

$323,211.27 (total)

> 45.9 acres
>
> ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Not funding this project will only increase wildland fire fuel load and further the rapid decline of APG's forested resources necessary for testing and training.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Forest Stand 2-4 MS4 Permit & TMDL Implementation

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

In support of continued forest management of Army mission landscape at APG and wildlife habitat on both the Aberdeen and Edgewood Areas, 54 acres of unhealthy forest in APG forest stand 2-4 will be rehabilitated. Maintenance of these forest stands is critical to sustaining necessary APG testing and training natural infrastructure as outlined in the APG Forest Management Plan component of the APG Integrated Natural Resources Management Plan (INRMP). Contractor will perform a minimum of 54 acres of forest enhancement and wildlife habitat improvement as specified in the APG Forest Management Plan. Contractor will tube and stake natural regeneration in conjunction with COR and based on canopy gaps and future basal area requirements in accordance with the APG Forest Management Plan. This project generates credits for Coastal Zone Management Act, Section 307 offsets and supports Chesapeake Bay Total Daily Load (TMDL) and MS4 permit.

Deliverable:

Forest enhancement and wildlife habitat improvement.

Reduction of wildland fire fuel load.

Credits for Coastal Zone Management Act, Section 307 offsets

Cost and Cost Basis:

$377,002.42 (total)

> 54 acres

Justification:

Failure to fund will increase wildland fire fuel load and potential for extensive wildland fires leading to delays in mission testing, and further lead to rapid decline of APG's forested resources necessary for testing and training landscapes. Regulatory credits are necessary to offset impacts to forest resources from mission activities, as identified through Coastal Zone Management Act, Section 307 determinations.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act; E.O. 13508 Chesapeake Bay Protection and Restoration; COMAR 26.08 Water Pollution; COMAR 26.08.02 Water Quality; CWA Sections 401-404; State Discharge Permit 13-SF-5501/NPDES Permit MDR055501

PROJECT: Forest Stand 30-18 MS4 Permit & TMDL Implementation

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

In support of continued forest management of Army mission landscape at APG and wildlife habitat on both the Aberdeen and Edgewood Areas, 18.7 acres of unhealthy forest in APG forest stand 30-18 will be rehabilitated. Maintenance of these forest stands is critical to sustaining necessary APG testing and training natural infrastructure as outlined in the APG Forest Management Plan component of the APG Integrated Natural Resources Management Plan (INRMP). Contractor will perform a minimum of 18.7 acres of forest enhancement and wildlife habitat improvement as specified in the APG Forest Management Plan. Contractor will tube and stake natural regeneration in conjunction with COR and based on canopy gaps and future basal area requirements in accordance with the APG Forest Management Plan. This project generates credits for Coastal Zone Management Act, Section 307 offsets and supports Chesapeake Bay Total Daily Load (TMDL) and MS4 permit.

Deliverable:

Forest enhancement and wildlife habitat improvement.

Reduction of wildland fire fuel load.

Credits for Coastal Zone Management Act, Section 307 offsets

Cost and Cost Basis:

$130,554.42 (total)

> 18.7 acres

Justification:

Failure to fund will increase wildland fire fuel load and potential for extensive wildland fires leading to delays in mission testing, and further lead to rapid decline of APG's forested resources necessary for testing and training landscapes. Regulatory credits are necessary to offset impacts to forest resources from mission activities, as identified through Coastal Zone Management Act, Section 307 determinations.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act; E.O. 13508 Chesapeake Bay Protection and Restoration; COMAR 26.08 Water Pollution; COMAR 26.08.02 Water Quality; CWA Sections 401-404; State Discharge Permit 13-SF-5501/NPDES Permit MDR055501

PROJECT: Forest Stand 38-23 MS4 Permit & TMDL Implementation

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

In support of continued forest management of Army mission landscape at APG and wildlife habitat on both the Aberdeen and Edgewood Areas, 73.8 acres of unhealthy forest in APG forest stand 38-23 will be rehabilitated. Maintenance of these forest stands is critical to sustaining necessary APG testing and training natural infrastructure as outlined in the APG Forest Management Plan component of the APG Integrated Natural Resources Management Plan (INRMP). Contractor will perform a minimum of 73.8 acres of forest enhancement and wildlife habitat improvement as specified in the APG Forest Management Plan. Contractor will tube and stake natural regeneration in conjunction with COR and based on canopy gaps and future basal area requirements in accordance with the APG Forest Management Plan. This project generates credits for Coastal Zone Management Act, Section 307 offsets and supports Chesapeake Bay Total Daily Load (TMDL) and MS4 permit.

