

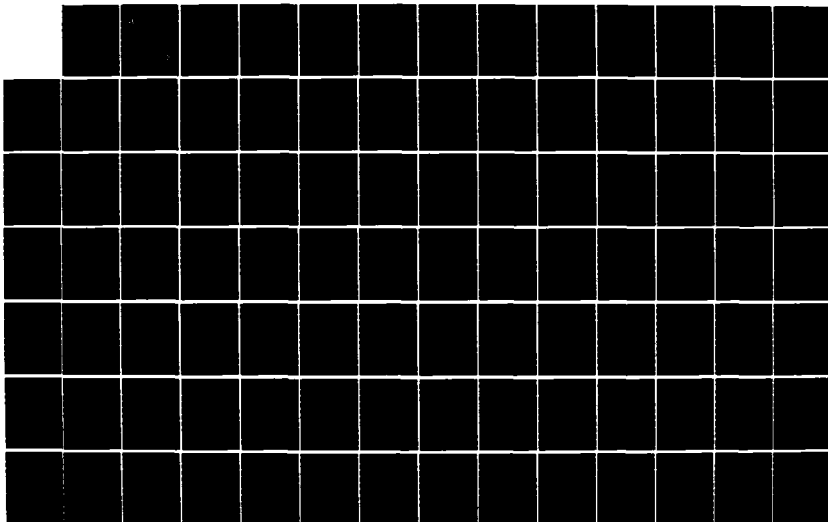
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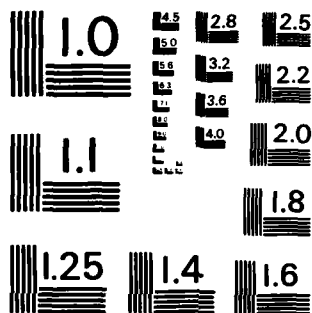
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GROUNDS CONSERVATION MANAGEMENT PLAN (1982-1991) FISH
AND WILDLIFE MANAGE. (U) NAVAL SURFACE WEAPONS CENTER
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NAVAL SURFACE WEAPONS CENTER DAHLGREN SITE

GROUND CONSERVATION MANAGEMENT PLAN (1982-1991)

AD-A161 946

FISH AND WILDLIFE MANAGEMENT PLAN (1982-1991)

FOREST RESOURCE MANAGEMENT PLAN (1979-1988)

PUBLIC WORKS DEPARTMENT
IN COOPERATION
WITH VARIOUS FEDERAL AND STATE
AGENCIES

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GROUND'S CONSERVATION
MANAGEMENT PLAN

The Naval Surface Weapons Center
Dahlgren, Virginia

1982-1991

Prepared in Cooperation with: U.S. Department of Agriculture
Soil Conservation Service

Chesapeake Division
Naval Facilities Engineering Command
and
Naval Surface Weapons Center
White Oak, Maryland

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SECTION I

INTRODUCTION

This conservation plan was developed in cooperation with the U.S. Department of Agriculture (Soil Conservation Service), Chesapeake Division NAVFACENGCOM, and the Naval Surface Weapons Center.

An acre-by-acre assessment would be of limited benefit for a long term use given the size of the property. Instead, a more flexible conservation plan was prepared to address major and/or reoccurring conservation problems. These recommendations, when combined with existing Natural Resource Management Plans for woodland and wildlife, should be comprehensive enough to cover future land uses.

As the need arises, alternatives to new problems will have to be developed. In some cases, it may be necessary to prepare detailed revisions for a particular problem area. It would be advantageous to review this plan with the Tri-County Soil and Water Conservation District at the end of each fiscal year. In this way, problems could be addressed promptly and prioritized for the coming year.

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SECTION II

REFERENCES

Natural Resources Management Instructions for Grounds Management

DODINST	4170.8	Natural Resources: Soil and Water Management	21 Jun 1965
DODINST	5000.13	Natural Resources: Secretary of Defense Conservation Award	13 Dec 1976
OPNAVINST	4240.3E	Environmental Protection Manual	28 May 1980
NAVFACINST	7110.18C	Soil and Water Conservation Funds	29 Jul 1975
NAVFACINST	11015.6B	Soil and Water Conservation	6 Mar 1973
NAVFACINST	11015.3A	Land Use Conservation Planning; Coordination of	14 Mar 1968
CHESDIVINST	11015.5	Soil and Water Conservation Funds	18 Dec 1975
CHESDIVINST	11015.6	Natural Resources: Soil and Water Conservation	6 Apr 1977
CHESDIVINST	11015.7	Multiple Discipline Natural Resources	18 Apr 1977

These references set forth policy regarding Grounds Maintenance and Soil and Water Conservation Program requirements and delineate areas of responsibility for accomplishing the program.

SECTION III

DEFINITIONS

Grounds. Grounds are defined as all areas not occupied by buildings, pavements, railroads, or other engineering structures. In accordance with the intensity of maintenance required, grounds at military installations are grouped into three categories: improved, semi-improved, and unimproved. The intensity of maintenance includes, but is not limited to: (a) degree of soil fertility, (b) number of mowings required during the mowing season, (c) type of plant cover, (d) density of plant cover required, (e) station use of area, and (f) appearance.

Improved (I). Improved grounds are those areas which received intensive horticultural development and maintenance care. Such areas would include lawns and landscaped areas. The lawns are mowed to present a neat, attractive appearance. They are mowed to limit grass height to two to three inches. Landscaped areas are maintained to minimize weed growth and ensure a neat, well-trimmed appearance.

Examples of improved grounds include lawns, flower/ornamental shrub plantings, parade grounds, athletic fields, golf course greens, tees and fairways, and similar areas.

Semi-improved (SI). Semi-improved grounds are those areas which receive less intensive horticultural development and maintenance care than improved grounds. Maintenance care is usually provided to encourage a vegetative cover for the purpose of erosion control, critical area stabilization, and to eliminate fire hazards.

Examples of semi-improved grounds include airfields, ammunition and other storage areas and some golf course roughs. Agricultural and grazing out-lease areas and designated wildlife areas are included under semi-improved grounds.

Unimproved (UI). Unimproved grounds are those areas considered as forest lands, landfills, swamps, marshes, rocky or other land requiring minimum maintenance. Agricultural and grazing outlease areas and designated wildlife areas are also included under unimproved grounds.

Other (O). Other land is all of the land for which the reporting activity is responsible and which is not included in the above categories.

Examples of other land include areas occupied by buildings, roadways, paved areas and those reportable land areas that are submerged.

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SECTION IV

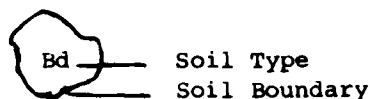
SOILS

This section contains information concerning the soils which comprise the land occupied by the Naval Surface Weapons Center, Dahlgren, Virginia. A general knowledge concerning the characteristics and limitations of the soils will assist in the application of a good soil and water conservation program.

The needed soils information was obtained for the NSWC from the Soil Survey for Stafford and King George Counties, Virginia. This soil survey was provided through the services of soil scientists of the Soil Conservation Service, U.S. Department of Agriculture. 19-5

The topography occupies an area of level to gently sloping Coastal Plain sediments. The land surface ranges from less than 25 feet to 25 feet above sea level.

The boundaries of each kind of soil are recorded on aerial photographs. Soil symbols are found within a specific soil boundary. This symbol indicates the type of soil, slope and degree of erosion. The symbols appear as follows:



The detailed soils map is the basis for all soils interpretations. The soils map gives the location of each of the soil types found on the NSWC. The Stafford and King George Soil Survey provides useful information regarding construction sites, recreation areas and other land use changes. Full utilization of this survey is recommended in preference to the brief soils information in this conservation plan. The soils are as follows:

Soil Symbol	Soil Name	Soil Description
Ae	<u>Alluvial Land, wet</u>	A nearly level to gently sloping soil and is found along drainageways and small streams. Textures range from loamy sand to sandy loam and loam. The soil is strongly to very strongly acid. It is low in natural fertility and organic matter content. Permeability is moderate to rapid. A seasonal high water table is at the surface for many months. It is subject to seepage and flooding from adjoining uplands. Capability class VI-w.

Soil Symbol	Soil Name	Soil Description
BaA	<u>Bertie</u> , very fine sandy loam, 0-3% slopes	A deep, somewhat poorly drained, nearly level to very gently sloping soil in low areas. Soil textures range from fine sandy loam, sandy clay loam to clay loam. It is very strongly to extremely acid. It is low in organic matter and natural fertility. Permeability is moderate. A seasonal high water table is at a depth of 1-1/2 feet in winter and in spring. Capability class III-w.
Bd	<u>Bladen</u> , loam, 0-2%	A deep, poorly drained, nearly level soil on Coastal Plain lowlands. Textures range from loam clay loam to clay. Permeability is slow. It is very strongly acid and low in natural fertility and organic matter content. A seasonal high water table is at a depth of 1-1/2 feet in winter and spring. Capability class IV-w.
BmA	<u>Bourne</u> , fine sandy loam, 0-2% slopes	A moderately well drained, nearly level to sloping soil on uplands. There is a moderate to strong fragipan at a depth of about 18 to 24 inches. The soil is strongly to very strongly acid. It is low in natural fertility, and organic matter content. Subsoil above the fragipan is moderately permeable, but the fragipan is slowly to very slowly permeable. A parched water table occurs above the fragipan during wet periods. Capability class III-w.
Bmb	<u>Bourne</u> , fine sandy loam, 2-6% slopes	Similar to above but it has steeper slopes. Capability class III-s.
Cw	<u>Cut and Fill</u>	Cut and fill land consists of areas where soil material has been removed or reworked by machinery. Texture ranges from loamy sand to clay loam and clay, but some areas are very gravelly. Sediment production is medium to high. Runoff is rapid, and permeability is moderate to slow.
Fd	<u>Fallingston</u> , very fine sandy loam, 0-2% slopes	A deep, poorly drained, nearly level soil on lowlands. Texture ranges from very fine sandy loam to sandy clay loam. It has a very strongly acid to extremely acid subsoil, and is also low in organic matter and natural fertility. The subsoil has moderate permeability. Available moisture capacity is moderate. It has a seasonal high water table at the surface or within a depth of 1-1/2 feet during wet periods. Capability class III-w.

<u>Soil Symbol</u>	<u>Soil Name</u>	<u>Soil Description</u>
Fs	<u>Fresh water swamp</u>	Low-lying areas consisting of mixed alleuvium that are waterlogged or covered by fresh water, except during extended dry periods. These areas consist of layers of sandy loam, loam and silt loam. A mat of partly decayed organic material is on the surface in many areas. The surface layer commonly is gray to dark gray. The lower layers are strongly gleyed. Capability class VII-w.
GsD	<u>Galestown-Sassafras</u>	This complex consists of deep, well to somewhat excessively drained soils on uplands. Texture ranges from loamy fine sands to fine sand. It is strongly acid and is low in natural fertility and organic matter content. Galestown soils make up about 45 percent of the complex with Sassafras representing about 30 percent. Permeability is rapid and available. Moisture capacity is low. Runoff is medium, and erosion is a moderate hazard if the soil is exposed. Capability class VI-e.
Sa	<u>Sand and Gravel Pits</u>	The soil material of this type is generally coarse. Runoff is slow, and permeability is moderately rapid. These soils commonly have a thin cover of weeds, brush and small trees. Thin stands of grass cover fine textured materials. Capability class VII-s.
SfA	<u>Sassafras, fine sandy loam, 0-2% slopes</u>	A deep, well drained soil on nearly level slopes. Texture ranges from fine sandy loam near the surface to sandy clay loam, loamy fine sands, and fine sands at lower substratum. Permeability is moderate in the subsoil, and available moisture capacity is moderate. It is well suited to agricultural crops if adequately limed and fertilized. Capability class I.
SfB	<u>Sassafras, fine sandy loam, 2-6% slopes</u>	Same as above, except slopes are increased. Runoff is medium to rapid. Erosion has a moderate hazard rate if this soil is cleaned tilled or exposed. Capability class II-e.
SfC	<u>Sassafras, fine sandy loam, 6-10% slopes</u>	Same as above with increased slope percentages. Runoff is rapid on this soil. Erosion is a very severe hazard if this soil is cleaned tilled or exposed. It is better suited to sod crops or pastures rather than row crops. Capability class IV-e.

<u>Soil Symbol</u>	<u>Soil Name</u>	<u>Soil Description</u>
TeA	<u>Tetotum</u> , fine sandy loam, 0-2% slopes	A deep, moderately well-drained soil on nearly level slopes. Texture ranges from fine sandy loam near the surface to sandy clay loam to mottled clay loam at lower layers. The subsoil is moderately permeable. Available moisture capacity is also moderate. A seasonal high water table is at a depth of 1-1/2 to 2-1/2 feet during winter and spring. Artificial drainage is desirable if the soil is to be farmed. Capability class II-w.
TeB	<u>Tetotum</u> , fine sandy loam, 2-6% slopes	Same as above except slopes have increased. Runoff is slow to medium, and erosion is a moderate hazard if it is cleaned tilled or exposed. Capability class II-e.
TeC ₂	<u>Tetotum</u> , fine sandy loam, 6-10% slopes	Same as above except slopes have increased. This creates a severe erosion hazard if the soil is cleaned tilled or exposed. Capability class III-e.
Tm	<u>Tidal marsh</u>	Broad, low areas of mixed alluvium that are covered periodically by tidal water. Textures range from coarse to medium materials. There are various layers of sandy, loamy, clayey, and muck materials. Subsurface is commonly gleyed. Tidal marsh is constantly waterlogged. Capability class VIII-e. Such areas represent an important role in fish and wildlife ecology.
WoA	<u>Woodstown</u> , fine sandy loam, 0-2% slopes	A deep, moderately well-drained soil on nearly level to gentle slopes. It has a medium acid to very strongly acid subsoil. Natural fertility and organic matter content are also low. The subsoil is moderately permeable, and available moisture capacity is moderate. There is a seasonal depth of 1-1/2 to 2-1/2 feet which makes artificial drainage beneficial for farm use. Capability class II-w.
WoB	<u>Woodstown</u> , fine sandy loam, 2-6% slopes	Same as above except slope has increased. Runoff is slow to medium, and erosion is a moderate hazard if the soil is cleaned tilled or exposed. Artificial drainage is desirable if the soil is used for farming. Capability class II-e.

SECTION V

MANAGEMENT OF CENTER GROUNDS

This section contains recommendations for the performance of recurring management practices required to maintain the Center grounds at an optimum level.

A. GENERAL

The Naval Surface Weapons Center contains land in each of the defined categories; that is, improved, semi-improved, unimproved, and other.

Management requirements vary for each category. Improved grounds require more intensive management to maintain such areas while semi-improved areas may only need minor treatment and unimproved areas little or no grounds conservation treatment.

Several management items need attention. They are: proper maintenance of grassy areas; inadequate surface drainage; proper mowing; reestablishment of vegetation; and providing protective cover on critical areas. These are a few of the items that will be addressed in this plan. Recommendations for the performance of individual practices, such as seeding, are listed in Appendix A.

The need for applying lime and fertilizer periodically cannot be over-emphasized. The soils of the Center are naturally acidic and low in fertility. Adequate amounts of lime and fertilizer to apply can be determined by soil tests. Optimum pH levels are important because the soil pH directly influences the ability of plants to obtain plant food from the soil. This, in turn, affects the quality of plant cover. Brief descriptions of some of the major land uses on this Center follow:

LAWNS--Developed areas of the Center contain lawns which are maintained as an integral part of the landscape, providing an attractive appearance consistent with improved grounds.

OTHER GRASSED AREAS--Other areas containing grass cover, such as roadside areas, incorporate the use of grasses and forbs as a method of controlling erosion, while providing an attractive appearance. Such areas are usually designated as semi-improved.

RECREATION AREAS--Grounds devoted to recreation are basically lawn areas. They are usually subject to intensive foot traffic which will require additional treatment. Ball fields and picnic areas would fall within this category.

B. MANAGEMENT OPERATIONS

There are few soil erosion problems on the Center. The problems are listed in Section VI as well as their corrective actions.

Maintenance problems and costs can be reduced if proper installation of sound conservation measures are incorporated during the development of plans for construction and ground improvement. Often problems which occur as the result of

construction operations are neglected following the completion of the contract. The proper installation and maintenance of ground cover is an important requirement in land development, both during and following construction and will result in fewer grounds conservation problems.

Soil and water conservation practices may be performed on a recurring or non-recurring basis, generally depending on the magnitude of the problem and the associated costs. Construction, repair and maintenance projects of a magnitude which may strain existing budget limitations may be performed through the submission of a special project; that is, a non-recurring project. Following the completion of a project, periodic maintenance may be required; this is a recurring requirement. For example: The initial landscaping of a specific area is a non-recurring requirement; however, the maintenance necessary to provide permanency of the work is applied on a recurring basis.

B.1 NON-RECURRING OPERATIONS

Soil and water conservation practices involve control of surface and subsurface water, stabilization of slopes and other engineering applications as well as the establishment of vegetative cover. Their application will result in the control of erosion, safe removal of excess water and the protection of land and water resources.

The recognition of the need for such practices, their consideration during planning, inclusion in the plans and specifications, with subsequent installation during construction, will reduce maintenance requirements. Failure to do so will probably involve repair and maintenance with limited funds. Recurring maintenance such as those required for optimum appearance in lawns cannot be reduced in costs without affecting the overall landscape. The information contained in this plan should assist the installation in deciding where, when and how these requirements should be met.

Construction operations generally involve earth moving or grading operations. These operations pose specific problems which should be considered during the planning stages. The decision to select a construction site, in addition to satisfying activity requirements, must also reflect consideration of the natural resources involved over which the Navy exercises authority.

For example: landfill and borrow operations may affect recreation and wildlife programs or resources; such programs as well as site suitability should be carefully considered. Site investigations should include a review of soils data contained in the Soil Survey Report, particularly during the early stages of land use planning.

Special problems which were inventoried during the preparation of this management plan, and which are considered of a non-recurring nature, are discussed in Section VI of this report.

B.2 RECURRING OPERATIONS

Grass, shrubs and other plant materials are used extensively on Naval installations for landscaping, recreation and erosion control. Each use represents a different degree of maintenance; also, maintenance will vary by field category, i.e., improved and semi-improved. The more intense operations are performed on improved grounds.

In addition, more care may be required where vegetative cover is used in critical areas, such as, on steep slopes for erosion control, than might be required on level fields within the same grounds category.

Where grass cover is to be maintained, it must be recognized that lime, fertilizer, cutting height and frequency and other practices must be properly applied to maintain effective cover. Grassed areas usually fail to provide adequate cover when the soil fertility is permitted to decline to the level where conditions are more favorable for competing plants which are not capable of protecting the soil or providing an attractive lawn. Adequate amounts of lime and fertilizer required to sustain good grass is determined by soil analysis. Optimum pH levels, which are obtained by applying lime, are very important because the soil pH directly influences the plants' utilization of nutrients supplied by fertilizer. Even though some grass species will tolerate a low pH level, they provide a more desirable cover if adequate lime is applied. Untreated soils in this locality have a low pH and require lime applications for the establishment of grass cover. Guidance for obtaining optimum soil fertility, based on soil tests, are included in Management Practices 3, 4, and 13 in Appendix A.

IMPROVED GROUNDS

Improved grounds of the Naval Surface Weapons Center consist of lawns and secondary use of recreation.

These lawns include playgrounds, athletic fields, and other recreation areas, as well as those in proximity to ordinary station buildings requiring well-groomed lawns which contribute to station appearance.

The lawns on the Center are generally made up of a mixture of cool season and warm season grasses. Cool season grasses of Kentucky bluegrass and red fescue were planted over much of the improved area. These have been invaded by common Bermudagrass, a warm season grass which occurs in the soils of coastal Virginia. The more droughty parts of the landscape--very sandy spots, slopes and southern exposures have a higher percentage of Bermudagrass than do the northern exposed slopes, shaded areas and level, well-managed lawns. Both warm and cool season grasses have advantages over the other. Cool season grasses furnish green cover from early fall through late spring when Bermudagrass is dormant or slow growing. The cool season grasses furnish protection in shaded areas where Bermudagrass does rather poorly. On the other hand, Bermudagrass stays green through hot, dry weather due to its deep root system. The dense growth of roots, rhizomes and stolens make Bermudagrass desirable on critical areas and heavily used areas if these areas are exposed to several hours of sunlight during the day.

A lime and fertilizer program is a must if the improved areas are to be maintained at an acceptable level of growth and appearance. A program for the improved grounds of the Station follows:

Soil aeration--A combination of seasonal wetness, and foot traffic, in some areas, tends to cause poor aeration in grass root zones. Aeration of the soil can be accomplished by using aeration machines that spike the soil or that take small cores of soil, leaving small holes.

Weed control--Any management practice which improves the density and vigor of the desired turf will discourage weed invasion. Some common management practices which favor weed invasion are: summer fertilization (except on Bermudagrass and Zoysias), misuse of pesticides, close and infrequent mowing. Chemical weed control should be initiated only if weeds are a problem after good turf management practices have been in use for some time.

The following includes descriptions of some common broadleaved lawn weeds that can be controlled with 2, 4-D, silvex or dicamba.

Weed Group 1 includes white clover and yellow wood sorrel (*Oxalis*). These may be best controlled with silvex or dicamba.

Weed Group 2 includes chickweed, henbit, ground ivy and wild strawberry. Silvex will control these weeds but repeat treatments at one month intervals may be necessary for complete control.

The third weed group includes purslane, spotted spurge and knotweed. These weeds may be controlled with dicamba.

The fourth weed group are weeds which can be controlled with 2, 4-D. These include wild garlic (or wild onion) and the mustards, dandelions and plantains.

Spray formulations, wettable powders or liquids, are much more effective than granular forms or broadleaf herbicides. For best results, spray when the temperature is above 60°F and the weeds are actively growing. Do not mow for two days after spraying. Areas containing weeds controlled by 2, 4-D and weeds controlled by dicamba or silvex may be treated with a combination of the two materials.

Crabgrass or goosegrass control: Use Bensalide, DCPA or Siduron according to label instructions in late March or early April for preemergence control. Use Disodium methanearsonate (DMA or DSMA) or Ammonium methanearsonate (AKA) when grass is in seedling stage and soil is moist. Foxtail, chickweed, goosegrass, knotweed and nutsedge will often be killed when treated in seedling growth stage. Repeat treatments may be needed in 7 to 10 days.

Mature nutsedge can be controlled with Amitrole, a soil sterilant, which kills all grasses in the spots. Follow-up treatment is needed

CAUTION

Although most herbicides are relatively non-toxic to humans, they should be handled with care. Avoid prolonged or repeated contact with skin, and be sure to wash thoroughly after using them. Store them away from children, animals and foods.

Other information can be found in Management Practice #11 in Appendix A.

Prior to application of pesticides, contact the pest control coordinator (Code W-632) for the Center (telephone 663-7100).

Lime--On areas to be planted, apply 80 pounds of ground limestone per 1,000 square feet or equivalent hydrated lime. Mix into top 4 to 6 inches of soil before seeding. Existing turf, apply 50 pounds per 1,000 square feet or ground limestone every three to five years. Apply during late fall and winter months.

Fertilizer--Fertilizers with slowly available nitrogen should be used to reduce the rate of loss by leaching. They give more uniform grass growth over a longer period of time and will not burn the grass. This results in monetary savings in labor, since the number of applications per year can be reduced. A fertilizing schedule follows:

FERTILIZERS WITH MORE THAN 50% SLOWLY AVAILABLE NITROGEN

<u>Time to Apply</u>	<u>Fertilizers Per 1,000 Sq. Ft. of Area</u>
September	10 lbs. 10-6-4, or 16.6 lbs. 12-6-6, or
and	12.6 lbs. 16-8-8, or 10 lbs. 10-10-10, or
March	30 lbs. natural organic fertilizer*
	(Favors cool-season grass)

*Processed sewage sludge or process tankage

Relatively new bermudagrass hybrids, such as "Tufcote", which will stand intensive use and need less mowing than common bermudagrass, should be considered when establishing intensive use areas and critical areas to improved conditions. Places where this grass would fit in especially well include drained shallow areas, steep or southern exposure slopes, and improved grounds which are subject to foot traffic.

Lack of adequate ground cover and low plant vigor are the two principal problems affecting grasses in the improved areas. These two conditions are brought about by close mowing, heavy duty use of some areas and a general need for use of more lime and fertilizer. The vigor of the grasses and the percent ground cover could be improved by cutting the grass at a height of 1-1/2 to 2-1/2 inches in full sun and at a height of 2 to 2-1/2 inches in partial shade. Mow grasses at a height of 2 to 3 inches in dense shade. Do not let grasses grow too tall between mowings. A good guide on when to mow is at a height of the grass which will remove one-third of the green leaf area. This means mowing approximately once a week during spring and fall and less frequently during the summer. Mowing at proper heights will leave more green leaf surface area which will speed up the manufacture of organic compounds used in cell construction and plant food reserves. The proper cutting heights will permit the vegetative cover to develop a more extensive and vigorous root system. Deeper root systems and higher plant stubble will result in faster water penetration, reducing the effects of hot, dry periods during the summer months.

Watering--Lawns should be watered only when they become dry. If a regular watering program is started in early summer, it should be continued throughout the summer. When applying water, wet the soil to a depth of at least four to six inches--the equivalent of about one inch of rainfall per application. Avoid light frequent watering of established lawns which will cause shallow rooting and weak turfs.

Refer to Table A-1 in Appendix A for general seeding recommendations. Refer to Appendix A Management Practices 1 through 14 for further guidance on management of improved grounds.

Landscaping is generally adequate throughout the improved grounds. Native shrubs and trees and introduced species have been used to good advantage for aesthetic value as well as shade, erosion control, visual and noise screening, and urban wildlife habitat. The landscaping plan for the housing area is included in Appendix B.

One other way to reduce maintenance costs of improved areas would be to reduce the size of these areas. The unmowed part would either be invaded by native grass and shrubs or could be planted to attractive shrubs. Autumn olive or red berry Amur Honeysuckle could be used at key spots for beautification and food for non-game wildlife. See Appendix C for guidance on use of these plants.

SEMI-IMPROVED GROUNDS

Semi-improved grounds of the Naval Surface Weapons Center consist of runway and road shoulders, the area in vicinity of testing sites and the flats of the Magazine Storage Area.

Grounds in this category contain grass cover and require periodic maintenance necessary to control erosion, provide a satisfactory appearance and maintain land value. They have an aesthetic as well as functional value.

Lime and fertilizer should be applied to these areas only if needed to maintain adequate ground cover to prevent erosion and satisfy aesthetic needs. If lime and fertilizer are needed, application rates should be according to soil test recommendations. Refer to Management Practice 13 in Appendix A for guidance on soil testing.

Most semi-improved grounds require approximately 6 mowings a year. Mow vegetation on semi-improved grounds at a height of 2 to 4 inches.

Potential agricultural and grazing out-lease lands are also contained under this category. A more detailed description of these areas is given in Appendix B. However, conservation treatment should be considered for the out-lease areas. Various conservation tillage practices are available to the lessee. A conservation plan for the leased parcels should be part of the leasing program. This will ensure the protection of the Navy's resource base. It will also assist the lessee in his crop production. Such plans need to be specific to the parcel and land user. It can be developed as part of the leasing program.

Likewise, the potential grazing lands need conservation and good management treatment to protect the resource base. The present grass cover is mainly warm season grasses and forbs. Over a period of time, grasses that provide better grazing and protection can be introduced on these areas. This information can be included in a conservation plan for each grazing unit.

The forested areas on the Center have potential for timber production. Detailed planning for forestry is contained in the Forestry plan. Additional assistance is also available through the Virginia Division of Forestry. A consideration should be given to proper erosion and sediment control practices under any timber management operation or harvest.

The Base has much potential for further wildlife habitat development. Fire-breaks, field borders, wetlands habitat development are a few of the areas that can be enhanced for wildlife. Perennial or other low maintenance plants can be used to keep annual grounds maintenance costs low. A more detailed plan for wildlife is contained in the Fish and Wildlife Management Plan. Personnel in charge of Grounds Maintenance functions are urged to reference the Fish and Wildlife Management Plan to identify specific habitat improvements which substantially reduce maintenance requirements in certain areas.

SPECIAL PROBLEMS.

Special problems are conservation problems which are nonrecurring. These problems are beyond the normal scope of annual maintenance funds. Corrective treatment is needed to prevent the continuing depreciation of the Navy facility. Special problems will require specifications and cost estimates for funding.

The design criteria, specifications, cost estimates and other supporting information necessary to initiate and guide funding and application of the conservation measures required are to be developed with the Natural Resources Manager.

An inventory of special problems (see Figure 1) which were found on the Center during the preparation of this Ground Conservation Management Plan and recommended treatment follows. Priority for the correction of these problems is to be assigned by the Center.

Problem 1

Problem Description. A short, steep bank above the marina area is eroding. The erosion is caused by people walking down the bank to take a short-cut to the marina.

Recommended Corrective Action. A ground cover can be established to serve two purposes. First, the vegetative cover will provide a greater degree of erosion control with less maintenance work. Secondly, pedestrian traffic can be controlled by the proper choice of ground cover. Several plants have the necessary characteristics needed to do the above. Memorial or Max Graf Rose, Pyracantha (Firethorn), Cotoneaster or Honeysuckle will do well on such a site. These plants are available at commercial nurseries, or are growing on the Center. See listing of critical area plantings for specific information on each species and sources.

Problem 2

Problem Description. Another bank along Machodoc Creek shore near the recreational pier is beginning to erode due to lack of protective vegetation.

Recommended Corrective Action. Again, the area lends itself to the use of ground covers. Using the above-mentioned plants or other suitable plant species, the ground cover will stabilize the site and require little maintenance work once it is established.

Problem 3

Problem Description. Fire roads throughout the forested area are either sparsely vegetated or lacking vegetative cover.

Recommended Corrective Action. Kentucky 31 fescue can be planted at the rates mentioned in Appendix C to control erosion. Sericea Lespedeza can be either planted alone or in a grass mixed to enhance wildlife habitat and reduce annual maintenance work on the roads. Lespedeza is seeded at a rate of 20 lbs. of scarified seed per acre. Other perennial plantings can be used as long as the plants do not interfere with the intended use of the roads. Field borders can also be planted along the wider roadways and along open fields bordered by wooded areas. Again, wildlife will benefit from such actions.

Problem 4

Problem Description. The shoreline along the Potomac River is beginning to erode at various points. The bank below the firing range is the largest area with a problem. Much of the erosion problem is caused by wave action from the river undercutting the bank.

Recommended Corrective Action. The least expensive method that will correct the problem is an adapted plant material species. Where there is one mile or less of open water in front of the shoreline, vegetative control of the erosion can be highly successful. Greater distances than the one mile will be less effective with vegetative controls. Another method would be to rip-rap the problem areas. This method will be more costly than using plant materials. However, care must be taken with either method as the area contains dud ammunition rounds from previous weapons' testing. It may be necessary to leave the area as it is rather than chance an accident.

A source of information and technical expertise in shoreline stabilization is the Shoreline Erosion Advisory Service. They are located in Gloucester, Virginia, and their services are available through the Virginia Soil and Water Conservation Commission.

Problem 5

Problem Description. Several small streams flowing into the Hideaway Pond have been dredged recently. The spoils material is placed along the stream's bank where it can wash back into the stream.

Recommended Corrective Action. The spoils material should be either removed from the site and spread away from a water course, spread nearby and then properly stabilized. The banks can be stabilized by planting adapted plant material species. Through a cooperative study project, plant materials can be made available for use on the Center. Purple osier willow is one such plant that may provide the needed results.

Future dredging operations should be coordinated with the Center's Natural Resources Manager. This would lessen the chance of damage to areas used in the research project.

Problem 6

Problem Description. Mulch, ashes, and other materials are piled along the shoreline of Gambo Creek. These materials can easily run off and pollute the creek.

Recommended Corrective Action. The first course of action would be to select a more appropriate site to store these materials. Whatever site is chosen should be away from water sources, or have sediment control structures installed to prevent excessive runoff from the site. If it is determined that no other suitable site is available, a protective berm can be installed around the storage site. The berm can also be stabilized with one of the seeding mixtures listed on the critical planting list.

Problem 7

Problem Description. Surface water is ponding in low areas near the Public Works Facility buildings. The ponded water creates a favorable environment for pests, namely mosquitoes.

Recommended Corrective Action. An open ditch can be installed to drain off excessive surface water. The grading can be done so the area can be maintained easily, and not detract from the landscape. A grade stabilization structure may be needed where the ditch outlets over the shoreline. This will prevent the bank from eroding and creating an additional problem.

Problem 8

Problem Description. Low, wet areas exist throughout the agricultural out-lease areas. This may create some problems for the lessees in their cropping the land.

Recommended Corrective Action. As the land is leased for agricultural use, specific recommendations can be developed for each parcel with the lessee using the land.

Problem 9

Problem Description. Vines and other vegetation are covering the security fence located around the Tetotum Flats section of the Center. This obscures the visibility needed for security.

Recommended Corrective Action. Chemical treatment of the area will effectively kill the unwanted vegetation from the fence. This should be coordinated with the Center's Natural Resources Manager and Pest Control Coordinator who can select and clear the necessary chemicals. The dead vegetation will most likely have to be hand cleared from the fence to obtain the proper visibility.

Problem 10

Problem Description. The perimeter road in the Tetotum Flats section of the Center has some eroding banks that need attention.

Recommended Corrective Action. These areas should be corrected as soon as possible to prevent the problem from enlarging itself. Native vegetation such as honeysuckle or other native vines or ground covers can best stabilize these borrow areas along the road. Selected trees may need to be cut to open the area up for more sunlight to penetrate the problem areas. This would help stimulate vegetative growth to protect these eroding areas. Some of the areas may need additional site preparation and seeding to get vegetation established on them.

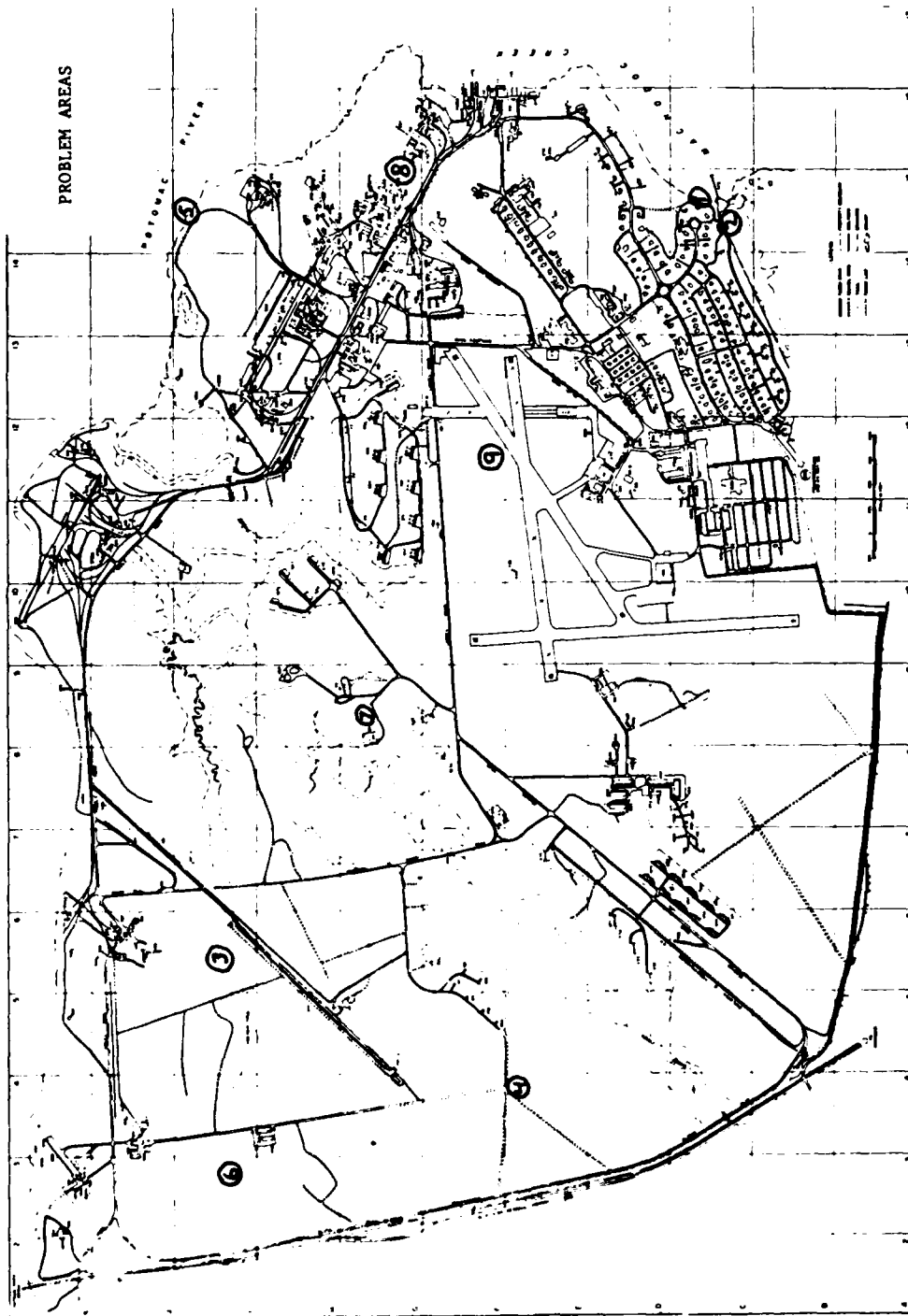


FIGURE 1. PROBLEM AREAS

NSWC MP 84-147

APPENDIX A

MANAGEMENT PRACTICES

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MANAGEMENT PRACTICE #1
SITE PREPARATION

During or following grading operations, remove all construction debris and foreign material such as cans, bottles, wood, bricks, stones, and concrete. Do not bury any of this material in the subsoil.

Two methods may be employed for preparing a site containing poor soil for seeding. The first method involves use of compost sewage sludge or other organic material as soil conditioners. The second method involves the use of topsoil.

In order to maintain a desirable grade adjacent to control features such as sidewalks and curbs, it may be necessary to remove 4 to 6 inches of soil prior to adding soil conditioners or topsoil.

Organic Matter

Thoroughly disk a 4- to 6-inch layer of processed sludge or other organic material into the subsoil. The required amount of lime as determined by soil test results should be incorporated into the soil during the disking operation. After completion of the disking, level the area by dragging or by the use of a dozer or grader; then, roll with a suitable land roller, such as a cultipacker. Do not use a heavy roller that will compact the soil.

Topsoil

Where the use of processed sewage sludge or other organic material is not practical, economical, or desirable, the following method is recommended. Disk the lime into the subsoil to a 4-inch depth. An application of fertilizer may also be required at this time. Spread a 4- to 6-inch layer of suitable topsoil uniformly over the subsoil and disk the lime into this layer of soil. Roll the area with a cultipacker or other suitable land roller following final grading operation. The final grading should be performed by minimal dragging to smooth the area. Note the first lime and fertilizer requirement is to be applied on the basis of a soil analysis of the subsoil. The second lime requirement is to be applied on the basis of a soil analysis of the topsoil. The second fertilizer requirement is to be applied just prior to seeding. Refer to Management Practice 2, Seedbed Preparation.

The success of a topsoiling operation is dependent primarily on the careful selection and inspection of topsoil. Prior to purchasing or otherwise obtaining topsoil, the Chesapeake Division, Naval Facilities Engineering Command, shall be requested to approve the use of the material. Suitable specifications and adequate inspection procedures must be developed to ensure that proper control is exercised over the use of topsoil.

MANAGEMENT PRACTICE #2
SEEDBED PREPARATION AND SEEDING

Prepare the area to be seeded as outlined below:

1. Prepare seedbed by plowing or heavy disking thoroughly loosening the soil to a depth of 5 inches. The soil should not be pulverized and should be free of weeds, stones, and other foreign and objectional debris. After loosening the soil, all surface irregularities where surface water could collect or pond should be smoothed out. After smoothing, lightly compact with a land roller such a cultipacker before and after seeding for a firm seedbed.
2. Take soil samples from the top 4 to 6 inches of the soil following grading operations. Obtain a sample from it in at least 10 different places in the field to be treated, and form a composite sample. The soil samples should be taken several weeks before starting the work to allow time for analysis to be made.
3. Have the sample tested. Recommended rates and analysis of lime and fertilizer to be applied will be furnished with the soil test data. Soil tests may be obtained by forwarding soil samples to the Natural Resources Manager, Chesapeake Division, Naval Facilities Engineering Command.
4. Incorporate the lime requirement into the top 5 inches of the soil with tillage equipment.
5. Firm the seedbed with a cultipacker or other suitable land roller.
6. Just prior to seeding, apply the fertilizr requirement and work it lightly into the surface of the soil with a rake or suitable tillage equipment. Omit this step when seeding a temporary cover and apply the fertilizer requirement prior to sowing the permanent cover.
7. Seed the area in accordance with recommendations contained in the table of seeding recommendations in Appendix C of this management plan. If mechanical spreaders are used for applying seed, check equipment to ensure proper seeding rates. It is generally a good practice to apply one-half of the seed requirement in one direction and the remainder at right angles to the first direction. This will help provide a uniform seeding application. Cyclone hand seeders generally distribute seed more uniformly than mechanical spreaders.
8. Firm the seedbed with a cultipacker or other suitable land roller. A firm seed bed is essential for good seed germination.
9. Mulch the seeded area with small grain straw. Fields subject to wind or water erosion should be protected with mulch net or jute. Refer to Management Practice 12 for mulch materials and methods for anchoring mulch.
10. Water frequently, soaking the entire 5 inches as needed for a 2-week period if feasible.

Areas in which it is desired to improve the density of turf grasses may be overseeded in the fall. Refer to Management Practice 10, Overseeding and Renovation. Steps 1-5 do not apply to fields prepared for seeding in accordance with Management Practice 1, Site Preparation.

Tables contained within this Management Plan list lime and fertilizer requirements, seeding recommendations, seeding rates, planting data, and mulch requirements. The seeding rates are ample for establishing turf, provided an adequate fertility level is established as recommended. Mulch will promote seed germination by retaining moisture near the soil surface. The lime and fertilizer requirements are based on soil test data supplied by the Soil Testing Laboratory, Virginia Polytechnical Institute and State University. In order to ensure the successful establishment of grass, sow seed strictly in accordance with the recommended rates and dates. If cover must be established during periods not recommended for seeding, use a temporary grass cover of rye grass, and reseed with the permanent grass mixture at the proper time.

TABLE A-1. SOUTHERN PIEDMONT AND COASTAL PLAIN SEEDING MIXTURES, RATES AND DATES

Site Conditions	Seeding Mixtures (%)		Per Acre (lb)	Rates		Dates		
				Per 1000 sq. ft. (lb)		3/1 to 4/15	4/15 to 8/1	8/1 to 10/15
High Maintenance Lawns	1.	Tall fescue 90 Kentucky bluegrass 10	250	6		X	No	X
Low Maintenance General Use	2.	Tall fescue 50 Ladino clover 10 Red clover 10 Korean lespedeza 15 Annual ryegrass 15	80	2		X	X(a,b)	X
	3.	Tall fescue 50 Sericea lespedeza 30 Annual ryegrass 20	70	1-1/2		X	X(a)	X
	4.	Tall fescue 50% Sericea lespedeza 20 Korean lespedeza 15 Annual ryegrass 15	80	2		X	X(a,b)	X
	5.	Tall fescue 65 Korean lespedeza 20 Annual ryegrass 10	80	2		X	X(a,b)	X
Droughty Areas, Sandy Soils								
Poorly Drained Areas								

- a. After May 1, use 10 lb/A german millet or 2 lb/A weeping lovegrave in place of annual ryegrass.
- b. After May 1, Korean lespedeza will not reseed itself. You may increase the amount of other legumes accordingly.