Deliverable:

Forest enhancement and wildlife habitat improvement.

Reduction of wildland fire fuel load.

Credits for Coastal Zone Management Act, Section 307 offsets

Cost and Cost Basis:

$515,236.18 (total)

> 73.8 acres

Justification:

Failure to fund will increase wildland fire fuel load and potential for extensive wildland fires leading to delays in mission testing, and further lead to rapid decline of APG's forested resources necessary for testing and training landscapes. Regulatory credits are necessary to offset impacts to forest resources from mission activities, as identified through Coastal Zone Management Act, Section 307 determinations.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act; E.O. 13508 Chesapeake Bay Protection and Restoration; COMAR 26.08 Water Pollution; COMAR 26.08.02 Water Quality; CWA Sections 401-404; State Discharge Permit 13-SF-5501/NPDES Permit MDR055501

PROJECT: Forest Stand 38-18 Tree Planting

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

This project will restore a degraded forest stand with 8 acre canopy gap located in riparian buffer. Project will remove invasive species taking over the forest floor, plant 8 acres of native trees species within the canopy gap and provide 5 years of tree maintenance to restore forest health and generate Coastal Zone Management Act, Section 307 regulatory offsets for mission activities. This project will also support Chesapeake Bay Total Daily Load (TMDL) and APG's MS4 permit. This project is adjacent to a test track and will support long-term mission sustainability.

Deliverable:

8 acres of native trees planted in existing canopy gap located in riparian buffer.

Credits for Coastal Zone Management Act, Section 307 offsets

Long-term mission sustainability as site is adjacent to test track.

Cost and Cost Basis:

$206,336 (total)

> 8 acres

Justification:

Failure to fund will increase wildland fire fuel load and potential for extensive wildland fires leading to delays in mission testing, and lead to rapid decline of APG's forested resources necessary for testing and training. Regulatory credits are necessary to offset impacts to forest resources from mission activities, as identified through Coastal Zone Management Act, Section 307 determinations.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act; E.O. 13508 Chesapeake Bay Protection and Restoration; COMAR 26.08 Water Pollution; COMAR 26.08.02 Water Quality; CWA Sections 401-404; State Discharge Permit 13-SF-5501/NPDES Permit MDR055501

PROJECT: Forest Inventory

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Forest inventory on a minimum of 600 acres. Forest inventory will document existing species, stocking levels, disease/damage, forest type, regeneration, understory vegetation, stand age, site index, and opportunity for forest scrub removal.

Deliverable:

Updated forest inventory data sheets to incorporate into Installation Forest Management Plan

Cost and Cost Basis:

$85,086 (total)

> 600 acres @ $141.81 per acre

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Failure to fund will lead to further degradation of overall forest health required for mission to include continued testing and training.

Class:

0 - Recurring

Legal Driver:

Sikes Act

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PROJECT: Tree Planting Maintenance

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

In support of continued forest management, wildland fire fuel load reduction, range maintenance, tenant and Garrison project regulatory offsets and integrated pest / invasive species management of Army mission landscape and wildlife habitat on all areas of APG, 55 acres of previously planted mitigation and forest tree planting areas on APG as outlined by COR, shall be rehabilitated through forest enhancement and invasive species removal. Included in this project is the Living Legacy Forest for Gold Star families totaling over 12 acres. Maintenance of these forest stands is critical to sustaining necessary APG testing and training natural infrastructure as outlined in the APG Forest Management Plan portion of the APG Integrated Natural Resources Management Plan.

Deliverable:

Maintenance of existing 55 acres of tree planting already credited as regulatory offsets for mission projects.

Invasive species removal, reduced wildland fire fuel load, and improved wildlife habitat.

Living Legacy Forest maintained to standards appropriate for public ceremonies.

Cost and Cost Basis:

$109,423.60 (total)

> Forest enhancement and invasive removal:
> 55 acres @ $1,989.52/acre = $109,423.60

Justification:

Failure to fund will result in degraded tree planting sites already credited as mitigation for sustainable ranges and other mission-related projects needed for APG's testing and training mission. Portion of project includes 12 acres dedicated as Living Legacy Forest for Gold Star families. This project supports TMDL implementation.