TABLE A-2. MAINTENANCE FERTILIZATION FOR PERMANENT SEEDINGS
(Use Soil Test Recommendations or Rates Shown Below)

Mixture No.	Seeding Mixtures	Lbs/1000		Formulation	Lbs/Acre	Time		Mowing
		Sq. Feet	Sq. Feet					
1,2,3,4,7,8, 11,12,13	Cool Season Grass makes up 70% or more of cover	10-10-10	500	11.5	Fall Yearly, or as needed			*Not closer than 4" if occasional mowing is desired
4,5,6	Crownvetch Sericea lespedeza	0-20-20	400	9.2	Spring Year following estab- lishment and every 4 to 5 years, thereafter			Do not mow crownvetch. Mow sericea lespedeza only in the fall after seed is matured
4	Fairly uniform stand of tall fescue and sericea	5-10-10	500	11.5	Year following estab- lishment and every 4 to 5 years, thereafter			Not required. Not closer than 4" if occasional mowing is desired, and then in fall after sericea seed has matured
14	Weeping lovegrass and sericea les- pedeza. Fairly uniform plant distribution	5-10-10	500	11.5	Spring Year following estab- lishment and every 3 to 4 years thereafter			Not required. Closer than 4" if occasional mowing is desired, and then in fall after sericea seed has matured
9	Bermudagrass	20-10-10	400	10	Spring, or 1/2 this amount May 1, July 1, Aug. 15 for lawn type appearance			Once yearly at 3" or at 2" as needed for lawn type appearance
10	Vines, trees, shrubs	See standards and specifications for critical area planting with vines, trees, and shrubs (340)						

MANAGEMENT PRACTICE #3
LIMING

All soils in this region are acid in their natural state and require applications of agricultural limestone prior to the establishment of grass cover. The amount of limestone required is determined by having a sample of the soil analyzed. Refer to Management Practice 13. The importance of establishing and maintaining an optimum soil pH level cannot be over-emphasized because the soil pH directly influences the utilization of plant nutrients supplied by fertilizer and the soil.

Prior to establishing new cover, limestone should be applied at the recommended rate and thoroughly incorporated into the top five inches of the seedbed. Applications of limestone on established grass cover should not exceed 50 pounds per 1,000 square feet (1 ton per acre) at any one application. Once an optimum pH level has been attained, repeated applications may not be required for a 3- to 5-year period. The need for repeated lime applications should be determined from soil analysis records for each field. Lime may be applied at any time, but best results are obtained from fall applications.

MANAGEMENT PRACTICE #4
FERTILIZING

Proper fertility levels are necessary for the establishment and maintenance of adequate grass cover. These levels of fertility are obtained by uniformly applying proper amounts of commercial fertilizer. The frequency and amount of fertilizer to apply to a given area is dependent upon the type of cover, the soil characteristics, and soil analysis.

Obtain a soil analysis as explained in Management Practice #13 when seeding a new area or fertilizing an established area.

Improved Fields

Fertilize cool season grasses such as Kentucky Bluegrass and Creeping Red Fescue annually. Lawns of special importance will benefit from a light spring application and a fall application of fertilizer. Other lawns will perform well with one application in the fall. Fertilizer containing organic or urea-formaldehyde forms of nitrogen will provide more uniform growth response over a longer period of time plus eliminating the need for two applications of fertilizer in special areas.

Semi-improved and Unimproved Fields

Fields in either of these categories do not require annual fertilization. Satisfactory grass cover which affords adequate protection from soil erosion may be maintained by fertilizing when needed as indicated by soil test data. Fertilizer applications may not be required for 3 to 5 years following the initial treatment when it provides adequate soil fertility.

Note: A complete fertilizer contains nitrogen (N), phosphorus (P), and potassium (K).

MANAGEMENT PRACTICE #5
LAWN GRASS RECOMMENDATIONSSodding

Installing sod is an art. The better the sod quality, the easier it is to transport and install. High quality "certified" sod is light and does not tear apart easily. The sod should not be excessively dry when removed from the field. Prior to laying, dampen the soil if necessary to avoid placing the turf roots in contact with a dry, hot soil. When ordering sod to be delivered, you must have the soil completely prepared so that the sod can be installed immediately. The longer the sod remains on the pallet or stack, the weaker each turf plant will be. Distinct yellowing of the foliage and the presence of mildew is usually good evidence of reduced vigor.

When laying sod, it is essentially best to establish a straight line lengthwise through the area. The sod can then be laid on either side of the line and a minimum of pieces will need to be cut. The end of the sod pieces should be staggered as when laying brick. A sharpened concrete trowel is very handy for cutting pieces, forcing the sod tight and leveling and filling small depressions. Be careful not to disturb the prepared soil so that depressions form.

The sod should be so tightly pushed together that there will be no space between sections. The sod should be rolled before watering. The soil must be kept moist until the sod is well established.

Grasses

Many new turfgrasses have been developed in recent years. Some of these have performed well in this region, whereas others are not well adapted. Exotic grasses and ground covers are often publicized but are seldom satisfactory. Recommended varieties are the best choice.

The following grass is recommended for use in this climatic region:

Tall Fescue

This is a tall, growing, cool season bunch type grass. The Kentucky 31 variety is especially adapted to this climatic region. It is recommended for use on playgrounds, athletic fields, parade grounds and lawn areas subject to hard use. The best stands of tall fescue are obtained by seeding without a companion (nurse) crop. Frequent mowing is essential for prevention of clumping of this grass. Do not mow closer than 2 inches high in higher developed areas such as athletic fields. Higher mowings (3 to 6 inches high) are desirable on steeper slopes and rough areas.

There may be areas where another species of grass will be more appropriate to establish than fescue. This can be reviewed on a site by site need.

MANAGEMENT PRACTICE #6
LOW MAINTENANCE GROUND

A cooperative U.S. Navy--U.S. Department of Agriculture, Soil Conservation Service ground cover test plot was initiated in 1982. The purpose of this test was to determine if a particular plant species will be useful as a vegetative cover on critical areas. Purple osier willow have been established and seem promising as an erosion control plant. Other plants suggested for this center are Japanese Spurge, Vinca Minor, Cotoneaster and Max Graf Rose.

These plants provide adequate soil protection with the minimum requirements for management. They are intended to be used in areas where mowing costs become high. Many of these plants also add to the attractiveness of an activity when used to reduce maintenance requirements in improved fields. Areas containing these plants may be used as sources of material for transplanting to other areas with similar problems.

Recommendations concerning the establishment and maintenance of these plants are to be obtained from the Natural Resources Manager, Chesapeake Division, Naval Facilities Engineering Command, unless otherwise specified in this management plan.

TABLE A-3a. CRITICAL AREA PLANTING (WITH GROUND COVERS, VINES, SHRUBS, AND TREES)

Winter Aspect Covered Percentage	Land Resource Area	Site Conditions Required	Light Prefers Tolerates	Range of Height (inches)	Spread of Plants (inches)	Time to Cover (Years)	Area (size) Limitations Large-over 500 sq. ft.	Bloom Distinct Indistinct Color	Notes	
S	All	Pref. mod. moist soils; tolerates wet soils	T	P	4-8	9-12	1-2	None	Blue	Purp.
E	All	All but droughty soils	T	P	10-15	10-12	2	None	White	I
H	All	Pref. moist soils; seepage areas; tol. all but droughty soils	P	T	16-24	12-24	2-3	None	Orange	D
H	All	Pref. rich moist soils; tolerates acid soils	-	P	6-8	6-8	2	None	White	D
H	All	Pref. moist soils; tol. droughty, acid soils, rocky slopes	P	-	12-15	18	1	Large	Pink-red	D
E	All	Pref. slightly acid, moist, fertile soils	P	T	8-12	12-18	2	None	White	I
E	All	Pref. well-drained soils; tolerates poor droughty soils	P	T	2-4	8-10	2	None	Red	D
S-E	All	Pref. well-drained soils; tol. acid, moist soils to dry, poor soils	P	T	6-12	12-18	2	None	Rose	I
E	All	Pref. moist soils with high organic matter	-	P	6-8	6-8	2	None	White	I
E	All	Pref. moist soils with high organic matter	T	P	6-12	18-24	2	Large	White	I
E	All	Pref. moist, fertile soil tol. acid, moist soils	T	P	6-8	12-18	1-2	None	White	D
E	Mountains	Pref. droughty, acid sands	P	T	4-8	12-24	2-3	None	Wh. to pink	I
E	All	All but droughty and wet soils	P	-	10-15	12-18	2	None	White	I
H	Mountains	All well-drained soils except coarse sands; drought-tolerant	P	-	12-24	12-18 (usually needed)	2-3	None	Wh.-Purp.	D

PROPAGATED BY: a/ stolons b/ tubers c/ plant division
d/ cuttings e/ layering f/ seed g/ grafting

TABLE 3b. CRITICAL AREA PLANTING (WITH GROUND COVERS, VINES, SHRUBS, AND TREES

Winter Aspect	Perennation	Land Area	Site Conditions Required	Light Tolerances	Range of Height Spread (ft.)	Range of Rapid Medium Slow	Spacing (ft.)	Time to Form Cover (Years)	Area (size) Limitations 500 sq. ft.	Bloom Indistinct Color	Notes		
S-E	Winter-rosette	All	Pref. well-drained soils; tol. acid, moist soils	T	P	6-12 10+	M-R	1-2	2-3	Large	I	Green	Forms weed-free mat, lacking at nodes; less subject to scale than other eumyos; frost turns foliage reddish purple; covers steep slopes. d/
S-E	Winter-rosette	All	Moderately moist soils with high organic matter	P	T	6-8 15+	R	2-3	2	Large	D	Red	A vigorously growing twiner with rich dark green, clean foliage, somewhat like honeysuckle; covers steep slopes; will climb. d/ f/
S-E	Winter-rosette	All	Nearly all soils-stony rough slopes; tol. moist acid soils	P	T	12-18 25+	R	2-3	2	Large	D	Wh.-Vel.	A rampant grower requiring some control shearing; long-lived; fragrant bloom; low maintenance; will climb trees; covers steep slopes. S/ d/
S-E	Winter-rosette	All	Nearly all soils-stony rough slopes; tol. moist acid soils	P	T	12-18 25+	R	2-3	2	Large	D	Reddish	Similar in many ways to <i>L. japonica halliana</i> , may be more hardy with showy green winter foliage; not as vigorous. S/ d/
S	Winter-rosette	All	All but poorly drained soils; tol. stony, rough slopes	P	-	12-24 20+	R	2-3	2	Large	D	White	A strong grower that forms a prostrate, tangled, thorny, traffic-resistant cover; requires occasional clipping and dead cane removal; covers steep slopes. d/
S	Winter-rosette	All	All but poorly drained soils; tol. stony, rough slopes	P	-	12-24 20+	R	2-3	2	Large	D	Pink	A prostrate, strong-growing vine similar to <i>R. wichura</i> but with bright pink flowers. d/
S	Winter-rosette	All	Pref. medium to well-drained soils; tol. dry soils, rough slopes	P	T	10-20 15	R	2-3	2	Large	I	Greenish	A vigorous climbing vine of loose habit; showy scarlet fall foliage, black berries; will climb. d/ S/ f/
D	Winter-rosette	All	tol. dry soils, rough slopes; Pref. heavy moist soils; slopes	P	T	24-48 20+	R	2-3	2	Large	I	Greenish	A twining vine with spines which make it a good barrier plant; fruit smaller than other bittersweets; male and female plants. S/ S/ f/
L	Winter-rosette	All	tol. dry soils, rocky slopes; Pref. heavy moist soils; tol. dry soils, rocky slopes	P	T	24-48 20+	R	2-3	2	Large	I	Greenish	A scrambling-type vine with branched woody stems; showy yellowish orange autumn fruit; male and female plants. S/ S/ f/
D	Winter-rosette	All	tolerates moist to wet soils	P	T	12-18 12+	R	2-3	1	Large	I	Greenish	A rampant ground cover of ivy-like foliage usually killed to the ground in winter, but quickly grows back in spring; very aggressive. d/ S/ g/
D	Winter-rosette	All	Pref. well-drained soils; tolerates all but wet soils	P	T	18-36 75+	P	4-6	1	Very Large	D	Purple	Fastest growing of all woody vines; coarse-textured vine that must be kept prostrate and confined; do not plant near trees. S/

TABLE A-4. OPTIMAL AREA PLANTING (WITH GROUND COVERS, VINES, SHRUBS, AND TREES)

Plant Name	Soil	Area	Site	Soil	Plant	Height	Flower	Fruit	Color	Notes
Almond (Prunus amygdalus)	All	Al	Al	Al	Al	Al	Al	Al	Al	A true dwarf shrub with drooping branches that root as they touch the ground.
Prickly Pear (Cholla)	All	Al	Al	Al	Al	Al	Al	Al	Al	A low, dense, irregular, spreading shrub; forms colonies; brilliant autumn foliage and fruit.
Blackberry (Rubus occidentalis)	All	Al	Al	Al	Al	Al	Al	Al	Al	An upright clump-type shrub with rooting branches; good for naturalizing and clump plantings.
Black Chokeberry (Aronia melanocarpa)	All	Al	Al	Al	Al	Al	Al	Al	Al	A suckering shrub of loose habit with upright stems; good woodland border plant; black berries and red foliage in autumn.
Black Rose (Rosa sp.)	All	Al	Al	Al	Al	Al	Al	Al	Al	A low, dense, freely suckering, moundlike shrub; thickets form; profuse bloomer.
Blackberry (Rubus occidentalis)	All	Al	Al	Al	Al	Al	Al	Al	Al	A low shrub with slender clustered stems and gray foliage; and long, deep-set root.
Blue Arctic Willow (Salix arctica)	All	Al	Al	Al	Al	Al	Al	Al	Al	Dense tufts; can be sheared; foliage has blue cast.
Blue Arctic Willow (Salix purpurea nana)	All	Al	Al	Al	Al	Al	Al	Al	Al	
4 to 6 ft.										
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	A vigorous shrub with pendulous, spreading, rooting branches.
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	A much-branched, thick-forming shrub; spreads vigorously by underground suckers; give plenty of space; excellent soil stabilizer.
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	Forms dense mat of erect stems; foliage, fruit, and stems scarlet in autumn; spreads by underground stems; clump or contour row plantings.
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	A slender, loosely ascending shrub with showy white autumn fruit.
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	A low, freely suckering shrub with slender, upright, spreading branches; clump former; showy coral fruit; excellent soil stabilizer.
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	An erect shrub which increases by underground stems to form a dense mass.
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	A rather open-branched, somewhat spreading yet upright shrub; forms thickets by stoloning branches, especially new ones, are bright red; pith is white.
Shrub (Spiraea)	All	Al	Al	Al	Al	Al	Al	Al	Al	A symmetrical spreading shrub with aromatic deciduous to sub-persistent leaves and trailing, rooting branches; showy waxy-gray berries; male and female plants.

*See bottom of first page of table.

TABLE 11. CRITICAL AREA PLANTING (WITH GROUND COVERS, VINES, SHRUBS, AND TREES)

Evergreen Shrubs	Areas	Site Conditions Required	Sun	Shade	Slow	(ft.)	(Years)	Notes
<u>Needle Evergreen-4 to 6 ft.</u>								
Creeping Juniper (Juniperus horizontalis)	All	Pref. moist, slightly acid, sandy soils; tolerates droughty banks	P	T	M	3-4	2-3	A low-creeping, very hardy shrub with attractive trailing branches of dark green to blue-gray foliage; covers steep, sunny slopes.
Sargent Juniper (Juniperus chinensis sargentii)	All	Pref. moist, slightly acid, sandy soils; tolerates dry soils	P	-	M	3-4	2-3	A low prostrate, creeping shrub with steel-blue foliage; forms dense mat; tolerates salt spray.
Shore Juniper (Juniperus conferta)	Coastal Plain	Sand dunes and seashore; tolerates inland droughty sand	P	-	M	3-4	2-3	A procumbent shrub especially adapted for seashore planting; salt tolerant; requires organic supplement for establishment.
Japanese Juniper (Juniperus pfitzeriana)	All but Mountains	Sandy and loamy, moderately moist soil	P	-	R	3-4	2	A handsome, hardy, low spreading shrub with ascending branches; free from disease and insect problems.
Canada Yew (Taxus canadensis)	All	Pref. moist, acid soils	T	P	S	2-3	2-3	A very hardy, low spreading, straggling, long-lived shrub; showy, scarlet fruit in autumn.
<u>Broadleaf Evergreen-4 to 6 ft.</u>								
Prostrate Cotoneaster (Cotoneaster horizontalis)	All but Mountains	Pref. well-drained soils; tolerates poor, dry soils	P	T	M	2-3	2-3	An attractive shrub with flat, horizontal branches; bright red autumn foliage and berries; excellent for short, steep, rocky slopes; do not use bare root stock.
Heathberry Cotoneaster (Cotoneaster dameri)	All but Mountains	Pref. well-drained soils; tolerates dry, rocky slopes	P	T	M	2-3	2-3	A prostrate shrub with long, trailing, often rooting, branches; red berries; covers steep rocky slopes; susceptible to fire blight; do not use bare root stock.
<u>Needle Evergreen-4 to 6 ft.</u>								
Pfitzer's Juniper (Juniperus chinensis pfitzeriana)	All	Pref. well-drained soils; tolerates droughty soils	P	T	R	3-4	2	A broad, often flat-topped, wide spreading shrub; long- lived; very hardy; subject to bagworm infestation.
Japanese Yew (Taxus cuspidata)	All	Moist, well-drained soils with moderate organic matter						A handsome, compact, low shrub with dark green foliage and red fleshy berries in autumn; long-lived.

*see bottom of first page of table

TABLE A-3e. CRITICAL AREA PLANTING (WITH GROUND COVERS, VINES, SHRUBS, AND TREES)

Land Use Area*	Site Conditions Required	Light Tolerates	Growth Medium	Spacing Between Plants (ft.)	Time to Form Cover (Years)	Bloom		Notes
						Distinct	Indistinct	
		Sun	Shade			Color	Color	
All	Nearly all soils; tolerates wet soils	P	T	R	3-4	2	I	Bushy, spreading stoloniferous shrub; suckers freely; colony former.
All	Prof. medium to well drained soils; tol. sandy soils	P	T	S	2-3	2-3	I	A very twiggy, compact shrub with red autumn foliage and berries; forms a deterrent to traffic; thorns toxic to some people.
All	Tol. dry to somewhat poorly drained soils	P	T	M	3-4	2-3	D	A dependable shrub, open branched and suckering; showy red fruit and foliage in autumn.
All	Tolerates dry to medium well drained soils	P	-	M	3-4	2-3	I	A low growing hardy shrub with distinctive horizontal branching; make attractive contour row plantings.
All	Any well drained soil	P	T	R	3-4	2	D	Refined upright shrub free of disease and insects; good for clump or contour row plantings.
All	Any well drained soil; tol. droughty soils	P	-	M	4-5	2-3	I	A straggling shrub with a flattish crown; brilliant scarlet autumn foliage and fruit; colony-former for large areas.
All	Any well drained soil; tol. droughty soils	P	-	M	4-5	2-3	I	One of the most ornamental shrubs; brilliant red fall color; colony-former for large areas.
All	Dry to moderately well drained soils; excellent for dry slopes	P	-	R	4-5	2	I	A very hardy spreading shrub with silvery foliage and abundant red fruit; for large areas.
All	Moderately well drained to well drained soils	P	-	R	4-5	2	I	A dense, pyramidal, upright shrub with stiffly upright, lateral twigs; considerably harder than California privet; large areas.
All	Prefers well drained to moist soils	P	T	P	4-5	2	D	A vigorous bush, upright shrub which spreads from numerous basal shoots; large areas, mass plantings.

*See bottom of first page of table.

TABLE A-11. OPTIMAL AREA PLANTING (WITH GROUND COVERS, VINES, SHRUBS, AND TREES)

Trees	Winter Aspect Evergreen Deciduous	Land Resource Area*	Site Conditions Required	Growth Rate Slow	Spacing Between Plants (ft.)	Height Range (ft.)	Notes
Green Ash (<i>Fraxinus pennsylvanica</i>)	D	All	Moist to wet soils	R	8-10	70	Full sunlight best; fruit is samara, liked by birds; pale yellow to purple in autumn.
White Ash (<i>Fraxinus americana</i>)	D	All	Moist to wet soils	R	8-10	70	Requires full sunlight; fruit is samara, liked by birds; pale yellow to purple in autumn.
Eastern Hemlock (<i>Tsuga canadensis</i>)	E	Mt. & Valleys and Piedmont	Moist soils	M	6-8	60	Grows in shade to full sunlight; drooping branches; good bird and squirrel food in cones.
Red Maple (<i>Acer rubrum</i>)	D	All	Wide range of dry to wet soils	M	8-10	60	Likes partial shade to full sunlight; yellow to red in autumn; fruit is samara.
Striped Maple (<i>Acer saccharum</i>)	D	Mt. & Valleys and Piedmont	Moist soils	M	8-10	60	Likes shade to full sunlight; yellow to red in autumn; fruit is samara.
Black Oak (<i>Quercus velutina</i>)	D	All	Dry to moist soils	M	8-10	60	Good squirrel habitat; part shade to full sunlight; fruit is acorn; good squirrel food.
Chestnut Oak (<i>Quercus prinus</i>)	D	All	Dry to moist soils	M	8-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Live Oak (<i>Quercus virginiana</i>)	D	Coastal Plain	Dry to moist soils	S	8-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Northern Red Oak (<i>Quercus rubra</i>)	D	All	Dry to moist soils	M	8-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Pin Oak (<i>Quercus palustris</i>)	D	All	Dry to wet soils	M	8-10	60	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Scarlet Oak (<i>Quercus coccinea</i>)	D	All	Dry to moist soils	M	8-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Southern Red Oak (<i>Quercus falcata</i>)	D	All	Dry to moist soils	M	8-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Swamp White Oak (<i>Quercus bicolor</i>)	D	All	Wet soils	M	8-10	60	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Water Oak (<i>Quercus nigra</i>)	D	Piedmont	Dry to wet soils	M	7-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
White Oak (<i>Quercus alba</i>)	D	Coastal Plain	Dry to moist soils	M	8-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Willow Oak (<i>Quercus phellos</i>)	D	Piedmont	Dry to wet soils	M	8-10	70	Part shade to full sunlight; fruit is acorn; good squirrel habitat.
Shortleaf Pine (<i>Pinus echinata</i>)	E	All	Dry to moist soils	M	6-8	70	Full sunlight best; fruit is cone.
Norway Spruce (<i>Picea socha</i>)	E	Mt. & Valleys	Moist soils	R	6-8	60	Full sunlight best; fruit is cone; drooping branches.
Sycamore (<i>Platanus occidentalis</i>)	D	All	Moist to wet soils	R	8-10	80	Full sunlight best; fruit is seed ball.

*See bottom of first page of table

MANAGEMENT PRACTICE #7
WATERING

Improved areas containing turf grasses should be watered, if feasible, during extended summer dry periods. A single heavy application of water which saturates the surface soil to a minimum depth of 6 inches is preferred over frequent light waterings. Frequent, light waterings encourage weed infestation, shallow root systems, severe drought injury and disease infestation.

Proper managed grasses can survive long periods of drought. Grasses mowed at 2 to 2-1/2 inches tolerate drought better than those mowed at shorter heights. Although they may turn brown, the grass will remain alive and begin to grow when rain does fall. Water is needed during summer months in order to prolong a green turf. Care must be exercised when watering turf grasses; more turf is damaged by too much water than too little.

It is not practical or economical to irrigate semi-improved areas.

MANAGEMENT PRACTICE #8
MOWINGImproved Grounds

Do not permit lawn grasses to grow too tall between mowings because you should never remove more than about one-third of the green leaf area at one time. This usually means mowing about once a week for most cool-season grasses. More frequent mowing will be needed when grasses are growing very fast and probably less mowing during the summer. If the grass grows too tall, reduce the height gradually. Do not cut it all off at one time.

Keep your mower blade sharp. It not only makes mowing easier, it also results in a healthier, better looking turf. A sharp mower makes a clean even cut instead of leaving grass with ragged and shredded tips. When properly sharpened and adjusted, reel type mowers are preferred, but sharp rotary mowers also give a clean cut and are easier to maintain.

Clippings need to be removed after mowing when they are thick enough on the lawn to shade the grasses or if thatch or disease is a problem. If evenly distributed, clippings will aid the grasses by returning the nutrients contained in them back to the soil. If diseases are a problem, removing clippings may help prevent their further development.

The bluegrasses and fescues should be mowed to a height of 2 to 3 inches above the soil surface. The mowing height for these grasses is probably the single most important factor in determining their longevity. Close mowing greatly restricts root development and the grasses become very susceptible to diseases, heat, and drought damage, traffic injury, and weed infestation. During late spring and summer, close mowing quickly weakens turf and encourages crabgrass invasion. Crabgrass seeds require light to germinate. High mowing in May and June helps shade the crabgrass seedlings and prevents their becoming established.

Semi-improved Grounds

Fields in this category are mowed only to the extent necessary for maintaining a desirable appearance. Normally six to ten mowings per season are adequate. These fields should be mowed to a 4- to 6-inch height. Types of mowers used in these fields are the reel, rotary, and flail-type mowers. Reel mowers designed for use in areas such as air fields and road shoulders perform well where dense grass cover exists and weed control is only a limited problem. Rotary and flail-type mowers are used when weed control is a major problem and where the terrain does not lend itself to the efficient use of reel mowers. Rotary mowers will mow taller grasses than either the reel or flail-type mowers.

Special care should be taken to avoid equipment damage to semi-improved grounds such as roadsides and ditchbanks. Once these areas are damaged by scalping or deep vehicle tracks, erosion may become a problem necessitating reestablishment by liming, fertilizing, seedbed preparation and mulching.

Another control of vegetative growth on such areas is grazing by livestock through the use of grazing leases. This is further discussed in Appendix 3.

Unimproved Grounds

It is recommended that fields in this category which contain grass cover be mowed twice each growing season to control woody vegetation and noxious weeds. The rotary mower can perform satisfactorily under these field conditions.

MANAGEMENT PRACTICE #9
EDGING AND TRIMMING

Careful planning which will provide for an efficient mowing operation can reduce the amount of edging and trimming required in a large portion of the improved areas. Where obstacles interfere with mower operation, grass which is left unclipped must be removed by handclipping for good appearance. Many of the obstacles can usually be eliminated through the use of ground cover plants, approved herbicides, and intelligent planning. Curbs and walks are normally maintained in a satisfactory manner with the mower but will occasionally require edging where the grass has grown beyond its bounds. Good judgment must be exercised in all decisions where edging and trimming is to be performed. Careful consideration should be given to methods of reducing edging and trimming.

Excessive edging and trimming operations are required under some types of landscape planting, and adjacent to obstacles such as benches or poles. This operation can be drastically reduced or eliminated completely in some areas by the use of Management Practice #6, Low Maintenance Ground Covers, and crushed rocks, gravel, and similar material. Landscape plants should be mulched with peat moss, coca bean mulch, pine needles, or other acceptable material which will help reduce edging and trimming requirements.

Formal hedges of privet, or yew require annual pruning in order to confine them to the desired height or shape. Except for privet, one trimming in the spring before new growth has started or in mid to late summer after growth has ceased will be sufficient. Privet hedges will require three to four trimmings per season to maintain a good appearance. Care should be exercised to select planting materials which do not require trimming in order to maintain a good appearance. Care should be exercised to select planting materials which do not require trimming in order to maintain their attractiveness, or which grow too large for the location planted.

MANAGEMENT PRACTICE #10
OVERSEEDING AND RENOVATION

Overseeding is performed when it is desirable to improve the density of the existing stand of grass cover. This operation may be accomplished in improved fields by raking, verti-cutting, or disking to remove as much debris from the turf as possible and seeding as outlined in Management Practice #2, Seedbed Preparation. Some soil disturbance is desirable. Old sod may be treated with chemicals followed by verti-cutting or disking after the sod dies.

Semi-improved fields should be scarified with a harrow or rake prior to seeding. Areas subject to erosion should be protected to prevent erosion of the seedbed.

Renovation is performed in fields where the existing cover has deteriorated to the extent that it no longer provides adequate cover. Lawn areas which contain over 50% undesirable vegetation require renovation. Semi-improved fields which are not adequately protected from erosion will require renovation; overseeding methods outlined above will correct poor cover conditions in these fields.

The following steps are recommended for renovating improved areas:

1. Scarify the area with a rake, disk, verti-cutter, or mechanical cultivator and remove all debris.
2. Spread the lime and fertilizer requirement uniformly over the area. Rates and analysis of fertilizer used should be based on soil test results. Seed as outlined in Management Practice #2, Seedbed Preparation.
3. Roll the seeded area with a cultipacker or other suitable land roller and mulch with small grain straw. Mulching is not necessary when remnants of the sod furnish cover and soil protection.

For seeding recommendations, refer to table of seeding recommendations contained in Appendix C.

MANAGEMENT PRACTICE #11
WEED CONTROL RECOMMENDATIONS

A high incidence of weeds in turf grass is generally an indication of improperly applied fertilizers or mowing practices. Minor weed control may be performed where practical in order to reduce other time-consuming operations such as edging.

Undesirable vegetative growth along fence lines, curbs adjacent to structures, and other obstacles may be effectively controlled with herbicides. Soil sterilants are commonly used to control all vegetative growth in areas of this type. Extreme care must be exercised in selecting and applying soil sterilants to prevent damage to landscape plantings, grass cover on slopes, or other vegetative cover. Runoff water may carry a soil sterilant to an area containing desirable vegetative cover. Such possibilities must be considered when applying the chemical. These same precautions apply to other herbicide materials.

A general herbicide listing is not included as each weed problem should be reviewed individually and have recommendations developed to fit the specific problem.

CAUTION

Chemicals can be harmful. Handle according to applicable laws. Keep out of reach of children and pets. Avoid prolonged or repeated contact with skin and be sure to thoroughly wash after handling chemicals. Keep away from animals and food. The Pest Control Coordinator is responsible for all weed control functions.

MANAGEMENT PRACTICE #12
EROSION CONTROL--METHODS AND MATERIALS

All newly seeded areas require protection from erosive elements in order to obtain adequate cover. The following methods and materials, or combination of materials, should be selected for seedbed protection as part of the seeding operation. None of the protective materials listed will replace the need for good vegetative cover; their primary use is to aid the successful establishment of vegetative cover, particularly in critical areas.

Mulch

Small grain straw, such as barley, rye or wheat straw, not hay, make suitable mulching materials. It is to be applied to all newly seeded areas except those to be covered with jute or other such materials. The mulch is to be anchored immediately following placement with emulsified or liquid asphalt, by mechanical means using special equipment, or by mulch netting.

Wood Cellulose Blanket

This material is suitable for use on seeded areas where water turbulence is not a problem. It is stapled in place with flat top U staples. It serves as a mulch and an erosion retardant.

Gravel

One-fourth to one-half inch in size, screened gravel can be used to stabilize an area.

There are other practices that can be used in erosion control. These are listed in the Virginia Erosion and Sediment Control Handbook, 1980. A reference copy is available at the Tri-County SWCD Office.

MANAGEMENT PRACTICE #13
SOIL TESTING PROCEDURES

It is suggested that when optimum pH and fertility levels have been attained, soil tests be obtained a minimum of every two years. Permanent records of soil test results by area or field should be maintained by Grounds Maintenance personnel as supporting data for the application of a continuing fertilization program. These records are essential for determining the required frequency of liming and fertilizing for improved and semi-improved areas. All lime and fertilizer applications are to be made on the basis of these soil test results.

The following procedures are to be followed in order to obtain satisfactory soil samples for testing

1. Use a soil probe or auger to obtain a core. If necessary, a shovel may be used if care is exercised to ensure that only a small portion of the slide is retained as a sample. Remove leaves, sticks, and stones from soil sample.
2. In establishing grass fields or lawns in improved areas, sample only the upper 2 inches. Obtain samples to a 6-inch depth in areas which have been prepared for seeding. Obtain two samples from lawn areas and 15 to 20 samples in semi-improved fields. Mix the samples from each field or lawn area sampled and make a composite sample for that field or area.
3. Air dry and number each sample. Record the type of grass to be grown, indicate if it is to improve the existing cover or establish a new cover, state lime and fertilizer treatment to date, and indicate purpose of cover (erosion control, lawn, athletic field).
4. Deliver the sample to: NDW Horticulturist, Department of Public Works, Washington Navy Yard, Washington, DC 20374.

MANAGEMENT PRACTICE #14
EQUIPMENT

The effectiveness of a good management program, especially for lawns, is entirely dependent upon the use of the proper type of mowing equipment. When the proper equipment has been selected, the next item of importance is equipment maintenance. Even the very best mowing equipment cannot perform properly unless it is kept sharp and in proper adjustment. Regular, frequent inspections should be made of all mowing equipment to ensure that they are sharp and properly adjusted.

Many types and sizes of mowers are available, ranging from small hand-operated mowers to a large self-propelled gang unit. Mower selection depends upon the size of the area to be mowed, type of cover, topography, the use which is to be made of the area, and availability of repairs and service.

The following is a list of various types of equipment which are available and their general use.

Rotary Mower

The rotary mower is one of the most versatile types of mowers available and can be used for a variety of mowing conditions. Small hand-operated or self-propelled units may be used for trimming operations following mowing operations performed with reel mowers. Generally, this mower is used where the control of weeds and woody vegetation is of importance, both semi-improved and unimproved areas.

Frequent maintenance is necessary for optimum mowing results. The blade requires frequent sharpening and balancing to ensure clean cutting and to prevent damage to the mower. Also, these rugged machines are subjected to severe mowing conditions and require regular, frequent inspection to prevent major damage to the equipment.

Large self-propelled and tractor-drawn units are available for rugged field conditions. However, the elimination of irregular field surfaces and mower obstacles will substantially improve the efficiency and increase the service of this machine. The mower is recommended for use in semi-improved and unimproved areas and is not recommended for use on good turf grasses. Rotary mowers are available on hydraulic arms to facilitate mowing ditches, slopes, and limited access areas.

Edger

A hand tool with a cutting edge used to shape areas near sidewalks, pavements, and curbs. Suggested reference--see Grounds Maintenance Magazine.

Aerator

On heavy soils or where lawns receive a lot of traffic, soil compaction may be a problem. Aeration of the soil with a mechanical aerifier or a spade fork may help in such cases. This permits water, air, and fertilizer to penetrate faster into the compacted soil. If done properly, aerating will not injure or detract from the appearance of the lawn. Aeration should be done in the fall or early spring when grass is growing fastest.

Sprinklers

Lawn irrigation type equipment for use during dry periods and on new sodded areas.

NSWC MP 84-147

APPENDIX B
SUPPLEMENTARY PLANS

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NSWC MP 84-147

APPENDIX B-1

SOIL AND WATER CONSERVATION

Agricultural Outlease Plan for the
NAVAL SURFACE WEAPONS CENTER
Dahlgren Laboratory

Prepared by
Naval Surface Weapons Center,
Public Works Office

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INTRODUCTION

LOCATION

The Naval Surface Weapons Center, Dahlgren Laboratory is located in the Northern Neck Region of Virginia on the Potomac River. The Station is divided by the Upper Machodoc Creek into the Main Site on the north and the Explosive Experimental Area (Pumpkin Neck) on the south. The Dahlgren facility is 28 miles east of Fredericksburg, Virginia, and 53 miles south of Washington, DC. (see Figure B-1-1).

CLIMATE

The NSWC, Dahlgren Laboratory is located in the temperate climate zone of the Eastern United States. The average temperatures by season are: Spring, 55.7°F; Summer, 74.6°F; Autumn, 58.1°F; and Winter 37.9°F. The average annual rainfall is approximately 40 inches per year, with approximately 56 percent of this falling between April 1 and September 30. There is a great deal of variation in the average rainfall in the Dahlgren area. Over a recent 30-year period, precipitation at Dahlgren ranged from 27.4 to 54.8 inches, a variation of 100 percent. Although rainfall is greatest in the summer months, it is commonly insufficient because of the greater demand at this time for moisture by vegetation, and much of this rainfall occurs during heavy thundershowers resulting in considerable runoff.

SOILS

The formation of soil is by weathering and other processes that act upon parent material. Soil characteristics at any given point depend upon interaction of parent material, climate, plants, animals, relief, and time. Climate, plants, and animals are the active forces of soil formation.

Parent material is the unconsolidated mass from which soil is formed. It is largely responsible for the chemical and mineralogical composition of soil. The primary parent material types in the NSWC, Dahlgren area are fluviomarine and alluvia.

Fluviomarine parent materials are transported materials that have been reworked by stream and marine action. These materials form the parent materials for the Coastal Plain. These materials are composed of transported and reworked sands, silts, and clays that in places are gravelly to extremely gravelly. In a few places, sandy layers have been consolidated to form soft sandstones. Soils formed from fluviomarine materials commonly are strongly acidic to very strongly acidic and low in bases. The texture of the soils reflects the textures of the layers from which they were formed. Most of the sands are quartz, which weathers very slowly; and soils formed in sandy layers have slight to moderate development.

Alluvial parent materials are stream transported and form the basis for soils such as Altavista, Congaree, or Wichkham on terraces and flood plains in both the Piedmont and Coastal Plain areas. Alluvial parent materials are of local origin along smaller streams and drainageways. The alluvium has a mixed lithology because of the wide variety of igneous and metamorphic rocks and fluviomarine deposits found in the uplands. Total thickness of alluvium ranges from several to many feet.

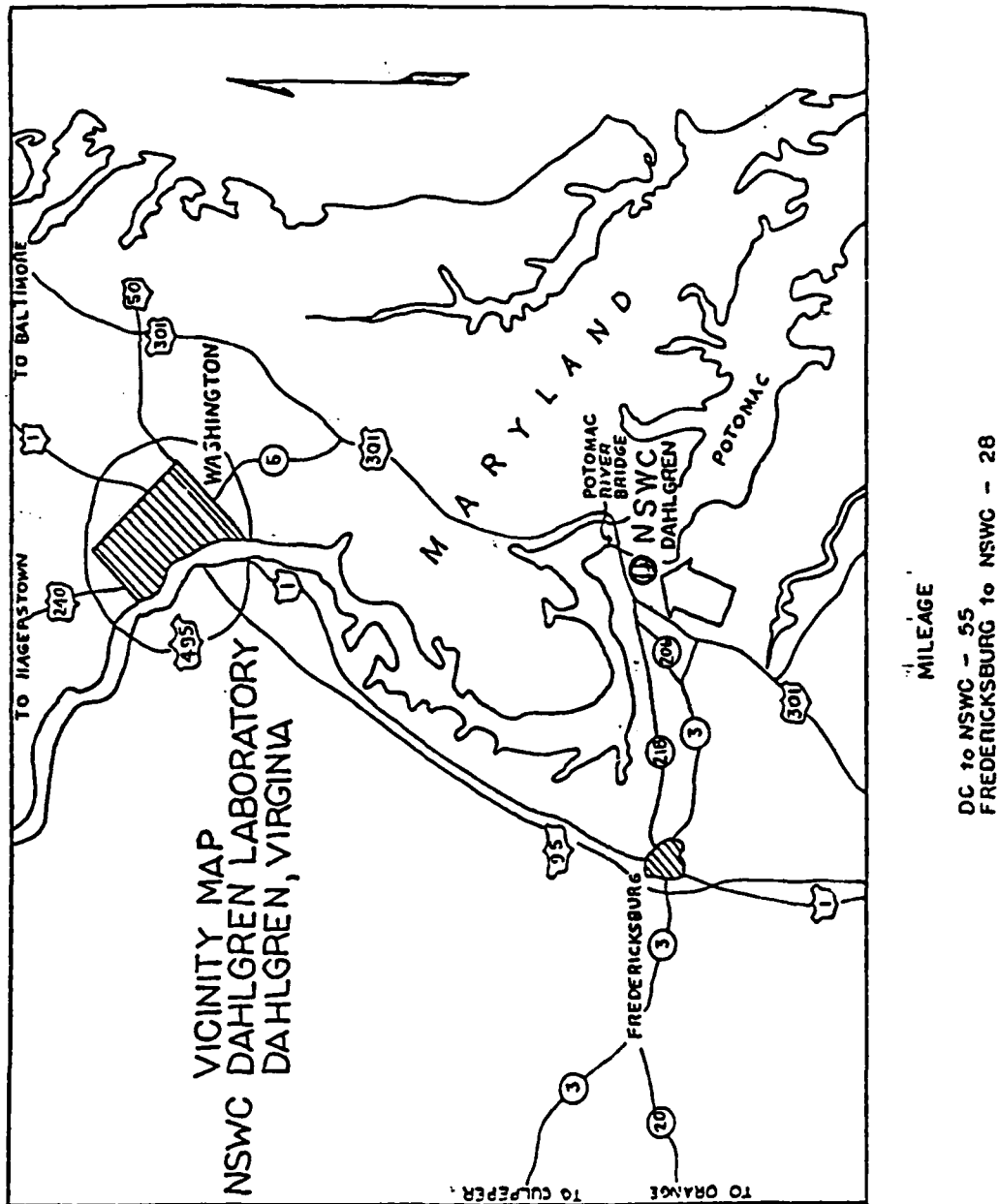


FIGURE B-1-1. VICINITY MAP OF DAHLGREN LABORATORY, DAHLGREN VIRGINIA

Alluvium textures vary widely from fine to coarse, but are commonly medium to coarse in texture. Soils formed in the alluvium are low to moderate in bases and medium acid to strongly acid.

The majority of the soil resource in the potential lease area consists of 56 percent Bladen loam with 0-2 percent slope, and 23 percent Fallsington very fine sandy loam with 0-2 percent slope. Other soils that occur in the agricultural lease areas are Woodstown fine sandy loam 12 percent, Tetotum fine sandy loam 6 percent, and Bertie very fine sandy loam 3 percent.

The Bladen loam soil series consists of deep, poorly drained, nearly level soils on the Coastal Plain lowlands. This soil was formed from loamy and clayey sediment along the Potomac River. Most areas are wooded, but a few have been cleared and used for pasture or general farming. The soil has a seasonal high water table at a depth of about 1 foot. It ponds many times during wet periods. In most areas, artificial drainage is required if the soil is to be cultivated. If the soil is drained, limed, and fertilized, it is suited to water tolerant crops and to pasture.

The Fallsington very fine sandy loam series consists of deep, poorly drained, nearly level soils on lowlands. This soil is formed in loamy and sandy Coastal Plain sediment. Most areas of the Fallsington series in Virginia are wooded. Fallsington soils have a strongly acid to extremely acid subsoil. The subsoil has moderate permeability, and available water holding capacity is moderate. It has a seasonal high water table occurring at 1 to 1-1/2 feet during wet periods. Artificial drainage may be required for farm use. It has limited suitability for most locally grown crops, if it is drained, limed, and fertilized.

The Woodstown fine sandy loam series is a deep moderately well-drained soil. This soil is used for general farming and woodland. The subsoil of this series is medium acid to strongly acid. Permeability and water holding capacity are moderate. This series has a seasonal high water table at a depth of 1-1/2 to 2-1/2 feet. Artificial drainage is beneficial if the soil is farmed. Adequately drained, limed and fertilized, this soil is suited to most locally grown crops.

The Tetotum fine sandy loam series is a deep, moderately well-drained soil. Tetotum soils are important for farming. Tetotum subsoils are strongly acid, low in fertility and organic matter. Permeability and water holding capacity are moderate. This soil has a seasonal high water table at a depth of 1-1/2 to 2-1/2 feet. Artificial drainage is desirable when the soil is farmed. When adequately drained, limed, and fertilized, this soil is well suited to most locally grown crops.

The Bertie very fine sandy loam series is a deep, poorly drained soil. Only small areas are used for farming in Virginia. The subsoil of this series is very strongly acid to extremely acid. Permeability is moderate with a moderate to high water holding capacity. The seasonal high water table is at a depth of 1 to 1-1/2 feet during wet periods. Artificial drainage is required if this soil is cultivated. The soil is suited to most locally grown crops if adequately drained, limed, and fertilized.

COORDINATION WITH THE MILITARY

MILITARY USE

The primary mission of NSWC, Dahlgren, is to function as the principal Navy research, development, test, and evaluation center for the surface ship weapon system, ordnance, mines, and strategic systems support. The agricultural lease operation is secondary and subject to the military requirements for the land. The lessee or his representative, hereinafter referred to as lessee, shall conduct his operation in a manner that will not interfere with military use of activities. All Station regulations regarding health, safety, security, and vehicle travel shall be adhered to by the lessee and his employees.

NOTIFICATION AND COORDINATION

The lessee shall closely coordinate his operations with Station Security personnel (Ext. 8500) and the Natural Resources Specialist (Ext. 8695). The lessee shall provide current telephone numbers where the lessee may be contacted during working and nonworking hours. The lessee or his representative shall be available at all times to correct emergency situations with regard to the lease unit.

ACCESS

Access routes to and from the lease unit or units may be designated by the Station. If designated, such routes will be utilized by the lessee, his employees and agents. Schedules of work will be arranged with Security to coordinate movement by the lessee or his representative into and out of the lease unit or units.

OTHER ACTIVITIES

The right is reserved for others, at the direction of the Station, to conduct conservation programs, fire control and prevention, and pest control on leased areas. Hunting or discharging firearms on the leased unit or units is expressly prohibited.

AGRICULTURAL AND CONSERVATION PRACTICES AND MEASURES

GENERAL

Agricultural and conservation practices and measures contained herein are intended to provide for: (1) the multiple use of these lands for military activities and security, agricultural production, wildlife management, soil and water conservation; and (2) protect the ecological balance of the land to insure the continued productivity of the land while permitting economic returns to the lessee. It is the intent of the Government that the land be utilized in accordance with sound soil, water, and crop management practices consistent with concurrent multiple use.

Protection of the Station's resources from deterioration by erosion, wildfire, noxious weeds, rodents, and other pest infestation, or other detriments is considered part of the sound lease management to be carried out by the lessee. The lessee will be required to carry out the planned soil and water conservation improvements on the priority scheduled basis outlined in Appendix B-1.3--Schedule of Conservation Work, exceptions to the schedule being when funds are not available if the work is reimbursable, or if instructed otherwise by the Natural Resources Specialist. All improvements constructed or installed hereunder remain the property of the Government upon expiration of the lease.

CROP MANAGEMENT

The lessee may cultivate locally adapted row and field crops. No crop receiving federal price support (i.e., tobacco) may be grown. Turf farming is expressly prohibited. The outlease unit lands shall not be used to qualify for crop subsidy payments by the Department of Agriculture, nor may a lessee apply for or receive USDA-SCS payments under the ACP program for conservation projects performed on the outlease unit.

The lessee shall perform the best management and conservation practices recommended for the area in order to maintain soil tilth, fertility, and to reduce wind and water erosion.

IRRIGATION

The lessee will be required to provide all pertinent irrigation equipment, including motors, pumps, valve openers, surface lines, etc., as needed to deliver irrigation water to lease units. Irrigation of the lease units will be done only with prior permission and approval of the Natural Resources Specialist. Permission and approval of irrigation will be based on the availability of irrigation water and the Station mission and status at the time of the request.

Irrigation water will be applied by the lessee in quantities and at frequencies that will meet the needs of the crops grown, with allowances for peak consumptive uses, and in a manner that will provide proper penetration without causing erosion. The lessee will be responsible for repair and restoration of any outlease or Station land or facilities damaged or degraded by negligent irrigation water management, as well as damages that may result from such mismanagement.

MANAGEMENT OF MAINTENANCE AREAS

Any outlease area not cultivated for crop production shall be considered a maintenance area. The lessee, at his own expense, will be required to control weeds on the maintenance area, and maintain vegetation at a maximum height of 18 inches year round. The lessee may control vegetation on maintenance areas only by mowing or chopping. The use of herbicides or discing is prohibited for the control of vegetation on maintenance areas. Maintenance areas are clearly identified in Appendix B-1.4.

PEST MANAGEMENT

The lessee, at his own expense, shall vigorously undertake to control all noxious or undesirable weeds and undesirable rodents, insects and other pests on the leased area. Should the lessee fail to provide said pest control in accordance with this agreement, the Government may arrange for pest control services. The lessee shall then be required to reimburse the Government for said services. The following procedures apply for pest control.

1. Mechanical Methods for Weed Control

If the lessee elects to control weeds in areas other than designated maintenance areas by mechanical means, such as mowing, discing or chopping, the operation shall be accomplished by the lessee at his own expense. This method of weed control will be done at least twice during the year; once prior to the maturing of weed seeds; and once again to control late growing summer weeds.

2. Pesticides

As used herein, the term pesticide includes herbicides, insecticides, fungicides, rodenticides, algacides, and avicides. With regard to all actions relating to pest control undertaken by the lessee or his agents, the lessee shall assume full responsibility for and comply with all federal, state and local standards for the prevention, control, and abatement of environmental pollution. All applications of pesticides shall be at the lessee's expense and shall be accomplished in compliance with Department of Defense requirements for safety, effectiveness and environmental protection. In this regard, the services of the Pest Control Coordinator (W632, telephone 703-663-7100), hereinafter referred to as the PCC, will be provided as needed. In addition, any state or county permit required for application of a particular pesticide shall be obtained by the lessee prior to application. Specific and complete information of the lessee's proposed pesticide program will be furnished by the lessee a minimum of five working days prior to any pesticide application. Said information shall be provided directly to and as required by the PCC. This information will include the following: (a) common name and concentration of the product (pesticide); (b) formulation of the product; (c) approximate amount of the product to be used; (d) target pest; (e) crop and approximate acreage to be treated; (f) application rate per acre; and (g) approximate time and frequency of application. Additional advisory assistance on how to submit the above information is available upon request from the PCC. Only those pesticides reported to and approved by the PCC shall be utilized by the lessee. The Government may provide a trained and certified pest controller to observe and approve all pest control operations on the leased area.

ROAD DAMAGE PREVENTION

The lessee shall not maneuver "track-laying", or "spike-wheeled" vehicles over the paved roads of the Station unless road protective measures are provided. The lessee shall be liable for the costs of repairing any paved road on the Station which is damaged or cut by any equipment under his supervision or authorization.

DEBRIS REMOVAL

The lessee shall insure proper cleanup of areas used by his personnel and agents. The lessee, at his own expense, shall dispose of all refuse and debris generated at his work sites to the satisfaction of the Natural Resources Specialist. The lessee shall promptly clean up any spillage on Station roads which result from the hauling of crops or other lease related activities.

STORAGE FACILITIES REQUIREMENTS

The storage of equipment, fuel and oil, pesticides, or any other materials is subject to approval by the Station. If the Station provides a storage area, it is the lessee's responsibility to provide fencing, maintenance of the area, and upkeep of all buildings if buildings are provided. The Station reserves the right to approve the type of fencing to be used around storage areas. Maintenance of the storage area will include, but not be limited to, keeping the area free of trash and debris; repair of damage to the grounds caused by the lessee's activities; cleanup of oil or chemical spills; and mowing grass or weeds at a height not to exceed 3 inches inside the storage area and 3 inches on the outside of the fenced storage area a distance of 8 feet around the entire storage facility. Maintenance of buildings, if so provided, includes, but is not limited to, repair of all damage caused by the lessee or his agents to the buildings provided.

FIRE PREVENTION

The lessee, his agents and all persons in his employ shall perform all operations in a manner to prevent and/or reduce fire hazards. The lessee shall comply with the Station's fire control and prevention regulations (a copy of which may be obtained from the Station's Fire Department). The following practices are required and must be undertaken by the lessee at his own expense:

1. Equipment

All engine driven equipment utilized by the lessee on the Station must be equipped with properly operating spark arresters, mufflers and tailpipe assemblies. In addition, any 1975 or newer vehicle having a catalytic converter pollution control device may not be driven off of improved roads due to the extreme heat generated by these devices.

2. Storage of Equipment and Flammable Materials

If storage facilities are provided, equipment fuel and oil, and chemicals shall be stored in a safe and orderly manner. The storage area shall be kept neat and orderly at all times. Extreme care shall be taken by the lessee and his agents to reduce the risk of fire in the area.

In the event of accidental or uncontrolled fire, the lessee shall immediately contact the Station's Fire Department (Telephone Ext. 8333).

NSWC MP 84-147

APPENDIX B-1.1

CLIMATOLOGICAL DATA FOR DAHLGREN,
KING GEORGE COUNTY, VIRGINIA

B-13/(B-14 blank)

TABLE B-1.1-1. TEMPERATURE AND PRECIPITATION DATA* (DATA FROM RECORDS AT DAHLGREN, KING GEORGE COUNTY, VA.)

Month	2 Years in 10 Will Have At Least 4 Days With--				Precipitation				Average Snowfall (in.)
	Temperature		Maximum Temperature Higher Than (°F)	Minimum Temperature Equal to or Lower Than (°F)	Average Total (in.)	1 year in 10 will have--			
	Maximum (°F)	Minimum (°F)				Less than-- (in.)	More than-- (in.)		
	Average Daily		Maximum Temperature Higher Than (°F)	Minimum Temperature Equal to or Lower Than (°F)	Average Total (in.)	Less than-- (in.)	More than-- (in.)		
	Maximum (°F)	Minimum (°F)							
January	45	29	63	17	3.2	1.4	6.0	3.9	
February	47	30	64	19	2.4	1.1	3.8	3.4	
March	55	36	73	27	3.2	1.5	5.3	1.9	
April	65	45	82	37	2.1	1.6	6.0	.1	
May	74	55	87	46	3.1	.9	5.5	.0	
June	83	64	93	56	3.2	1.1	5.6	.0	
July	86	69	94	63	4.6	1.2	7.5	.0	
August	84	67	93	61	4.5	.6	10.6	.0	
September	79	61	89	51	3.8	.8	11.2	.0	
October	68	49	82	40	3.0	1.3	4.8	(1)	
November	57	39	72	29	2.4	.7	4.5	.7	
December	47	31	61	19	3.0	.9	5.1	2.3	
Year	66	48	98 (2)	12 (3)	39.5	30.9	51.8	12.3	

(1) Less than 0.05 inch

(2) Average annual highest temperature

(3) Average annual lowest temperature

*Taken from: Soil Survey, Stafford and King George Counties, Virginia. Prepared by USDA, SCS, in cooperation with Virginia Polytechnic Institute and State University, February, 1974.

TABLE B-1.1-2. PROBABILITIES OF LAST FREEZING TEMPERATURES IN SPRING
AND FIRST IN FALL (ALL DATA FROM RECORDS AT DAHLGREN,
KING GEORGE COUNTY, VA.)

Probability	Dates for Given Probability and Temperature			
	32°F or lower	28°F or lower	24°F or lower	20°F or lower 16°F or lower
Spring				
1 year in 10 later than	Apr. 20	Apr. 8	Mar. 27	Mar. 18
2 years in 10 later than	Apr. 14	Apr. 1	Mar. 20	Mar. 11
5 years in 10 later than	Apr. 3	Mar. 20	Mar. 8	Feb. 25
				Feb. 1
Fall				
1 year in 10 earlier than	Oct. 27	Nov. 8	Nov. 15	Nov. 25
2 years in 10 earlier than	Nov. 1	Nov. 13	Nov. 20	Nov. 30
5 years in 10 earlier than	Nov. 11	Nov. 22	Nov. 30	Dec. 11
				Dec. 5
				Dec. 11
				Dec. 26

*Taken from: Soil Survey, Stafford and King George Counties, Virginia. Prepared by
USDA, SCS, in cooperation with Virginia Polytechnic Institute and State University.
February, 1974.

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APPENDIX B-1.2

SOILS

B-17/(B-18 blank)

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INSERT TABLES
IDENTIFYING PERCENT SOIL TYPE
BY OUTLEASE UNIT AND ACREAGE OF SOIL TYPE
BY OUTLEASE UNIT

B-19/(B-20 blank)

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APPENDIX B-1.3

SCHEDULE OF CONSERVATION WORK

B-21/(B-22 blank)

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INSERT SCHEDULE
OF
CONSERVATION WORK PER OUTLEASE UNIT

B-23/(B-24 blank)

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APPENDIX B-1.4

MAINTENANCE AREAS WITHIN THE OUTLEASE UNITS

B-25/(B-26 blank)

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INSERT MAINTENANCE REQUIREMENTS

PER OUTLEASE UNIT

B-27/(B-28 blank)

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APPENDIX B-1.5
DIRECTORY OF CONTACTS

B-29/(B-30 blank)

DIRECTORY OF CONTACTS

I. Naval Surface Weapons Center

A. Natural Resources

P. H. Schoenfeld (W053)
Natural Resources Branch
Extension 8695

B. Safety

J. W. Warden (X32)
Accident Prevention Branch
Extension 8684

C. Security

J. F. Blakely (X124)
Physical Security Section
Extension 8500

D. Fire Protection

T. G. Peery (X122)
Fire Protection Section
Extension 8726

E. Pest Control

R. C. Conley (W632)
Pest Control Coordinator
Extension 7100

II. Chesapeake Division, Naval Facilities Engineering Command

J. Hautzenroder (243)
Natural Resources Branch
(202) 433-3586
(Autovon--288-3586)

S. Aschman
Natural Resources Branch
(202) 433-3586
(Autovon--288-3586)

III. United States Department of Agriculture

R. Wisniewski
District Conservationist
USDA/Soil Conservation Service
601 Caroline Street
Fredericksburg, Virginia 22401

IV. Virginia Cooperative Extension Service

Extension Agent, Agriculture
P. O. Box 147
King George, Virginia 22485
(703) 773-3062

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APPENDIX B-1.6

MAP

B-33/(B-34 blank)

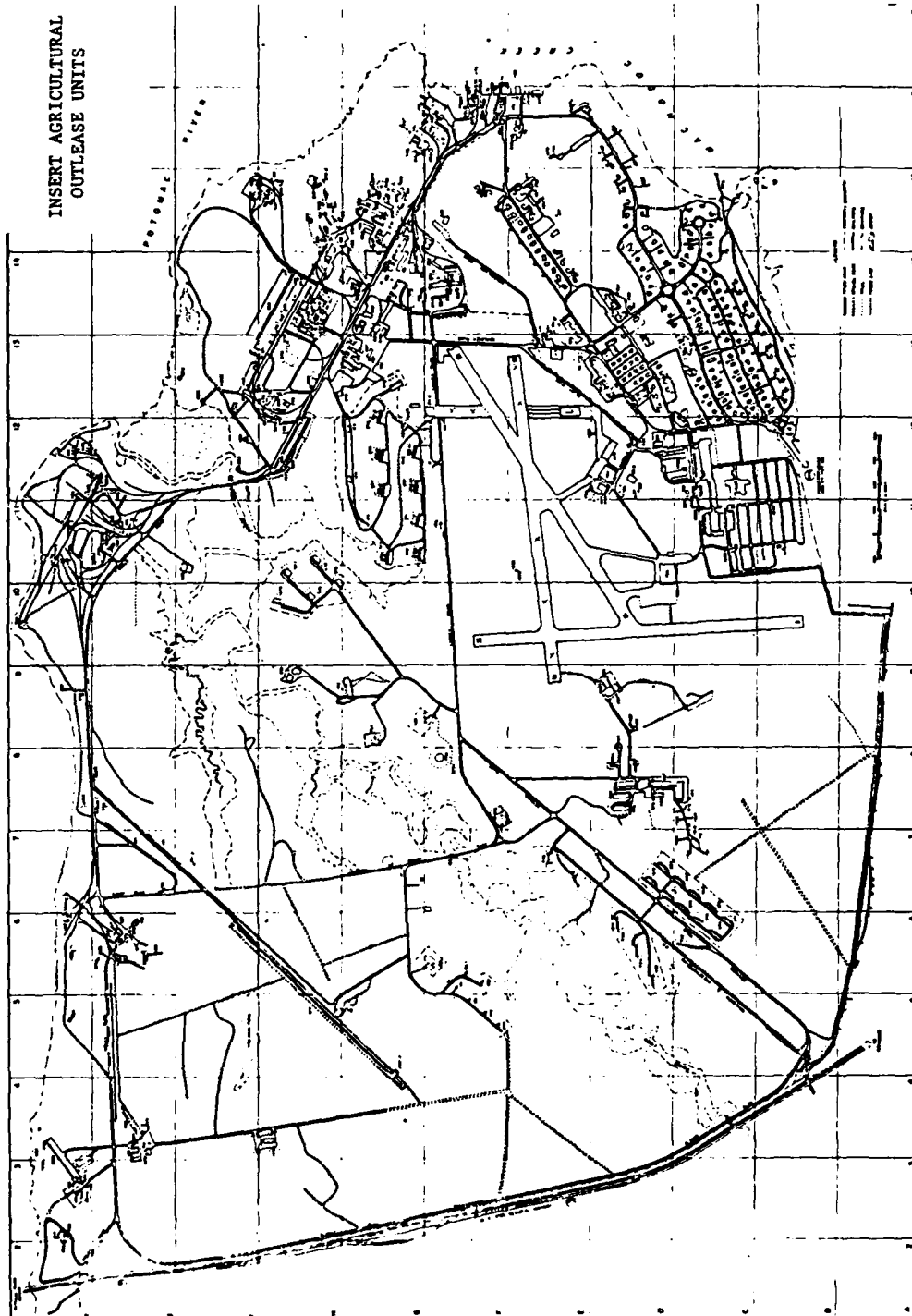


FIGURE B-1.6-1. AGRICULTURAL OUTLEASE UNITS

APPENDIX B-2

SOIL AND WATER CONSERVATION

Grazing Outlease Plan for the

NAVAL SURFACE WEAPONS CENTER

Dahlgren Laboratory

Prepared by

NSWC, Public Works Office

and

Chesapeake Division, Naval Facilities Engineering Command
Natural Resources Management Branch

NSWC MP 84-147
DEPARTMENT OF THE NAVY
LEASE FOR AGRICULTURAL
OR GRAZING PURPOSES

CONTRACT NUMBER
NF(R)

LEASE BETWEEN

HEREINAFTER CALLED THE "LESSEE" AND THE UNITED STATES OF AMERICA, HEREINAFTER CALLED THE "GOVERNMENT."

THE GOVERNMENT HEREBY LEASES TO LESSEE THE PROPERTY DESCRIBED BELOW UNDER THE TERMS, CONDITIONS, GENERAL PROVISIONS AND SPECIAL PROVISIONS SET FORTH ON THIS PAGE AND SUBSEQUENT PAGES OF THIS LEASE FORM.

1. LEASED PROPERTY: ALL THAT PORTION OF THE NAVAL ACTIVITY IDENTIFIED IN ARTICLE 9, WHICH PORTION IS HEREIN- AFTER CALLED THE "PREMISES" AND DESCRIBED AS FOLLOWS: Magazine Storage Areas 1-5 consisting of approximately 104 acres at NSWC/DL, Dahlgren, VA as indicated in Appendix G of this lease
2. TERM: THE TERM OF THIS LEASE SHALL BEGIN ON _____ AND END ON _____ UNLESS SOONER TERMINATED IN ACCORDANCE WITH THE PROVISIONS OF ARTICLE 10H HEREOF.

3. RENT: LESSEE SHALL PAY THE GOVERNMENT ANNUAL RENTAL OF \$ _____, PAYABLE _____ IN ADVANCE OF THE RATE OF \$ _____ PER _____, IN CONFORMITY WITH THE PROVISIONS OF ARTICLE 10H HEREOF.

4. USE: THE PREMISES SHALL BE USED SOLELY FOR the grazing of sheep.

6. EXECUTION BY LESSEE

NAME OF LESSEE _____

BY _____ (Signature) _____ (Witness)

(Title) (Date)

7. CERTIFICATION BY SECRETARY OR ASSISTANT SECRETARY OF CORPORATE LESSEE

I CERTIFY THAT THE PERSON WHO SIGNED THIS LEASE ON BEHALF OF LESSEE WAS THEN THE OFFICER INDICATED AND THIS AGREEMENT WAS DULY SIGNED FOR AND ON BEHALF OF SAID CORPORATION BY AUTHORITY OF ITS GOVERNING BODY AND IS WITHIN THE SCOPE OF ITS CORPORATE POWERS.

(CORPORATE
SEAL)

(Signature)

(Title)

8. EXECUTION FOR AND ON BEHALF OF THE GOVERNMENT
THE UNITED STATES OF AMERICA

BY _____ (Contracting Officer) _____ (Date) _____ (Witness)

9. NAVY IDENTIFICATION DATA

NAME AND ADDRESS OF NAVAL ACTIVITY

NSWC/DL
Dahlgren VA
22485

ADDRESS OF LESSEE

LOCAL GOVERNMENT REPRESENTATIVE/TITLE AND ADDRESS

Natural Resources Specialist (W053)
NSWC/DL
Dahlgren, VA. 22485

10. GENERAL PROVISIONS

A. REPRESENTATIONS

Lessee has examined, knows and accepts the condition and state of repair of the Premises and all appurtenances thereto and acknowledges that the Government has made no representation concerning such condition and state of repair, nor any agreement or promise to alter, improve, adapt, repair or keep in repair such Premises and appurtenances, or any item thereof, which has not been fully set forth in this lease which contains all the agreements made and entered into between Lessee and the Government.

B. PROHIBITION OF FEDERAL SUBSIDY PARTICIPATION

Notwithstanding the uses permitted to it in Article 4 of this lease, Lessee shall at no time during the term of this lease, or any extension thereof, use the Premises or its interest therein in any manner which shall constitute direct participation in any subsidy program of the Federal Government relative to either the use or abstention from use of the Premises.

C. SUBJECTION TO GOVERNMENT LAND USE CONSERVATION PLAN

During the term of this lease the Lessee shall apply the conservation measures and use the Premises in accordance with the land use conservation plan attached hereto and made a part hereof. Lessee shall in no manner substantially change the contour or condition of the land constituting any part of the Premises except for such changes as shall be reasonably required to effect soil or water conservation measures.

D. INSTALLATIONS AND REMOVALS

Subject to the prior written approval of the Government, Lessee shall have the right to erect, at its own expense, such temporary structures on the Premises as may be necessary or incidental to its use thereof under this lease. All such structures shall remain the property of Lessee and Lessee shall remove same from the Premises prior to the expiration of the term of this lease, as the same may be extended, or the earlier termination thereof; *Provided*, in the event the Government shall terminate this lease upon less than thirty (30) days notice Lessee shall have thirty (30) days from receipt of notice of termination to accomplish such removal. All property not so removed shall be deemed abandoned by Lessee and may be used or disposed of by the Government in any manner whatsoever without any liability to account to Lessee therefor, but such abandonment shall in no way reduce any obligation of Lessee hereunder to restore the Premises.

E. SUBJECTION TO EXISTING AND FUTURE EASEMENTS AND RIGHTS-OF-WAY

This lease is subject to all outstanding easements and rights of way for location of any type of facility over, across, in and upon the Premises, or any portion thereof, and to the right of the Government to grant such additional easements

and rights of way over, across, in and upon the Premises as it shall determine to be in the public interest; *Provided*, that any such additional easement or right-of-way shall be conditioned on the assumption by the Grantee thereof of liability to Lessee for such damages as Lessee shall suffer for crops or property destroyed or property rendered unusable on account of Grantee's exercise of its rights thereunder. There are also reserved to the Government, and its assignees, all mineral rights in the Premises, together with such rights of access and use of the surface as may be necessary for the mining and saving of any mineral deposits located thereon or thereunder. There are hereby reserved to the holders of such easements and rights-of-way as are presently outstanding or which may hereafter be granted, to any workers officially engaged in the construction, installation, maintenance, operation, repair or replacement of facilities located thereon, and to any Federal, State or local official engaged in the official inspection thereof, such reasonable rights of ingress and egress over the Premises as shall be necessary for the performance of their duties with regard to such facilities.

F. RESTORATION OF PREMISES

Before the expiration of this lease or the prior termination thereof, Lessee shall, if required to do so by the Government, restore the Premises to the condition existing at the time of its entrance thereon under this lease, or to such improved condition as they may have been placed in by the Government or the Lessee during the term of this lease, reasonable wear and tear and damage by the elements or from other causes over which Lessee had no control excepted; *Provided*, in the event the Government shall terminate this lease upon less than thirty (30) days notice Lessee shall have thirty (30) days from receipt of notice of termination to accomplish such restoration.

G. LIENS

Lessee shall promptly discharge or cause to be discharged any valid lien, right in rem, claim or demand of any kind, except one in favor of the Government, which at any time may arise or exist with respect to the Premises or materials or equipment furnished therefor, or any part thereof, and if the same shall not be promptly discharged by Lessee, the Government may discharge, or cause to be discharged, the same at the expense of Lessee.

H. TERMINATION BY GOVERNMENT

The Government shall have the right to terminate this lease, in whole or in part, at any time, without prior notice, and regardless of any lack of breach by Lessee of any of the terms and conditions of this lease. In the event of termination for any reason not involving a breach by Lessee of the terms and conditions of the lease the Government shall make an equitable adjustment of any advance rentals paid by Lessee hereunder and, if the Government's use of the Premises does not require immediate possession thereof, Lessee shall be permitted, within such time as the Local Government Representative shall prescribe, to harvest, gather and remove from the Premises such crops as can be so harvested and removed, but if the Government's requirements necessitate immediate repossession of the Premises, so as to require immediate removal of Lessee's livestock, and/or,

to preclude Lessee from such harvesting and removal of any growing or matured crops, Lessee hereby specifically releases, remises, and forever discharges the Government from any and all liability or claims for loss or damage of any nature arising out of such termination and repossession, including, but not limited to, destruction of, diminution in value of, or inability to harvest any growing crops, and/or death or diminution of value of any livestock of Lessee.

In the event that the Government shall elect to terminate this lease on account of the breach by Lessee of any of the terms and conditions hereof no adjustment in advance rentals paid by Lessee shall be made, and the Government shall be entitled to recover and Lessee shall pay to the Government:

- (1) The costs incurred in resuming possession of the Premises.
- (2) The costs incurred in performing any obligation on the part of Lessee to be performed hereunder.
- (3) An amount equal to the aggregate of all rents and charges assumed hereunder and not theretofore paid, less the net rentals, if any, collected by the Government on the reletting of the Premises, which amounts shall be due and payable at the time when the rent reserved under this lease would become due and payable.

The Government may, at its option, attach any livestock or crops of Lessee on the Premises in full or partial satisfaction of Lessee's obligations under this Article.

L. SURRENDER

Upon the expiration of this lease or its prior termination, in whole or in part, Lessee shall quietly, and peacefully remove itself and its property from the Premises, or part thereof as to which this lease shall be terminated, and surrender the possession thereof to the Government. Upon failure or neglect of Lessee to so remove, the Government and its officers or agents may enter the Premises and cause the removal of all persons and property therefrom without recourse to any action or proceeding at law or in equity. Lessee hereby expressly waives any provision of law requiring notice to quit possession of the Premises. Such removal shall be at the sole cost and expense of Lessee and Lessee shall indemnify and save and hold harmless the Government, its officers, agents and employees for and from any and all liability or claims for damages of any nature whatsoever which may arise out of or be attributable to such removal.

J. DAMAGE TO GOVERNMENT PROPERTY

In the event of the destruction of or damage to any Government property located on or adjacent to the Premises by Lessee, or any of its officers, agents, servants, employees, subtenants, licensees or invitees, Lessee shall promptly repair or replace such property to the satisfaction of the Government, or pay to the Government an amount of money sufficient to compensate it for the loss or damage sustained, as the Government shall elect.

K. NON-LIABILITY OF GOVERNMENT

Lessee covenants that it will indemnify and save and hold harmless the Government, its officers, agents and employees for and from any and all liability or claims for loss of or damage to any property owned by or in the custody of Lessee, its officers, agents, servants, employees, subtenants, licensees or invitees, or for the death of or injury to any of the same which may arise out of or be attributable to the condition, state of repair or Lessee's use and occupancy of the Premises, or the furnishing of any utilities or services (including supply of water from wells or other sources), or any interruption therein or failure thereof, whether or not the same shall be occasioned by the negligence or lack of diligence of Lessee, its officers, agents, servants or employees.

L. UTILITIES AND SERVICES

In the event that the Government shall furnish Lessee with any utilities and services maintained by the Government which Lessee may require in connection with its use of the Premises, Lessee shall pay the Government the charges therefor in addition to the cash rent required under this lease. Such charges and the method of payment thereof shall be determined by the Local Government Representative in accordance with applicable laws and regulations, on such basis as the Local Government Representative may establish, which may include a requirement for the installation of adequate connecting and metering equipment at the sole cost and expense of Lessee. It is expressly agreed and understood that the Government in no way warrants the continued maintenance or adequacy of any utilities or services furnished by it to Lessee.

M. ACCESS

The Government shall have access to the Premises at all reasonable times for any purposes not inconsistent with the quiet use and enjoyment thereof by Lessee, including, but not limited to, the purpose of inspection.

N. COVENANT AGAINST CONTINGENT FEES

Lessee warrants that no person or agency has been employed or retained to solicit or secure this lease upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, excepting bona fide employees or bona fide established commercial agencies maintained by Lessee for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this lease without liability or in its discretion to require Lessee to pay, in addition to the rental or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

O. STATE AND LOCAL TAXES

In the event that as a result of any future Act of Congress, subjecting Government-owned property to taxation, any taxes, assessments or similar charges are imposed by State or local authorities upon the Premises (other than upon Lessee's possessory interest therein), Lessee shall pay the same when due and payable and this lease shall be renegotiated so as to accomplish an equitable reduction in the rental provided for herein, which reduction shall in no event exceed the amount of such taxes, assessments, or similar charges; *Provided*, in event the parties hereto are unable to agree within ninety (90) days from the date of the imposition of such taxes, assessments, or similar charges, upon a rental which in the opinion of the Local Government Representative constitutes a reasonable return to the Government on the Premises, then in such event the Local Government Representative shall have the right to determine the amount of the rental, which determination shall be binding on Lessee, subject to appeal as a dispute in accordance with the provisions of paragraph P of this Article 10.

P. DISPUTES

(a) Except as otherwise provided in this lease, any dispute concerning a Question of fact arising under this lease which is not disposed of by agreement shall be decided by the Commander, Naval Facilities Engineering Command, who shall reduce his decision to writing and mail or otherwise furnish a copy thereof to the lessee. The decision of the Commander, Naval Facilities Engineering Command shall be final and conclusive unless, within 30 days from the date of receipt of such copy, the lessee mails or otherwise furnishes to the Commander, Naval Facilities Engineering Command a written appeal addressed to the Secretary of the Navy. The decision

of the Secretary or his duly authorized representative for the determination of such appeals shall be final and conclusive. This provision shall not be pleaded in any suit involving a question of fact arising under this lease as limiting judicial review of any such decision to cases where fraud by such official or his representative or board is alleged: *Provided, however,* that any such decision shall be final and conclusive unless the same is fraudulent or capricious or arbitrary or so grossly erroneous as necessarily to imply bad faith or is not supported by substantial evidence. In connection with any appeal proceeding under this clause, the lessee shall be afforded an opportunity to be heard and to offer evidence in support of his appeal. Pending final decision of a dispute hereunder, the lessee shall proceed diligently with the performance of the lease and in accordance with the decision of the Commander, Naval Facilities Engineering Command.

(b) This "Disputes" clause does not preclude consideration of questions of law in connection with decisions provided for in paragraph (a) above. Nothing in this lease, however, shall be construed as making final the decision of any administrative official, representative, or board on a question of law.

Q. OFFICIALS NOT TO BENEFIT

No Member of or Delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this lease, or to any benefit to arise therefrom but this provision shall not be construed to extend to this lease if made with a corporation for its general benefit.

R. LABOR PROVISION

(1) Equal Opportunity

During the term of this lease the lessee agrees as follows:

(a) The lessee will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; selection for training, including apprenticeship. The lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Government setting forth the provisions of this nondiscrimination clause.

(b) The lessee will, in all solicitations or advertisements for employees placed by or on behalf of the lessee, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(c) The lessee will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding a notice to be provided by the government, advising the labor union or worker's representative of the lessee's commitments under this Equal Opportunity clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(d) The lessee will comply with all provisions of Executive Order 11246 of September 24, 1965, as amended by Executive Order 11375 of October 13, 1967, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(e) The lessee will furnish all information and reports required by Executive Order 11246 of September 24, 1965, as amended by Executive Order 11375 of October 13,

1967, and by the rules, regulations, and orders of the Secretary of Labor or pursuant thereto, and will permit access to his books, records, and accounts by the Government and the Secretary of Labor for purposes of investigating to ascertain compliance with such rules, regulations and orders.

(f) In the event of the lessee's noncompliance with the Equal Opportunity clause of this lease or with any of said rules, regulations, or orders, this lease may be cancelled, terminated or suspended in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, as amended by Executive Order 11375 of October 13, 1967, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, as amended by Executive Order 11375 of October 13, 1967, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(g) The lessee will include the provisions of paragraphs (a) through (g) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, as amended by Executive Order 11375 of October 13, 1967, so that such provisions will be binding upon each sublessee or vendor. The lessee will take such action with respect to any sublessee or purchase order as the Government may direct as a means of enforcing such provisions including sanctions for non-compliance: *Provided, however,* that in the event the lessee becomes involved in, or is threatened with, litigation with sublessee or vendor as a result of such direction by the Government, the lessee may request the United States to enter into such litigation to protect the interests of the United States.

(2) Convict Labor

In connection with the performance of work required by this lease, Lessee agrees not to employ any person undergoing a sentence of imprisonment at hard labor.

(3) Contract Work Hours Standards Act (40 U.S. Code 327-330)

This lease, to the extent that it is a contract of a character specified in the Contract Work Hours Standards Act (40 U.S.C. 327-330) and is not covered by the Walsh-Healy Public Contracts Act (41 U.S.C. 35-45), is subject to the following provisions and exceptions of said Contract Work Hours Standards Act and to all other provisions and exceptions of said law:

(a) The Lessee shall not require or permit any laborer or mechanic in any workweek in which he is employed on any work under this contract to work in excess of 8 hours in any calendar day or in excess of 40 hours in such workweek on work subject to the provisions of the Contract Work Hours Standards Act unless such laborer or mechanic receives compensation at a rate not less than one and one-half times his basic rate of pay for all such hours worked in excess of 8 hours in any calendar day or in excess of 40 hours in such workweek, whichever is the greater number of overtime hours. The "basic rate of pay," as used in this clause, shall be the amount paid per hour, exclusive of the Lessee's contribution or cost for fringe benefits and any cash payment made in lieu of providing fringe benefits, or the basic hourly rate contained in the wage determination, whichever is greater.

(b) In the event of any violation of the provisions of paragraph (a), the Lessee shall be liable to any affected employee for any amounts due, and to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic employed in violation of the provisions of paragraph (a) in the sum of \$10 for each calendar day on which such employee was required or permitted to be employed on such work in

excess of 8 hours or in excess of the standard workweek of 40 hours without payment of the overtime wages required by paragraph (a).

S. NOTICES

No notice, order, direction, determination, requirement, consent, or approval under this lease shall be of any effect unless in writing. All notices required under this lease shall be addressed to Lessee, or to the Local Government Representative, as may be appropriate, at the address thereof specified in Article 9 of this lease or at such other address as may from time to time be agreed upon by the parties hereto.

T. FAILURE OF GOVERNMENT TO INSIST ON COMPLIANCE

The failure of the Government to insist, in any one or more instances, upon performance of any of the terms, covenants or conditions of this lease shall not be construed as a waiver or relinquishment of the Government's right to the future performance of any such terms, covenants or conditions and Lessee's obligations in respect to such future performance shall continue in full force and effect.

U. ASSIGNMENT OR SUBLETTING

Lessee shall not transfer or assign this lease or any interest therein nor sublet or otherwise make available to any third party or parties any portion of the Premises or rights therein without the prior written consent of the Government. Under any assignment made, with or without consent, the assignee shall be deemed to have assumed all the obligations of Lessee hereunder, but no assignment shall relieve the assignor of any of Lessee's obligations hereunder except for an extension of the lease term beginning after such assignment, and then only if the Government shall have consented thereto.

V. GOVERNMENT RULES AND REGULATIONS

Lessee shall comply with such rules and regulations regarding station security, ingress, egress, safety and sanitation as may be prescribed, from time to time, by the Local Government Representative, or by the Commanding Officer of the Naval activity of which the Premises forms a part.

tion as may be prescribed, from time to time, by the Local Government Representative, or by the Commanding Officer of the Naval activity of which the Premises forms a part.

W. PAYMENTS

All payments to the Government required under this lease shall be made by check or postal money order made payable to the Department of the Navy and delivered to the Local Government Representative.

X. INTEREST

Notwithstanding any other provision of this lease, unless paid within thirty (30) days, all amounts that become payable by the Lessee to the Government under this contract (net of any applicable tax credit under the Internal Revenue Code) shall bear interest from the date due until paid and shall be subject to adjustments as provided by Part 6 of Appendix E of the Armed Services Procurement Regulation, as in effect on the date of this lease. The interest rate per annum shall be the interest rate in effect which has been established by the Secretary of the Treasury pursuant to Public Law 92-41; 85 STAT 97 for the Renegotiation Board, as of the date the amount becomes due as herein provided. Amounts shall be due upon the earliest one of (i) the date fixed pursuant to this contract; (ii) the date of the first written demand for payment, consistent with this lease, including demand consequent upon default termination; or (iii) the date of transmittal by the Government to the Lessee of a proposed supplemental agreement to confirm completed negotiations fixing the amount.

Y. ADMINISTRATION

The local Government Representative specified in Article 9 of this lease shall, under the direction of the Commander, Naval Facilities Engineering Command, have complete charge of the administration of this lease, and shall exercise full supervision and general direction thereof insofar as the interests of the Department are affected.

11. SPECIAL PROVISIONS

The following specified additional provisions, which shall control in the event of any conflict with the General

Provisions of Article 10, are hereby incorporated into this lease by attachment hereto.

The attached Grazing Outlease Plan contains special provisions and becomes part of this lease.

INSTRUCTIONS TO BIDDERS

1. If a bidder wishes to make more than one bid, each bid must be made separately.
2. All bids submitted shall be deemed to have been made with full knowledge of all the terms, conditions, and requirements herein contained.
3. The premises described herein will be opened for inspection. Chesapeake Division, Naval Facilities Engineering Command will, upon request, make arrangements for such inspection and will furnish Invitation and Bid forms, a facsimile of the lease, and such further information as may be necessary in connection with the terms and conditions herein contained. The failure of any bidder to inspect or to be fully informed as to the condition of all or any portion of the premises or property offered will not constitute grounds for any claim or demand for an adjustment or withdrawal of a bid after opening.
4. Bids must be executed and submitted in duplicate on the bid form furnished by the Chesapeake Division, Naval Facilities Engineering Command. Bids submitted in any other manner may be rejected.
5. A bid executed by an attorney or agent on behalf of the bidder must be accompanied by three (3) authenticated copies of his power of attorney or other evidence of his authority to act on behalf of the bidder. If the bidder is a corporation, the certificate of corporate bidder must be signed by the Secretary or Assistant Secretary of the corporation, under the corporate seal. In lieu of the certificate of the corporate bidder, there may be attached to the bid, copies of so much of the records of the corporation as will show the official character and authority of the officer signing, duly certified by the Secretary or Assistant Secretary under the corporation seal, to be true copies.
6. It will be the duty of each bidder to see that his bid is delivered within the time and at the place prescribed in the Invitation. Bids received prior to the time of opening will be secretly kept unopened. The person whose duty it is to open them will decide when the time has arrived for such opening, and no bid received thereafter will be considered, except that when a bid arrives by mail after the time fixed for opening, but before the award is made, and it is proved to the satisfaction of the Chesapeake Division, Naval Facilities Engineering Command that the non-arrival on time was due solely to delay in the mails, for which the bidder was not responsible, such bid will be received and considered. No responsibility will attach to the Chesapeake Division, Naval Facilities Engineering Command, the Navy Department, or any agent or employee of the United States of America for the premature opening of a bid not properly addressed and identified.
7. Bids may be withdrawn on written or telegraphic request, which must be received prior to the time fixed for opening of such bids. Bids may be modified in the same manner as original submissions and upon compliance with the same terms and conditions of the Invitation. Neglect on the part of the bidder in preparing the bid, confers no right for the withdrawal of the bid after it has been opened.
8. At the time for the opening of bids, the contents thereof will be publicly announced for the information of bidders and others properly interested, who may be present, either in person, or by representative; provided, however, that any

INSTRUCTIONS TO BIDDERS (Continued)

information submitted in support thereof, the disclosure of which might tend to subject the person submitting it to competitive business disadvantage, will upon request, be held in strict confidence by the Navy Department and any and all other Federal agencies to which it may be made available.

9. Each bid must be accompanied by a deposit in the amount of less than ten (10%) percentum of the annual bid rate. Certified checks, cashier's checks or money orders shall be made payable to the Treasurer of the United States of America. Personal, or corporation checks, are not acceptable.

10. The Government reserves the right, as the interests of the Government may require, to reject any and all bids, to waive any technical defect or informality in bids received and to accept any bid that is determined by the Navy Department to fulfill best the purposes for which the property is to be leased.

11. All bids received shall be deemed continuing offers from the date of opening of bids until accepted or rejected by the Navy Department, provided however, that after sixty (60) days have elapsed from the date of opening, any bidder not having received notice of rejection, shall consider his bid rejected, and if the Navy Department decides to accept any bid after such rejection date, the consent of the bidder thereto shall be obtained.

12. The foregoing invitation with all the instructions, terms, and conditions set forth, and the bid when accepted by the Government, shall constitute an agreement between the successful bidder and the Government. Such agreement shall be succeeded by a formal lease. No oral statements or representations made by, for, or on behalf of either party, shall be part of such contract. Nor shall the contract or any interest therein be transferred or assigned by the successful bidder without the consent of the Government.

13. Deposits accompanying bids of unsuccessful bidders will be returned without interest as promptly as possible after rejection.

14. In the event of revocation of any offer after the opening of bids, but prior to acceptance, the bidder's deposit shall become the property of the United States. In the event of default after notice of acceptance, but prior to the execution and delivery of the formal lease, the deposit shall become the property of the United States.

15. The successful bidder agrees to assume the responsibility for the care and handling of the premises covered by the lease as soon as practicable, but in any event within ten (10) days after notice of acceptance by the Government.

16. In the event Government-owned items of personal property or equipment not included in the Invitation are located upon the premises, the Lessee shall notify the Chesapeake Division, Naval Facilities Engineering Command thereof, who shall remove the same from the premises. Any such removal will be conducted in such manner as to cause the least possible interference with the successful bidder's use and occupancy of the premises after possession thereof is assumed as provided in these instructions.

INTRODUCTION

LOCATION

The Naval Surface Weapons Center, Dahlgren Laboratory is located in the Northern Neck Region of Virginia on the Potomac River. The Station is divided by the Upper Machodoc Creek into the Main Site on the north and the Explosive Experimental Area (Pumpkin Neck) on the south. The Dahlgren facility is 28 miles east of Fredericksburg, Virginia, and 53 miles south of Washington, D.C. (see Figure B-2-1).

CLIMATE

The NSWC, Dahlgren Laboratory is located in the temperate climate zone of the Eastern United States. The average temperatures by season are: Spring, 55.7°F; Summer, 74.6°F; Autumn, 58.1°F; and Winter, 37.9°F. The average annual rainfall is approximately 40 inches per year, with approximately 56 percent of this falling between April 1 and September 30. There is a great deal of variation in the average annual rainfall in the Dahlgren area. Over a recent 30-year period, precipitation at Dahlgren ranged from 27.4 to 54.8 inches, a variation of 100 percent. Although rainfall is greatest in the summer months, it is commonly insufficient because of the greater demand at this time for moisture by vegetation, and much of this rainfall occurs during heavy thundershowers resulting in considerable runoff.