Class:

0 - Recurring

Legal Driver:

Sikes Act

PROJECT: Timber Marking at CTA

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 3 – Manage natural resources for multiple uses when appropriate, including sustainable yield of renewable resources, scientific research, education, and recreation

> **Objective 3.1 –** Provide renewable natural resource products when such products can be produced in a manner that sustains the military mission and natural resources

Project Description:

Timber Marking at Churchville Test Area (CTA) for shelterwood thinning. This project will mark up to 80 acres of timber needed to improve the productivity of the stands located in the CTA area of APG. These stands are severely overstocked and timber marking and appraisal by Maryland Licensed Forester is required to move forward on this shelterwood thinning. This project will provide the tools that enable the APG Forester to thin and remove timber which will enhance forest lands productivity and sustain the long-range testing mission. All timber will be marked by a Maryland Licensed Forester within this non-UXO area of APG. This project support's goals within the APG INRMP and APG IWFMP. All proceeds from shelterwood thinning will be deposited into Army Forestry Account.

Deliverable:

Up to 80 acres of marked and appraised timber to sell and deposit proceeds into Army Forestry Account

Cost and Cost Basis:

$16,889.60 (total)

Justification:

Generates funds for Army Forestry while improving long-term sustainability of testing mission.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: Unexploded Ordnance (UXO) Support for Forest Management Plan Implementation

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

Contract provides for local APG approved UXO support in advance of the execution of biological forest management projects that mitigate for Army testing, training, and construction at APG. The purpose of a programmatic contract vehicle for UXO support of forest management and compliance is to centralize and streamline forest natural resources management for the Garrison and its 92 tenant organizations' mission execution. Contractor will complete UXO support on 25 acres of the Aberdeen Area and Edgewood Area of APG in support of forest management and CZMA forestry compliance mitigation execution. Partial funding is acceptable.

Deliverable:

UXO sweeps to include scans and avoidance. Letters of completion to include UXO swept GIS layer maps indicating UXO completion by specific contractor letter, technician, anomalies found and UXO work dates. Each site geographic area will be GPS captured for APG's GIS.

Cost and Cost Basis:

$127,632.75 (total)

25 acres @ $5,105.31 per acre

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Failure to fund this contract will delay mission critical construction projects and/or required mitigation in support of testing and training.

Class:

0 - Recurring

Legal Driver:

Sikes Act

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PROJECT: Integrated Pest Management Plan

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species

Project Description:

Comprehensive revision of APG Integrated Pest Management Plan (IPMP) to ensure that it is fully up to date and compliant with current standards (e.g., AR 200-1; DoDM 4150.07). The IPMP establishes a protocol to maintain safe, effective, and environmentally sound integrated pest management programs to prevent or control pests and disease vectors that may adversely impact readiness or military operations by affecting the health of personnel or damaging structures, material, or property.

Deliverable:

Draft and Final versions of updated IPMP.

Cost and Cost Basis:

$45,000 (total)

Justification:

Not having current, signed IPMP will impact military readiness and operations by restricting ability to maintain range vegetation with aerially-applied herbicides. If an existing pest management plan is not available, a separate Pesticide Discharge Management Plan will have to be written to obtain the necessary State permits, resulting in significant time delays for test missions.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: BESS IV Contract Award

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment
>
> **Objective 1.2 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

> **Objective 2.1 –** Manage natural resources in compliance with environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act
>
> **Objective 2.2 –** Conserve threatened and endangered species in compliance with federal, DoD, and Army regulations and policies
>
> **Objective 2.3 –** Use adaptive management strategies to conserve and enhance native fauna and flora, and manage or eliminate invasive species
>
> **Objective 2.4 –** Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles
>
> **Objective 2.5 –** Comply with National Environmental Policy Act to make informed decisions

Project Description:

This project supports contract award of the Base Environmental Support Services (IV) IDIQ contract which directly supports mission sustainment and environmental compliance at APG, including Adelphi Laboratory Center and Blossom Point Research Facility. Project is required for the minimum guarantee required for contract award and will support kick-off meeting(s) and contractor development of Key Management Plan for contract award and any associated documents for the anticipated 5-7 awardees.