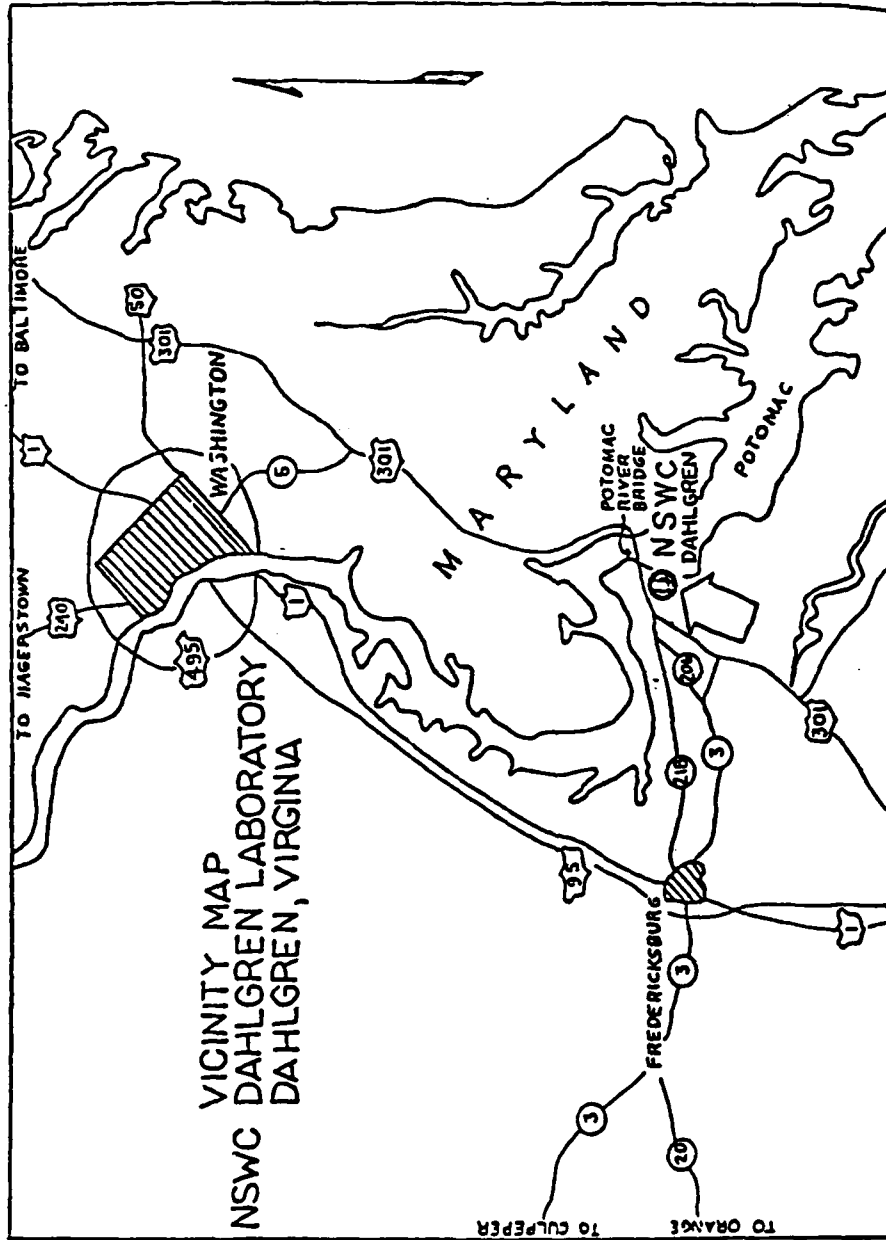
SOILS

The formation of soil is by weathering and other processes that act upon parent material. Soil characteristics at any given point depend upon interaction of parent material, climate, plants, animals, relief, and time. Climate, plants, and animals are the active forces of soil formation.

Parent material is the unconsolidated mass from which soil is formed. It is largely responsible for the chemical and mineralogical composition of soil. The primary parent material types in the NSWC, Dahlgren area are fluviomarine and alluvial.

Fluviomarine parent materials are transported materials that have been reworked by stream and marine action. These materials form the parent materials for the Coastal Plain. These materials are composed of transported and reworked sands, silts, and clays that in places are gravelly to extremely gravelly. In a few places, sandy layers have been consolidated to form soft sandstones. Soils formed from fluviomarine materials commonly are strongly acidic to very strongly acidic and low in bases. The texture of the soils reflects the textures of the layers from which they are formed. Most of the sands are quartz, which weathers very slowly; and soil formed in sandy layers have slight to moderate development.

Alluvial parent materials are stream transported and form the basis for soils such as Altavista, Congaree, or Wickham on terraces and flood plains in both the Piedmont and Coastal Plain areas. Alluvial parent materials are of local origin along smaller streams and drainageways. The alluvium has a mixed lithology because



MILEAGE

DC to NSWC - 55
 FREDERICKSBURG to NSWC - 28

FIGURE B-2-1. VICINITY MAP OF DAHLGREN LABORATORY, DAHLGREN, VIRGINIA

of the wide variety of igneous and metamorphic rocks and because of the wide variety of igneous and metamorphic rocks and fluviomarine deposits found in the uplands. Total thickness of alluvium ranges from several to many feet. Alluvium textures vary widely from fine to coarse, but are commonly medium to coarse in texture. Soils formed in alluvium are low to moderate in bases and medium acid to strongly acidic.

The majority of the soil resource in the potential lease area (excluding magazine bunkers) consists of Bladen loam, and Fallsington very fine sandy loam. Other soils that occur in the lease areas are Woodstown fine sandy loam, Tetotum fine sandy loam, and Bertie very fine sandy loam.

The Bladen loam soil series consists of deep, poorly drained, nearly level soils on the Coastal Plain lowlands. This soil was formed from loamy and clayey sediment along the Potomac River. Most areas are wooded, but a few have been cleared and used for pasture or general farming. The soil has a seasonal high water table at a depth of about 1 foot. It ponds many times during wet periods.

The Fallsington very fine sandy loam series consists of deep, poorly drained, nearly level soils on lowlands. This soil is formed in loamy and sandy Coastal Plain sediment. Most areas of the Fallsington series in Virginia are wooded. Fallsington soils have a strongly acid to extremely acid subsoil. The subsoil has moderate permeability, and available water holding capacity is moderate. It has a seasonal high water table occurring at 1-1/2 feet during wet periods.

The Woodstown fine sandy loam series is deep, moderately well drained soil. This soil is used for general farming and woodland. The subsoil of this series is medium acid to strongly acid. Permeability and water holding capacity are moderate. This series has a seasonal high water table at a depth of 1-1/2 to 2-1/2 feet.

The Tetotum fine sandy loam series is a deep, moderately well drained soil. Tetotum soils are important for farming. Tetotum subsoils are strongly acid, low in fertility and organic matter. Permeability and water holding capacity are moderate. This soil has a seasonal high water table at a depth of 1-1/2 to 2-1/2 feet.

The Bertie very fine sandy loam series is a deep, poorly drained soil. Only small areas are used for farming in Virginia. The subsoil of this series is very strongly acid to extremely acid. Permeability is moderate with a moderate to high water holding capacity. The seasonal high water table is at a depth of 1 to 1-1/2 feet during wet periods. The magazine bunkers are man-made structures built out of various fill materials.

LAND USE

The grazing outlease will make Magazine Storage Areas 1-5 available for grazing sheep. Grazing cattle, commercial boarding of horses, pasturing or stabling of horses is expressly prohibited. The lessee, his/her employees, or agents is required to maintain the grazing outlease in a condition that will reduce the overall fire hazard and assure optimum forage production. Grazing will be managed so as to leave a minimum 2-5 inch average stubble height on annual perennial forage crops. Average stubble heights shorter than 2 inches may indicate an overgrazed condition while heights longer than 5 inches may indicate a fire hazard. Specific livestock management requirements are detailed in Section IV of this plan.

The lessee is authorized to use dogs to assist in herding sheep. Dogs will be under verbal control at all times while on the Station. When not being used for herding, dogs will be confined or leashed.

The lessee is required to participate in a conservation program designed to improve the grazing resource of the outlease parcels and to protect all other natural resources on the Station. The lessee will be required to complete all planned soil and water conservation projects on the priority scheduled basis outline in Appendix D. The lessee will be reimbursed for certain conservation projects while other conservation projects must be accomplished by the lessee at his own expense. All improvements constructed or installed on a required or reimbursable basis become and remain property of the U.S. Government. All improvements constructed or installed at the lessee's option and expense shall be approved by the Government prior to installation and shall be removed by the lessee upon expiration of the lease. Conservation measures contained in this plan are designed to improve the Magazine Storage Areas for grazing purposes, provide for the multiple-use of these lands for military activities, wildlife habitat protection, soil and water conservation, and to protect the ecological balance of the land to assure continued productivity of the land while permitting economic returns to the lessee. It is the intent of the Government that the land be utilized in accordance with existing multiple-uses. Protecting Station resources from degradation by erosion, wildfire, noxious weeds, pest infestations, or other detriments is considered part of sound outlease management to be carried out by the lessee.

The nature of this outlease and the nature of the livestock being grazed preclude intensive conservation project requirements. Non-reimbursable conservation projects are limited to those which maintain NSWC's ecological integrity and those which insure sound livestock management. A detailed list of non-reimbursable projects is identified in Appendix B-2.4. Reimbursable projects will be identified annually (i.e., establishing permanent livestock watering facilities; liming, fertilizing, and zip-seeding; repairing eroded slopes).

COORDINATION WITH THE MILITARY

MILITARY USE

The primary use of the Station is weapons research and development. The grazing outlease is a secondary or additional land-use program and is subject to the military requirements for the land. The lessee shall conduct this operation in a manner that will not interfere with military use or activities. The lessee, his/her employees, and agents shall obey all station regulations regarding safety, vehicle travel, security, and health. Overnight habitation on the Station is prohibited.

NOTIFICATION AND COORDINATION

The lessee shall closely coordinate his operations with the Station's Natural Resources Specialist (Building 182, telephone no. 663-8695). The lessee shall provide the Natural Resources Specialist with current telephone numbers where the lessee and/or his representatives may be contacted during working and non-

working hours. The lessee will be available at all times to correct emergency situations with respect to the grazing outlease. Access routes to, from, and within the grazing outlease may be designated by the Station. If such routes are designated, they will be utilized by the lessee, his/her employees, and agents. Ingress and egress schedules shall be arranged with the Natural Resources Specialist in order that they be coordinated with security. The lessee shall notify the Natural Resources Specialist at least 24 hours prior to placing livestock on or removing livestock from the grazing outlease.

OTHER ACTIVITIES

The right is reserved for others, at the discretion of the Station, to conduct Natural Resources Conservation programs and projects, fire control, weed control, pest control, and other functions within the grazing outlease. Hunting or discharging firearms within the grazing outlease is prohibited.

AGRICULTURAL AND CONSERVATION PRACTICES AND MEASURES

Agricultural and conservation practices and measures contained herein are intended to provide for: (1) the multiple use of these lands for military activities and security, agricultural production, wildlife management, soil and water conservation; and (2) protection of the ecological balance of the land to insure the continued productivity of the land while permitting economic returns to the lessee. It is the intent of the Government that the land be utilized in accordance with sound soil, water, and livestock management practices consistent with concurrent multiple use. Protection of the Station's resources from deterioration by erosion, wildlife, noxious weeds, rodents, and other pest infestation, or other detriments is considered as part of the sound lease management program to be carried out by the lessee.

GENERAL MAINTENANCE REQUIREMENTS

The lessee will be required to complete the planned conservation improvements on a priority scheduled basis as outlined in the schedule of conservation projects (Appendix B-2.4).

The lessee, at his own expense, is required to repair and maintain in good condition, any additional facilities constructed during the lease term. Such facilities include livestock loading ramps, watering troughs, cattle guards, gates and corrals. All permanent type facilities constructed during the term of the lease shall remain property of the Station upon expiration of the lease.

Unless damaged by the lessee, all chain link fences on the Station will be maintained by Station work forces; however, should the lessee notice any damage to chain link fences, he/she will make emergency repairs to prevent escape of livestock from the grazing outlease. Following such repair, the lessee shall notify the Natural Resources Specialist or Security (telephone no. 663-8500) of the location of the needed repair.

LONG-TERM MAINTENANCE REQUIREMENTS

In lieu of the rental obligation, the Station and the lessee may mutually allow that all or a portion of the rent be fulfilled by performing long-term maintenance requirements. The long-term maintenance program is further described in Appendix B-2.5.

DAVIS-BACON WAGE DETERMINATIONS

In the event the Lessee contracts out for reimbursable work projects, he is required to abide by the Davis-Bacon Act (40 U.S.C. 276a), which applies to all construction, alteration, or repair undertaken on the leased premises, for which Federal funds in excess of \$2,000.00 are expended.

The Davis-Bacon Act requires the lessee to pay various classes of laborers and mechanics the minimum wage as determined by the Secretary of Labor. Davis-Bacon wage determinations are normally published in the Federal Register, on a geographical area basis, remaining effective until superseded. In some areas, a wage determination must be obtained specifically before each contract may be awarded and therefore, no bids should be opened.

WATER FACILITIES

The lessee is required, at his own expense, to install and maintain temporary livestock watering troughs. Permanent livestock watering troughs may be installed on a reimbursable basis and will remain property of the Station upon expiration of the lease. Technical assistance concerning water facilities is available from the Soil Conservation Service. All livestock watering facilities will be continually maintained in good clean operating condition to prevent excessive build-up of algae and manure. Other maintenance requirements include repairing baffles, lids, leaky tanks, troughs, pipelines, float and valve mechanisms, and others in consonance with sound livestock management. Water will be furnished by the Station but will not exceed annual limits established by the Fire Chief (telephone no. 663-8726). Watering livestock is the responsibility of the lessee and includes taking all appropriate actions to obtain water. Such actions include notifying the Station's Fire Department 48 hours in advance.

PEST MANAGEMENT

1. General. The lessee is required at his own expense to vigorously undertake to control all noxious and undesirable weeds, undesirable rodents, insects, livestock parasites and other pests within the grazing outlease. Should the lessee fail to provide said pest control in accordance with this agreement, the Government may arrange for pest control services. The lessee shall then be required to reimburse the Government for said services.

2. Specific. The following pests are known to occur within the grazing outlease and will be controlled by the lessee:

- a. Mountain Laurel (*Kalmia latifolia*)
- b. Wild Cherry (*Prunus serotina*)
- c. Groundhog (*Marmota monax*)

Prior to placing any livestock on the Station, the lessee will submit to the Natural Resources Specialist (W053) and the Pest Control Coordinator (PCC) (W632) and receive approval of, an annual schedule for controlling noxious and undesirable weeds, rodents, and other pests. The lessee's annual schedule shall include target pests and timeframes within which the lessee will initiate and complete pest control measures. The lessee must resubmit this schedule annually.

For the purpose of controlling groundhogs, the services of the PCC (W632, telephone no. 663-7100) are available; however, solicitation of these services remains the responsibility of the lessee.

3. Mechanical Methods for Weed Control. The lessee is explicitly prohibited from discing or tilling soil to achieve weed control. Other mechanical means such as mowing, hand hoeing, or chain saw felling (Mountain Laurel and Wild Cherry) are permissible. The lessee will be responsible for insuring vegetation does not exceed the height restrictions established for magazine storage areas either by an increase in Animal Unit Months (A.U.M.) or by mowing. The Station reserves the right to conduct hay cutting outleases within the grazing outlease when forage improvements are made by lessees on a reimbursable basis or when made by natural processes of grazing sheep. When forage improvements are made by lessees at their own expense, hay cutting outleases within the grazing outleases will not be conducted by the Station.

4. Biotic Methods for Weed Control. The lessee, at his own expense, is authorized to supplement livestock with goats for the purpose of controlling broad-leaf weeds. Any goats used for this purpose will not affect A.U.M. stocking rates established for sheep; however, any goats used for this purpose will be maintained in a manner equal to that of the principle livestock species and will remain the property and responsibility of the lessee. All goats will be removed annually at the end of the grazing season and will be removed permanently upon expiration of the lease.

5. Pesticides. As used herein, the term pesticide refers to herbicides, fungicides, rodenticides, algaecides, and avicides. With regard to all actions related to pest control undertaken by the lessee, his/her employees, or agents, the lessee shall assume full responsibility for complying with all Federal, state, local, and DOD standards for the prevention, control, and abatement of environmental pollution. All applications of pesticides shall be at the lessee's expense and shall comply with DOD requirements for safety, effectiveness and environmental protection. In this regard, the services of the PCC (telephone no. 663-1700) will be available and provided as needed. Further, any state or local permits required for application of a particular pesticide shall be obtained by the lessee prior to application. Specific and complete information concerning the lessee's proposed pesticide application program will be furnished by the lessee a minimum of five working days prior to any pesticide applications. Said information shall be provided directly to and as required by the PCC. This information will include the following: (a) common name and concentration of product (pesticide); (b) formulation of the product; (c) approximate amount of product to be used; (d) target pest or weed; (e) crop and approximate acreage to be treated; (f) application rate (per

acre); and (g) approximate time and frequency of application. Additional advisory assistance on how to submit the above information is available upon request from the PCC. Only those pesticides reported to and approved by the PCC shall be utilized by the lessee. The government may provide a trained and certified pest controller to observe and approve all pest control operations conducted on the leased area.

6. Rodent Control. Rodent control measures shall be undertaken by the lessee, at his own expense, to prevent damage to the leased area. The lessee must have approval from the PCC prior to using any rodenticide on the leased premises. In no instance will the lessee be allowed to use any chemical toxicant that has secondary poisoning effects.

FIRE PREVENTION

1. General. The lessee, his agent, and all persons in his employ shall perform all operations in a manner to prevent and/or reduce fire hazards. The lessee shall comply with the Station's fire control and prevention regulations, a copy of which may be obtained from the Fire Department. In the event of any accidental or uncontrolled fire on the premises, the lessee shall immediately contact the STATION FIRE DEPARTMENT (telephone no. (703) 663-8726) and exercise due care to prevent damage to the Premises from such a fire.

2. Equipment. All engine-driven equipment utilized by the lessee on the Station must be equipped with operable spark arresters, mufflers, and tail pipe assemblies. In addition, any 1975 or newer vehicle having a catalytic converter pollution control device may not be driven off of improved roads due to the extreme heat generated by this device.

DEBRIS REMOVAL

The lessee shall insure proper cleanup of areas used by his personnel and agents. The lessee, at this own expense, shall dispose of all refuse and debris generated at his work sites to the satisfaction of the Natural Resources Specialist. The lessee shall promptly clean up any spillage on Station roads which results from the hauling of livestock, feed, or other lease related activities.

PASTURE AND LIVESTOCK MANAGEMENT

TYPES OF USES

The use of the grazing outlease is limited to the grazing of sheep and a nominal number of goats to be used by the lessee in controlling broad-leaf weeds. Any other agricultural or animal husbandry practices such as cutting hay, seeding or growing forage crops, or grazing other species of livestock must have PRIOR written approval of the Natural Resources Specialist.

GRAZING CAPACITY

The annual grazing capacity of the grazing outlease is established at 288 A.U.M.'s as defined in paragraph IV.F. below. The season of use is established as 1 April through 1 October. The season may be extended only with PRIOR written permission from the Station's Natural Resources Specialist and CHESDIV. Appendix C lists A.U.M. stocking rates for each Magazine Storage Area. An A.U.M. increase will be authorized for controlling initial spring growth of vegetation.

INTENSITY OF GRAZING

The availability of forage and the general condition of the grazing outlease shall determine the intensity of grazing by livestock. It is the concern of the Government that the range not be overgrazed and that a minimum two (2) inch layer of living vegetation or dry mulch be maintained on the entire range to protect soil from erosion and to facilitate growth of annual and perennial forage crops. All grazing shall cease on any or all parts of the grazing outlease when, in the opinion of the Station's Natural Resources Specialist, further grazing is not in the best interest of the Government. Accordingly, said grazing capacity may be modified as follows:

1. The Station reserves the right to decrease the number of allowable A.U.M.'s in any lease year. Should the lessee be prevented from utilizing 288 A.U.M.'s during the lease year as a result of compliance with written instruction from the Station requiring an A.U.M. reduction, the lessee shall be entitled to compensation in rental. Such compensation will be determined in accordance with the calculations contained in Appendix B-2.2.

2. The Station may allow an increase in the grazing capacity if, in the opinion of the Station's Natural Resources Specialist, that sufficient forage exists to support additional livestock. Written permission from the Station must be granted prior to the lessee's exceeding the 288 A.U.M. grazing capacity. The lessee hereby agrees to pay for each additional A.U.M. at the rate defined in Appendix B. For lessees utilizing only portions of the entire grazing outlease, reductions or gains in A.U.M. stocking rates will be determined by the maximum allowable A.U.M. established for each Magazine Storage Area (Appendix B-2.3).

DISTRIBUTION OF LIVESTOCK

The lessee shall make every effort to insure uniform distribution of livestock to obtain uniform range utilization, to minimize overgrazed areas, and to reduce the overall fire hazard. To meet these objectives, salt licks and feed supplements will not be located adjacent to watering areas or roads but will be distributed uniformly throughout the grazing outlease. The lessee shall periodically move salt blocks and feed supplement sites at the direction of the Station's Natural Resources Specialist.

REPORTING REQUIREMENTS

The lessee shall submit, by the first day of each month, a report form certifying the number of A.U.M.'s grazed during the previous month. The reporting format is included as Appendix B-2.2. The form specifies the method for computing A.U.M.'s. The lessee shall forward a copy of the form to the following addresses:

Natural Resources Specialist (W053)
NSWC/Dahlgren Lab
Dahlgren, VA 22448

Soil Conservationist (243:1)
CHESNAVFACENGCOM
Washington Navy Yard
Washington, D.C. 20374

ANIMAL UNIT DEFINITIONS

The following definitions apply for the purposes of this report, notwithstanding any other commonly known definitions. An animal unit is equivalent to one adult sheep (Ewe or Ram). Juvenile sheep (less than 12 months old) will be considered three-fourths (3/4) of an animal unit. An Animal Unit Month (A.U.M.) is defined as one animal unit grazing for an entire month.

ANIMAL HEALTH

The lessee shall comply with all federal, state, and local animal health laws and regulations with respect to livestock grazing on the leased premises and upon request shall furnish written evidence to that effect to the Station's Natural Resources Specialist. In accordance with appropriate Navy regulations, the Station's Natural Resources Specialist reserves the right to impose quarantine, immunization or other health requirements deemed necessary to prevent or control zoonotic diseases.

DISPOSAL OF DEAD LIVESTOCK

The lessee, (at his own expense) is required to immediately dispose of dead livestock in a manner satisfactory to the Station. The lessee is required to remove dead animals from the Station.

LOSS OF LIVESTOCK TO PREDATORS

The Station considers the grazing outlease areas to be far superior to similar lands with respect to protecting livestock from feral dogs; therefore, the Government will not assume any liability for livestock lost to feral dogs, natural predators, or other predators. The lessee is hereby advised that natural predators do occur on Station property and that adequate protection of livestock remains the responsibility of the lessee. Any predator control techniques must have PRIOR written approval from the Station. Of critical importance is the fact that Bald

Eagles (Haliaeetus leucocephalus) do nest on the Station. Bald eagles have been known to occasionally prey on very young lambs. Absolutely no predator control techniques which violate Endangered Species Act requirements or Bald Eagle Protection Act requirements will be permitted on the Station. Any violations of the requirement will be cause for immediate termination of the lease without compensation for the lessee. Further, appropriate State and Federal officials will be notified for appropriate legal action. It is the lessee's responsibility to insure that livestock brought on the Station are not vulnerable to Bald Eagle predation.

ANIMAL IDENTIFICATION

Lessee shall properly identify individual animals. It is recommended that animals be paint branded and/or eartagged.

LONG-TERM MAINTENANCE PROGRAM

In lieu of paying rent the lessee may option to perform maintenance on Station. The long-term maintenance program is further explained in Appendix B-2.5.

NSWC MP 84-147

APPENDIX B-2.1
CLIMATOLOGICAL DATA FOR DAHLGREN,
KING GEORGE COUNTY, VIRGINIA

B-57/(B-58 blank)

TABLE B-2.1-1. TEMPERATURE AND PRECIPITATION DATA* (DATA FROM RECORDS AT DAHLGREN, KING GEORGE COUNTY, VA.)

Month	Temperature		Least 4 Days With--		Precipitation			
	Average Daily		Maximum		1 year in 10			
	Maximum (°F)	Minimum (°F)	Temperature Equal to or Higher Than (°F)	Temperature Equal to or Lower Than (°F)	Average Total (in.)	Less than-- (in.)	More than-- (in.)	Average Snowfall (in.)
January	45	29	63	17	3.2	1.4	6.0	3.9
February	47	30	64	19	2.4	1.1	3.8	3.4
March	55	36	73	27	3.2	1.5	5.3	1.9
April	65	45	82	37	2.1	1.6	6.0	.1
May	74	55	87	46	3.1	.9	5.5	.0
June	83	64	93	56	3.2	1.1	5.6	.0
July	86	69	94	63	4.6	1.2	7.5	.0
August	84	67	93	61	4.5	.6	10.6	.0
September	79	61	89	51	3.8	.8	11.2	.0
October	68	49	82	40	3.0	1.3	4.8	(1)
November	57	39	72	29	2.4	.7	4.5	.7
December	47	31	61	19	3.0	.9	5.1	2.3
Year	66	48	98 (2)	12 (3)	39.5	30.9	51.8	12.3

(1) Less than 0.05 inch

(2) Average annual highest temperature

(3) Average annual lowest temperature

*Taken from: Soil Survey, Stafford and King George Counties, Virginia. Prepared by USDA, SCS, in cooperation with Virginia Polytechnic Institute and State University, February, 1974.

FIGURE B-2.1-2. PROBABILITIES OF LAST FREEZING TEMPERATURES IN SPRING
AND FIRST IN FALL (ALL DATA FROM RECORDS AT DAHLGREN,
KING GEORGE COUNTY, VA.)

Probability	Dates for Given Probability and Temperature				
	32°F or lower	28°F or lower	24°F or lower	20°F or lower	16°F or lower
Spring					
1 year in 10 later than	Apr. 20	Apr. 8	Mar. 27	Mar. 18	Mar. 15
2 years in 10 later than	Apr. 14	Apr. 1	Mar. 20	Mar. 11	Feb. 22
5 years in 10 later than	Apr. 3	Mar. 20	Mar. 8	Feb. 25	Feb. 1
Fall					
1 year in 10 earlier than	Oct. 27	Nov. 8	Nov. 15	Nov. 25	Dec. 5
2 years in 10 earlier than	Nov. 1	Nov. 13	Nov. 20	Nov. 30	Dec. 11
5 years in 10 earlier than	Nov. 11	Nov. 22	Nov. 30	Dec. 11	Dec. 26

*Taken from: Soil Survey, Stafford and King George Counties, Virginia. Prepared by
USDA, SCS, in cooperation with Virginia Polytechnic Institute and State University.
February, 1974.

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APPENDIX B-2.2

REPORT OF ANIMAL UNIT MONTHS GRAZED

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REPORT OF ANIMAL UNIT MONTHS GRAZED
NSWC/DAHLGREN LABORATORY

REPORT OF ANIMAL UNIT MONTHS GRAZED
NSWC/DAHLGREN LABORATORY

Magazine Area # Lease # Report for (mo/day/yr)

Animal Unit Factor (AUF)--The AUF is defined as follows:

Adult Sheep (Ewe or Ram)--1.0
Juvenile Sheep (under 12 mos.)--0.75
Goats (Adult or Juvenile)--0.00

Number of each type of livestock on leased area on:

first day of the month: changes this month: (include date)

Adult Sheep _____	Adult Sheep _____
Juvenile Sheep _____	Juvenile Sheep _____
Goats _____	Goats _____
Total _____	Total _____

<u>Day of</u> <u>Month</u>	<u>Changes in Number of Livestock</u>	
	<u>Livestock added to</u> <u>leased area this month</u>	<u>Livestock removed from</u> <u>leased area this month</u>
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

I certify that the above figures are accurate to the best of my knowledge.

NAME OF LESSEE _____

SIGNATURE _____

DATE _____

NO-A161 946

GROUNDS CONSERVATION MANAGEMENT PLAN (1982-1991) FISH
 AND WILDLIFE MANAGE. (U) NAVAL SURFACE WEAPONS CENTER
 DAHLGREN VA JUN 85 NSNC/MP-84-147

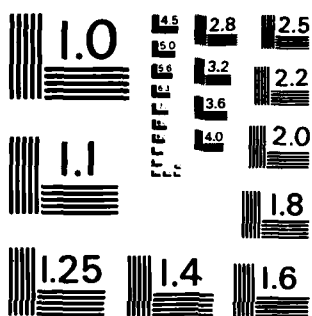
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UNCLASSIFIED

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NL

A 10x10 grid of squares, with the top-left square missing.



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

METHOD OF DETERMINING THE COST OF ANIMAL UNITS GRAZED FOR THE MONTH

A. Multiply the number of animals of each type of livestock on the leased area the first day of the month by the animal unit factor (AUF) times the bid (price per head).

B. When the number of animals in each type of livestock changes during the month, the increase or decrease is either added to or subtracted from the previous number of animals of that type on the leased area. To calculate this, take the number of AU x AUF x Price per month x % of the month.

C. At the end of the month the accumulative figure for each type of livestock grazed in that particular month will be the sum of methods A and B. The resulting figure will be the total charge or cost during the month for grazing that type of livestock.

D. The average animal unit months for each type of livestock are added together to determine the total yearly livestock usage and charges incurred.

SAMPLE CALCULATION (Based on the sample cost of \$1.00/head/month):

Method A

No. animal units x AUF x Cost = grazing fee for month

20 ewes x 1 x \$1.00 = \$20.00

5 lambs x .75 x \$1.00 = 3.75

1 ram x 1 x \$1.00 = 1.00

Total cost \$24.75

Method B (adding 10 ewes and 10 lambs for 21 days (.67 months))

No. AU x AUF x Cost x % of the month

10 ewes x 1 x \$1.00 x .67 = \$6.70

10 lambs x .75 x \$1.00 x .67 = \$5.02

Change cost \$11.72

Total cost of grazing month*

A + B = \$24.75 + \$11.72 = \$36.47

*Note: If B above had been an AU reduction, total cost would be

A - B = \$24.75 - \$11.72 = \$13.03

NSWC MP 84-147

APPENDIX B-2.3

MAXIMUM ALLOWABLE A.U.M.'S PER MAGAZINE
STORAGE AREA

B-65/(B-66 blank)

NSWC MP 84-147

<u>Magazine Area</u>	<u>Acres*</u>	<u>Maximum A.U.M.</u>
1	44	132
2 (Main)	16	48
2 (Bldg. 954)	1	3
2 (Bldg. 436)	2	6
3 (Main)	7	21
3 (Bldg. 980)	2	6
4 (Main)	8	24
4 (Bldg. 435)	2	6
5	14	42
 TOTAL	 96	 288

Average A.U.M. per acre--3.0

*Figures approximated to whole acres

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APPENDIX B-2.4

GENERAL MAINTENANCE REQUIREMENTS

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GENERAL MAINTENANCE REQUIREMENTS

STATION: NSWC/Dahlgren Lab

OUTLEASE AREA: Magazine Storage Area

PREPARED BY: Natural Resources Management Branch

Field Number	Land Use and Treatment	Scheduled Amount	Reimbursable		Priority
			Yes	No	
Entire Parcel	Debris removal	As required	X		Continuous responsibility Refer to Section III G
Entire Parcel	Pasture and livestock maintenance	As required	X		Continuous responsibility during grazing season Refer to Section IV
Entire Parcel	Fence maintenance	As required	X		Continuous responsibility Refer to Section III A
	Water facilities maintenance	As required	X		Continuous responsibility Refer to Section III D
Entire Parcel	Fire prevention	As required	X		Continuous responsibility Refer to Section III F
Entire Parcel	Pest management	As required	X		Continuous responsibility Refer to Section III E

NOTE: The Government reserves the right to add, modify, or delete items of work.
The Government will negotiate with the lessees for such adjustments.

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APPENDIX B-2.5

LONG TERM MAINTENANCE PROGRAMS

B-73/(B-74 blank)

A. EXPENDITURES FOR LONG TERM MAINTENANCE

The "Maximum Dollar Amount to be Expended" for items of Long-Term Maintenance for which Lessee assumes an obligation in accordance with this lease is the amount of the annual rental plus the amount of any rentals previously paid during the term of this lease which have not already been credited to Long Term Maintenance. In order to receive credit for Long-Term Maintenance, the Lessee shall on the first day of each month of the term of this lease submit invoices and vouchers in support of "Actual Cost" charges made, in accordance with provisions of this lease. Labor and equipment charges will be commensurate with the rate paid for like equipment and labor by the Naval Surface Weapons Center.

B. LONG-TERM MAINTENANCE OBLIGATION

(1) In addition to the general maintenance obligations of this lease, Lessee shall, at its own expense, perform such items of "Long Term Maintenance", which is hereby defined as those conservation measures enumerated herein as may from time-to-time be approved or directed by the Natural Resources Specialist; Provided, the Lessee shall receive credit against the Maximum Dollar Amount to be Expended specified in this lease, for the "Actual Costs" incurred in the performance of said items upon the satisfactory completion of such performance; Provided, further, Lessee shall at no time be obligated hereunder to expend for Long-Term Maintenance any amount in excess of the difference between:

- (a) the Maximum Amount to be Expended as accrued to such time, and
- (b) the total credits allowed against the Maximum Amount to be Expended up to that time

Such difference is hereinafter called the "Current Obligated Maintenance Amount"

Long-Term Maintenance shall be performed on the Leased Property, as described herein. In addition, the Lessee may be required to perform Long-Term Maintenance on other Navy-owned property if such property is utilized by the Lessee. The Lessee will in no event, however, be responsible for Long-Term Maintenance, on Navy property, incidental to the grazing of livestock, growing or harvest of Agricultural crops, or any items which Lessee is obligated to perform under the provisions of this Lease.

"Actual Costs" as used herein, shall mean the sum of: (a) direct labor costs, plus 10 percent thereof for incidental expenses for general supervision, administration and overhead, and (b) direct material costs, which Lessee has incurred such costs directly in the performance of any items of Long-Term Maintenance approved or directed by the Natural Resources Specialist.

(2) Pending completion of performance and final determination of the actual costs of any items of Long-Term Maintenance approved or directed aforesaid, there shall be tentatively credited against the Maximum Amount to be Expended at the end of each month of the lease term an estimate of the actual costs incurred in the performance thereof, in order to facilitate administration of this lease and enable the Local Government Representative to properly direct the performance of Long-Term Maintenance under this Article.

(3) Lessee shall keep adequate records and books of account showing the actual cost of all items of labor, materials, equipment, supplies, services, and other items of cost of any nature constituting an item of Actual Costs incurred by it directly in the performance of any item of Long-Term Maintenance. The Lessee shall provide the Government with access to such records and books of account for inspection thereof at all reasonable times. All information obtained from said records and books of account shall be deemed confidential.

NSWC MP 84-147

APPENDIX B-2.6
DIRECTORY OF CONTACTS

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DIRECTORY OF CONTACTS

I. Naval Surface Weapons Center

A. Natural Resources

P. H. Schoenfeld (W053)
Natural Resources Branch
Extension 8695

B. Safety

J. W. Warden (X32)
Accident Prevention Branch
Extension 8684

C. Security

J. F. Blakely (X124)
Physical Security Section
Extension 8500

D. Fire Protection

T. G. Peery (X122)
Fire Protection Section
Extension 8726

E. Pest Control

R. C. Conley (W632)
Pest Control Coordinator
Extension 7100

II. Chesapeake Division, Naval Facilities Engineering Command

J. Hautzenroder (243)
Natural Resources Branch
(202) 433-3586
(Autovon--288-3586)

S. Aschman
Natural Resources Branch
(202) 433-3586
(Autovon--288-3586)

III. United States Department of Agriculture

R. Wisniewski
District Conservationist
USDA/Soil Conservation Service
601 Caroline Street
Fredericksburg, Virginia 22401

IV. Virginia Cooperative Extension Service

Extension Agent, Agriculture
P. O. Box 147
King George, Virginia 22485
(703) 773-3062

NSWC MP 84-147

APPENDIX B-2.7

STATION MAP IDENTIFYING

GRAZING OUTLEASES

B-81/(B-82 blank)

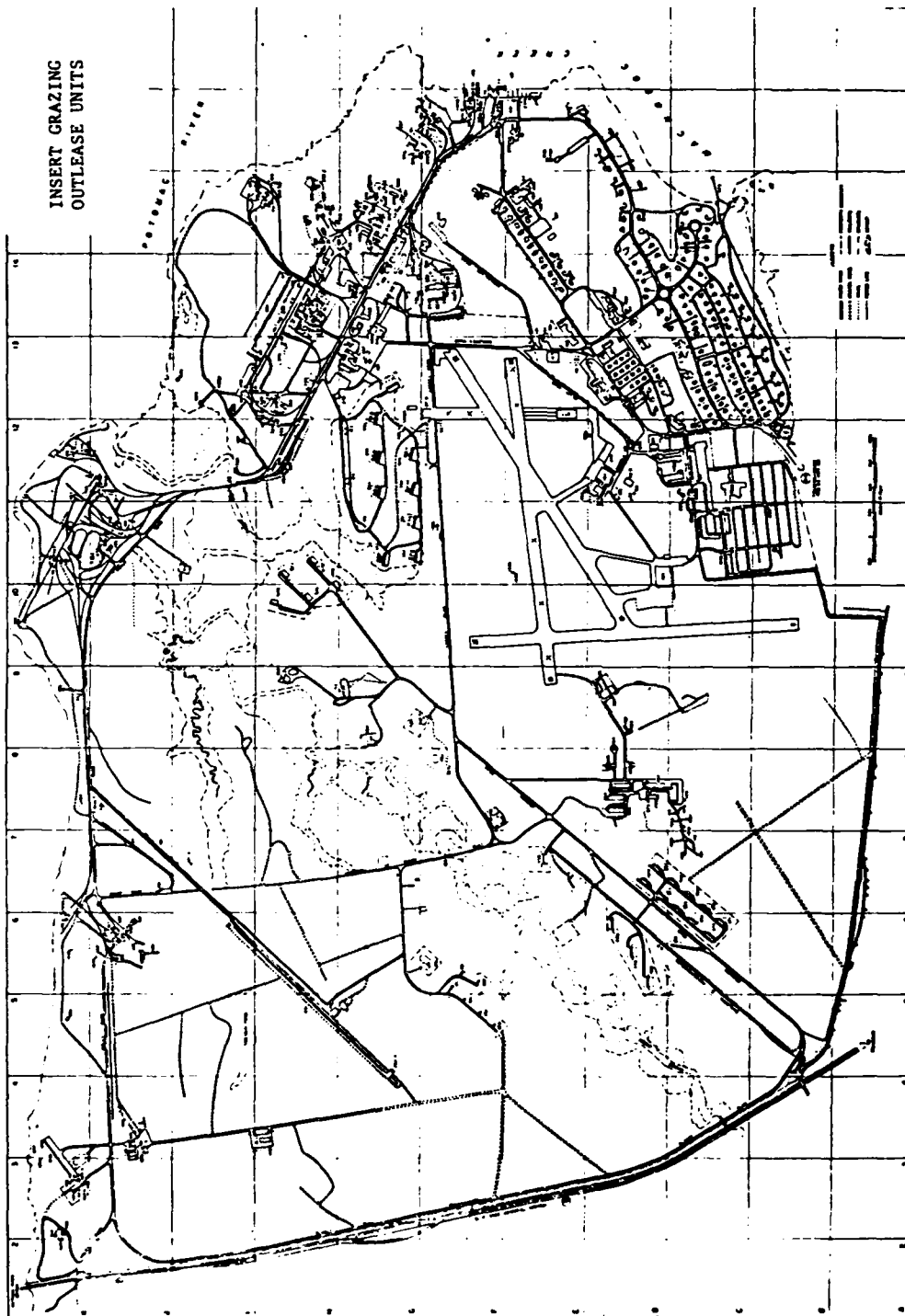


FIGURE B-2.7-1. GRAZING OUTLEASE UNITS

NSWC MP 84-147

APPENDIX B-3

LANDSCAPE PLAN

FOR

NSWC/DL UNRESTRICTED ACCESS AREA

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LANDSCAPE PLAN
FOR
NSWC/DL UNRESTRICTED ACCESS AREA

1. INTRODUCTION

The NSWC housing and community support areas have a variety of cultural resources including Victorian architecture, waterfront properties and ornamental landscapes dominated by large trees. These large trees are important elements to the area's character because they create an air of elegance which not only improves aesthetics but also increases property value.

Because the large dominant trees are old and relatively "even-aged," they can be expected to die-off regularly due to disease, heartwood rot or other mortality agents. Other large trees may need to be removed to prevent damage to powerlines, buildings or structures. If replacement trees were planted as dominant trees died or were removed, the area would soon be dominated by smaller trees which would not complement the area's aesthetic value.

2. PURPOSE

The primary purpose of this plan is to design and implement a landscaping program which allows replacement trees adequate time to grow to large sizes BEFORE the dominant trees die or need to be removed.

Other goals and objectives which are integral to this plan include:

- a. Select proper locations and species of replacement trees to improve energy efficiency of buildings (i.e., wind and sun screens)
- b. Meet NSWC non-game wildlife management requirements with suitable landscaping techniques.
- c. Eliminate mowing costs by replacing certain lawn areas with low growing, low maintenance evergreen ground covers.
- d. Establish low maintenance evergreen ground covers in areas where lawns are shaded out by the tree canopy.
- e. Eliminate erosion and sedimentation with either lawns or evergreen ground covers.

3. WORK SCHEDULES

Work schedules will be written annually and will be based on estimated available funding, success of the prior year's program and the needs of the area to be landscaped. Generally, however, annual work schedules will consist of:

- a. Identifying trees which need to be removed and removing them.

- b. Replanting areas where trees were removed with species recommended in Table 1.
- c. Identifying proper locations for replacement trees to act as effective wind and sun screens.
- d. Identifying trees requiring pruning or other routine maintenance.
- e. Identifying areas to be landscaped with ground covers recommended in Table 2.
- f. Specifying unique projects to be accomplished in the landscaped area (i.e., establish ground covers in traffic islands).
- g. Identifying factors responsible for plant materials failure and take appropriate actions to correct them (i.e., notify pest control coordinator for insect infestations).
- h. Itemizing a list of plant materials to be purchased, including the proper time to order them.

4. RECOMMENDED TREES AND GROUND COVERS

Tables B-3-1 and B-3-2 list recommended species of trees and ground covers respectively. These recommendations are based on the species' growth rates, adaptability to NSWC soils, ornamental value, shade tolerance, value to wildlife, ability to act as a wind or sun screen, and other intrinsic characteristics such as autumn color, etc. Although other species may be included in annual work schedules, those types listed in Tables B-3-1 and B-3-2 will achieve the goals and objectives previously stated.

5. LANDSCAPING POINT-OF-CONTACT

The landscaping points-of-contact for NSWC are:

- a. General Foreman, Grounds Structures (Code W63)
Building 134, Extension 7100
- b. General Foreman, Grounds Maintenance (W632)
Building 134, Extension 7100

Problems related to NSWC/DL's landscape should be reported to either W63 or W632. Such problems include insect pests, diseased trees, branches rubbing against houses and others.

Problems related to vertebrate pests such as racoons, skunks, squirrels, rabbits and birds should be reported to:

- a. Natural Resources Specialist (Code W053)
Building 182, Extension 8695

TABLE B-3-1. RECOMMENDED TREE SPECIES

Species	Other Characteristics
TYPE I--SPECIES HAVING FASTER GROWTH RATES	
White Pine (<i>Pinus strobus</i>)	Ornamental value; cover for songbirds; wind shelter for NW exposure of buildings
Bald Cypress (<i>Taxodium distichum</i>)	Ornamental value; seeds eaten by some songbirds; does well in poorly drained sites.
Norway Spruce (<i>Picea abies</i>)	Ornamental value; cover for songbirds, wind shelter for NW exposure of buildings
Dogwood (<i>Cornus florida</i>)	Ornamental value; fruit and twigs eaten by several songbirds, game birds, rabbits, and squirrels
Redbud (<i>Cercis canadensis</i>)	Ornamental value; seeds eaten by quail and some songbirds.
Eastern Hemlock (<i>Tsuga canadensis</i>)	Ornamental value; wind shelter for NW exposure of buildings
Autumn Olive (<i>Elaeagnus umbellata</i>)	Ornamental shrub; valuable wildlife food plant; erosion control; fix nitrogen in the soil from atmospheric nitrogen
TYPE II--SPECIES HAVING INTERMEDIATE GROWTH RATES	
Black Cherry (<i>Prunus serotina</i>)	Large tree; among the most widely eaten of all wildlife food plants; nest tree for several songbirds
Domestic Apple (<i>Pyrus malus</i>)	Ornamental value; wildlife food; provide fruit for residents
Domestic Pear (<i>Pyrus communis</i>)	Ornamental value; provide fruit for residents
American Crabapple (<i>Pyrus coronaria</i>)	Ornamental value; wildlife food
Willow (Weeping) Oak (<i>Quercus phellos</i>)	Large tree; provide sun screen for SE exposure of buildings
Sawtooth Oak (<i>Quercus acutissima</i>)	Provide sun screen for SE exposure of buildings; excellent wildlife food tree; provide firewood for residents

TABLE B-3-1. RECOMMENDED TREE SPECIES (CONTINUED)

Species	Other Characteristics
Northern Red Oak (<i>Quercas rubra</i> var. <i>borealis</i>)	Ornamental with faster growth rate than typical oaks; sun screen for SE exposure of buildings; excellent wildlife food; excellent firewood for residents
Cherrybark Oak (<i>Quercas falcata</i> var. <i>pagodaefolia</i>)	Ornamental; provide food for wild turkey, gray and fox squirrel, woodpeckers, and several songbirds
California Incensecedar (<i>Libocedrus decurrens</i>)	Ornamental; wind screen for NW exposure of buildings
Flowering Oriental Cherry (<i>Prunus serrulata</i>)	Ornamental; provide food for wildlife
Atlantic White Cedar (<i>Chamaecyparis thyoides</i>)	Ornamental; does well in swampy conditions

TYPE III--SPECIES HAVING SLOW GROWTH RATES

White Oak (<i>Quercas alba</i>)	Ornamental; sun screen for SE exposure of buildings; provide high quality firewood for residents
American Holly	Ornamental; fruits eaten by songbirds, quail, wild turkey; provide wind screen for NW exposure of buildings
Siberian Spruce (<i>Picea omorika</i>)	Ornamental; provide wind screens for NW exposure of buildings; provide winter shelter for songbirds; somewhat shade tolerant
Sugar Maple (<i>Acer saacharum</i>)	Ornamental with excellent autumn colors; sun screen for SE exposure of buildings; fruits eaten by several songbirds
Red Maple (<i>Acer rubrum</i>)	Ornamental with excellent autumn colors; sun screen for SE exposure of buildings; fruits eaten by several songbirds and squirrels
Black Gum (<i>Nyssa sylvatica</i>)	Ornamental with excellent autumn colors; fruits eaten by several songbirds and wild turkey; sun screen for SE exposure of buildings
Yellowwood (<i>Cladrastis lutea</i>)	Ornamental with excellent autumn colors and white showy flowers in spring

TABLE B-3-1. RECOMMENDED TREE SPECIES (CONTINUED)

Species	Other Characteristics
Thornless Honey Locust (<i>Gleditsia triacanthos</i> var. <i>inermis</i>)	Ornamental; fruits eaten by rabbit, squirrel, and quail
Live Oak (<i>Quercas virginiana</i>)	Ornamental
Hickory (<i>Carya</i> spp.)	Ornamental; provide food for wildlife; provide excellent firewood for residents
Ash (<i>Fraxinus americana</i>)	Ornamental with excellent autumn colors; provide excellent fire for residents
Beech (<i>Fagus grandfolia</i>)	Ornamental; provide food for wildlife; sun screen for SE exposure of buildings

TABLE B-3-2. RECOMMENDED GROUND COVER SPECIES

Species	Characteristics
Bugleweed (<i>Ajuga reptans</i>)	Dense evergreen ground cover; shade tolerant; showy flowers, requires limited weed control
Periwinkle (<i>Vinca minor</i>)	Can replace lawn in large or small areas; shade tolerant; showy flowers; requires limited weed control
Japanese Spurge (<i>Pachysandra terminalis</i>)	Dense attractive evergreen ground cover used in borders, under trees, and under shrubs. Can replace lawn in nontraffic areas; requires no weed control
Lily-of-the-Valley (<i>Convallaria majalis</i>)	Low-maintenance ground cover; shade tolerant; showy flowers and berries
St Johnswort (Aarons beard) (<i>Hypericum calycinum</i>)	Good evergreen cover for sandy soils; shade and drought tolerant; showy flowers and berries
Cotoneaster (<i>Cotoneaster micaophylla</i>)	Ground cover for large areas around commercial/industrial sites; showy flowers
Bearberry (<i>Arctostaphylos uva-ursi</i>)	Ground cover for low fertility, sandy soils; shade and drought tolerant
Ground Juniper (<i>Juniperus</i> spp.)	Dense attractive evergreen ground cover; drought tolerant; low maintenance
Crownvetch (<i>Coronilla varia</i>)	Ground cover for low visibility areas and areas where low maintenance is important; drought tolerant; improves soil fertility via nitrogen fixation; good forage; maintenance free

6. THE PLAN

As previously stated, the primary purpose of this plan is to establish replacement trees BEFORE mature trees die or need to be removed. To accomplish this purpose, trees will be selected according to growth rates (Table B-3-1). Each year, a variety of Type I, Type II, and Type III trees listed in Table B-3-1 will be planted in areas outlined in the work schedule. The long term result of this technique will break-up the monotony created by too few size classes dominating the landscape. Further, this technique will provide a continuous supply of replacement trees reaching large sizes in a manner similar to sustained yield management.

A general trend of this plan is to reduce the consumption of fossil fuels associated with mowing, routine maintenance and home heating. Therefore, each year, areas will be identified where evergreen ground covers can replace lawns. Such areas should include traffic islands (Figure B-3-1), clusters of trees requiring hand mowing (Figure B-3-2), and slopes which are difficult to mow (Figure B-3-3).

Also, each year, areas will be identified where trees should be planted to screen the houses from the sun and the wind. When properly located, sun screens can have a cooling effect on a house by reducing the immediate ambient temperature (Figure B-3-4). Trees listed in Table B-3-1 as sun screens insure that deciduous trees are planted for this purpose. Further, the houses receive a warming effect from the winter sun after the leaves have fallen (Figure B-3-4). When properly located, trees can reduce the velocity of wind striking a house and therefore reduce the cooling effect of the wind (Figure B-3-5). Wind screens should be planted to screen the north-northwest face of a house (Figure B-3-5). Trees listed in Table B-3-1 as wind screens insure evergreen species are used for this purpose. Appropriate locations and species for sun and wind screens will be detailed in the annual work schedule.

To enhance the non-game wildlife populations currently living in the housing area, trees and ground covers listed in Tables B-3-1 and B-3-2 respectively include species which offer food and shelter for wildlife. A minimum of two trees listed as being beneficial to wildlife should be included in each annual work schedule as replacement trees. This will insure non-game wildlife objectives are met in areas unsuitable for harvesting game species.

Certain lawns within the housing area have been shaded out by the tree canopy and several attempts to reseed these lawns have been unsuccessful. Therefore, shade tolerant ground covers will be planted as lawn substitutes in these areas (Figure B-3-6). Ground covers will serve many purposes including lawn substitutes in areas which are difficult or expensive to mow, lawn substitutes in areas where grass is shaded out, vegetative covers for eroded slopes and banks, and shelter for non-game wildlife. However, it should be noted that ground covers are initially expensive to establish and do require maintenance. Such maintenance includes weeding until the ground cover is completely established and manual labor to remove leaves and litter. Therefore, areas to be planted with ground cover will require approval from W63 or W632. Unique projects for the area to be landscaped will be detailed in the annual work schedule and will also require approval from W63 or W632.

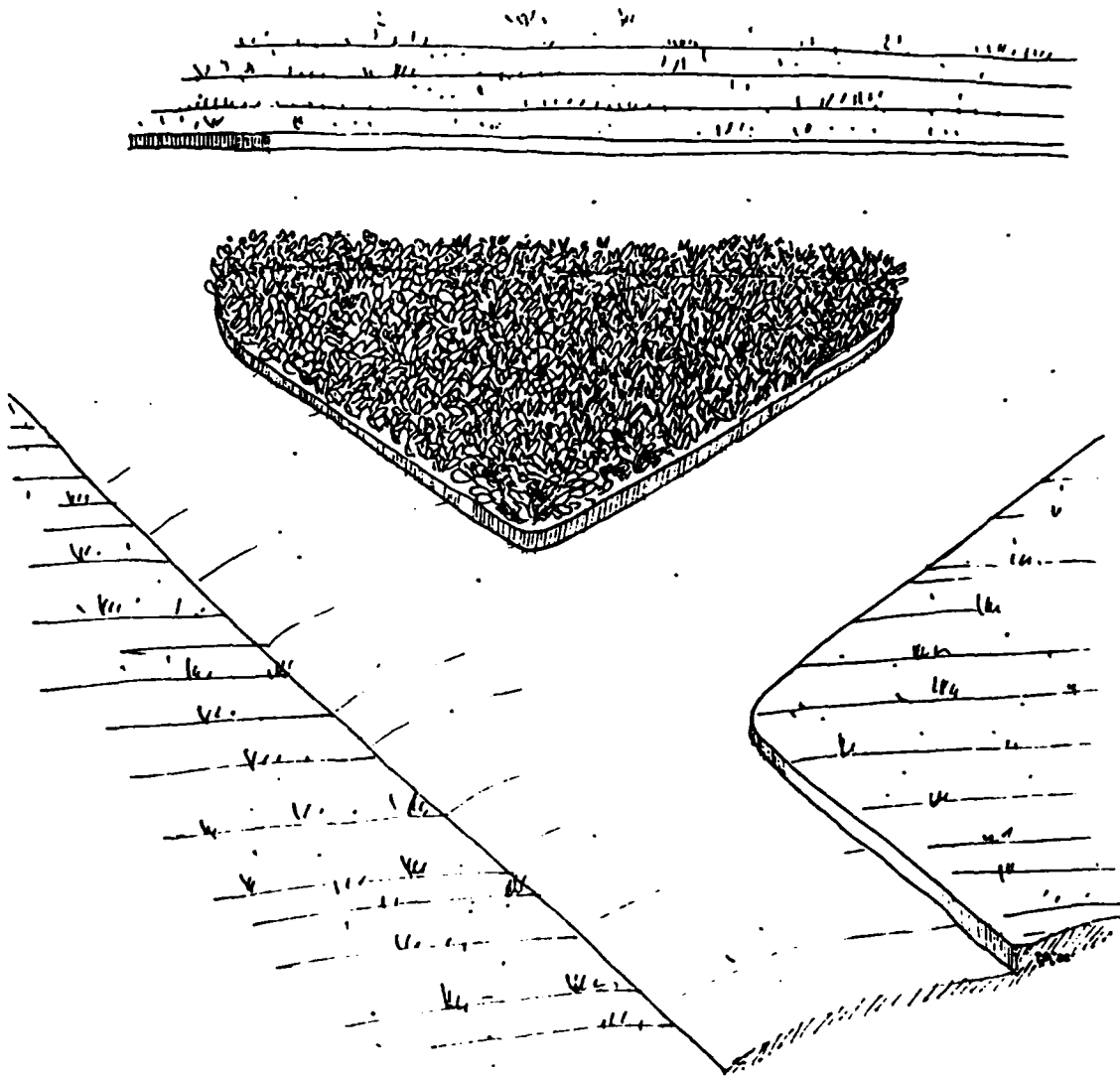


FIGURE B-3-1. ANY TRAFFIC ISLAND IN DAHLGREN LABORATORY AREA IS TO BE PLANTED WITH GROUND COVER. SPECIES AS SPECIFIED

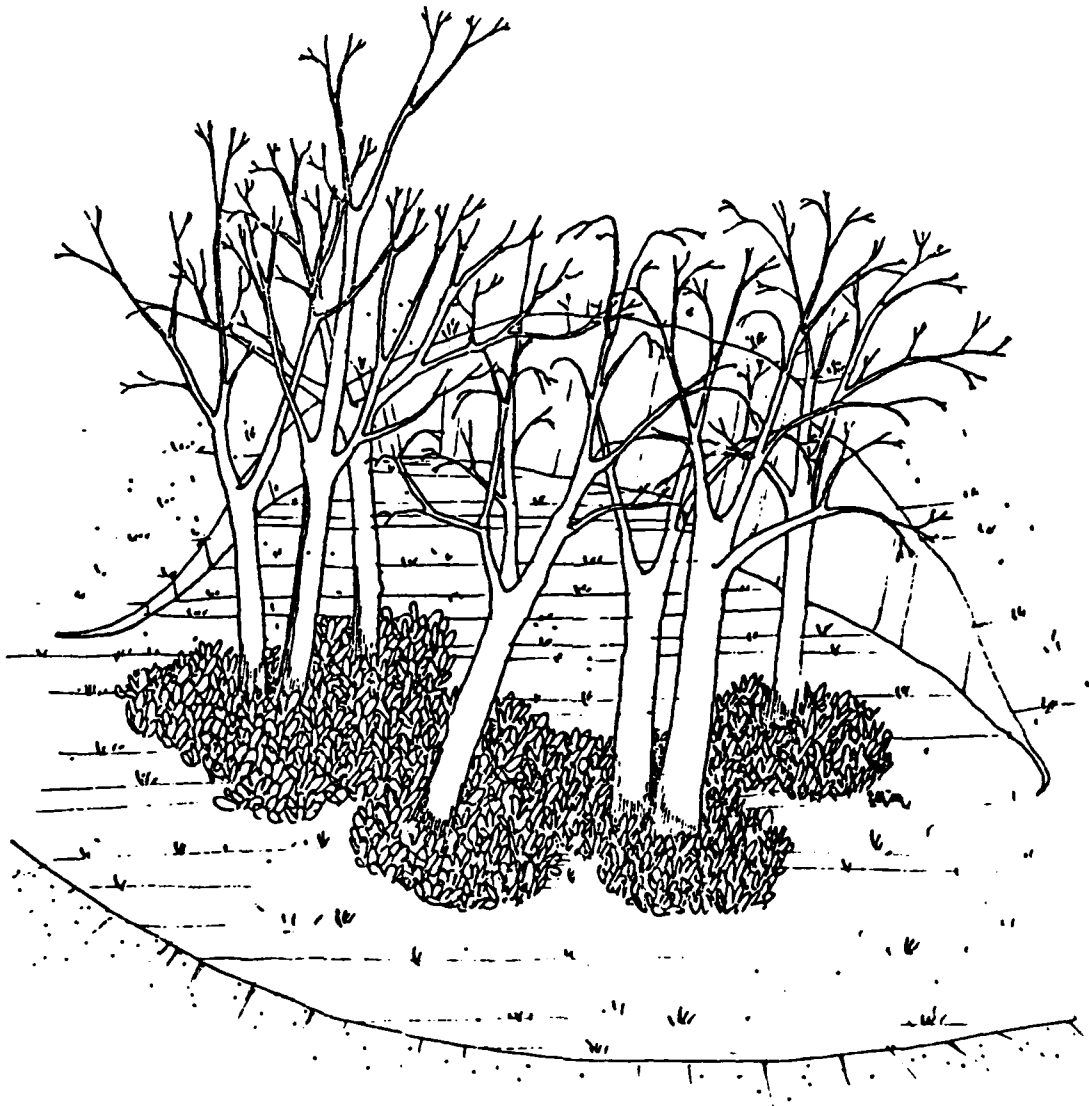


FIGURE B-3-2. IN GROVES OF TREES GROUND COVER MAY BE USED TO GROUP THESE TREES THUS REDUCING THEIR MAINTENANCE

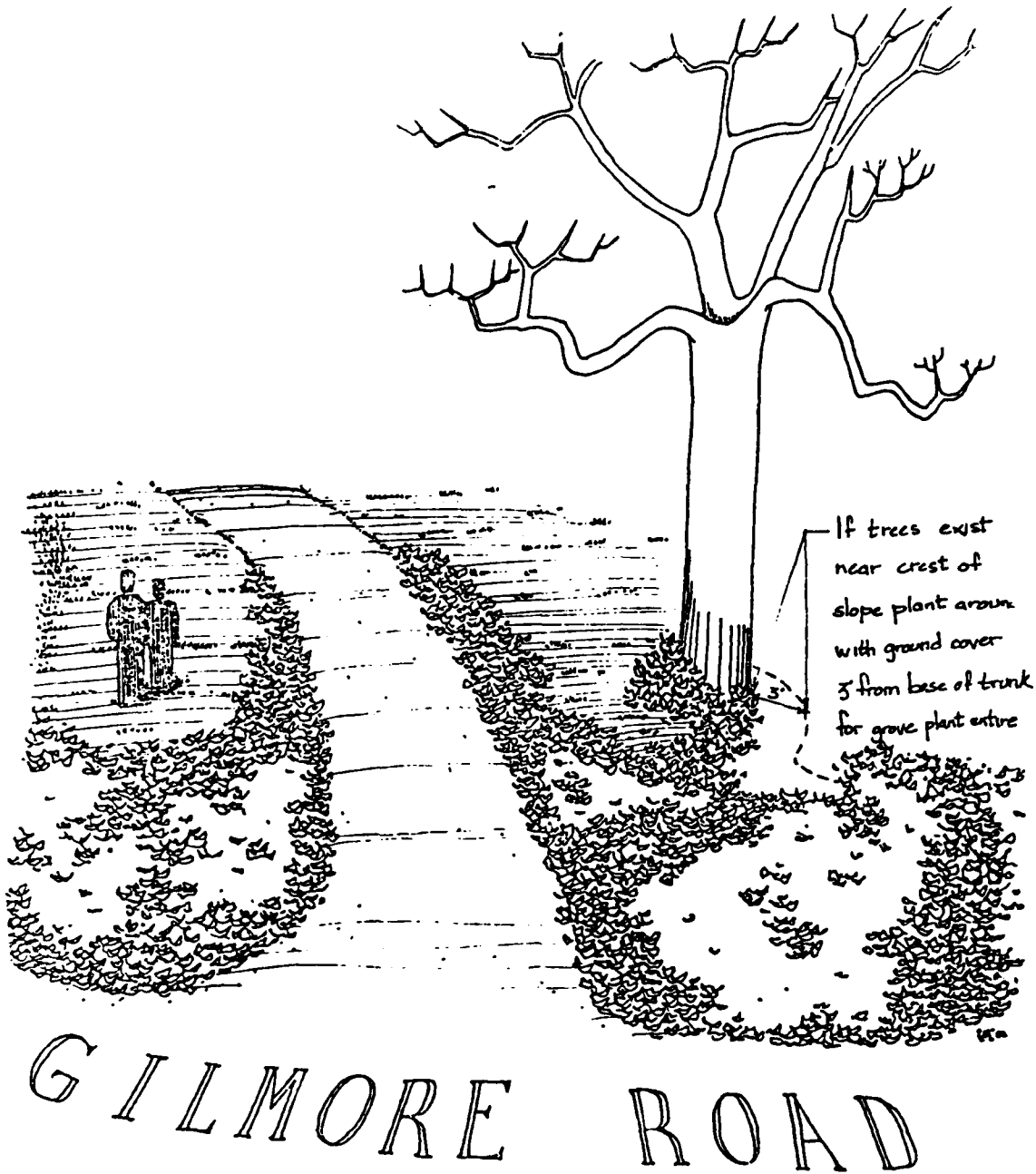


FIGURE B-3-3. SLOPING TERRAIN NEAR RECREATIONAL PIER ON GILMORE ROAD
TO BE PLANTED WITH GROUND COVER, AS SPECIFIED

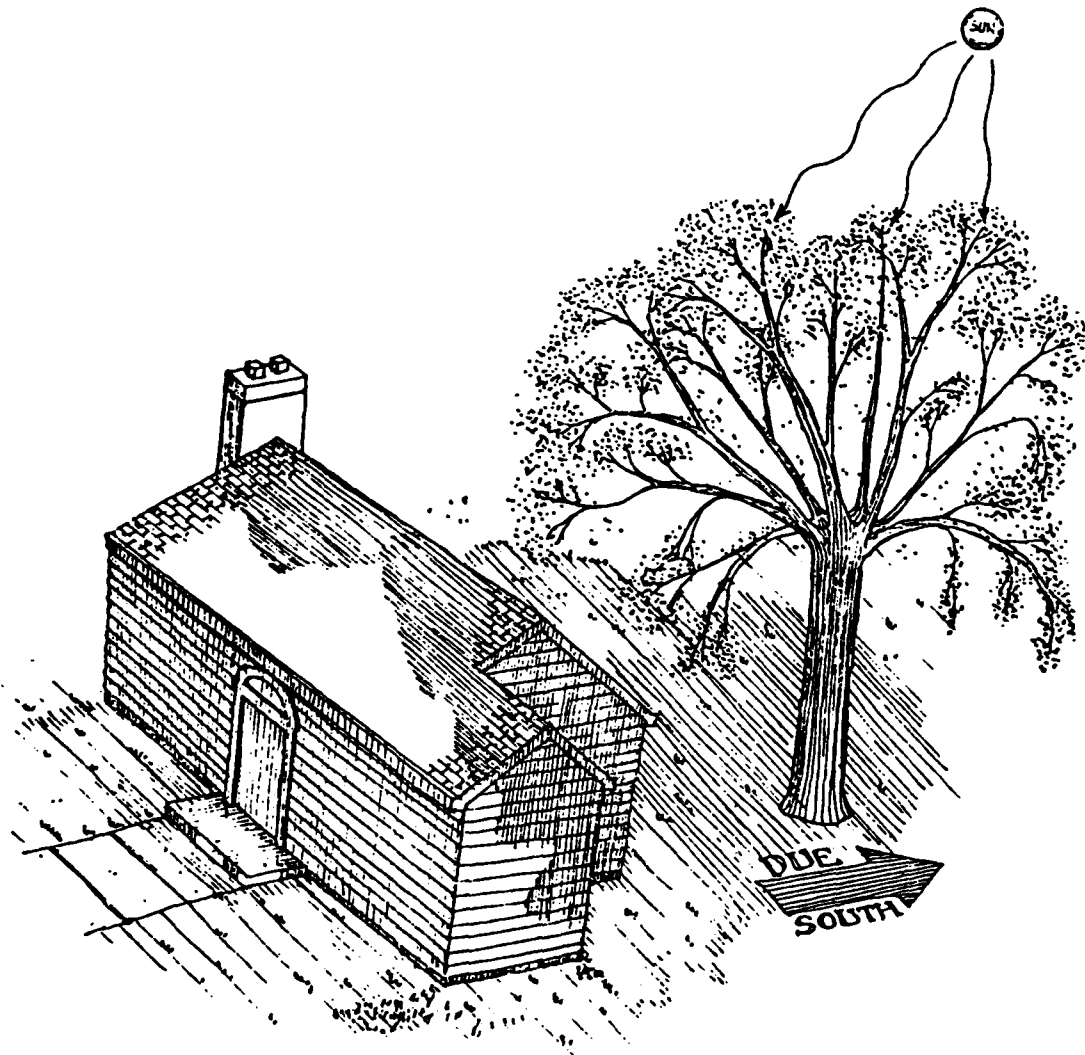


FIGURE B-3-4. PLANTS OF ALL SUN SCREENS ARE TO BE DUE SOUTH OF HOUSES IN AREAS WHERE HOUSES ARE BAKED BY SUMMER SUN. BECAUSE THESE TREES ARE DECIDUOUS THE HOUSES WILL CATCH WARMTH OF WINTER SUN

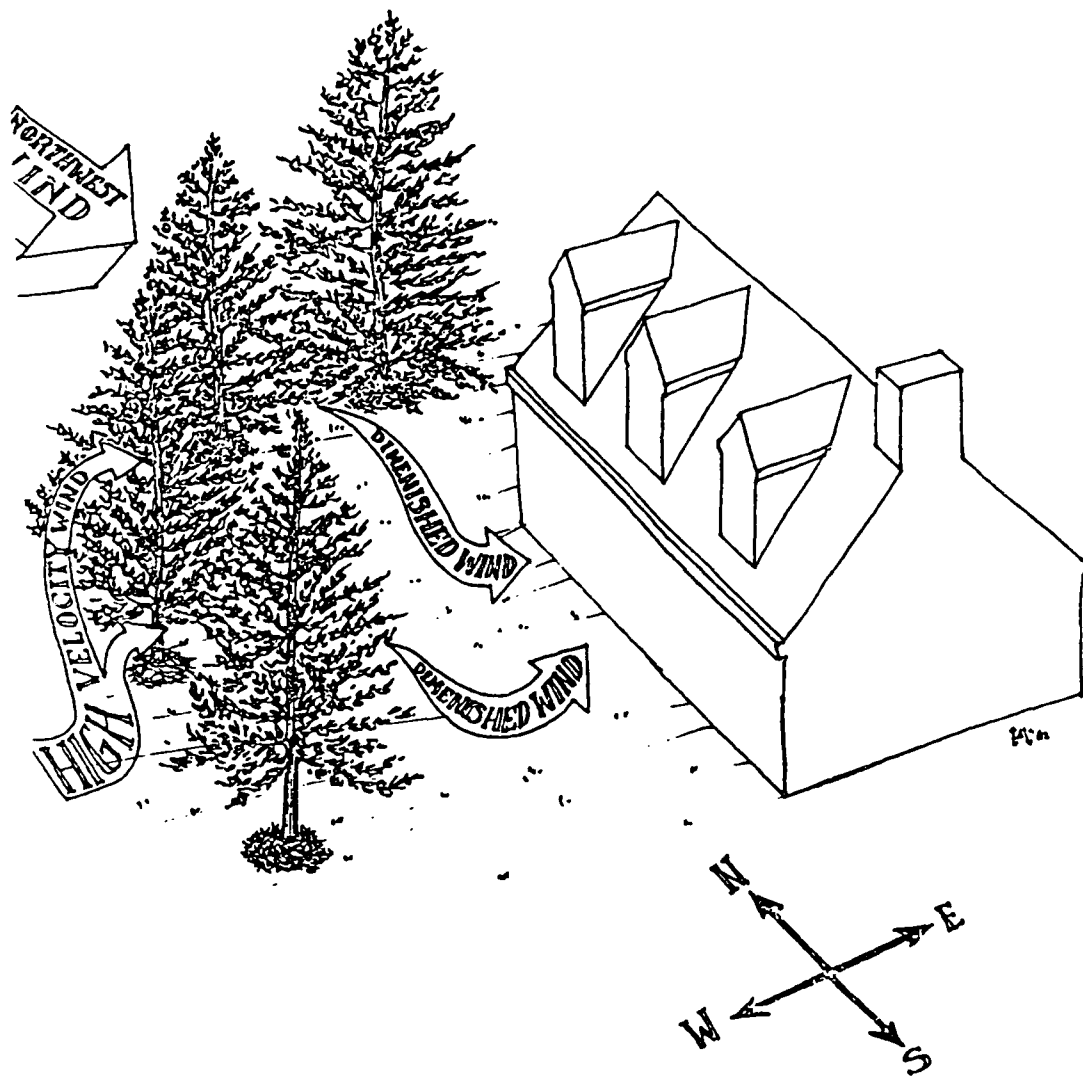


FIGURE B-3-5. WIND SCREENS ARE TO BE CREATED AT THE NORTH-NORTHWEST FACE OF HOUSES WHO EXPERIENCE HIGH VELOCITY WINDS FROM THE NORTHWEST. THIS WILL DIMINISH VELOCITY AND REGULATE TEMPERATURE DROPS

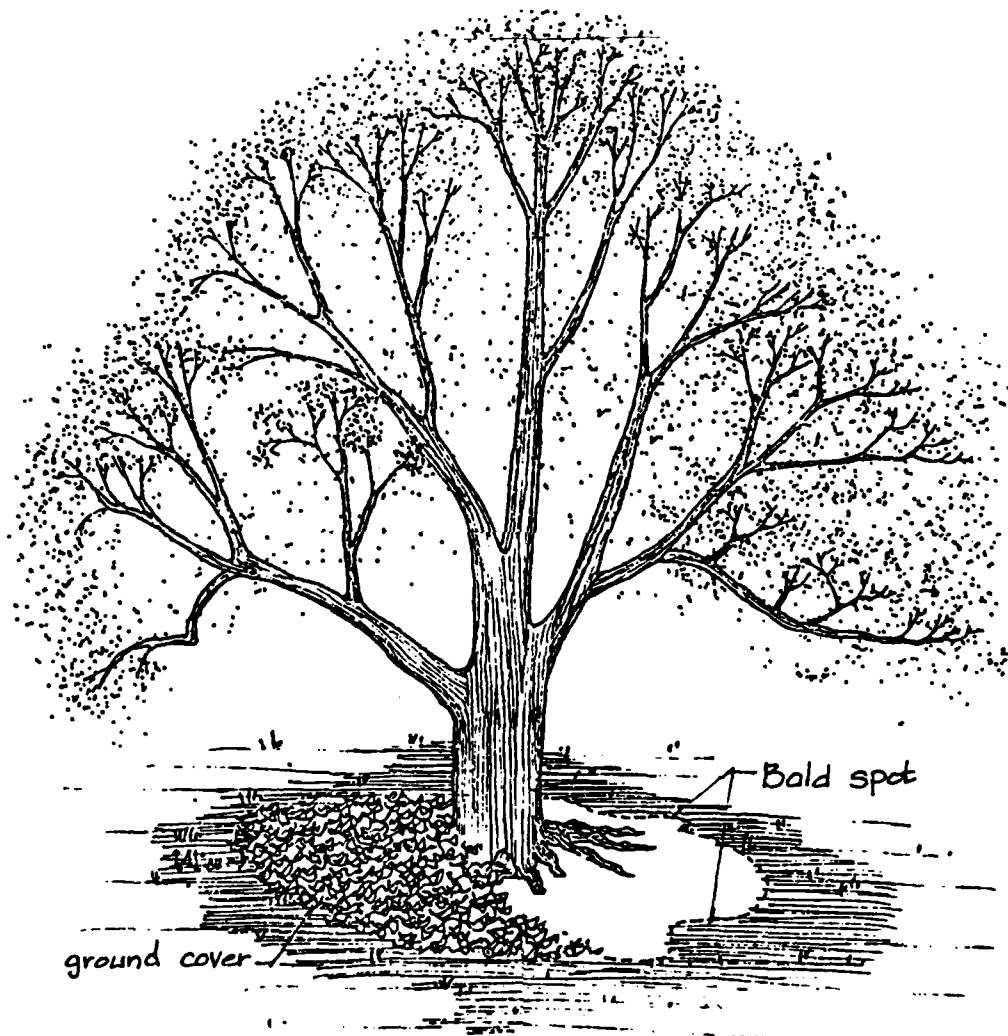


FIGURE B-3-6. WHERE LARGE TREE HAS SHADED OUT GRASS, PLANT
GROUND COVER AS SPECIFIED

PLANTING GUIDELINES

1. BARE-ROOT STOCK

A hole is to be dug sufficient enough so that the width and depth do not compromise the tree roots. But the hole is not to be dug without reasonable consideration to the roots of the tree. After digging this hole, fill in at bottom with a mound of top soil three to four inches high. This mound will serve as a resting place to center the tree on. When the tree is centered on the mound, existing soil excavated from the hole may be added around the roots for extra support. After this, the hole may be doused with water. Shovel in prepared soil and compact it firmly up to the existing grade line. If diameter of tree trunk is two inches or less, fasten tree with wire to a stake driven into ground one foot from its base. If two to four inches use two or three stakes. A three to four inch layer of peat moss or mulch should be spread at base of tree's trunk (Figure B-3-7A).

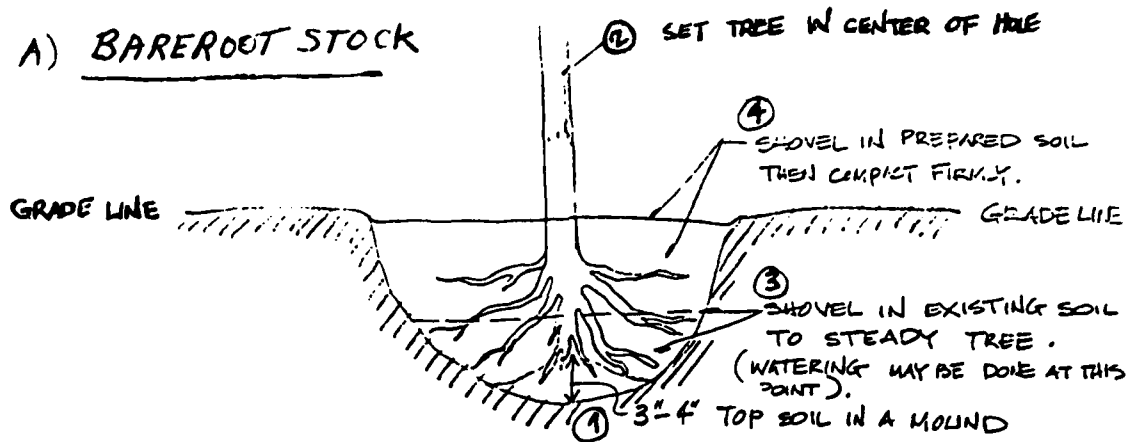
2. BALLED STOCK

A hole is to be dug so that the ball is six inches from all sides of the hole and five inches from the bottom. Shovel in a mound of prepared soil five inches high and center the ball on it. Then fill in some soil from excavation to steady the ball. Fill about to half the ball. Now untie the ball and expose roots. For the remaining depth of the hole, fill half with prepared soil and compact it; then douse with water. Fill in remaining area with prepared soil. Now peat moss or mulch may be added; build up a three or four-inch ridge encompassing tree with a radii comparable to the size of the hole dug. The specification for supporting the tree is the same as for bare-root stock (Figure B-3-7B).

3. GROUND COVER PLANTING

All ground cover is to be planted in a bed of top soil six inches deep. These plants are to be spaced a foot apart. In each individual hole for planting, water is to be added, the hole covered and firmly packed. After all plants have been planted in bed, a 3- to 4-inch layer of mulch or dried pine needles or dried straw is to be laid. Then spray thoroughly with water.

A) BAREROOT STOCK



B) BALLED STOCK

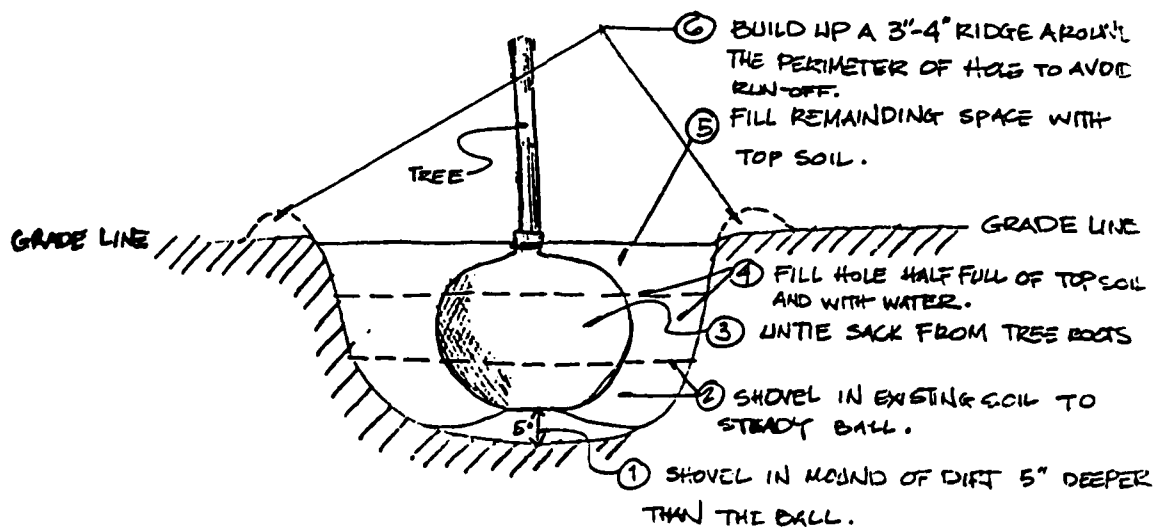


FIGURE B-3-7. BAREROOT AND BALLED STOCK

NSWC MP 84-147

APPENDIX B-3.1

TREE PURCHASE SPECIFICATIONS

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TREE PURCHASE SPECIFICATIONS

ALL TREES shall conform to the latest edition of USAS Z60.1: USA Standards for nursery stock. All trees will be subject to inspection and approval by the General Foreman, Grounds Structures (W63) by the General Foreman, Grounds Maintenance (W632) or the Natural Resources Specialist (W053) upon delivery to NSWC, Dahlgren, Virginia.

ALL TREES shall have been grown in the nursery for at least two years under the same climatic conditions as occur at Dahlgren, Virginia. All trees shall have well developed and vigorous branch and root systems and shall be healthy, free of disease, injury or any form of infestation. All trees shall have a well developed central leader. Forked or damaged leaders will be cause for rejecting trees. All trees of a specified size and species shall be of uniform size and character of growth and have a normal habit of growth for the species or variety. Caliper size of all trees shall be 1.5 to 1.75 inches measured six inches above the groundline trunk swell. Height of all trees shall be between eight and twelve feet above the groundline trunk swell.

ALL TREES, unless specified as bare root stock, shall be balled and burlapped. Trees shall have been nursery grown under proper cultural treatment to develop good root systems. Ball size for the specified tree size, shall be a minimum of twenty inches in diameter and sixteen inches in depth.

ALL TREES shall be dug, balled and burlapped and delivered during the dormant season prior to bud break. Depending upon weather conditions, the estimated cut-off date is April 1.

ALL TREES shall be free of deadwood, suckers, and broken or badly bruised branches upon delivery. All cuts over one-half inch in diameter shall be bark shaped and painted with an approved antiseptic tree paint.

ALL TREES shall be tagged with a durable, legible label stating, in weather resistant ink, the correct plant name (common name and scientific binominal) as specified in the plant list (See Table B-3-1 in Appendix B-3). Labels will be securely attached to each tree.

ALL TREES shall be certified free of disease and infestations. Inspection certificates required by law to this effect shall accompany each shipment.

ALL TREES shall be subject to inspection at the nursery and at the time of delivery. Any rejected trees shall be removed and replaced without additional compensation. If replacement of rejected trees is impractical due to season, availability or other factors, an adjustment in compensation will be made by the Government based upon the unit price.

A copy of these tree purchase specifications shall be furnished to all parties interested in selling nursery stock to NSWC.

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APPENDIX B-3.2

GROUND COVER PURCHASE SPECIFICATIONS

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GROUND COVER PURCHASE SPECIFICATIONS

Because ground covers are purchased as potted plants, the purchase specifications are less complex than those for trees. However, the following specifications should be used as guidelines when purchasing ground covers.

ALL GROUND COVERS shall have well developed and vigorous branch and root systems and shall be free of disease, injury or any form of infestation.

ALL GROUND COVERS shall be free of deadwood and broken or badly bruised branches upon delivery.

ALL GROUND COVERS shall be guaranteed as to species or variety (common name and scientific binomial) as specified in the plant list (Table B-3-2 in Appendix B-3).

ALL GROUND COVERS shall be certified as free of diseases and infestations. Inspection certificates to this effect shall accompany each shipment.

ALL GROUND COVERS will be subject to inspection and approval by the General Foreman, Grounds Structures (W63) or the General Foreman, Grounds Maintenance (W632) upon delivery to NSWC, Dahlgren, Virginia. Any rejected plant shall be removed and replaced without additional compensation. If replacement of rejected plants is impractical due to season, availability or other factors, an adjustment in compensation will be made by the Government based upon the unit price.

A copy of these ground cover purchase specifications shall be furnished to all parties interested in selling nursery stock to NSWC.

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APPENDIX B-3.3

WORK SCHEDULE

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WORK SCHEDULE
1983

LOCATION

This phase of the landscape plan will include the housing area from the Gilmore Road fenceline to the service road known as Hall-Gilmore Alley. This area needs vegetative ground covers, sun screens, wind screens, and replacement trees. Replacement trees will be used as both sun screens and wind screens.

DESCRIPTION OF WORK

Steep slopes which are expensive and difficult to mow are located at the Gilmore Road--Hall-Gilmore Alley junction (Figures C-1 and C-2). These areas are to be planted with Japanese Spurge (*Pachysandra terminalis*), a vegetative ground cover which will stabilize the banks and outcompete weeds. Plants are to be planted one foot apart and will cover the slopes as indicated in Figure C-3.

Sun screen and wind screen plantings are indicated in Figure C-4. The area between Gilmore Road and the fence will be planted with white Pine (*Pinus strobus*), Norway Spruce (*Picea abies*), Bald Cypress (*Taxodium distichum*), Eastern Hemlock (*Tsuga canadensis*), and California Indensecedar (*Libocedrus decurrens*). These trees will act as wind screens for houses with frontage on Gilmore Road. The back yards of these houses will be planted with White Oak (*Quercus alba*), Cherrybark Oak (*Q. falcata* var. *pagodaefolia*), Sawtooth Oak (*Q. acutissima*), Black Cherry (*Prunus serotina*), Sugar Maple (*Acer saccharum*), Red Maple (*A. rubrum*) and Beech (*Fagus grandifolia*). These trees will act as sun screens. Contracting Officer will accompany the Contractor to the designated planting locations for on-site inspection before planting begins.

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APPENDIX C
GENERAL TURF

C-1/(C-2 blank)

GENERAL TURF

Special Purpose Turf (for use in full sun areas under intensive management).

Kentucky Bluegrass

20-60% Certified Merion
20-40% Certified Kenblue (KY origin)
or South Dakota Certified
0-40% Certified Fylking, Certified Pennstar,
or Certified Adelphi

Seeding rate: 1.5-2 lbs of mixture/1,000 sq. ft.

General Purpose Turf (for use in dry or semi-shady areas under medium management).

Kentucky Bluegrass

20-60% Certified Merion
20-40% Certified Kenblue (KY origin)
or South Dakota Certified
0-40% Certified Fylking, Certified Pennstar,
or Certified Adelphi

Seeding rate: 1.5-2 lbs. of mixture/1,000 sq. ft.

Creeping Red Fescue

10-50% Certified Pennlawn or Certified Jamestown*

Seeding rate: 1.5-2 lbs. of mixture/1,000 sq. ft.

Multi-use Turf (for use in drought-prone areas where low maintenance is expected).

Tall Fescue

90-100% Certified Kentucky 31

Seeding rate: 1 lb. 6 ozs./1,000 sq. ft.

*If lawn is under heavy shade, use higher percentages of Creeping Red Fescue and no more than 20% Merion Kentucky Bluegrass.

Kentucky Bluegrass

0-10% Certified Kenblue (KY origin),
South Dakota Certified, or Certified Merion

Seeding rate: 5 to 8 lbs. of mixture/1,000 sq. ft.

Warm-season Turf (for use in dry areas to be maintained under medium management in drought-prone areas).