Deliverable:

Contract vehicle for Garrison and tenants to execute environmental compliance and mission sustainability in direct support of Warfighter.

Multi-program contract management.

Cost and Cost Basis:

$17,500 (total)

$2,500 per awardee, up to 7 awardees

Justification:

This project is required for contract award of BESS IV IDIQ contract which directly supports mission sustainment and environmental compliance for Garrison and over 70 plus tenants.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Multiple compliance drivers for natural resources and other environmental programs

PROJECT: Aviation Support for Other Natural Resources Surveys

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Aviation support for surveys and/or monitoring of natural resources. Scope includes but is not limited to labor, fuel, aircraft, airfield support, and photography support for pre- and post-burn surveys, pre- and post-spray surveys, beaver impact surveys, white-tailed deer FLIR surveys, great blue heron rookery surveys, other encroachment surveys, and shoreline resiliency surveys.

Deliverable:

Impact evaluations including estimation of controlled burn and herbicide spraying successes (acreages), estimation of white-tailed deer and great blue heron populations, photographic interpretation of beaver impacts, other encroachment issues, and shoreline resiliency.

Cost and Cost Basis:

$2,500.00 (total)

3 flight hours for UH-60 Blackhawk aircraft

Flight rate = $802.51 for first hour, $546.16 per each additional hour

Flights:
Three (3) 1-hr flights = 3($802.51) = $2,407.53

Photography:
0.5 hour @ $184.94 per hour = $92.47

Direct charge to Aberdeen Test Center

Justification:

Supports multiple INRMP implementation projects as required under Sikes Act.

Class:

1 - Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

PROJECT: Aerial Spraying to Control Common Reed Dominated Wetlands

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Common reed (*Phragmites australis*) is a native species that has colonized wetlands on APG. Full eradication of the plant is impossible and unnecessary, but selective eradication in specific areas is required for ecological and wetland management reasons, permit compliance, and for light-of-sight at several range areas. The technique for its eradication utilizing a combination of aerial herbicidal spraying (53.8 percent glyphosate) and controlled burning. Ideally, the common reed is sprayed with herbicide at the end of the growing season in October (effective for maximum kill). The dead biomass is then burned off in the December-February time frame. Finally, the reed is sprayed again at the end of the next growing season. This project addresses the aerial spraying portion.

Deliverable:

Selective eradiction in specific range areas (e.g., Carroll Island, Henry Field, Mulberry Point, Mosquito Creek, Delph Creek, Stony Point, Little Romney Creek, Taylor Island). Areas prioritized based on wetland permit compliance.

Cost and Cost Basis:

To be determined

Justification:

Failure to fund will result in non-compliance with wetland permits, impeded sight lines, and increased wildland fire fuel loads.

Class:

0 - Recurring

Legal Driver:

Clean Water Act

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PROJECT: Vegetation Management for Range Line of Sight Mission Sustainability

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

Conduct herbicide application for vegetation management and range line of sight mission sustainability on up to 500 acres.

Deliverable:

Mission sustainability of ranges, proactive management and offsets meeting federal and state requirements.

Cost and Cost Basis:

$250,000 (total)

500 acres @ $500 per acre

ARA Forestry and Ag/Grazing Funding Eligible

Justification:

Failure to fund will worsen existing line-of-sight obstructions and impact target functionality within existing range boxes. These areas are not conducive to normal range mowing operations and require periodic vegetation maintenance. Failure to fund will cause delays in testing missions due to permitting/compliance requirements.

Class:

0 – Recurring

Legal Driver:

Sikes Act

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PROJECT: Coastal Zone Management Act (CZMA) Mitigation Maintenance

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.1 – Manage natural resources within the spirit and intent of environmental laws such as the Sikes Act, Endangered Species Act, Clean Water Act, Coastal Zone Management Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act

Project Description:

Maintenance of forest stands planted specifically for APG compliance with CZMA and Maryland's Coastal Zone Program. Trees planted over the past 10 years have had an initial maintenance of two years, but require additional periodic maintenance to ensure survivability and resiliency for future Army training and/or testing mission. The majority of these forest stands are in riparian areas of the installation.

Deliverable:

Maintenance on up to 30 acres

Cost and Cost Basis:

$186,018 (total)

$133,488 for UXO support (30 acres @ $4,449.60 per acre)

$52,530 for forest enhancement (30 acres @ $1,751 per acre)

Costs based on existing APG FFP requirements contract

Justification:

Failure to fund will result in continued degradation of forest health conditions at APG.

Class:

0 - Recurring

Legal Driver:

Sikes Act

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PROJECT: Public-Public Partnerships

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

Develop business case analysis for using public-public partnerships that APG is currently pursuing with Harford County, USACE, NGOs, and other federal, state, and local government entities. Specifically, these partnerships are to meet the new TMDL requirements for stormwater and to address the stabilization of Pooles Island on APG. Analysis shall identify benchmarks of existing partnerships; capabilities and resources of public partners to meet mutual goals; opportunities for shared services arrangements; savings or cost avoidance for the APG; and innovative approaches to meet regulatory mandates.

Deliverable:

Business case analysis

Cost and Cost Basis:

$75,000

2080 hours @ $36.06 per hour

Justification:

Failure to fund will result in failure to meet TMDL requirements and loss of mission capabilities on Pooles Island due to sea level rise resulting from climate change.

Class:

0 - Recurring

Legal Driver:

Sikes Act

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PROJECT: Coastal Resilience Strategy Assessment

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

This activity includes a study aimed at building off recent baseline modeling efforts to identify the most cost effective installation resilience measures to be implemented in the most cost effective geographic areas. With a goal of identifying multiple funding streams, partnership opportunities and co-benefits, including meeting regulatory requirements.

Deliverable:

Deliverables associated with this project include GIS layers, GIS models, and a report to identify areas around and on APG where actions taken to increase installation resiliency can be undertaken.

Cost and Cost Basis:

To be determined (estimated $35,000)

Justification:

Recent changes in NDAA authority has increased use of various funding streams (REPI, OEA, etc), to be used to sustain and expand the resiliency of military installations in light of changing climates, rising sea levels and increased development. This project would identify ways and means to merge the goals of these various programs and authorities.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: ATC Range Shoreline Stabilization Design

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.2 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Aberdeen Test Center (ATC) previously funded partial design for shoreline stabilization at three ranges on APG: Henry Field; C Field; and Underwater Explosion Test Facility (UTF). These ranges are extremely susceptible to shoreline erosion and other impacts of climate change. This is a multi-year request in order to complete data collection, design, and permitting required for a buildable project. This activity includes the costs needed to comply with the requirements for the Chesapeake Bay watershed.

ATC previously funded portions of the design up to 35% for each of the sites. This project would advance the projects to 100% design and permit stage.

Deliverable:

Contract award and management.

Multi-year data collection, design, and permitting actions.

Cost and Cost Basis:

To be determined (estimated $35,000)

Justification:

DoD has documented climate change and sea level rise as a threat to national security. In support of both The National Defense Strategy and the Army Strategy, ATC focuses on maintaining readiness, while ensuring the modernization of DoD assets and equipment. Considered a "national asset" as a Major Range and Test Facility Base (MRTFB), ATC provides the infrastructure and workforce needed to deliver test capabilities to support the DoD acquisition system and plays a key role in the Army Modernization enterprise. ATC operates multiple ranges on APG, three of which are immediately adjacent to the Bush River: Henry Field, C Field, and UTF. All three of these facilities are experiencing shoreline erosion and are in danger of significant loss of mission capabilities.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Imagery Analysis to Evaluate Changes to Shoreline and Wetland Extent

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.2 –** Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

A comprehensive analysis of past aerial imagery to identify changes in the coastline and wetland extent and composition. This task will document installation-wide changes from 1932 to 2020, identify areas of greatest coastline change, and identify changes in wetland extent and composition.

Deliverable:

Quarterly briefings on project status and final briefing presentation of results and interpretations.

Modeling analysis.

Geodatabase of shoreline extent and extent of vegetation classes over time; Released using USGS ScienceBase platform and will include metadata describing methods.

Interpretations with identifying regions of greatest change and placing results in context of previously published reports and regional studies.

Interactive online mapping viewer or story map to display results and interpretations of study; Enabling viewer to zoom, view, interact, and download results.