Bermudagrass

100% Tufcote Bermudagrass

Sod or sprigs

NOTE: As an aid to erosion control on sloping lawns and on areas seeded to other than recommended seeding dates, 1/4 lb./1,000 sq. ft. of Certified Manhattan or Certified Pennfine perennial ryegrass may be seeded with Mixtures 1 and 2.

NSWC MP 84-147

FISH AND WILDLIFE MANAGEMENT PLAN

FOR

NAVAL SURFACE WEAPONS CENTER
DAHLGREN LABORATORY
DAHLGREN, VIRGINIA

1982-1991

Prepared in Cooperation with: PUBLIC WORKS OFFICE
NAVAL SURFACE WEAPONS CENTER

AND

CHESAPEAKE DIVISON
NAVAL FACILITIES ENGINEERING COMMAND
THE UNITED STATES FISH AND WILDLIFE SERVICE
THE VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

NSWC MP 84-147

FISH AND WILDLIFE PLAN

NAVAL SURFACE WEAPONS CENTER
DAHLGREN SITE
DAHLGREN, VIRGINIA

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INTRODUCTION

The Naval Surface Weapons Center, Dahlgren Laboratory (NSWC) is located approximately 60 miles south of Washington, D.C. and 69 miles north of Richmond, Virginia, via Route 301. The nearest metropolitan area is Fredericksburg, Virginia located approximately 30 miles west via Route 218 (Figure 1).

NSWC is situated on the Potomac River waterfront of King George County, Virginia. King George County is predominantly rural, agricultural, forested, and marsh land providing suitable habitat for abundant and diverse wildlife species.

INSTALLATION DESCRIPTION

SOILS

The topography is level to nearly level lying 20 to 25 feet above mean sea level. The soils are composed of 5 to 8 feet of fine sand and sandy coastal plain materials in which the soils have developed; a few pockets and thin strata of fine gravel occur. A very slowly permeable, sticky and plastic clay layer, 20 to 30 inches thick, is found at depths of 5 to 8 feet. The soils may be considered as generally poorly drained, primarily due to the existence of the clay layer. A water table is present above the clay layer in wet seasons and usually extends to the surface in low-lying areas.

The population levels and diversity of wildlife species on the installation depend largely on the types, amounts, and distributions of food, shelter, and water, which are closely related to soil types. Every soil, regardless of its fertility or moisture content, grows something useful to wildlife.

Detailed information concerning soil types at NSWC can be found in the Soil and Water Conservation Plan.

CLIMATE

The NSWC, Dahlgren Laboratory is located in the temperate climate zone of the Eastern United States. The average temperatures by season are: Spring, 55.7° F; Summer, 74.6° F; Autumn, 58.1° F; and Winter, 37.9° F. The average annual rainfall is approximately 40 inches per year, with approximately 56 percent of this falling between April 1 and September 30. There is a great deal of variation in the average annual rainfall in the Dahlgren area. Over a recent 30 year period, precipitation

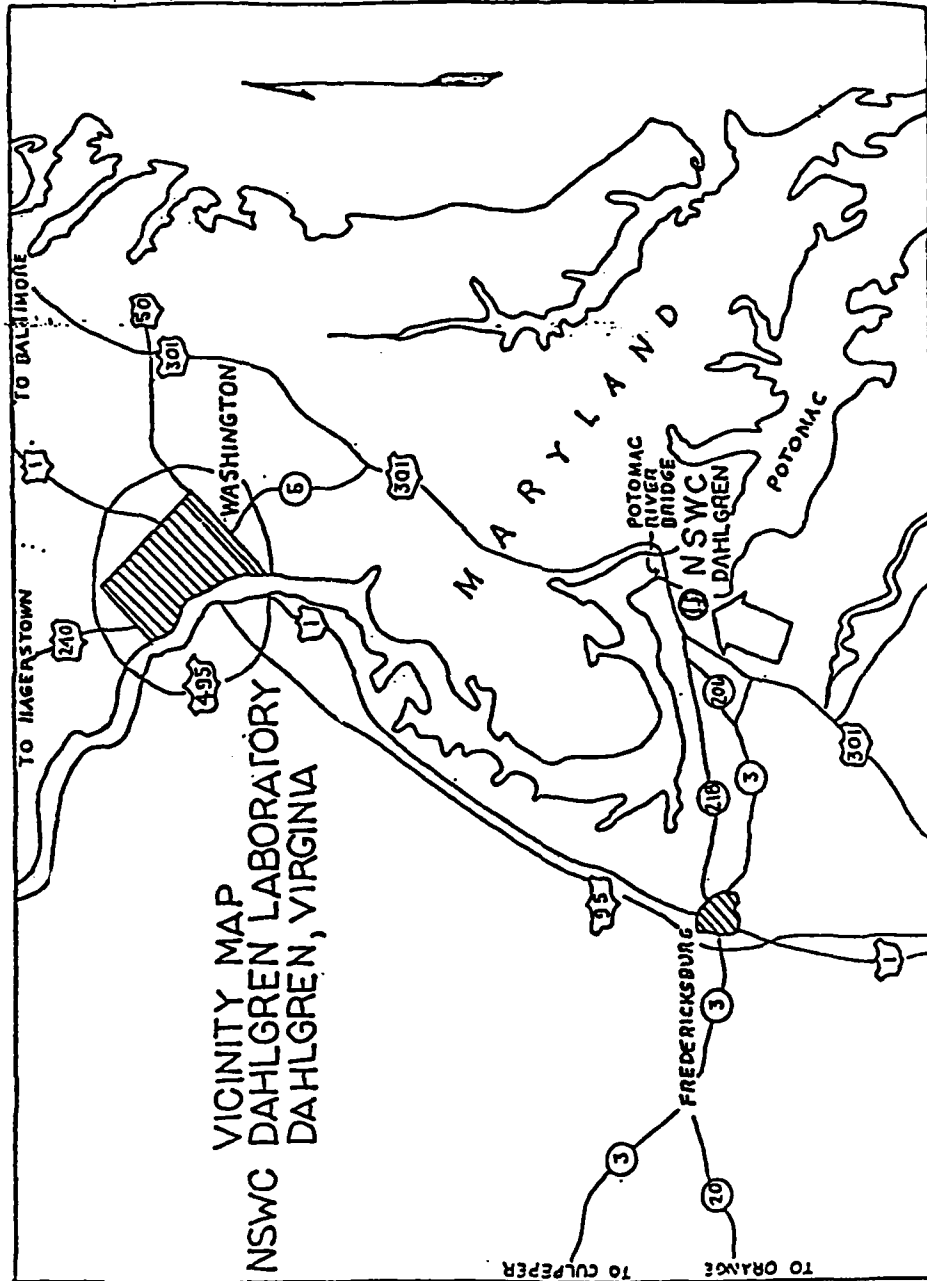


FIGURE 1. VICINITY MAP OF DAHLGREN LABORATORY, DAHLGREN, VIRGINIA

at Dahlgren ranged from 27.4 to 54.8 inches, a variation of 100 percent. Although rainfall is greatest in the summer months, it is commonly insufficient because of the greater demand at this time for moisture by vegetation, and much of this rainfall occurs during heavy thundershowers resulting in considerable runoff.

HABITAT TYPES

A variety of habitat types produces a corresponding variety of wildlife species. NSWC contains 9 distinct habitat types:

1. Open Fields--Old field communities develop mostly on abandoned upland farm fields. Vegetation in these areas is largely influenced by the time since abandonment. Pioneer species include crabgrass and horseweed. Mid-successional species are dominated by white aster, with broomsedge appearing later on. As succession continues pine begins to invade the area. If left undisturbed, old field will eventually evolve into hardwood forests.
2. Shrub Community--Shrub communities represent the successional stage between an open field and forest. These areas support vegetation representative of both open fields and young forests and, are very diverse. Plants characteristic of shrub communities include loblolly pine, Virginia pine, sweetgum, red cedar and black locust in the upper layers, Japanese honeysuckle, persimmon, brambles, poison ivy, trumpet creeper, sumac, Virginia creeper, and grapes in the middle layers, and asters, goldenrods, wild onion, strawberries, and blackberries dominate the ground layer.
3. Pine Forests--Pine forest in the Atlantic Coastal Plain are successional in nature and indicative of disturbances in the area. Major overstory species are loblolly and Virginia pine. Older pine stands may have an understory of white and red oaks, hickory, blackgum, and sweetgum. Shrub and ground vegetation consists of Japanese honeysuckle, trumpet creeper, poison ivy, Virginia creeper, highbush blueberry, flowering spurge, and spotted wintergreen.
4. Pine Hardwood Forests--Pine hardwood stands have an overstory predominately of loblolly and Virginia pine, yellow poplar, and white oak. Vegetation characteristic of the understory includes white oak, blackgum, sweetgum, red maple, and American holly. Dominant ground vegetation consists of Japanese honeysuckle, highbush blueberry, Virginia creeper, and panic grasses.
5. Hardwood Forests--The hardwood forest type is considered the climax vegetational stage in the Atlantic Coastal Plain. Principal overstory trees include both white and red oaks and hickory. Understory vegetation consists mainly of sweetgum, American holly, and flowering dogwood. Predominant shrub and ground flora include Virginia creeper, strawberry bush, highbush blueberry, partridge berry, and ground pine.
6. Coastal Areas--Much of NSWC borders on the Potomac River and Machodoc Creek. These shoreline areas consist of a narrow beach with sparse vegetation. Common vegetation along the shore-side of the beach consists of black locust, persimmon, false indigo, poison ivy, sea myrtle, grape, and Virginia creeper. Other vegetation along the beach includes phlox, gama grass, panic grass, bermuda grass, and finger grass.

7. Fresh Water Marsh--Fresh water marsh communities are NSWC support a wide variety of plants making exceptionally valuable wildlife habitats. Common plant species include jewelweeds, alders, buttonbush, cattails, willows, and others.

8. Brackish Water Marsh--Brackish water marshes at NSWC are also quite rich in plant species diversity which support equally diverse wildlife species. These marshes are characterized by dense stands of cattails and phragmites interspersed with other marsh plants such as bulrushes, smooth (saltmarsh) cordgrass, smartweed, marshmallow, and sedges.

9. Developed Areas--Though not widely recognized as wildlife habitat, areas which are developed and subsequently landscaped have proven to be valuable for several wildlife species. Trees in those areas include oaks, maples, yellow poplars, dogwoods, hollies, spruces, pines, and several ornamental cultivars (cultivated varieties).

Habitat types with approximate acreages at NSWC are delineated in Appendix A.

WILDLIFE ECOLOGY

All living things can be classified as either producers, consumers, or decomposers. The physical, chemical, and biological surroundings where living things are found is called the habitat. Groups of individuals of the same species occupying the same habitat are called populations; groups of populations occupying similar habitats or geographic locales are called communities.

Within the community, each species has its own ecological niche. A niche is not simply a physical place within the habitat. Specifically, a niche is the manner with which each individual utilizes the habitat to insure the species survival (i.e., its manner of acquiring food and cover in order to survive to reproduce). The occupation of a niche is a mechanism by which different species in the same community reduce competition for a habitat's limited life necessities (interspecific competition). Other relations within a community include intraspecific competition, parasitism, predation, symbiosis or cooperation, and neutrality. These relations combined with the total available habitat (and other factors), result in an environmental carrying capacity.

The environmental carrying capacity is the maximum number of individuals of each population able to live in a given community over an extended time period. Normally, populations will slightly fluctuate about the carrying capacity due to reproduction and mortality. To ensure the species survival, many species have a high biotic potential or are very prolific in order to fill all available niches in a community, up to and beyond the carrying capacity. The overabundance of offspring results in considerable intraspecific competition. Those individuals fit to survive will successfully occupy their niche and will live to reproduce while those unfit to survive will perish due to one or more mortality agents. Usually, the very young, the old, and the sick individuals perish.

The environmental carrying capacity is determined by the environmental resistance. Environmental resistance comes in the form of the previously mentioned community relations, accidents, lack of food, water, or cover, and various other factors which act against population growth beyond a certain level.

Environmental resistance reaches a peak during late fall and winter thus making the carrying capacity lowest at this time of year. The surplus of animals born in the spring and summer result in large fall populations; vegetative growth has slowed or completely stopped reducing total available food and cover; competition is keen and often so intense that the habitat is severely degraded; many animals fall to diseases, parasites, or starvation; other animals are weak and can no longer escape natural predators who are also subjected to the hardships of winter; the winter mortality is high.

Normal healthy communities are balanced with all populations living together in harmony. Predators live with prey consuming only those individuals they can catch (or those unfit to survive). Diseases and parasites take those unfit to survive also. When a community is taken out of balance by removing one or more population mortality agents, the carrying capacity does not necessarily increase even though more individuals may survive. The increased survival is only temporary. For example, if natural predators are eliminated from a community, individuals which may have fallen prey may now fall to diseases, parasites, starvation, or some other mortality agent at a later time. If the time lag is much later, high population numbers may have seriously degraded the habitat resulting in a massive population "die-off". This "die-off" may be from an epidemic rapidly spreading through a dense population of weakened animals or it may be from direct starvation. There is a wide variety of mortality factors which act both together and singly to limit populations exceeding the environmental carrying capacity.

Hunting now enters the picture. Originally, hunting laws simply regulated or controlled the numbers of animals being taken. It should be noted, however, that laws now regulate the seasons in which hunting is allowed. Most hunting seasons are scheduled during fall and winter when there is a surplus of wild animals trying to survive on habitat at its lowest carrying capacity. Hunters take only the "harvestable surplus" of wildlife and reduce populations to the winter carrying capacity. Thus, there is less strain on the habitat and the percentage of overwinter survival actually increases. The hunters have simply used the wildlife as a renewable natural resource in the same sense that a farmer harvests his crops. The animals taken by hunters results in fewer animals lost to natural mortality agents such as disease, parasites, or starvation.

In the case of game animals, land managers seek to increase the carrying capacity of an area by reducing environmental resistance thus permitting the hunter to remove a larger portion of the animals (surplus), provided that the proportion removed does not impair a population's reproduction in succeeding years. Management techniques to improve migratory and non-game wildlife habitat also center on reducing environmental resistance.

Land management practices such as forestry and agriculture can be modified to not only supply timber and crops, but also to improve the carrying capacity. Forestry and agriculture in relation to wildlife management are discussed later. Further, supporting management techniques such as hedgerow planting, firebreak maintenance, and artificial nesting devices can greatly improve wildlife habitat.

FISHERIES MANAGEMENT

Sport fisheries at NSWC consist of both fresh water ponds and tidal creeks and rivers. Due to tidal influence and therefore introduction of undesirable fish species, the tidal creeks and rivers cannot be efficiently managed. However, fresh-water impoundments at NSWC are intensively managed for large-mouth bass, crappie, perch, chain pickerel, bream, and catfish.

A complete Fisheries Management Plan is included in Appendix B-1.

WILDLIFE MANAGEMENT

INTRODUCTION

Wildlife Management at NSWC will be predominately habitat management. This type of management produces the greatest diversity of habitat types which in turn produces the greatest diversity of wildlife populations. Species specific management plans are included as separate plans in Appendix B.

HABITAT MANAGEMENT

Habitat management will create a mosaic of vegetative types. The mosaic will consist of early successional stages interspersed among mid and late successional stages. The mosaic of vegetational stages will provide ample, food, cover, and nesting areas for a wide variety of game and non-game wildlife. The following techniques will be utilized in managing wildlife habitats:

1. Prescribed Fire--Prescribed fires will be used to maintain open field, brushland, and pine plantation communities on a three year rotation. A complete prescribed fire plan is included as Appendix C.

2. Strip Discing--Edge habitat (the borders of two different habitat types) will be strip disced on a three year rotation. The first year, a strip along a wooded edge will be disced down to bare soil. The width of the strip will be equal to that of disc itself. The second year, a strip adjacent to the first strip will be disced down to bare soil. The third year, a strip adjacent to the second strip will be disced down to bare soil. The fourth year, the first strip will be disced again starting the rotation over.

3. Hedgerow Plantings--Where practical, hedgerows will be established in open fields and will be of sufficient distance from edge habitats to allow strip discing as described above. Hedgerows will be planted with perennials in order to eliminate annual maintenance or will be established by installing fence posts. The fence post will restrict mower access and provide perches for songbirds. Restricting mower access will allow rapid hedgerow establishment while the perches attract songbirds whose droppings contain viable seeds.

4. Brushpile Construction--Brushpiles built in select locations improve habitat for ground nesting small game and non-game wildlife. A description of suitable areas and materials used is included in appropriate species management plans.

5. Firebreak Maintenance--Where possible, firebreaks will be used for strip planting grasses, grains, legumes, and other plants beneficial to wildlife.

6. Daylighting Woodlots--This technique will be used to establish small open areas within dense hardwood stands. The location of daylighting areas will correspond to timber harvest and firewood harvest areas which are not planned for reforestation.

7. Annual Food Plots--The use of general annual food plots will be accomplished by volunteer efforts of local conservation organizations. However, specific annual plantings in select locations are addressed in the Waterfowl Management and Wild Turkey Management Plans (Appendices B-3 and B-4, respectively).

8. Artificial Nesting Devices--Artificial nesting devices, although a form of habitat management are species specific. Therefore, artificial nests are included in species management plans.

SPECIES MANAGEMENT

Species management plans contain management strategies which improve habitat for either individual species or groups of species occupying similar ecological niches. Although most species occupying NSWC are not included in the species specific plans, their habitat requirements are thoroughly covered in the previously described Habitat Management.

Species Management Plans are included in Appendix B; Supplementary Plans. Specific plans are written for Bald Eagles, Wild Turkeys, Fisheries, Urban and Non-Game Wildlife, Small-game, and Waterfowl. Additional Species Management Plans will be formulated as the need arises.

FORESTRY AND AGRICULTURE IN RELATION TO WILDLIFE MANAGEMENT

A Forestry Management and an Agricultural Outleasing Plan have been formulated for NSWC. Both these plans contain modified management techniques to insure that wildlife habitat is improved rather than degraded as a result of these programs. For example, a Seed Tree Cut within the Bald Eagle Secondary Management Zone was modified to leave the seed trees for future Bald Eagle nesting/resting sites instead of harvesting these trees after natural regeneration.

Other Forestry and Agricultural modifications include size and location of clear-cuts, prescribed fire, firebreak maintenance, leaving row crops along woodland edges, and others. Annual work schedules contained in Section IX of this plan will avoid duplication of effort by identifying wildlife projects which may be accomplished through Forestry and Agricultural Outleasing. Therefore, Fish and Wildlife funds will be used exclusively for program requirements which cannot be accomplished through Forestry and Agricultural Outleasing.

COOPERATIVE RESEARCH

In addition to carrying out responsibilities for Fish and Wildlife Management identified in the Cooperative Agreement, NSWC supports wildlife research carried out by State and private agencies and the U.S. Fish and Wildlife Service (USFWS). To date, research projects include mid-winter Bald Eagle surveys and nesting success in cooperation with the College of William and Mary and the National Wildlife Federation and a diving duck banding project (Potomac River) in cooperation with the USFWS. Other research projects having fish and wildlife implications are being conducted under the Forestry and Soil and Water programs. Additional research projects will be carried out within the limits of mission and man-hour constraints.

TYPICAL WILDLIFE INHABITING NSWC

Several documents are available which give detailed information concerning floral and faunal distribution and abundance for the Dahlgren vicinity. Most notably are the Dynaplan Documents developed by the Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University and the Floral and Faunal Survey of NSWC compiled by Terrestrial Environmental Specialists, Inc. Further, a computerized inventory of the Birds of Dahlgren is currently being expanded to include all wildlife resources either known to occur or expected to occur at NSWC. It should be emphasized, however, that this list is subject to continuous change as more information concerning species' occurrence, abundance, and habitat utilization becomes available. This list is included as Appendix E of this plan.

Tables 1-8 summarize the typical wildlife inhabiting NSWC.

CONSUMPTIVE USES OF FISH AND WILDLIFE RESOURCES

Consumptive uses of fish and wildlife resources will be in accordance with the rules and regulations established by the Commander, NSWC, and will be strictly enforced by his appointed Game Wardens and the Security Force. It is emphasized that these consumptive uses are a privilege, not a right. Flagrant violations will be cause for permanent revocation of consumptive uses privileges and prosecution in State or Federal Courts.

Generally, consumptive use regulations will be in consonance with local, State, and Federal regulations. Any deviations will be based upon recommendations by applicable State and Federal agencies or will be a result of mission requirements.

Consumptive uses of fish and wildlife will be limited to hunting, fishing, gigging, and trapping. Target shooting at blackbirds, varmints, etc. is prohibited. All animals taken aboard NSWC will be subjected to harvest data requirements when required by the Natural Resources Specialist. Appendix D describes hunter harvest data requirements.

Hunting, fishing, and gigging programs will be used to improve outdoor recreational opportunities and to promote conservation education. Trapping will be contracted with trapping privileges awarded to the highest bidder.

TABLE 1. TYPICAL ANIMAL INHABITANTS OF AN OPEN FIELD COMMUNITY

Toads	Lizards	Snakes	Raptors	Game Birds	Songbirds	Small Mammals	Large Mammals
Fowls	Six-lined-racerunner	Black racer	Red-shouldered hawk	Bobwhite quail	White eyed vireo	Opposum	Red fox
American		Black rat	Red-tailed hawk	Mourning dove	Prairie warbler	Short-tailed shrew	White-tail deer
				Wild turkey	Yellow throat	Least shrew	
			Rough legged hawk		Yellow breasted chat	Common mole	
					Meadowlark	Eastern cotton-tail	
					Cardinal	White footed mouse	
					Towhee		
					Savanna sparrow	Meadow mouse	
					Grasshopper sparrow	House mouse	
					Bachman's sparrow	Meadow mole	
					Field sparrow	Long-tailed weasel	
						Striped skunk	

TABLE 2. TYPICAL ANIMAL INHABITANTS OF A SHRUB COMMUNITY

Frogs and Toads	Turtles	Lizards	Snakes	Game Birds	Songbirds	Mammals
American toad	E. Mud turtle	Six-lined racrunner	E. Kingsnake	Bobwhite quail	Robin	Short-tailed shrew
Fowler's toad	E. painted turtle		N. black racer	Wild turkey	Starling	White-footed mouse
M. Cricket frog	Box turtle		Black rat snake		Yellow-rumped warbler	Meadow mole
M. spring peeper					Cardinal	Red fox
Upland chorus frog					Dark-eyed junco	Raccoon
					Tree sparrow	Skunk
					White throated sparrow	White-tailed deer
					Field sparrow	
					White eyed vireo	
					Prairie warbler	
					Indigo bunting	
					Goldfinch	

TABLE 3. TYPICAL ANIMAL INHABITANTS OF A PINE FOREST COMMUNITY

Frogs	Turtles	Lizards	Snakes	Raptors	Game Birds	Songbirds	Mammals
Eastern spadefoot	Box turtle	Fence lizard	Cornsnake	Red-tailed hawk	Bobwhite quail	Yellow shafted flicker	Pine mouse
Pine woods tree frog		Six-lined racerunner	Black rat snake	Broad-winged hawk	Mourning dove	Hairy wood-pecker	Opossum
Green tree frog		Ground skink		Great horned owl	Woodcock	Brown headed nuthatch	Eastern cottontail
		Five-lined skink			Wild turkey	Eastern blue-bird	Gray fox
						Yellow throated warbler	Raccoon
						Pine warbler	White-tailed deer
						Prairie warbler	
						Meadowlark	
						Towhee	
						Pine woods sparrow	

TABLE 4. TYPICAL ANIMAL INHABITANTS OF A PINE-HARDWOOD FOREST COMMUNITY

Salamanders and Lizards	Turtles	Frogs and Toads	Snakes	Raptors	Game Birds	Songbirds	Mammals
Dusky salamander	Box turtle	Eastern spadefoot	Eastern garter snake	Screech owl	Bobwhite quail	Ruby throated humming bird	Masked shrew
Red-backed salamander		Fowler's toad	Eastern hog- nose snake	Great horned owl	Woodcock	Eastern wood peewee	Short tailed shrew
Six-lined racerunner			Black racer		Wild turkey		Meadow mole
Ground skink			Eastern coachwhip			Carolina chickadee	Common mole
			Corn snake			Blue grey nuthatcher	White footed mouse
			Black rat snake			White eyed vireo	Opossum
			Copperhead			Pine warbler	Eastern cotton- tail
						Summer tanager	Gray squirrel
						Cardinal	Southern flying squirrel
						Field sparrow	Gray fox
							Raccoon
							White-tailed deer

TABLE 5. TYPICAL ANIMAL INHABITANTS OF A HARDWOOD FOREST COMMUNITY

Salamanders and Skinks	Frogs and Toads	Turtles	Snakes	Raptors	Songbirds	Mammals
Dusky salamander	Eastern spadefoot	Box turtle	Eastern garter	Red shouldered hawk	Ruby throated humming bird	Masked shrew
Red backed salamander	Fowler's toad		Black snake	Broad winged hawk	Yellow shafted flicker	Short tailed shrew
Slimy salamander			Black rat snake	Screech owl	Pileated woodpecker	White footed mouse
Ground skink			Eastern hognose snake	Great horned owl	Red headed wood- pecker	Pine mole
Broad headed skink					Hairy woodpecker	Opposum
			Copperhead		Downy woodpecker	Eastern cotton- tail
					Acadian flycatcher	Gray squirrel
					Eastern wood peewee	Gray fox
					Crested flycatcher	Raccoon
					Common crow	Long tailed weasel
					Blue jay	Striped skunk
					Tufted titmouse	White-tailed deer
					Carolina chickadee	
					White breasted nuthatch	
					Carolina wren, cardinal	
					Wood thrush	
					Red eyed vireo	
					Black & white warbler	

TABLE 6. TYPICAL ANIMAL INHABITANTS OF A COASTAL COMMUNITY

Lizards	Snakes	Shorebirds	Waterfowl and		Songbirds	Mammals
			Duck-Like Birds			
Six-lined racerunner	E. hognose snake	Plovers	Canvasbacks		Ipwich sparrow	White footed mouse
	Black racer "	Turnstone	Ruddy duck		Savanna sparrow	Meadow jumping mouse
	Black rat snake	Willet	Lesser scaup		Redwing blackbird	House mouse
		Sanderling	Buffleheads		Common crow	Eastern cottontail
		Gulls	Redhead		Fish crow	
		Terns	Common goldeneye			
		Sandpipers	Blue-winged teal			
		Yellowlegs	Double-crested cormorant			
		Great-blue heron	American coot			

TABLE 7. TYPICAL ANIMAL INHABITANTS OF A MARSH COMMUNITY

Frogs and Toads	Turtles	Snakes	Waterfowl and Duck-like Birds		Songbirds	Mammals
			Marsh Birds			
American toad	Snapping turtle	N. water snake	Virginia rail	Mallard	Common yellow throat	Opossum
Fowler's toad	E. Mudturtle	N. black racer	Sora rail	Black duck	Red winged black-bird	Muskrat
N. Cricker frog	Box turtle	E. kingsnake	Long billed marsh wren	Widgeon		Raccoon
N. spring peeper	E. painted turtle	Black rat snake	Great blue heron	Blue winged teal	Eastern kingbird	Skunk
			Cowbird	Pintail	Catbird	White-tailed deer
			Osprey	Wood duck	White eyed vireo	Beaver
			Marsh hawk	Ring-necked duck	Song sparrow	Otter
				Horned grebe	Barn swallow	
				Pie-eyed grebe	Purple martin	

TABLE 8. TYPICAL ANIMAL INHABITANTS OF DEVELOPED AREAS

Frogs and Toads	Lizards	Turtles	Snakes	Raptors	Game Birds	Songbirds	Mammals
Chorus frog	Fence lizard	Box turtle	Black racer	Barn owl	Mourning dove	Starling	Opossum
Fowler's toad			Black rat snake			House sparrow	Cottontail rabbit
						Cardinal	Gray squirrel
						Grackle	Red fox
						Dark-eyed junco	Raccoon
						White-throated sparrow	Striped skunk
						Barn swallow	
						Chimney swift	
						Purple martin	
						Robin	
						Catbird	
						Brown thrasher	
						Mockingbird	
						Song sparrow	

PROGRAM FUNDING

Although a great deal of wildlife management projects will be accomplished with properly planned Forestry and Agricultural modifications, funds are available for managing fish and wildlife resources.

When available, the major sources of fish and wildlife management funds are obtained through Sikes Act (Public Law 86-797) appropriations. These funds are for on-the-ground improvements; that is maintenance, repair, rehabilitation, and construction of essential fish and wildlife conservation projects. In addition to habitat improvements projects, Sikes Act money may be used for related travel, supplies, small equipment, and contract services to accomplish projects. Sikes Act funds may also be combined with other funds, such as hunting and fishing license fees. Sikes Act funds are not to be used for the hiring of consultants, personnel salaries, or the preparation of surveys and studies. Also, these funds may not be used for indoor recreation facilities, camps, athletic fields, golf courses, or similar facilities.

Also, NSWC has established a Fish and Wildlife Management charge code. These funds are available in the absence of Sikes Act appropriations or to supplement other fundings sources.

MILITARY FACTORS AFFECTING FISH AND WILDLIFE MANAGEMENT

The mission of NSWC involves research, development, testing, and evaluation of weapons. The very nature of the Center's mission combined with its location has resulted in what may be considered a haven for fish and wildlife resources. This is because large tracts of land and water are used as buffer zones for weapons testing and thus cannot be considered excess property. There are no apparent incompatibilities between mission requirements and the objectives of a Fish and Wildlife Management program.

REPORTING REQUIREMENTS

Reporting requirements to CHESDIV Code 243 are Semi-annual Fish and Wildlife Reports (due 15 April and 15 November). Annual Increments (due 1 June), and Participation and Usage Reports (due 15 November).

Semi-annual Fish and Wildlife Reports (Figure 2) are used to document program funding and expenditures. It is important to document all funding sources, management projects accomplished through other properly planned functions which incur no cost to the Fish and Wildlife program, and to provide estimated value of these projects (including volunteer labor).

Annual Increments (Figure 3) are yearly evaluations of the long range (10 year) Fish and Wildlife Management Plan which are used to document program success and to modify the next year's strategies appropriately.

SEMI-ANNUAL FISH AND WILDLIFE MANAGEMENT REPORT

From Activity Naval Surface Weapons Ctr To CHESDIV, Code 243 Quarter Ending _____ Signature _____

Management Area	Income		Expenditures	
	License Fees	Total Income		Projects
Fishing Hunting Trapping (Specify)		Year-to- Data	Food on-Hand	Suppli- Inventory mental and
		Reserves	Purchase Rentals* Plots Mgmt Feeding Surveys	

*rental includes hourly rates charged for Activity-owned Equipment to the Wildlife Fund.

Due on 15 April and 15 November of each year.

SEMI-ANNUAL FISH AND WILDLIFE MANAGEMENT REPORT (CONT'D)

EXPENDITURES

Habitat TOTALS

Imp.

YEAR-TO-DATE

COMMENTS

FIGURE 2. SEMI-ANNUAL FISH AND WILDLIFE MANAGEMENT REPORT

ANNUAL INCREMENT, FISH AND WILDLIFE PROGRAM

ACTIVITY Naval Surface Weapons Center DATE _____

FISCAL YEAR _____

1. ADMINISTRATIVE COSTS:

A. Personnel: (list separately by grade and man year equivalent)

B. Equipment:

1. Purchase (total cost)
2. Rental (hours used x rental/hour)
3. Reimbursable costs (usage rate x hours)

C. Projects (Acres involved, costs, quarter funding hooded)

1. Planting wildlife food plots (acres, material, cost)
2. Pond management (acres, materials, cost)
3. Supplemental feeding (Species fed, material used, cost)
4. Inventory and surveys (type, number of units)
5. Habitat improvement (planting/clearing, mowing, non-commercial timber stand improvement (cost location))
6. Obligational needs by quarter

D. Income and Funding

1. Reserve non-obligated funds on hand
2. Anticipated income from license fees
3. Central funding request (for additional funds above those generated in 1 and 2 above to meet requirements in total of A, B, and C above)

Due by 1 June of each year.

FIGURE 3. ANNUAL INCREMENT, FISH AND WILDLIFE PROGRAM

Participation and Usage Reports (Figure 4) are used to document acres of land and water under management, man-days of recreations, and an estimate of species harvested.

ANNUAL WORK SCHEDULE

The annual work schedule (Figure 5) is used to insure long-term program continuity, document fish and wildlife projects accomplished through forestry, agricultural and grounds maintenance functions, to identify special projects (i.e., animal damage control), and to avoid duplication of effort. Annual work schedules will be strictly adhered to and used for informaion when compiling the above annual reports.

(Attach detailed narrative description and small activity map showing location of work (Definitive plans and specs. are required for construction projects). Use additional forms if required.

Small activity map showing location of work (definitive plans and specs. are required for construction projects). Use additional forms if required.	Proposed Completion Date	Appropriated Funds	Collected Fees	Activity Funds	Rod & Gun Club	Total 2 thru 5	Self Help	Forestry Projects	Outleaze Projects	Other	Total 7 thru 10
LIST OF PROJECTS - As per L. R. Plan	1	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
SPECIAL PROJECTS - Not Scheduled in LRP											
TOTALS											

FIGURE 5. THE ANNUAL WORK SCHEDULE

NSWC MP 84-147

APPENDIX A

HABITAT TYPES WITH APPROXIMATE ACREAGES

A-1/(A-2 blank)

HABITAT TYPES WITH APPROXIMATE ACREAGES

Habitat Type	Acreage		
	Mainside	Tetotum Flats	Total
Open fields	194.6	143.6	338.2
Shrub Community	77.9	179.5	257.4
Pine Forests	544.2	478.3	1022.5
(Loblolly)	(399.8)	(408.9)	(808.7)
(Virginia)	(144.4)	(50.8)	(195.2)
(White)	(-)	(18.6)	(18.6)
Pine Hardwood Forests	129.9	63.4	193.3
Hardwood Forests	434.0	527.5	961.5
(Mixed Hardwoods)	(117.1)	(314.4)	(431.5)
(Oak Dominant)	(293.0)	(93.6)	(386.6)
(Black Locust Dominant)	(12.1)	(79.8)	(91.9)
(Swampland Hardwood)	(11.8)	(39.7)	(51.5)
Coastal Areas	10.0	5.7	15.7
Marsh (Fresh and Brackish)	158.7	91.7	250.4
Developed Areas	1060.3	128.3	1188.6
Open Water	67.2	25.0	101.8
TOTAL	2677.6	1643.0	4320.6

NSWC MP 84-147

APPENDIX B
SUPPLEMENTARY PLANS

NSWC MP 84-147

APPENDIX B-1
FISHERIES MANAGEMENT PLAN

NSWC MP 84-147

FISHERY MANAGEMENT PLAN
FOR
NAVAL SURFACE WEAPONS CENTER
DAHLGREN LABORATORY
DAHLGREN, VIRGINIA

Prepared by
U.S. Fish and Wildlife Service
Office of Fishery Assistance
Gloucester Point, Virginia 23062

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FISHERY MANAGEMENT PLAN
NAVAL SURFACE WEAPONS CENTER
DAHLGREN LABORATORY
DAHLGREN, VIRGINIA

NOVEMBER 1981

SUMMARY STATEMENT

This management plan outlines goals and objectives for a successful fishery program as recommended by the United States Fish and Wildlife Service, Office of Fishery Assistance, Gloucester Point, Virginia and Naval Surface Weapons Center, Dahlgren Laboratory (NSWC). NSWC comprises of approximately 4,320 acres. Four impoundments exist on NSWC with three being conducive to intensive fishery management. Species of fish managed in these impoundments are primarily largemouth bass, bluegill and channel catfish.

A tri-party Fish and Wildlife Cooperative Agreement was entered into by NSWC with Virginia Commission of Game and Inland Fisheries, and the United States Department of the Interior, Fish and Wildlife Service, in 1963, and was updated with the preparation of this plan. Management techniques utilized to improve the fisheries resources are addressed in the plan.

Goals, factors preventing the achievement of goals, and objectives are outlined in the plan. The need for evaluation and update of management procedures are addressed. Proposals outlined in the management plan are supportive of the goals and objectives of Naval Surface Weapons Center, Dahlgren Laboratory.

INTRODUCTION

The fishery management plan was prepared by the United States Fish and Wildlife Service, Office of Fishery Assistance, Gloucester Point Field Station, Gloucester Point, Va, for Naval Surface Weapons Center, Dahlgren Laboratory, Dahlgren, Va. The plan outlines goals and objectives recommended by the U.S. Fish and Wildlife Service and the Naval Surface Weapons Center, Dahlgren Laboratory, and may be used as a guide to assist in managing the Laboratory's fishery resources.

DESCRIPTION OF THE AREA

Naval Surface Weapons Center, Dahlgren Laboratory (NSWC), is located 60 miles south of Washington, DC and 69 miles north of Richmond, VA, via Route 301; Fredericksburg, VA lies approximately 30 miles west of the Laboratory. The mission of NSWC is to conduct a program of warfare analysis, research, development, test evaluation, systems integration, and fleet engineering support in naval weapons systems, principally for surface warfare, and to conduct supportive programs in other warfare areas and fields of technology.

The Laboratory is comprised of two separate management areas: (1) Mainside, which is located adjacent to Route 301 at the south end of the Potomac River Bridge and bordering the Potomac River; and (2) the Tetotum Flats area across Upper Machodoc Creek from Mainside. Mainside occupies 2,678 acres and Tetotum Flats occupies 1,641 acres of which 1,665 acres and 1,610 acres, respectively, are suitable for wildlife management.

Topography of the area is level to nearly level, lying 20 to 25 feet above mean sea level. Soils are composed of 5 to 8 feet of fine sand and sandy coastal plain materials in which the soils have developed; a few pockets of thin strata of gravel do occur. A very slowly permeable, sticky and plastic clay layer, 20 to 30 inches thick, is found at depths of 5 to 8 feet. The soils can be considered as generally poorly drained, primarily due to the existence of the clay layer.

Precipitation is rather uniformly distributed throughout the year and from 1931 through 1955 the average yearly precipitation was 39.24 inches. The average yearly temperature during the same period was 57.3° F, with an average monthly range of 38.1° F in January to 77.8° F in July.

Various forms of habitat which are favorable to wildlife exist within both management area and include woodland (mostly mixed hardwoods and conifers), grassland, brushland, wetland, freshwater ponds and tidal creeks (Table B-1-1). In addition to these, the Potomac River borders Mainside and provides six miles of tidal shoreline. The ponds (4), one of which is tidally influenced, are all located on Mainside and contain a total of 78.8 acres (Table B-1-2). The management areas of NSWC offer habitat for several species of game and non-game wildlife including, but not limited to, wild turkey, white-tailed deer, bobwhite quail, eastern cottontail rabbit, gray squirrel, red and gray fox, otter, beaver, ducks (puddle and diving), woodcock, Canada geese and mourning dove. Also observed in the past at the Laboratory have been bald eagles and osprey.

TABLE B-1-1. HABITAT TYPES WITH APPROXIMATE ACREAGES

Habitat Type	Acreage		
	Mainside	Tetotum Flats	Total
Open fields	194.6	143.6	338.2
Shrub Community	77.9	179.5	257.4
Pine Forests	544.2	478.3	1022.5
(Loblolly)	(399.8)	(408.9)	(808.7)
(Virginia)	(144.4)	(50.8)	(195.2)
(White)	(-)	(18.6)	(18.6)
Pine Hardwood Forests	129.9	63.4	193.3
Hardwood Forests	434.0	527.5	961.5
(Mixed Hardwoods)	(117.1)	(314.4)	(431.5)
(Oak Dominant)	(293.0)	(93.6)	(386.6)
(Black Locust Dominant)	(12.1)	(79.8)	(91.9)
(Swampland Hardwood)	(11.8)	(39.7)	(51.5)
Coastal Areas	10.0	5.7	15.7
Marsh (Fresh and Brackish)	158.7	91.7	250.4
Developed Areas	1060.3	128.3	1188.6
Open Water	67.2	25.0	101.8
TOTAL	2677.6	1643.0	4320.6

TABLE B-1-2. IMPOUNDMENTS ON THE NSWC, DAHLGREN LABORATORY
(All on Mainside Management Area)

Impoundment	Surface Acres	Watershed	Watershed
		Acres	Ratio
Gambo Pond	46.2	2266	49:1
Hideaway Pond including Hideaway Pond Expansion	10.5	285	27:1
Cooling Pond	10.5	225	21:4
TOTAL	67.2		

Hunting, fishing, and trapping regulations at the Laboratory are in accordance with fish and game laws of the State of Virginia and existing directives by the Laboratory, i.e., issuing permits, regulating access, obtaining harvest data, registering firearms and enforcement of regulations. For hunting, access to the Mainside Management area is restricted to Center and Tenant Command employees and Station residents and their guests. Access to the Tetotum Flats management area is open to the general public. Within both areas, hunters must comply with published regulations including Hunter Safety Training and high visibility apparel. Availability of these area is dependent upon the military activity within the area.

DESCRIPTION OF AQUATIC RESOURCES

There are four impoundments on NSWC totalling approximately 78.8 acres (Table B-1-2). Three of the ponds are intensively managed. The other impoundment, Gambo Pond is tidally influenced, thus, not warranting intensive fishery management. Water quality data gathered from 1966 to 1977 indicate that water quality is generally adequate to maintain a fishery management program (Table B-1-3).

TABLE B-1-3. SOME CHEMICAL RANGES OF IMPOUNDED WATERS ON
DAHLGREN NAVAL SURFACE WEAPONS CENTER
(As taken during June through September 1966-1977)

<u>Pond</u>	<u>ph</u>	<u>Total Hardness (ppm)</u>	<u>Total Alkalinity (ppm)</u>
Upper Gambo Creek	6.8-7.3	51-93	23-90
Hideaway Pond	6.0-7.5	26-42	20-42
Cooling Pond	7.0-9.0	20-68	32-125

The waters on NSWC provide a warm-water recreational fishery to bluegill, largemouth bass, crappie and channel catfish. In addition to the fishery provided by the impoundments, the Potomac River provides approximately six miles of tidal shoreline from which one could fish for saltwater species, e.g., bluefish, spot, croaker, flounder and striped bass. Gambo and Macodoc Creeks provide tidal stream fishing for American shad, herring, striped bass and white perch.

MANAGEMENT HISTORY

Gambo Pond is influenced by the tide. Accumulations of silt have reduced the average depth to one to two feet and keep the water muddy in color. There is no feasible way to increase the water depth as a dam high enough to exclude tidewater

would back water on private land and buildings along U.S. Route 301. Aquatic vegetation (milfoil, arrowheads, and water lillies) were treated by a commercial firm in 1967. The dam was also replaced in 1967 and tiger musky stocked in 1976 with no apparent success.

Cooling Pond has a history of poor or a lack of largemouth bass reproduction, overcrowded population of black bullheads and/or bluegill, and intermittent fish kills. This impoundment has been, in the past, totally or partially reclaimed via rotenone, to control the bluegill and black bullhead populations. After treatment with rotenone, supplemental stockings of largemouth bass, channel catfish, and bluegill were made.

Intensive management of Hideaway Pond began in 1967 when the dam was reconstructed to raise the water level, and brush was eliminated from around the pond. The pond has been fertilized and limed to increase carrying capacity. Supplemental stockings of largemouth bass have been made. Hideaway Pond is planned to be available for management and recreational fishing after completion of the confirmation phase of the Navy Assessment and Control of Industrial Pollutants (NACIP) study.

POTENTIAL FOR MANAGEMENT

Potential for the management of the intensively managed ponds at NSWC varies. The variability for management lies in the watershed ratios, the components of the watershed, and military activities. The optimal watershed ratio ranges from 15:1 to 30:1, and the watershed should not be a source of contaminants of any type into an impoundment. Military activities influence management potential on NSWC by the types and intensity of the activities that may occur on the station. Fishery management potential for any newly constructed impoundment is in the preceding criteria.

Fishery management potential for Gambo Pond is poor. The pond has not been managed for a number of years due to the shallow nature of the pond as the result of silt accumulation. In addition, because it is tidally influenced, undesirable fish species populate the pond whenever a high tide occurs. The pond should not be considered a "managed pond" unless the pond is deepened and an adequate spillway structure is installed to prevent fish from entering the pond during high tides. It is recommended that Gambo Pond be managed for waterfowl.

GOALS

Goal I: Provide a recreational sport fishery capable of providing the maximum number of man-days of fishing per acre per year that are compatible with the mission of NSWC.

Factors Influencing Achievement of Goal I:

1. Managed species fail to establish strong year classes.
2. Impoundments receive contaminants, e.g., inorganic fertilizers, oil waste from surrounding watersheds.
3. Undesirable species of fish tend to overpopulate and outcompete managed species.

Objectives to Achieve Goal I:

1. Investigate parameters, physical and chemical, that may affect managed species reproduction success and/or survival.
2. Investigate and correct all possible sources of contamination of impounded waters.
3. Institute annual fall and winter water level drawdowns in an attempt to control undesirable species of fish and possible overcrowding of fish and aquatic vegetation.
4. Reclaim ponds with unbalanced fish populations by partial or total reclamation.
5. Continue fertilization and liming programs, where applicable, to enhance the carrying capacity of waters and to aid in control of aquatic vegetation.

Goal II: Protect all threatened or endangered species of fauna and flora present on NSWC.

Factors Influencing Achievement of Goal II:

1. Consideration for threatened and endangered species and their critical habitat should be included in training and testing plans, and all other activities.

Objectives to Achieve Goal II:

1. Conduct an in-depth survey of the station and map critical habitats for any threatened or endangered species.
2. Advise the Office of Fishery Assistance, Gloucester Point, Virginia of the occurrence or suspected occurrence of any threatened or endangered species.

EVALUATION AND UPDATE

Annual fish population surveys should be conducted to determine reproductive success of managed fish species and species composition of a body of water. These surveys assist in determining if problems exist in a fishery and, subsequently, corrective measures can be taken to alleviate the problem(s).

A voluntary creel census program should be instituted at pond sites to help in analyzing fishing needs of NSWC. Such a program offers information as to fishing pressure, angling success, fish preferred by anglers and status of a fishery. A creel census is valuable to the maintenance of a successful management program.

Implementation of the goals stated in this management plan will be the responsibility of the Naval Surface Weapons Center, Dahlgren Laboratory within available funds and manpower. Formulation of work plans to accomplish the goals will be the responsibility of the cooperators.

The management plan and progress toward achieving stated goals will be reviewed annually by a U.S. Fish and Wildlife Service biologist, and representatives of Naval Surface Weapons Center, Dahlgren Laboratory. Following such meetings, the management plan may be amended or remain as initially written.

DISTRIBUTION

After completion of the management plan and signature by all appropriate officials, the distribution of this plan will include the following:

1. Commander, Naval Surface Weapons Center, Dahlgren Laboratory, Dahlgren, Virginia.
2. Area Manager, U.S. Fish and Wildlife Service, Delmarva Area Office, Annapolis, Maryland.
3. Executive Director, Virginia Commission of Game and Inland Fisheries, Richmond, Virginia.
4. Project Leader, Office of Fishery Assistance, U.S. Fish and Wildlife Service, Gloucester Point, Virginia.
5. Fish and Game Manager, Naval Surface Weapons Center, Dahlgren Laboratory, Dahlgren, Virginia.

CONCURRENCES

Commander, Naval Surface Weapons Center

(date)

Area Manager, U.S. Fish and Wildlife Service
Delmarva Area Office

(date)

Executive Director, Virginia Commission of
Game and Inland Fisheries

(date)

Project Leader
Office of Fishery Assistance

(date)

Fish and Game Manager,
Naval Surface Weapons Center

(date)

NSWC MP 84-147

APPENDIX B-2

BALD EAGLE MANAGEMENT PLAN

B-13/(B-14 blank)

MANAGEMENT PLAN FOR BALD EAGLES
AT NSWC, DAHLGREN LABORATORY

DESCRIPTION OF THE AREA

The eagle nesting habitat of primary concern is located along the Upper Machodoc Creek, Tetotum Flats, NSWC, Dahlgren, Virginia. Tetotum Flats is an isolated weapons testing facility with few man-made structures. Uses are restricted to explosive ordnance testing, forestry, and occasional recreational uses such as hunting and fishing.

Potential eagle nesting habitat is located at the Black Marsh area of Tetotum Flats and adjacent to the Gambo Creek and Hideaway Pond areas of Mainside. These areas are delineated on Figure B-2-1.

Bald Eagles are observed regularly around Hideaway Pond and on the Main and Small Caliber Ranges. Eagles have been seen resting in trees along Hideaway Pond even during the construction of an extension to this pond. The Main and Small Caliber Ranges have abandoned "Drop Test Towers" offering eagles excellent views of the Potomac River.

NEST SITE CHARACTERISTICS

Nest #1 (KG 78-02), as shown in Figure B-2-2, is approximately 100 feet high in a loblolly pine tree on a bluff at the edge of Upper Machodoc Creek. The nest was discovered in 1978 and has not been used since. The nest has been struck by lightning; however, it seems to be in stable condition. The surrounding forest area is composed of loblolly pine, yellow poplar, American beech, and white and red oaks. Major understory vegetation includes American holly and mountain laurel.

Nest #2 (KG 78-04), as shown in Figure B-2-2, is located in a pine stand adjacent to the old rocket launching facility. At first, the nest was thought to be atypical, however, since its construction there have been several successful nestings.

Nest #3 (KG 81-01), recently blew down (1981-82). The nest was approximately 90 feet high in a yellow poplar tree on a bluff in the same hardwood stand as Nest #1. This nest was active on and off since 1962.

The nest, shown in Figure B-2-2, was reconstructed in 1981-82. It is located approximately 50 yards northwest of the blown down nest. The nest is located in a loblolly pine tree approximately 80 feet high.

Nest #4 (KG 83-02), as shown in Figure B-2-2, is located in a seed tree cut area where seed trees were purposely left intact to provide eagle nesting and resting sites. This nest is approximately 75 feet high in a loblolly pine. This nest blew down in 1984 and was rebuilt in the same tree in 1985. One chick was fledged from this nest in 1985.

 POTENTIAL HABITAT

 CRITICAL HABITAT

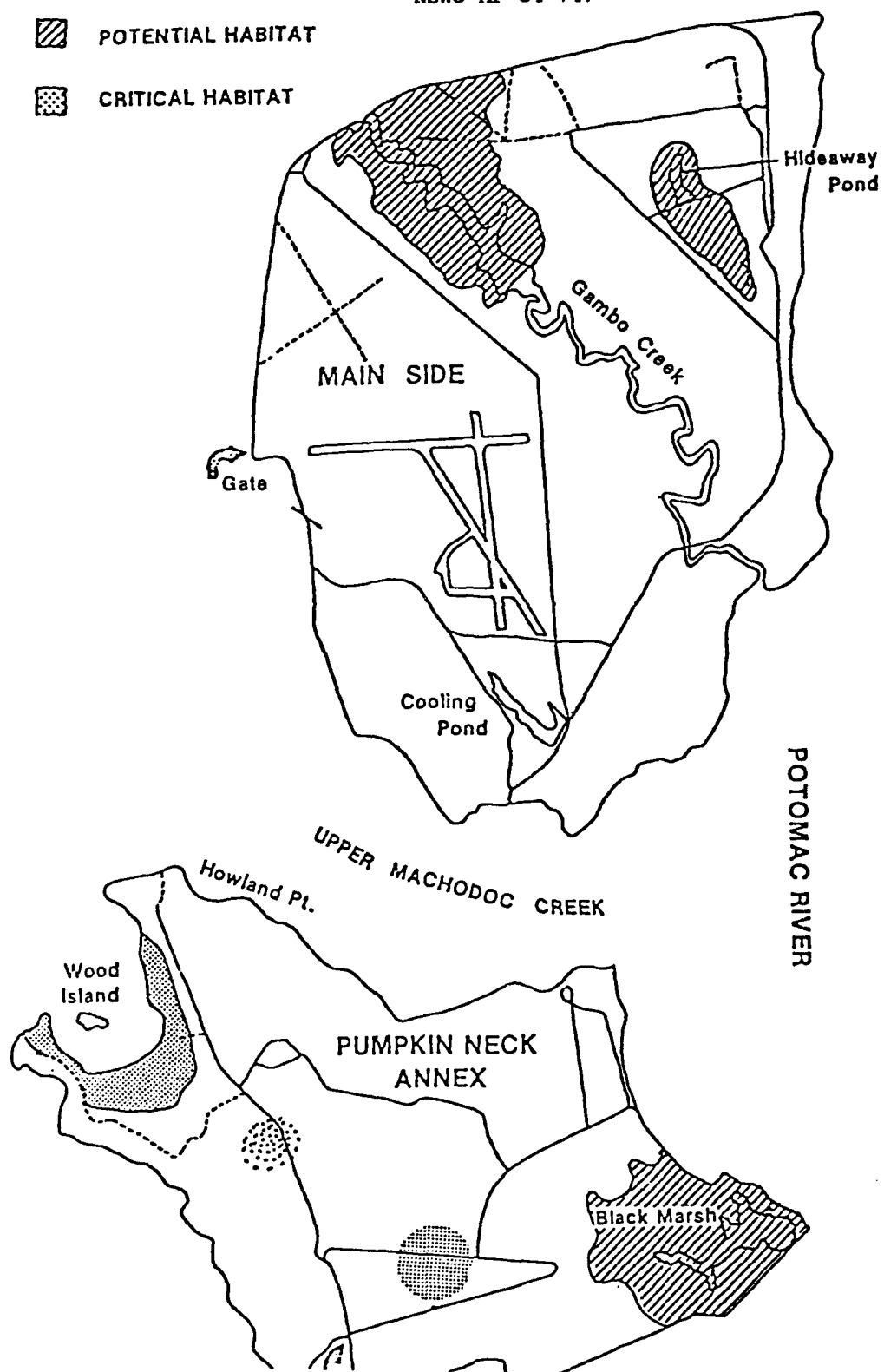


FIGURE B-2-1. BALD EAGLE CRITICAL AND POTENTIAL HABITAT

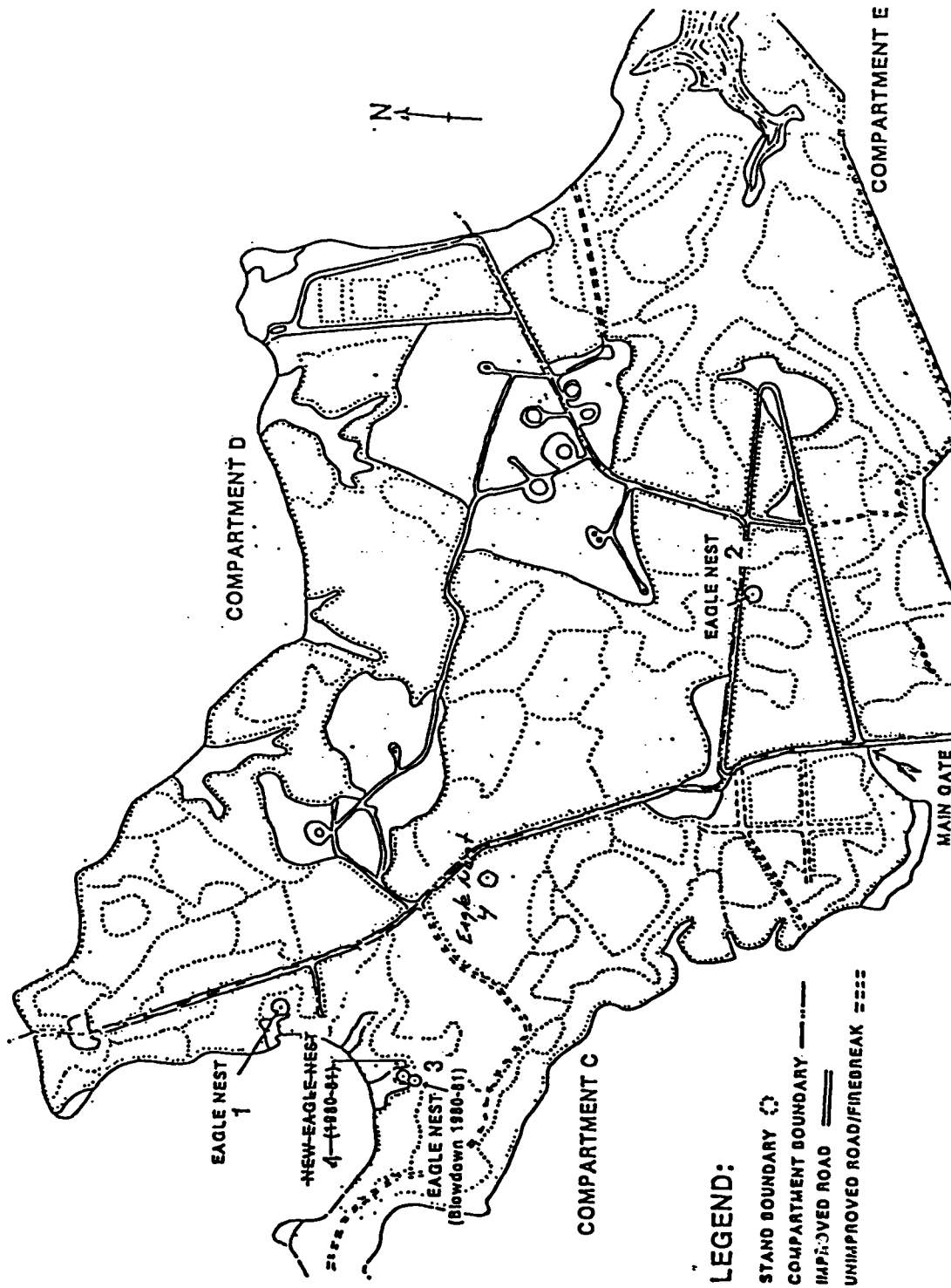


FIGURE B-2.2. BALD EAGLE NEST LOCATIONS - PUMPKIN NECK ANNEX

PAIR BEHAVIOR

All the eagles observed at NSWC are very sensitive to human intrusion, however, they seem to have become habituated to the explosive ordnance testing. Ordnance testing, which is the major mission of Tetotum Flats, takes place throughout the critical nesting period with no noticeable adverse effects.

NESTING HISTORY

Eagles have been observed nesting at Mainside and Tetotum Flats Annex in the past. The forestland bordering Gambo Creek on Mainside last supported eagles in 1961, however, no active nests have been observed since and no old nests are currently intact. Nesting at Tetotum Flats has been observed since 1962.

MANAGEMENT CONSTRAINTS

The eagles nesting territories are divided into a primary and secondary zone. Certain activities are restricted in each zone at different times of the year. Management techniques apply equally to all nests within the nesting territory, even though a particular nest may not be used for 1 or more years.

The primary zone is the most critical area around the nest. The size of the primary zone and the activities that may take place within it will vary, depending on the time of year. From July 16 to February 14, the primary zone will extend 100 yards in every direction from the nest tree. During the critical nesting period, which extends from February 15 to July 15, the primary zone will extend 300 yards in every direction from the nest tree. Year round restrictions within the primary zone include logging, building development, road construction, mining, and use of toxic chemicals. Chemicals toxic to eagles include: DDT, other persistent organochlorine pesticides, PCB, mercury and lead.

All human activities should be restricted in the primary zone during the nesting season. Critical period restrictions apply only to active nests; however, it is recommended that the materials stored under the rocket launching facility (in the vicinity of Nest #2) be placed somewhere else and that the road be blocked off during the critical period. It is also recommended that roads leading to the other nests be blocked off during the critical period.

The secondary zone, an area outside the primary zone, is managed to further minimize disturbance to the eagles and to possibly provide future nesting sites. Size of the secondary zone is variable, depending on local topography and forest type boundaries. The secondary zone, at Tetotum Flats, is composed of a hardwood stand bordering the Upper Machodoc Creek. This area is approximately 46 acres in size. Year round restrictions within the secondary zone include building development, permanent road construction and the use of toxic chemicals. Restrictions during the critical nesting period include logging, low level aircraft operations, use of firearms, camping and picnicking. Occasional and limited human intrusion such as solitary hiking, bird watching and fishing will not be disturbing in most cases. Management zones are delineated in Figure B-2-3.

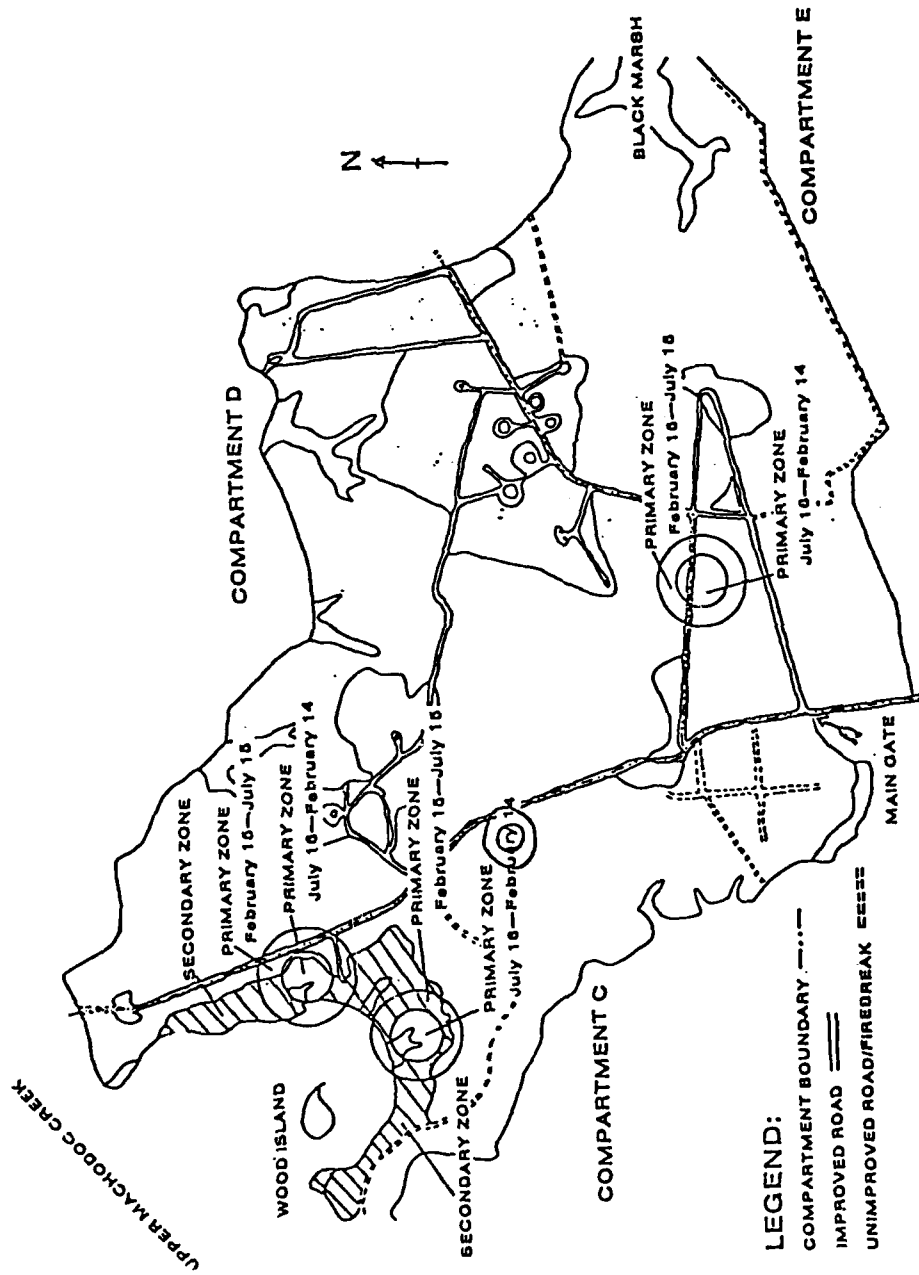


FIGURE B-2-3. PROPOSED BALD EAGLE CRITICAL HABITAT - PUMPKIN NECK ANNEX

POTENTIAL NEST SITES

Chesapeake Division natural resource personnel are planning selective tree harvests in the secondary zone, to commence within the next 2-3 years. This practice will ensure that there are adequate numbers of potential nesting trees in the secondary zone. Selective tree harvesting will encourage the growth of dominant and codominant (potential nesting and perching) trees and also provide for their regeneration. Selective tree harvesting outside of the secondary zone, within 1/4 mile of existing nests, will be encouraged as well.

In addition, the seedtree harvesting technique, as used in the pine stand bordering the secondary zone where Nest #4 is located, is ideally suited for the regeneration of loblolly pine and for providing possible nesting and perching sites. The seedtree regeneration system will be used to harvest pine trees in and adjacent to the secondary zone. Timber harvesting is planned and approved by Dr. M. Byrd, member-Chesapeake Bay Bald Eagle Recovery Team, will not adversely affect the eagles habitat and will provide potential nesting and perching sites.

If an eagle nest, other than the ones shown in Figure B-2-2 is discovered, Chesapeake Division should be notified.

FUTURE LAND USES

Future land use decisions should include considerations for preserving existing and potential Bald Eagle Nesting habitat. Generally, avoidance of those applicable areas outlined in Figures B-2-1 thru B-2-3 will suffice. Thus, proper planning is all that is necessary to allow for both real estate developments and the maintenance of Bald Eagle habitat.

NSWC MP 84-147

APPENDIX B-3

WILD TURKEY MANAGEMENT PLAN

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WILD TURKEY MANAGEMENT PLAN

INTRODUCTION

The eastern wild turkey (Meleagris gallapavo silvestris) is common to abundant in a wide variety of habitats at NSWC. Although most turkeys are found in the forested areas of Mainside and Tetotum Flats, they are often seen in developed areas such as in cattail (Typha latifolia) stands near the sewage treatment aeration ponds and along the runways.

Although much is known about the wild turkey, detailed information concerning habitat requirements and habitat utilization for the Northern Neck area of Tidewater Virginia is lacking. Therefore, the initial stages of this plan will concentrate on documenting habitat utilization, population distribution (especially following forestry operations), and compiling hunter harvest data. Habitat management projects will be limited to those known to be effective for wild turkeys in the southeastern coastal plain. Generally these projects will correspond to habitat management (i.e., prescribed burning) although other turkey specific projects are included. Additional management projects will be based on data analysis and recommendations by cooperating agencies.

A major reason for the successful reestablishment of wild turkeys throughout their range is protection from overhunting. Therefore, turkey hunts at NSWC will comply with regulations established by the State of Virginia for King George County.

DESCRIPTION OF THE AREA

The areas of primary concern are the hardwood forests, pine-hardwood forests, pine forests, and pine plantations of Mainside (Figure B-3-1(a)) and Tetotum Flats (Figure B-3-1(b)). These forests and plantations are interspersed with open areas such as fields, firebreaks, road shoulders, and military test areas. All areas contain sources of water in the form of ponds, creeks, rivers, marshes, springs, or surface water ponding. Appendix A of the main Fish and Wildlife Plan list approximate acreages of each habitat type.

MANAGEMENT HISTORY

The most significant program affecting wild turkeys at NSWC is Forestry. Timber harvests have taken place in the past with no apparent adverse effects on wild turkeys. It should be emphasized, however, that no documentation exists for turkey population distribution either before or after these timber harvests.

The timber harvest taking place in 1982 included areas where turkey concentrations are known to be high. Most noteworthy are four small clearcuts; one in a Virginia-loblolly pine (Pinus Virginiana-P. taeda) stand of approximately six acres and three in mixed hardwood stands dominated by oaks (Quercus spp.) of approximately five acres each. The remainder of the 1982 timber harvest consists of selective tree cuts in both pine and hardwood stands totalling approximately 150 acres (Figure B-3-2).

FOREST TYPE MAP
OF
COMPARTMENTS
A & B
NSWC DAHLGREN, VA.

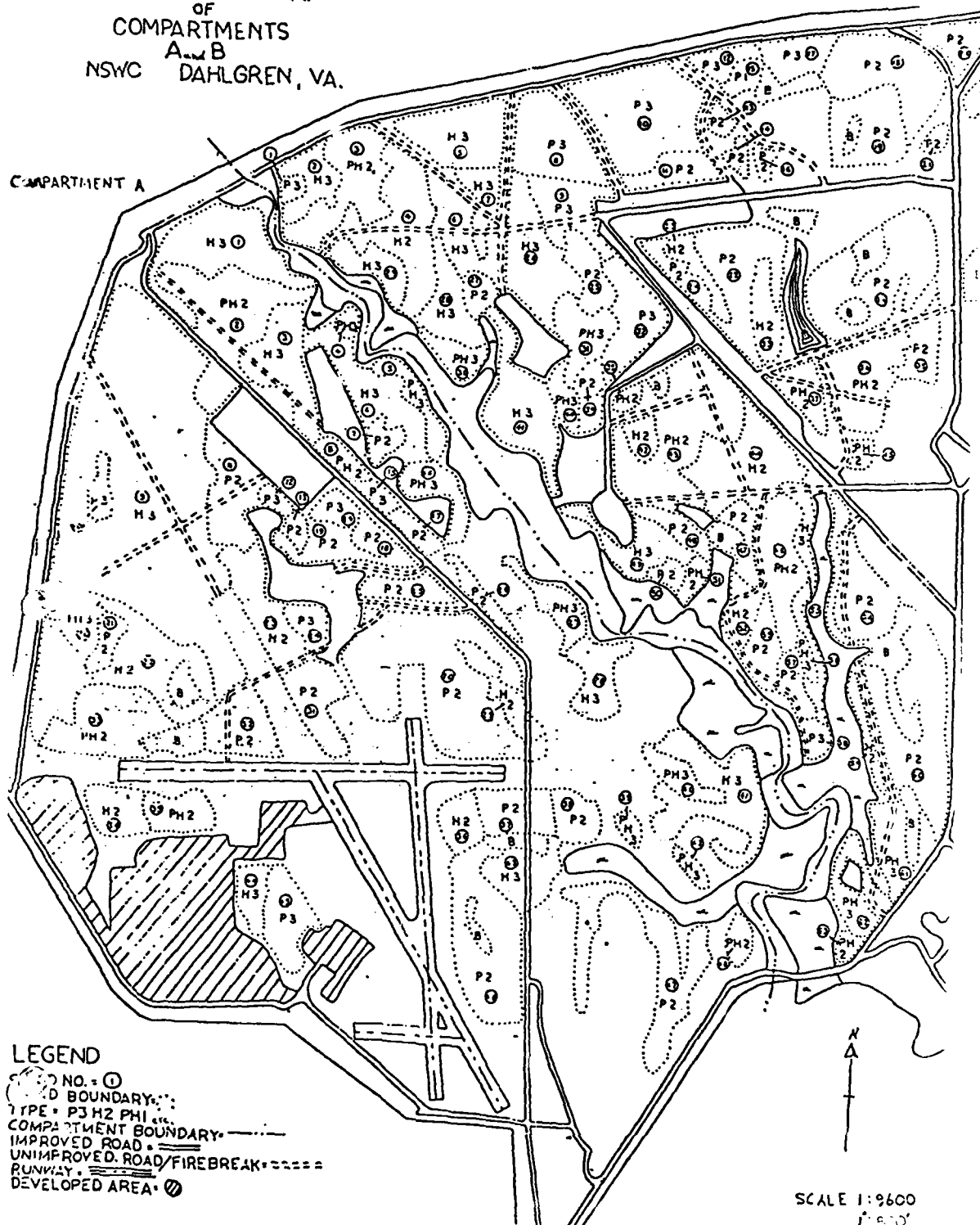


FIGURE B-3-1(a). MAINSIDE

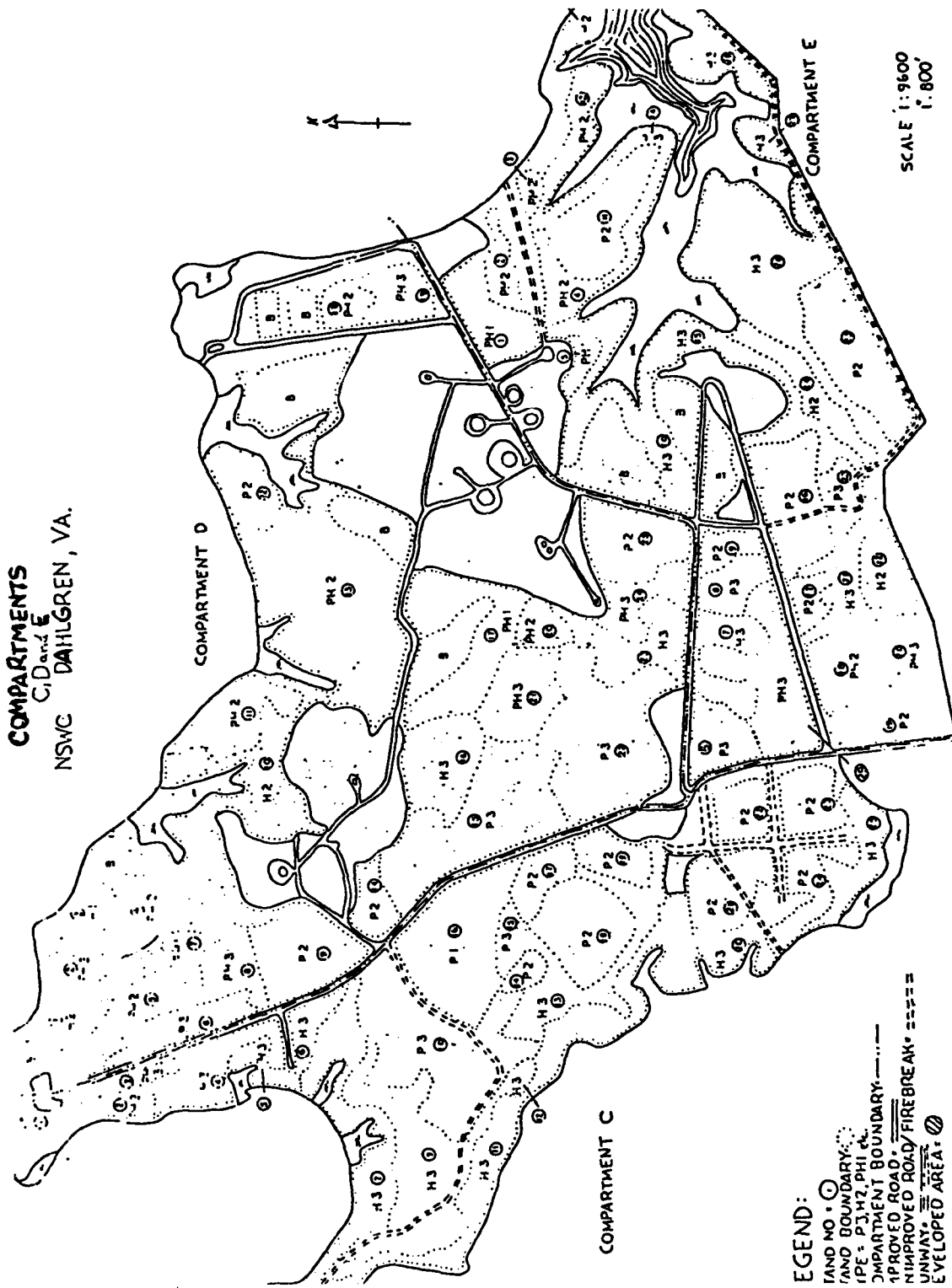


FIGURE B-3-1(b). TETOTUM FLATS

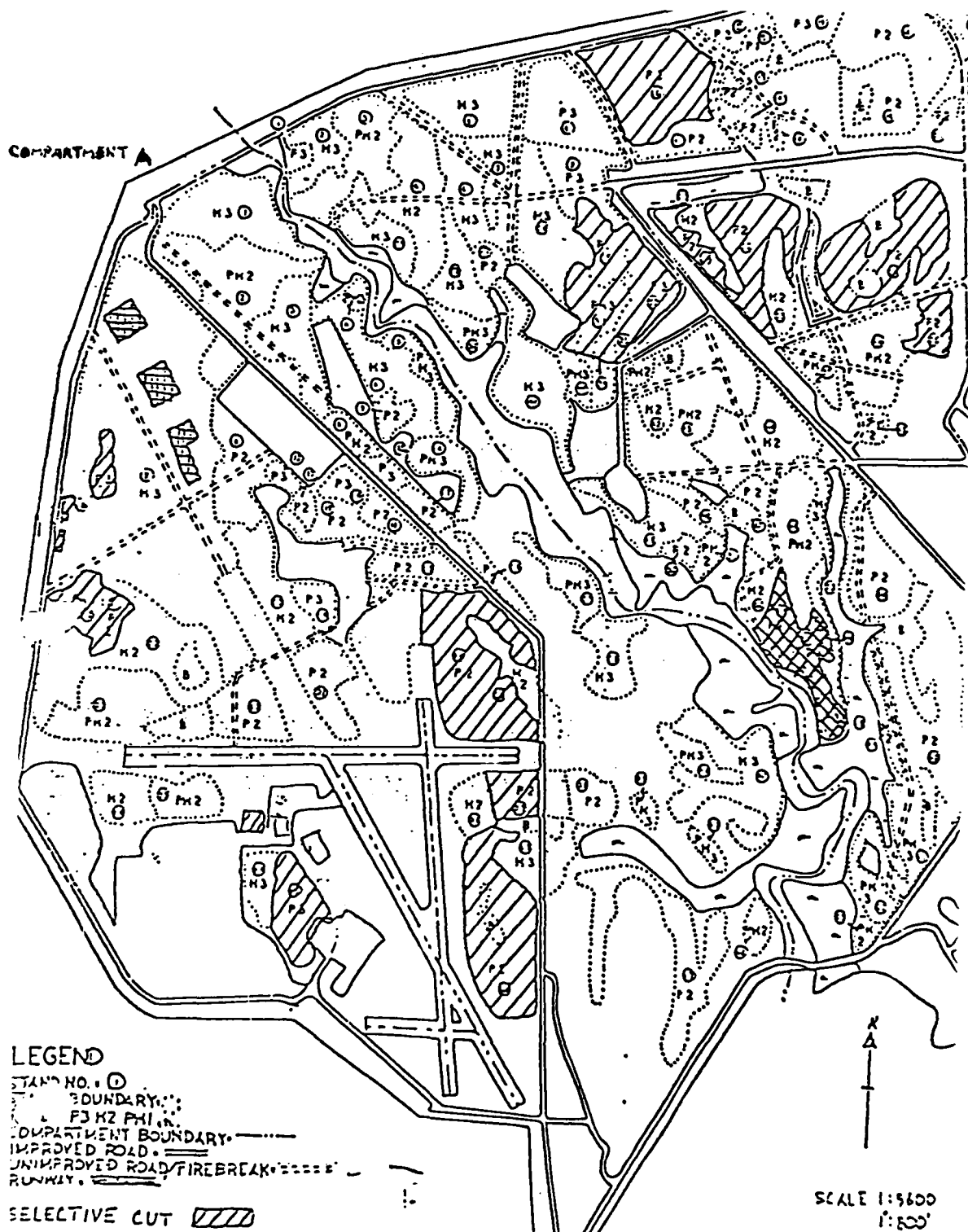


FIGURE B-3-2. SELECTIVE TREE CUTTING AREAS

Prior to 1982, wildlife management at NSWC was basically establishing annual food plots and was accomplished through volunteer efforts of the Dahlgren Chapter of the Izaak Walton League. It is unknown whether or not these food plots had any direct benefit to wild turkeys.

Certain areas used for military purposes are maintained as semi-improved and unimproved grounds by the Public Works Department. These areas include open fields with wooded edges, runway clear zones, and visual clear zones through pine forests. Unimproved grounds are mowed twice annually; once in mid-July and again in mid-October. This mowing schedule not only insures adequate maintenance of turkey nesting habitat, but also is timed so as not to interfere with nest construction, incubation, or brood rearing. The mid-July mowing probably benefits brood rearing by facilitating poult movements.

The General Foreman, Grounds Maintenance (Code W632) indicates no change is anticipated for the mowing schedule. However, any future changes should be planned to avoid turkey nesting habitat degradation. The responsibility for insuring that wild turkeys received adequate consideration in maintenance planning lies with the Natural Resources Specialist (Code W053).

WILD TURKEY HABITAT REQUIREMENT REVIEW

Hurst (1981) says that turkeys prefer open park-like pine forests or savannas which can be created with prescribed burning although some dense vegetation is desirable. He further states 1-4 year old pine plantations provide good feeding, nesting, brood rearing, and escape cover areas.

Speake et al. (1975) indicates that mixed hardwood forests dominated by mast producing trees and shrubs are ideal turkey habitats. Lindzey (1967) says hardwood sapling stands are used by wild turkeys while similar sized pine plantations are not (Holbrook 1973). Gobblers and hens with broods have been known to occur in dense loblolly pine plantations (sapling-pole sized) at NSWC evidenced by scats and direct observations; however, these areas do not support such high concentrations as do the mature pine and pine-hardwood stands.

Research by Kennamar et al. (1981) indicates that turkeys prefer natural timber stands (hardwood; pine-hardwood; hardwood pine) greater than 21 years old over pine plantations except during the spring when hens use pine plantations for nesting. They also studied nest predation using artificial nests containing chicken eggs and showed that pine plantations aged 3-10 years had significantly higher nest survivability than did mature pine stands aged 40-60 years. These pine plantations contained more dense vegetative cover than the mature pine stands.

Food habitat analysis by Martin et al. (1951) indicate preferred animal foods are arthropods, especially insects. These items include various beetles, grasshoppers, crickets, ants, bees, wasps, flies and true bugs. Preferred plant food include oaks, dogwood (Cornus florida), greenbriar (Simlax spp.), blackgum (Nyssa sylvatica), beech (Fagus grandifolia), oats (Avena spp.), grape (Vit's spp.), poison-ivy (Toxicodendron radicans), Korean lespedeza (Lespedeza stipulacea), hickory (Carya spp.), holly (Ilex spp.), and several others.

Scott (1973) determined that hens require a diet with both high protein and high calcium concentrations for egg laying. Korschgen (1973) determined that green forage and invertebrates meet these requirements.

Healy (1981) identified nest site requirements as having low cover structured to provide both concealment and a wide field of view, proximity to water, and adjacent to a tree or other vertical objects. These areas are normally found in forestry regeneration cuts, logging roads (loading areas), fields, and pine plantations. He further characterized early brood range (from hatching until poults can roost in trees; 3-4 weeks) by dense, low, herbaceous ground cover with species composition being less important than phytomass. This type structure provided insect and plant foods for hens and poults, cover for poults, and cover/field of view for hens. However, Perkins (1971) felt that turkeys avoid areas where ground cover is too dense and Healy (1978) felt that excessively dense ground cover retards movements of young poults thus inhibiting their ability to feed on insects.

Healy (1981) also described fall range for growth and winter range for maintenance as stands of mast producing hardwoods, the best being fully stocked sawtimber with a variety of mast producers. He states that mast consumption increases as the summer progresses and that broods move from open to forested areas in the early fall.

TURKEY MANAGEMENT

Turkey management will involve population surveys, collecting hunter harvest data, and habitat improvements.

Population surveys will consist of fall gang counts and spring gobbler counts. Fall gang counts will document both the number of gangs and the number of birds per gang. Over time, this type survey will provide trend data to indicate population recruitment and seasonal distribution. The survey route is identified in Figure B-3-3. The survey report form is included as Figure B-3-4. Fall gang counts will begin on the last Thursday (Friday for Tetotum Flats) of September and will be taken every two weeks until the third Thursday (Friday for Tetotum Flats) of December. The days are specified in order to minimize bias from turkey movements in response to hunting on Saturdays and NSW observed holidays.

Spring gobbler counts will be conducted every other week beginning two weeks before the Virginia Spring Gobbler Season and terminating two weeks after this season. Again, mainside counts will take place on Thursdays and Tetotum Flats counts on Fridays. Over time, this type survey will provide an estimate of number of distinct breeding populations. The spring gobbler count form is included as Figure B-3-5.

Hunter harvest data will necessarily be limited because spring gobbler hunts only are allowed in King George County. Food habitats can be determined by analyzing crops and stomachs. Age structure of the male cohort will be determined by examining beard length and weight (Kelly, 1975) (Figure B-3-6), contour of tail spread (Godin, 1960) (Figure B-3-7), contour of greater upper secondary coverts (Willilams, 1961) (Figure B-3-8), shape and coloration of the No. 10 primary (Petrides, 1942) (Figure B-3-9), or spur length (Kelly 1975) (Figure B-3-10). Data sheets for recording food habits and age determination with the method used are included as Figures B-3-11 and B-3-12 respectively.

OF
COMPARTMENTS
A and B
NSWC DAHLGREN, VA.

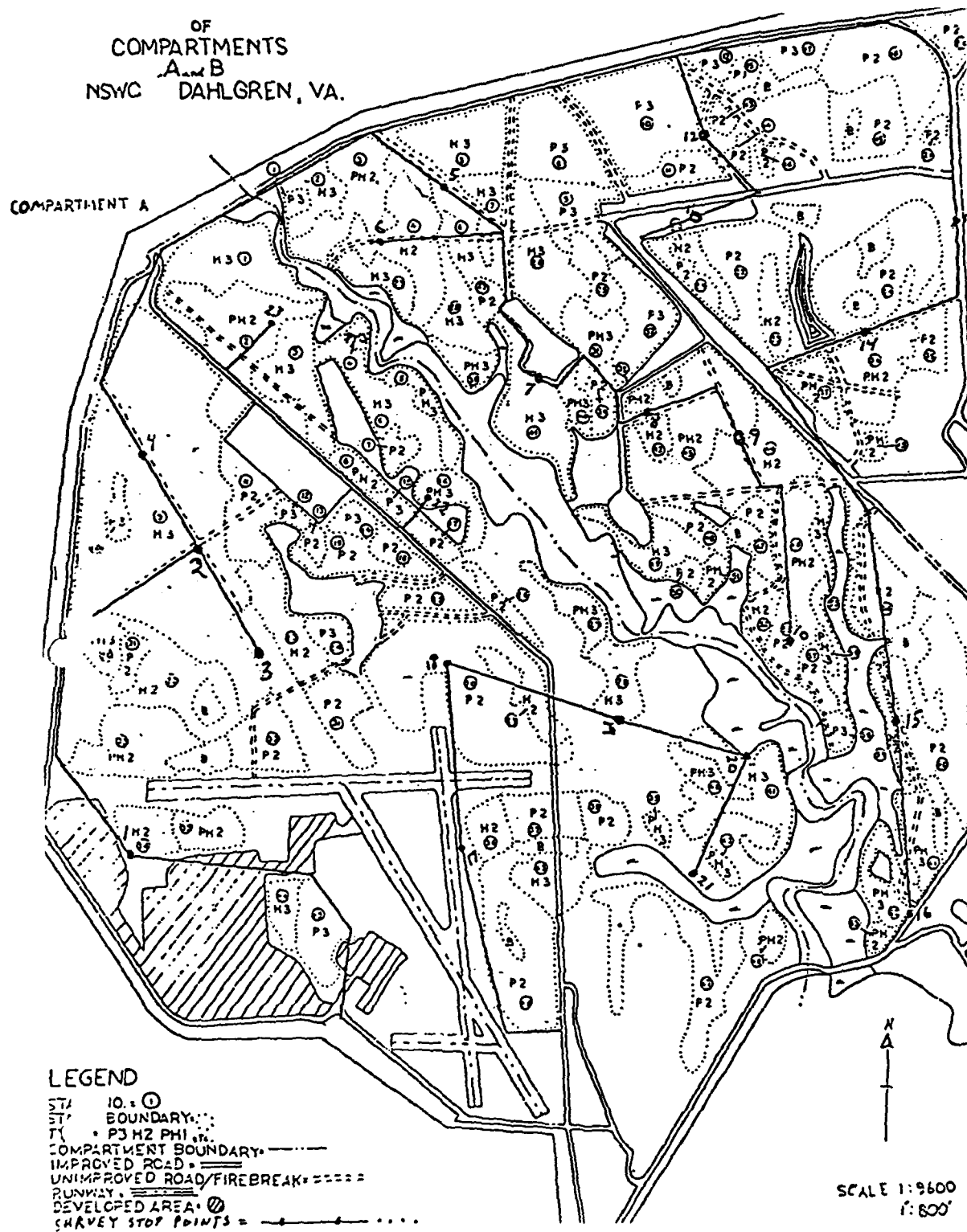


FIGURE B-3-3. SURVEY ROUTE

FALL GANG COUNT SURVEY REPORT FORM

<u>Enroute</u>	<u>Time</u>	<u>Number Gangs</u>	<u>Birds/Gang</u>	<u>Other Habitat</u>	<u>Sign</u>
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					
8-9					
9-10					
10-11					
11-12					
12-13					
13-14					
14-15					
15-16					
16-17					
17-18					
18-19					
19-20					
20-21					
21-22					
22-23					

TOTAL

DATE: _____

TEMPERATURE: _____

WEATHER CONDITIONS: _____

FIGURE B-3-4. FALL GANG COUNT SURVEY REPORT FORM

NSWC MP 84-147

<u>Average Beard Length (mm)</u>	<u>Standard Deviation</u>	<u>Average Body Weight (lbs)</u>	<u>Standard Deviation</u>	<u>Age</u>
112.84	26.31	15.47	1.58	1
240.56	25.88	21.14	1.63	2
240.40	21.59	21.90	2.54	3
228.57	54.90	22.48	2.65	4
277.50	3.54	23.80	0.35	5

Beard lengths and body weights alone are not reliable indices of age and should be used when spur lengths (Figure B-3-10) overlap year classes.