Cost and Cost Basis:

To be determined (estimated $129,967)

Justification:

DoD has documented climate change and sea level rise as a threat to national security. Accurate predictive models are critical for planning to protect the wetlands that make up a significant portion of APG, though effective place-based monitoring is required to inform these predictive models. Failure to plan for sea level rise impacts puts at risk the ability of wetlands to function as important habitat for protected and at risk wildlife species, and as protective buffer for surrounding military buildings and training areas. The care of wetlands at APG is also paramount to the military mission of environmental stewardship. Significant unexploded ordnance and environmental contamination exists at the installation at many sites in or near wetlands, where natural processes in the wetlands act to remediate contaminants and prevent their release to surface water, groundwater, and the air. This study will provide a complete monitoring program to evaluate sea level rise impacts at a range of spatial and temporal scales to support DOD resiliency planning. Impacts of sea level rise have already been mentioned in 5-

year reviews of sites with current RODs. Lack of place-based measurements will result in reliance on models not calibrated to site conditions, leaving habitat, mission assets, and restoration remedies in place at risk.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

PROJECT: Pooles Island Stabilization

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.1 – Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

This project would stabilize erosion rates along the shores of Poole's Island and restore the island to its previous historical acreage, preserving real estate that contains unique environmental, geographic, and situational characteristics essential to current and future Army missions. This task will generate a final biddable and constructible product, to include permits, design analysis, plans, specifications, and construction cost estimate.

Deliverable:

35% and 65% designs, economic cost benefit analysis, completion of required NEPA documents and refined construction cost.

Cost and Cost Basis:

$500,000 (estimated), multi-year request

Costs were developed as part of Plan of Study provided by USACE Baltimore District

Justification:

Failure to fund will result in continued erosion of Pooles Island shorelines and loss of mission land, historic lighthouse that is listed on National Register of Historic Places, habitat for protected wildlife species, and other unique natural resources. Project has potential to generate a mitigation bank for environmental resource credits, such as forestry, wetlands and stormwater (MS4 permit). These credits are needed to offset and/or mitigate mission-essential projects that have environmental impacts, such as Phillips Army Air Field vegetation maintenance.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Army Compatible Use Buffer – Chesapeake Bay

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

> **Objective 1.1 –** Conduct comprehensive planning and risk management to avoid or mitigate constraints and restrictions from encroachment

Project Description:

APG has an approved Army Compatible Use Buffer (ACUB) that targets encroachment along the Chesapeake Bay within APG's noise contours. APG's ACUB allows the Army to work with partners to encumber off-post land to protect habitat and buffer military operations without acquiring any new land for Army ownership. Through ACUB, the Army reaches out to partners to identify mutual objectives of land conservation and to prevent development of critical open areas adjacent to, or ecologically adjacent to, the installation. The Army can contribute funds to the partner's purchase of easements or properties from willing landowners. These partnerships preserve high-value habitat and limit incompatible development in the vicinity of military installations. Establishing buffer areas around Army installations limits the effects of encroachment and maximizes land inside the installation that can be used to support the installation's mission.

Deliverable:

Parcel secured by conservation easement or fee-simple purchase by APG partner.

Cost and Cost Basis:

To be determined per parcel

Justification:

Failure to fund ACUB efforts could result in increased incompatible land development within APG's noise contours, leading to increased noise complaints. ACUB provides the potential for APG to secure off-Post conservation credits for water quality and bald eagles, off-post mitigation for critical area and wetlands, and to assist in protection and restoration of the health of the Chesapeake Bay.

Class:

2 - Pending Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: Stormwater Management Best Management Practice (BMP) on Army Compatible Use Buffer (ACUB) Parcel

INRMP Goal and Objective:

Goal 1 – Manage the natural resources to sustain realistic testing and training environments for APG's military mission

Objective 1.2 – Sustain mission lands through management, monitoring, research, and rehabilitation

Project Description:

Contractor shall design and restore a stormwater management BMP in order to meet current state regulatory standards and in accordance with APG's MS4 permit and TMDL allocations. Design, restoration and monitoring shall be conducted in accordance with all applicable State and Federal laws and regulations. Restoration of this BMP will help APG meet its TMDL pollutant load reduction requirement through the requirements set forth in the MS4 permit. Conducting this effort on a parcel of land, conserved under the Army Compatible Use Buffer (ACUB) program, allows maximum use of mission lands for mission activities.

Deliverable:

Provide all site design, permit approvals, and construction services required to retrofit existing stormwater management BMP on Welzenbach Farm in Edgewood, Maryland.

Cost and Cost Basis:

$900,000 (total)

This project is proposed to cost share total cost with local government and potentially bring in other outside funding sources. Estimates based on USACE and NOAA data.

$550,000 for hard construction

$350,000 for soft construction

Justification:

If unable to complete BMP off-post, on-post locations will need to be identified.

Class:

2 – Pending Statutory Requirement

Legal Driver:

Clean Water Act, Sikes Act

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PROJECT: Annual APG Arbor Day / Earth Day Celebration

INRMP Goal and Objective:

Goal 3 – Manage natural resources for multiple uses when appropriate, including sustainable yield of renewable resources, scientific research, education, and recreation

Objective 3.3 – Provide educational outreach activities for installation users and the surrounding community

Project Description:

Annual combined Arbor Day / Earth Day celebration held on APG. Ideally, this annual celebration involves local schools with essay contests, child development centers, DPW Environmental staff, and Garrison Command staff. Funding restrictions have recently limited the full execution of the celebration. Celebration is usually coordinated with Tree City event (tree planting, etc.).

Deliverable:

Community outreach event to promote awareness of environmental stewardship and protection.

Cost and Cost Basis:

To be determined

Justification:

Failure to fund will deny APG opportunity to engage community in environmental stewardship awareness.

Class:

3 – Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Public Awareness Brochure for Riparian Buffers and Shoreline Sustainment

INRMP Goal and Objective:

Goal 3 – Manage natural resources for multiple uses when appropriate, including sustainable yield of renewable resources, scientific research, education, and recreation

Objective 3.3 – Provide educational outreach activities for installation users and the surrounding community

Project Description:

Develop, produce, and distribute brochure to promote public awareness of importance of riparian buffers and shoreline sustainment. Target audience is on-Post residents.

Deliverable:

Brochure (tri-fold)

Cost and Cost Basis:

Minimal (in-house costs to reproduce brochures)

Justification:

Failure to fund may result in continued decline of shoreline vegetation, shoreline stability, and increase in sediment run-off due to actions undertaken by un-informed persons in clearing vegetation close to shorelines.

Class:

3 - Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Public Awareness Brochure for Purple Loosestrife

INRMP Goal and Objective:

Goal 3 – Manage natural resources for multiple uses when appropriate, including sustainable yield of renewable resources, scientific research, education, and recreation

Objective 3.3 – Provide educational outreach activities for installation users and the surrounding community

Project Description:

Develop, produce, and distribute brochure to promote on-Post worker awareness of the invasive species purple loosestrife (*Lythrum salicaria*). Distribution of brochures will encourage reporting of sightings of this species to supplement monitoring efforts.

Deliverable:

Brochure (tri-fold)

Cost and Cost Basis:

Minimal (in-house costs to reproduce brochures)

Justification:

Project will supplement monitoring efforts to identify sites of the invasive species. Control of invasives species benefits biodiversity.

Class:

3 - Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: Public Awareness Brochure for Sturgeon

INRMP Goal and Objective:

Goal 3 – Manage natural resources for multiple uses when appropriate, including sustainable yield of renewable resources, scientific research, education, and recreation

> **Objective 3.3 –** Provide educational outreach activities for installation users and the surrounding community

Project Description:

Develop, produce, and distribute brochure to promote awareness among recreational anglers of the endangered species of sturgeon that are likely present in APG waters. Distribution of brochures will encourage reporting of sightings of these species to supplement monitoring efforts.

Deliverable:

Brochure (tri-fold)

Cost and Cost Basis:

Minimal (in-house costs to reproduce brochures)

Justification:

Project will supplement monitoring efforts for both species of sturgeon, educate public on proper handling of species if caught, and promote reporting of sightings.

Class:

3 - Best Management Practice

Legal Driver:

Endangered Species Act, Sikes Act

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PROJECT: Public Awareness Brochure for Zebra Mussels

INRMP Goal and Objective:

Goal 3 – Manage natural resources for multiple uses when appropriate, including sustainable yield of renewable resources, scientific research, education, and recreation

Objective 3.3 – Provide educational outreach activities for installation users and the surrounding community

Project Description:

Develop, produce, and distribute brochure to promote public awareness of the invasive species zebra mussel (*Dreissena polymorpha*). Distribution of brochures will encourage reporting of sightings of this species to supplement monitoring efforts.

Deliverable:

Brochure (tri-fold)

Cost and Cost Basis:

Minimal (in-house costs to reproduce brochures)

Justification:

Project will supplement monitoring efforts to identify sites of the invasive species within APG waters. Sightings will be reported to Maryland Department of Natural Resources to add to state-wide database.

Class:

3 - Best Management Practice

Legal Driver:

Sikes Act

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PROJECT: iSportsman Maintenance

INRMP Goal and Objective:

Goal 3 – Manage natural resources for multiple uses when appropriate, including sustainable yield of renewable resources, scientific research, education, and recreation

> **Objective 3.2 –** Provide outdoor recreational opportunities such as hunting, fishing, trapping, crabbing, etc. when compatible with military mission and management of natural resources

Project Description:

Option Year 1 of iSportsman contract. Maintenance of system deployed in FY21.

Deliverable:

Maintenance of online services within a certified FedRAMP environment capable of providing customized web based content management interface; online permit sales; safety briefings; online check-in/out; integration of payment acceptance service for permits; online help documentation and training videos; training on all services; and ongoing support for the new and existing systems. Contractor shall provide support to government administrators and managers responsible for SAPRMS with application\ interface training, documentation and warranty support. Additionally, provide critical services that support the full functionality of the automated recreation tracking and access system.

Cost and Cost Basis:

$22,600 (total)

> Eligible for Conservation Reimbursable and Fee Collection Program (CRFCP) funding

Justification:

Annual support is required to maintain the capabilities of the Hunting, Fishing and Outdoor recreation programs and to facilitate issuance and management of Sikes Act (16 U.S.C.670 et seq.) permits issued to individuals for access to installations for the purpose of hunting, fishing, trapping, firewood, and other dispersed outdoor activities.

Class:

0 - Recurring

Legal Driver:

Sikes Act

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PROJECT: Conservation Supplies and Equipment

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Funding for specialized tools and equipment to be used in the conduct of fish and wildlife conservation and management projects.

Deliverable:

Purchase of binoculars (standard and image stabilizer) and animal crate for use in Bald Eagle management program. Purchase of replacement lithium battery and buoys for acoustic receivers used in Sturgeon management program.

Cost and Cost Basis:

$2,500 (total)

Eligible for Conservation Reimbursable and Fee Collection Program (CRFCP) funding

Justification:

Bald and Golden Eagle Protection Act; Bald Eagle Incidental Take Permit; Endangered Species Act – Supplies and equipment required for compliance monitoring of federally protected species.

Class:

1 – Statutory Requirement (Non-Recurring)

Legal Driver:

Sikes Act

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PROJECT: Natural Resources Supplies, Equipment, and Training

INRMP Goal and Objective:

Goal 2 – Demonstrate sustainable stewardship of natural resources by protecting and enhancing those resources in compliance with legal requirements

Objective 2.4 – Monitor soils, waters, wetlands, vegetation, and wildlife and apply ecosystem-based management principles

Project Description:

Supplies, equipment, and training to support Natural Resource program areas to include Bald Eagle management, Endangered Species management, Wetlands management, Chesapeake Bay program, and Forestry.

Deliverable:

Supplies including but not limited to batteries for field GPS unit and image stabilizer binoculars ($40), packing tape ($60), battery for Sturgeon acoustic receiver ($40), buoys for Sturgeon acoustic receiver ($300), boat fuel ($300), and ADC map ($25).

Training needs ($5,000) for natural resources staff to maintain professional knowledge and proficiency in military natural resources management, to include but not limited to National Military Fish and Wildlife Association annual workshop; Maryland Arboriculture Chapter International Society of Arborists annual workshop (required to maintain Certified Arborist credentials); Forever Maryland annual workshop; Chesapeake Bay Commander's Conference; Army Environmental and Range Readiness Training Symposium; and Sustaining Military Readiness Conference

Cost and Cost Basis:

$5,765 (total)

Justification:

Supplies, equipment, and training include requirements to ensure field safety, program compliance, and sustainment of military mission.

Class:

1 – Statutory Requirement (Non-Recurring)

Legal Driver:

Bald and Golden Eagle Protection Act; Bald Eagle Incidental Take Permit; Endangered Species Act; Clean Water Act; Sikes Act

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