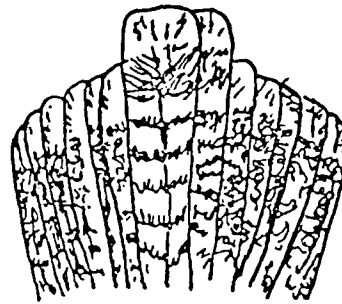
*Beard lengths measured from point of insertion to the tip.

Data from Kelly (1975)

FIGURE B-3-6. AGE DETERMINATION OF GOBBLERS BY BEARD LENGTH* AND BODY WEIGHT



Adult



Immature

From Godin (1960)

FIGURE B-3-7. AGE DETERMINATION FROM CONTOUR OF TAIL SPREAD

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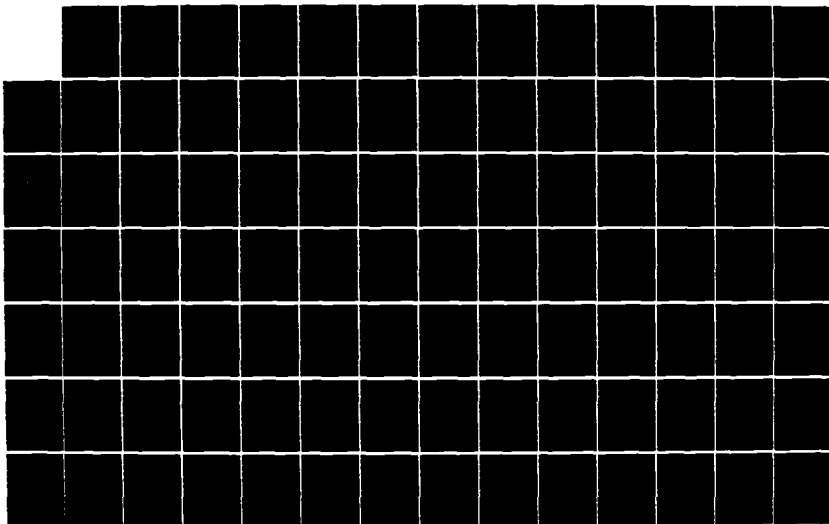
GROUNDS CONSERVATION MANAGEMENT PLAN (1982-1991) FISH
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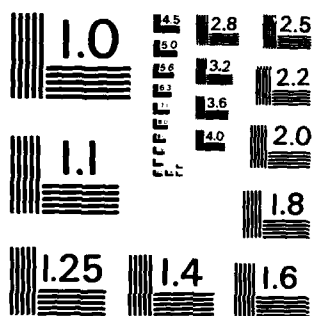
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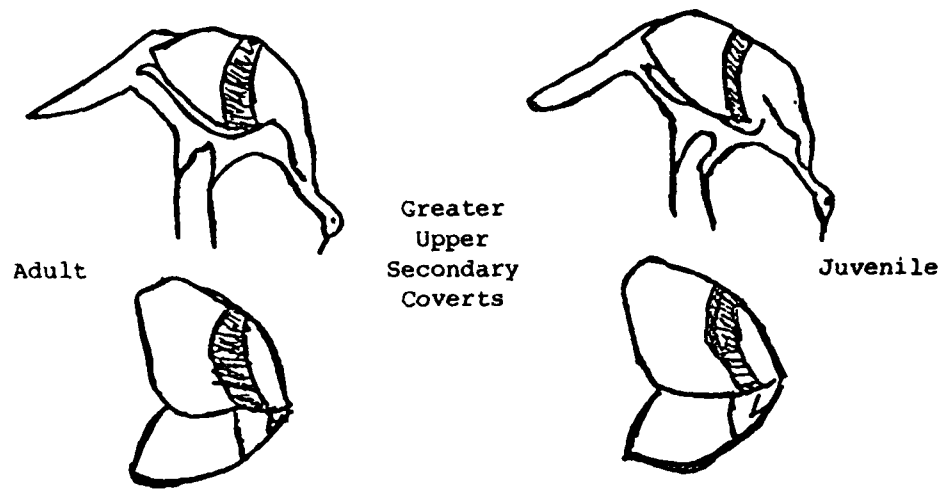
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NL



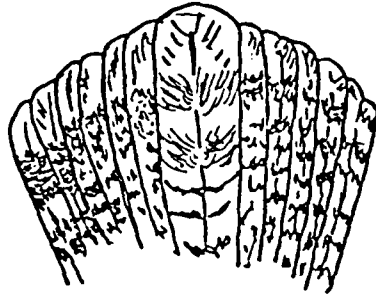


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

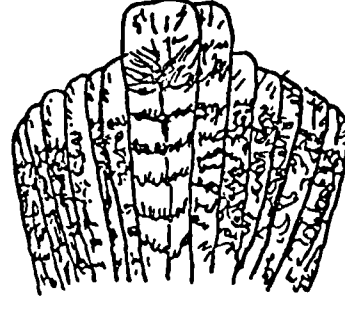


From Williams (1961).

FIGURE B-3-8. AGE DETERMINATION CONTOUR OF GREATER UPPER SECONDARY COVERTS



Adult

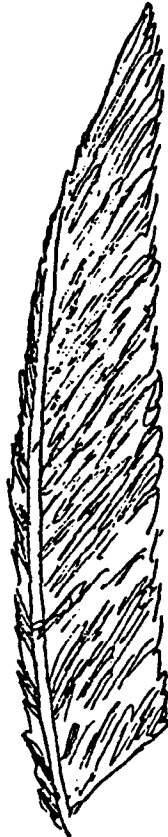


Immature

From Godin (1960)

FIGURE B-3-7. AGE DETERMINATION FROM CONTOUR OF TAIL SPREAD

Tip Pointed
And Plain Gray Color
And Lacks Definite
White Barring



Immature

Tip Broadly Rounded
White Barring Almost To
Extreme Tip



Adult

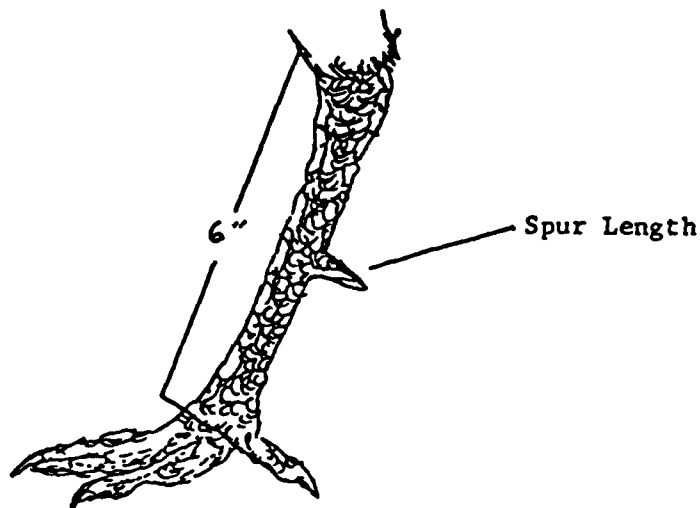
FIGURE B-3-9. AGE DETERMINATION BY SHAPE AND COLORATION OF NO. 10 PRIMARY

<u>Spur Length Average (mm)</u>	<u>Standard Deviation (mm)</u>	<u>Age</u>
6.64	2.27	1
21.96	2.86	2
25.73	4.17	3
27.43	5.09	4
29.50	6.36	5

When spur length falls between year class averages, use ± 2 standard deviations to obtain 95% confidence interval.

When 95% confidence interval overlaps two (2) year classes, combine spur length data with weights and/or beard length data to estimate age.

Data from Kelly (1975)



*Spur lengths measured from junction of spur and tarsus on inside edge to tip of the spur.

FIGURE B-3-10. AGE DETERMINATION OF GOBBLERS BY SPUR LENGTH*

DATA SHEET FOR FOOD HABIT ANALYSIS

Species: _____ Sex/Age: _____ Tag No: _____

Harvest Site: _____ Hunting Area-Station: _____

Crop Volume: _____ cc Date: _____

Stomach Volume: _____ cc

Contents	Stomach %	Crop %

Grit _____

FIGURE B-3-11. DATA SHEET FOR FOOD HABIT ANALYSIS

Habitat improvements will be accomplished with prescribed burning, hardwood management, reforestation and food plots (planting and maintenance). Prescribed burning to benefit wild turkeys need not deviate from the burn plan in Appendix C. The burn plan marks certain areas harvested for timber in 1982 for burning in February 1983 (along with other pine stands burned on a three year rotation). At this time of year, surface water ponding will extinguish ground fires in certain areas thus leaving areas with dense vegetative ground covers mixed with open park-like (savannah) pine forests. This should provide turkeys with excellent early brood rearing range with easy access to escape cover.

Certain hardwood stands will be managed with both group selection cuts and periodic thin cuts. All hardwood forests will have long (70-100 year) rotations in order to favor a variety of mast producers with good representation of sawtimber size trees. Group selection cuts will provide ample forest openings while thin cuts will favor crown development and therefore, mast production.

One of the four areas clear-cut in 1982 is marked for reforestation after burning in 1983. This area will be planted with loblolly pine which, after establishment of seedlings and herbaceous ground cover, should provide additional nesting habitat for several years.

Annual food plots targeted at wild turkeys will consist of buckwheat (Fagopyrum esculentum) and clovers (Trifolium spp.). Buckwheat will be strip planted along the shoulders of the firebreak systems near the Highway Weigh Station on Mainside and the southeast pine forests of Tetotum Flats. The clovers will be planted on logging/skidding trails and will be bushhogged down after the turkey poults have hatched (15 June).

All turkey management projects will be identified as such in the Annual Work Schedule of the Fish and Wildlife Management Plan.

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NSWC MP 84-147

APPENDIX B-4
WATERFOWL MANAGEMENT PLAN

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WATERFOWL MANAGEMENT PLAN

INTRODUCTION

Several species of ducks (diving and dabbling), Canada geese (Branta canadensis), and whistling swans (Cygnus columbianus) occur at NSWC. Although the majority of individuals and species are found during the fall migration, mallards (Ana platyrhynchos), black ducks (A. rubripes), and wood ducks (Aix sponsa) are known to breed here. Other waterfowl and duck-like birds which may possibly breed here include Canada geese, gadwalls (A. strepera), green-wing teal (A. crecca), blue-wing teal (A. discors), ruddy ducks (Oxyura jamaicensis), hooded mergansers (Lophodytes cucullatus), pied-billed grebes (Podilymbus podiceps), and double-crested cormorants (Phalacrocorax auritus). Waterfowl and duck-like birds found during the fall migration include pintails (A. acuta), wigeon (A. americana), ringnecked ducks (Aythya collaris), canvasbacks (Aythya valisineria), greater scaup (Aythya marila), lesser scaup (Aythya affinis), common goldeneye (Bucephala clangula), buffleheads (B. albeola), oldsquaw (Clangula hyemalis), common mergansers (Mergus merganser), red-breasted mergansers (M. serrator), loons (Gavis immer), and horned grebes (Podiceps auritus).

DESCRIPTION OF THE AREA

The areas of primary concern are Hideaway Pond, the Hideaway Pond Expansion, Cooling Pond, Gambo Creek Pond, the Black Marsh and their associated creeks and marsh grass areas. Additionally, NSWC controls approximately six miles of shoreline along the Potomac river and Upper Machodoc Creek, both of which contain numerous coves or pockets of various marsh grasses. All totaled, NSWC controls approximately 350 acres of marsh community.

Characteristic vegetation of marsh communities varies with salinity gradients from brackish to fresh waters. Hideaway Pond has a completely fresh water marsh (no tidal influence) dominated by buttonbush (Cephalanthus occidentalis ssp.), cattails (Typha latifolia), jewelweed (Impatiens capensis), spikerush (Eleocharis pecinatus), and swamploose strife (Decodon verticillatus). Waterfowl food plants such as sago pondweed (Potamogeton pectinatus), wild celery (Vallisneria spiralis) and nodding smartweed (Polygonum muhlenbergii) can be found in shallower open waters. The banks of Hideaway Pond were seeded with sericia lespedeza (Lespedeza cuneata).

Cooling Pond is also freshwater, however, it is located within the station golf course and is constantly maintained for a neat appearance. Crimson-eyed marsh mallow (Hibiscus palustris formosensis) dominates the bank along the restricted access area fence.

The sewage treatment aeration ponds are frequented by canvasbacks, lesser scaup and other migratory ducks.

Certain forests are regularly flooded by surface water ponding. These areas may become more suitable for dabbling ducks following selective tree cuts and small clear cuts.

Gambo Creek bisects Mainside and has brackish characteristics from its mouth at the Potomac to just beyond the dam. The upper reaches of Gambo have freshwater characteristics. Gambo is a small tidal creek meandering through large tidally flooded flats up to the dam where permanently flood open water covers nearly 47 acres with an average depth of 12 inches.

Near the Potomac, Gambo is dominated by three square bulrush (*Scripus fluviatilis*), saltmarsh bulrush (*Scirpus robustus*), saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*), and phragmites (*Phragmites communis*). Smartweeds (*Polygonum spp.*) and seashore saltgrass (*Distichlis spicata*) are associates near the mouth of Gambo becoming more dominant along with cutgrasses (*Leersia spp.*) and crimson-eyed marshmallows just below the dam. Above the dam are sparse stands of muskgrass (*Chara spp.*). The upper reaches of Gambo (far above the dam) are dominated by pickerel plant (*Pontedoria cordata*), crimson-eyed marshmallow, spikerushes and denser stands of muskgrass. Groundsel baccharis (*Baccharis halimifolia*) is common along the Gambo's marsh-open water edges while bigleaf sumpweed (*Iva frutescens*) is found evenly throughout Gambo. The numerous guts of Gambo Creek reach far inland and are dominated by cattails.

The Black Marsh is quite similar in species composition to the tidal areas of Gambo with the exception of denser stands of cattails throughout. Swamp dock (*Rumex verticillatus*) and smartweeds are associated with these cattail stands while three-square bulrush and hardstem bulrush (*Scirpus acutus*) occur in small isolated stands.

Numerous coves or pocket marshes convolute the shoreline of Tetotum Flats along Upper Machodoc Creek. Species composition varies with salinity and those pockets closer to the Potomac are characteristically brackish while those further up Macodoc are characteristically fresh. The brackish pocket marshes are dominated by saltmarsh cordgrass and big cordgrass (*S. cynosuroides*) while the fresher pocket marshes are dominated by pickerel plant.

WATERFOWL HABITAT REQUIREMENT REVIEW

Suitable nesting habitat for mallards, black ducks, and wood ducks, occurs at NSWC. Mallards are easily domesticated and nest in high use areas such as the Cooling Pond banks. They also nest in drainage swales, nest boxes, and natural vegetation such as cattails (Hammond and Mann, 1982) and phragmites.

Black ducks are ecologically very similar to mallards, however, they are not easily domesticated and avoid nesting in the high-use (developed) areas utilized by mallards (Huesmann, 1974). In remote areas, black ducks will nest in most any situation, without regard to vegetative types, provided they can find sufficient concealment for their nests (Bent, 1923).

Wood ducks are cavity nesters which were drastically reduced due to habitat destruction (Berger, 1978) and overhunting (Bellrose, 1976). Properly constructed and located nest boxes with access to preferred foods combined with adequate hunting laws have made wood ducks among our most common waterfowl. Wood ducks are somewhat different from most waterfowl in that natural nesting areas are located in forests rather than in marshes.

Waterfowl species composition varies with both season and habitat. Other than providing nesting habitat for the above mentioned species (and perhaps a few others), NSWC's primary value to waterfowl is providing resting and wintering habitat for migrants. The type waterfowl found in a given area throughout the migration will depend on that area's characteristics.

Dabbling ducks prefer shallow waters of 12-18 inches (Yoakum, et. al., 1980) where they can easily feed on submerged aquatics, emergent plants, and mast from trees along the shorelines. Dabbling ducks are predominantly plant feeders although some animal matter is eaten. Typical dabbling ducks found in Hideaway, Cooling Pond, Gambo, the Black Marsh and shallower portions of Machodoc are mallards, black ducks, wood ducks, pintails, gadwalls, wigeons, blue-wing teal and green-wing teal. Typical preferred foods of dabbling ducks which can be found in these areas include; pondweeds, smartweeds, bulrushes, cordgrasses, muskgrasses, buttonbush, pickeral plant, saltgrasses, and millets (Martin, et. al., 1951).

Diving ducks prefer more open deeper waters. Except for the marine species of diving ducks (sea ducks) and mergansers, diving ducks are predominately plant feeders also. Typical diving ducks are found along the Potomac River, deeper portions of Machodoc, and infrequently in Hideaway and Cooling Ponds, i.e., canvas-backs, redheads, oldsquaw, ruddy ducks, lesser scaup, greater scaup, ring-necked ducks, buffleheads and goldeneyes. Typical plant foods of diving ducks which can be found here include pondweeds, bulrushes, marshgrasses, wild celery, smartweeds, and millets (Martin, et. al., 1951).

Canada geese are found throughout the Dahlgren vicinity during the fall migration but rarely are found on the Station. Geese prefer broad open areas of protected waters for nesting and move inland to agricultural areas to feed on corn and wheat and to feed or rest on open fields. Broad, open, protected waters suitable for geese at NSWC are found only within the machine gun range thus rendering this area unsuitable for geese. Open fields suitable for geese at NSWC are limited to the Golf course and the airfields where geese would be a nuisance and a hazard to aircraft. Thus, only resting migratory flocks of geese can be considered desirable and management will avoid attracting high concentrations or resident populations.

Whistling swans are found throughout protected areas of the Potomac, Machodoc, and the Black Marsh. Preferred plant foods are similar to those of dabbling ducks, including various grasses, wild celery, pondweeds, smartweeds, muskgrasses and bulrushes (Martin, et. al., 1951).

WATERFOWL MANAGEMENT

Waterfowl management will be in the form of habitat management, waterfowl surveys, artificial nesting devices and cooperative research.

Habitat management will be both indirect and direct. Indirect techniques will be aimed at wetlands protection (i.e., erosion control, oil spill containment) while direct techniques will be aimed at establishing stands of desirable food and cover plants.

Waterfowl habitats will be continually surveyed to note changes in vegetative composition. When these surveys indicate inadequate amounts of preferred foods, native plants will be established either by transplanting wild stock or by planting nursery stock of native species. A cooperative research project with the Virginia Shoreline Erosion Advisory Service will attempt to establish native bay grasses in suitable areas along the Potomac and Machodoc Creek. These grasses include salt-marsh cordgrass, salt-meadow hay and others known to provide waterfowl foods. This project can be extended to other marshes as required to insure ample supplies of waterfowl food plants.

Station employees feeding ducks in Cooling Pond and the aeration ponds should be encouraged in the fall. However, feeding mallards in the nesting season should be discouraged because ample supplies of wild foods are available.

Waterfowl surveys will be conducted periodically to estimate numbers and record species, habitat, and times of arrival and departure from NSWC.

Wood duck nest boxes located throughout Gambo Creek will be replaced. Existing boxes are painted red, have entrance holes too small for wood ducks, and are located so as to make them quite vulnerable to predators. The correct specifications for constructing these boxes are shown in Figure B-4-1. Wood duck nest boxes will also be installed in the Black Marsh. Further, natural cavities are being protected under the Forestry Plan and cavities will be drilled in the Sycamore (Plantus occidentalis) trees which were left standing during the construction of the extension to Hideaway Pond. If determined practical, additional wood duck boxes will be installed in the seasonally flooded hardwood forests.

The diving duck banding project will be accomplished in cooperation with the USFWS, which will provide diving duck traps, banding equipment, and supervisory biologists to conduct this research on the Potomac River.

All waterfowl management projects will be identified as such in the Annual Work Schedule of the Fish and Wildlife Plan.

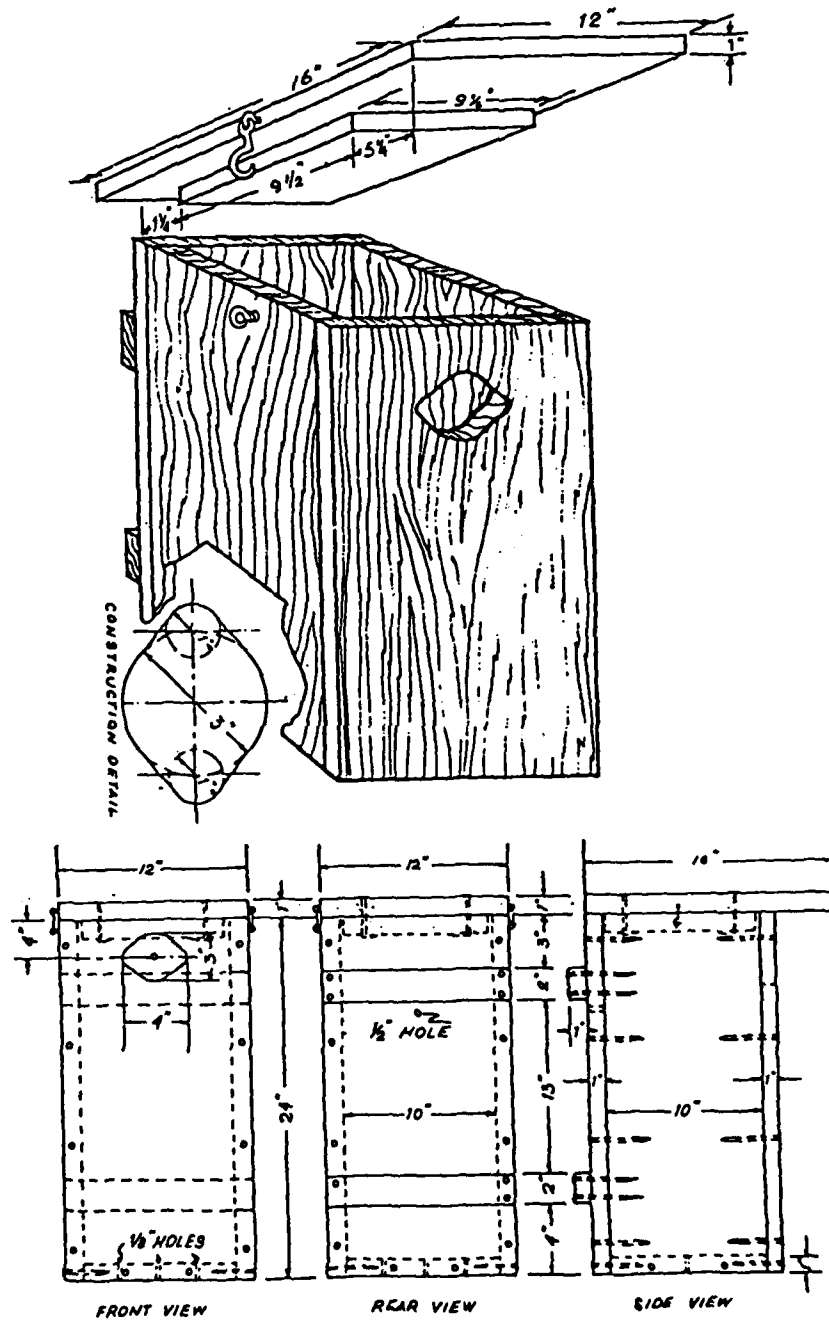


FIGURE B-4-1. PLANS FOR A WOODEN NEST BOX FOR WOOD DUCKS

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NSWC MP 84-147

APPENDIX B-5

SMALL GAME MANAGEMENT PLAN

B-51/(B-52 blank)

SMALL GAME MANAGEMENT PLAN

INTRODUCTION

Small game species found at NSWC include eastern gray squirrel (Scirus carolensis), eastern cottontail (Sylvalagus floridanus), bobwhite quail (Colinus virginianus), mourning dove (Zenaidura macroura), woodcock (Philohela minor), and snipe (Capella gallinago). Other hunted species such as rails (Rallus spp.); (Porzana carolina) and other "chicken-like" marsh birds can be found; however, their habitat requirements are significantly different from those typically referred to as small game. Therefore, these species are not considered within the text of this plan.

DESCRIPTION OF THE AREA

The areas of primary concern are the forested, shrub-scrub, and open field communities of Mainside and Tetotum Flats. Forested areas consist of mixed hardwood stands dominated by oaks (Quercas spp.), mixed pine (Pinus spp.)-hardwood stands, pine forests and pine plantations.

Shrub-scrub communities represent the successional stage between open fields and forests. Because these communities contain vegetative compositions found in both open fields and young forests (i.e., very diverse) they are especially valuable for small game.

Open field communities at NSWC are maintained at this successional stage for military purposes. These areas include various weapons testing areas, site lines (visual clear zones), airfields, and runway clear zones. Open fields consist of various grasses and legumes.

MANAGEMENT HISTORY

Habitat management on Mainside to benefit small game was a coincidental result of military land-uses. The open field communities maintained for weapons testing simultaneously created edge habitat between forest and open field habitats. Edges are extremely valuable for small game (and non-game) wildlife because they provide dense vegetation used for nesting and escape cover and additional diversity to the total available habitat. Other open fields which were abandoned have succeeded to shrub-scrub communities and provide still another form of ecological diversity.

The most intensive small game management took place at Tetotum Flats (Figure B-5-1) where the Virginia Commission of Game and Inland Fisheries established numerous hedgerows which subdivided a large open field. Perennial food plants such as autumn olive (Elaeagnus angustifolia) were planted between the hedgerows as were annual food plots of various millets (Seteria spp., Panicum spp., Echinochloa spp.). These areas, called Finger Fields, have since been abandoned and need to be rejuvenated. Finger Field management is discussed later.

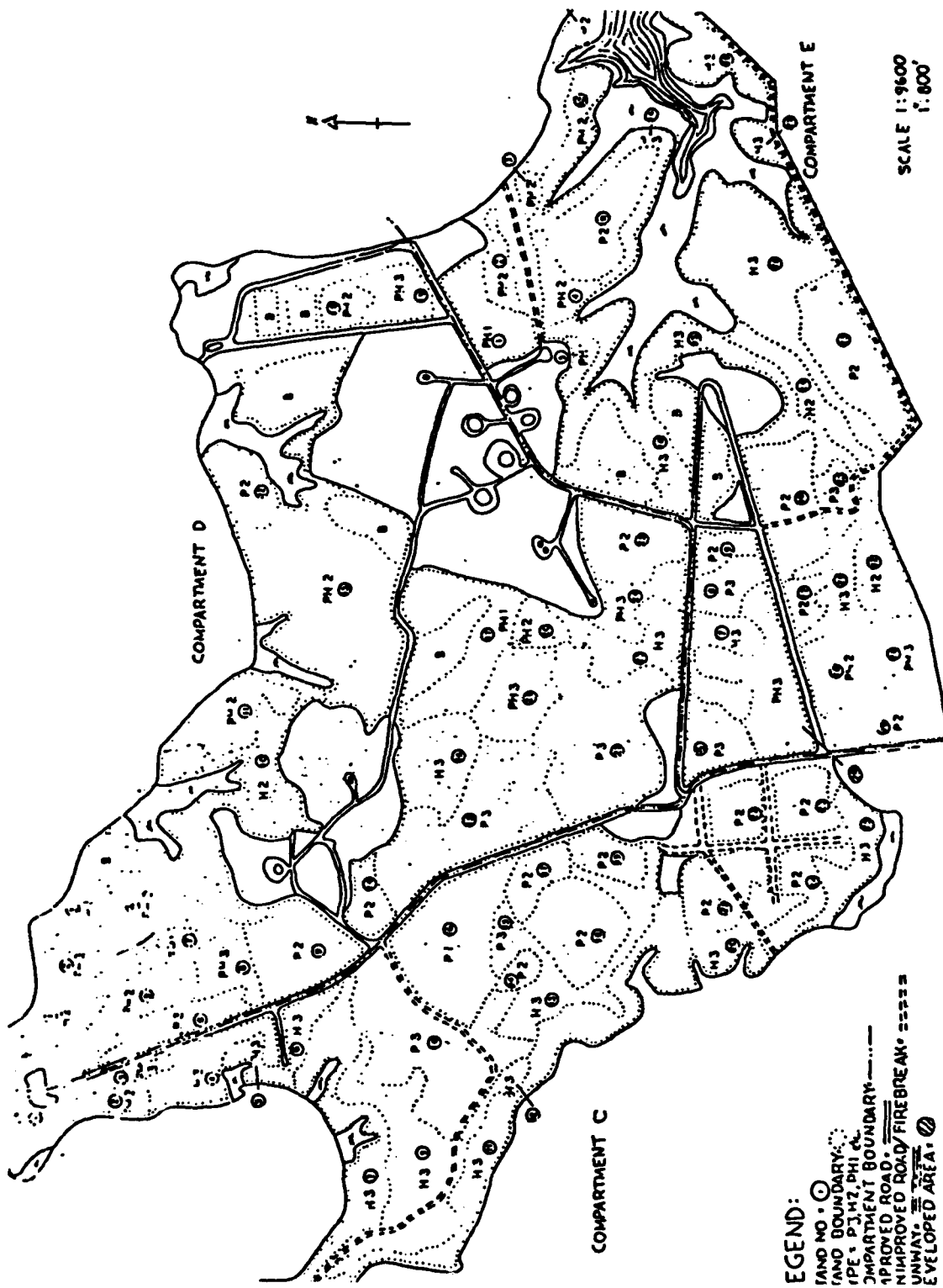


FIGURE B-5-1. TETOTUM FLATS

SMALL GAME HABITAT REQUIREMENT REVIEW

Small game include a variety of species whose habitat requirements, although different, are similar enough to respond favorably to techniques which diversify habitats. For example, a hedgerow providing escape cover for quail may simultaneously provide nest concealment for cottontails (and several non-game species). Likewise selective tree cuts in hardwood stands to improve mast production for squirrels (and several other species) also increases available nesting sites for mourning dove (and several other species) due to tree crown development.

Generally, the standard habitat management techniques mentioned in the main Fish and Wildlife Management Plan meet the requirements of small game found on Station. These requirements are adequate food, nesting cover, escape cover from predators, protection from the elements, roosting areas, and water. It should be noted that absence or poor distribution of cover will limit wildlife numbers in a given area.

SMALL GAME MANAGEMENT

Small game management consists of improving cover, nest sites, food, and roost sites.

Cover includes escape sites, nesting areas, and protection from harsh weather. Herbaceous vegetation, shrubs, and trees which provide protection from hunters, predators, and the elements can be created by establishing hedgerows and brushpiles.

Hedgerows provide desirable escape, refuge, and nesting cover for some species and food and travel corridors for others. Hedgerows should be established along gullies and stream banks or along ponds. When establishing hedgerows near wooded edges or protruding from forest areas, vegetative height restrictions for weapons testing must be observed. When planting hedgerows, recommended species are autumn olive, honeysuckles (Lonicera spp.), and dogwood (Cornus florida). These plants should be planted in staggered rows 4 feet apart with individual plants also 4 feet apart.

Another technique for establishing hedgerows is to site prepare a strip where the hedgerows are desired and then install fenceposts staggered every 20 feet. String a light gauge wire or strong twine between the fence posts. Songbirds perching on the wires have droppings which contain viable seeds and will plant the prepared site. This is a cost efficient technique for establishing hedgerows with native species such as dogwood, eastern red cedar (Juniperus virginianus), wild cherry (Prunus serotina), and others.

Brushpiles should be established within forested areas where hedgerows cannot be established. Brushpiles offer not only protection and concealment but also a medium for seed germination and plant growth. Brushpiles will be constructed out of logging slash or Christmas trees collected from Station residents. Brushpiles will be located in pine forests following thin cuts and prescribed burns and will be located within 200 feet of other cover areas (brushpiles located at the base of trees or near fallen logs may also provide nesting areas for wild turkeys).

Rejuvenation of the Finger Fields at Tetotum Flats will improve all habitat parameters for small game. The Finger Fields will be rejuvenated with prescribed fires on a three year rotation. Before burning, a firebreak will be disced along the hedgerow boundary and around desirable trees (autumn olive, dogwood, etc.) within the fields to protect these plants from the fire. The first year, every third field will be burned; the second year, fields adjacent to the "first year fields" will be burned; the third year, fields adjacent to the "second year fields" will be burned; the fourth year, the "first year fields" will be burned starting the rotation over again. Burns will begin in February and will be completed no later than 1 April each year. It should be noted that prescribed fires in pine forests will also improve habitat parameters for small game and other wildlife.

The maintenance of early successional vegetation in areas with easy access to cover provide nutritionally superior wildlife foods. This is the net effect of the prescribed fires described above. The three year rotation is important to not only control invading woody vegetation but also to promote the mosaic of habitat types in adjacent management units (i.e., habitat diversity). Likewise, strip discing open fields along wooded edges maintains early successional plant species which are readily utilized by wildlife because of easy access to escape cover. Strip discing will be conducted along edges between an open field and forest habitats on a three year rotation. The first year, a strip along the wooded edge will be disced down to bare soil; the second year, a strip adjacent to the first strip will be disced; the third year, a strip adjacent to the second strip will be disced; the fourth year, the first year strip will be disced again. When necessary, the disced strips can be limed and fertilized at rates specified by a soil sample analysis. The width of the strip will be equal to that of the disc.

Daylighting is another technique to improve small game habitat. Daylighting normally is done in dense hardwood forests to create open areas within the forests and to maximize edge habitat. Daylighting will be a by-product of other land uses such as timber and firewood harvests.

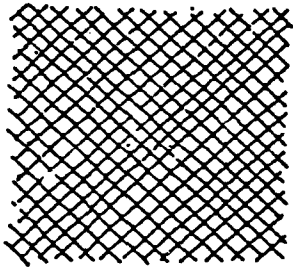
Annual food plots supplement natural foods and make excellent projects for youth groups and other organizations interested in wildlife conservation. Like other feeding areas, food plots should be located near escape cover areas. For small game, 1/4 acre food plots planted to various millets, clovers (Tri-folium spp.), or lespedezas (Lespedeza spp.) are adequate.

Proso millet (Panicum miliaceum) will be strip planted to attract mourning dove. Select large open fields will have strips approximately 20 feet wide and 20 feet apart, parallel to the long axis of the field, site prepared and planted to proso millet the first year. The second year, fallow strips will be planted and the "first year strips" will be left fallow. The planted-fallow strips will alternate every year.

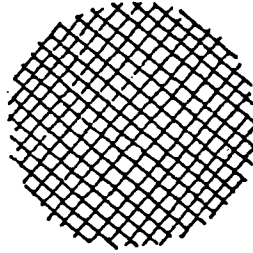
Selective tree cuts in hardwood forests will promote crown development and therefore mast production. Crown development will provide nest sites for gray squirrels, mourning dove, and other tree nesting squirrels; increased mast production will provide more food for gray squirrels and other mast consuming species.

Nesting habitat for mourning dove can be improved by the use of nest cones. Figure B-5-2 identifies the proper construction and installation of nest cones. This is also an excellent project for youth groups and local conservation organizations.

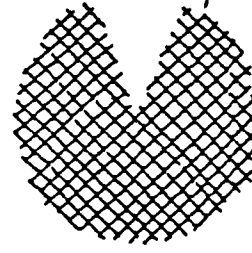
All small game management projects will be identified as such in the annual work schedule of the Fish and Wildlife Management Plan.



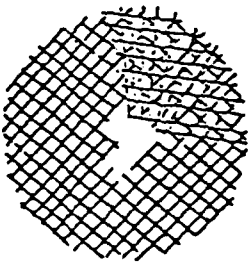
1. CUT OUT 12" SQUARE
PIECES OF HARDWARE
CLOTH



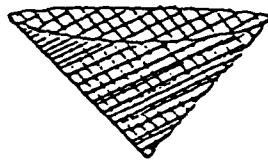
2. TRIM THE 12" SQUARE
TO FORM A CIRCLE



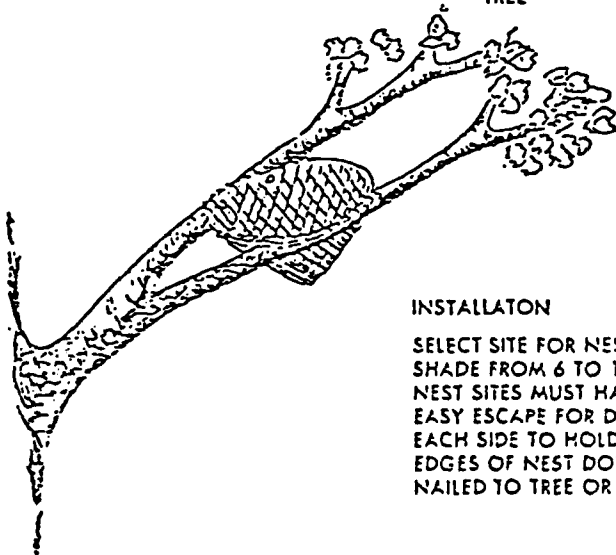
3. CUT OUT PIECE
OF PIE AS
SHOWN



4. CLOSE PIE CUT BY
OVERLAPPING EDGES
ABOUT 3"



5. SIDE VIEW OF
CONE NEST READY
FOR NAILING IN
TREE



INSTALLATION

SELECT SITE FOR NEST IN MODERATE
SHADE FROM 6 TO 16 FEET ABOVE THE GROUND.
NEST SITES MUST HAVE LIMB CLEARANCE FOR
EASY ESCAPE FOR DOVES. USE 2 NAILS ON
EACH SIDE TO HOLD NEST IN PLACE. BEND
EDGES OF NEST DOWN SLIGHTLY AFTER IT IS
NAILED TO TREE OR BRANCH.

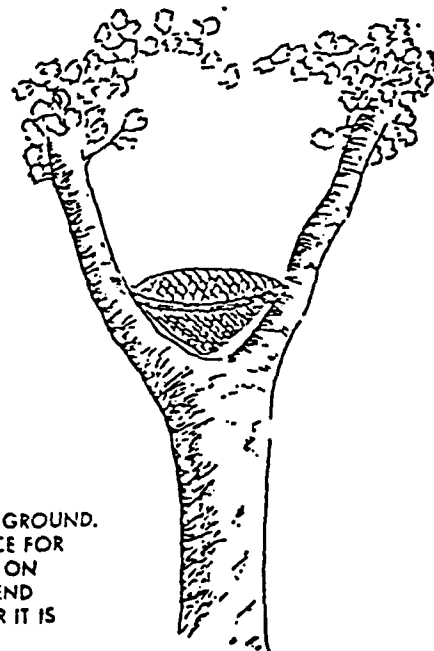


FIGURE B-5-2. NEST CONES FOR MOURNING DOVES

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APPENDIX B-6

URBAN AND NON-GAME WILDLIFE MANAGEMENT PLAN

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URBAN AND NON-GAME WILDLIFE MANAGEMENT PLAN

INTRODUCTION

Urban and non-game wildlife include several species of game and non-game found in developed areas. A complete inventory of non-game and urban wildlife can be found in the main Fish and Wildlife Management Plan.

Developed areas which have been properly landscaped have proven to be valuable habitat for several species called urban wildlife. Although real estate developments are generally believed to be detrimental to wildlife, this belief is not necessarily true. Certain species' habitats have been improved through developments and these species are more abundant than ever before (i.e., several songbirds). Other species having a generalized ecology have simply adapted to the human environment (i.e., raccoons). Still other species have so favorably responded to developments that they are often considered nuisances (i.e., squirrels).

Areas throughout NSWC support several species of non-game wildlife. In addition to species specific management projects such as nest boxes, non-game wildlife also benefit from improvements aimed at forests, large game, and small game. For example, prescribed fires for timber stand improvements also improve habitat for deer, turkey, quail, bluebirds, various woodpeckers, and other songbirds. Likewise, establishing hedgerows for small game refuge simultaneously create nesting habitat for several songbirds.

DESCRIPTION OF THE AREA

The areas of primary concern are the developed, housing and community support areas of Mainside. These areas occupy approximately 1200 acres which include nearly 3 miles of shoreline on the Potomac River, Machodoc Creek, and the Cooling Pond. These areas have a wide variety of ornamental and native trees producing an abundance of berries, acorns, and other forms of mast. Several coniferous trees provide winter refuge. In addition to an abundance of natural food and shelter, station residents maintain bird feeders, nest boxes, and ornamental shrubs.

Other areas throughout the Station included in the wildlife management program which benefit non-game wildlife.

MANAGEMENT HISTORY

Wildlife management aimed specifically at urban and non-game species include endangered species protection, nest boxes, and shrub plantings. Other efforts which benefit non-game wildlife are bird feeders and various conservation projects accomplished by Boy Scouts and Girl Scouts.

Bald eagles are the only endangered species found at NSWC. Bald eagle management is addressed in Appendix B-1.

Several nest boxes for purple martins and bluebirds have been installed throughout the Station. All purple martin boxes are utilized, however, bluebird boxes are in need of maintenance to promote utilization.

Autumn olive (*Elaeagnus augustifolia*) has been planted in several locations to provide food for songbirds and has been accomplished, in part, as Boy Scout and Girl Scout projects.

Bird feeders maintained by Station residents are an excellent technique to attract non-game wildlife and to promote participation in wildlife conservation. This practice will be encouraged.

URBAN AND NON-GAME HABITAT REQUIREMENT REVIEW

Habitat requirements for urban and non-game wildlife are no different than that of other species. Adequate food, cover, and nesting sites and their proper distribution will attract wildlife into any given area.

URBAN AND NON-GAME MANAGEMENT

Because non-game wildlife also benefits from habitat requirements aimed at other species, the majority of urban and non-game wildlife management will be concentrated in residential and other developed areas.

The existing landscape of the housing area combined with bird feeders maintained by Station residents is ideal for several species. The only limiting factor in this area is an absence of trees which provide a middle layer tree canopy. Existing trees are larger and provide an excellent overstory; existing shrubs are scattered throughout and provide an excellent understory. The arrangement of landscape plantings has created an open, park-like atmosphere. Appendix 1 of the Grounds Management Plan provides landscaping techniques to insure replacement trees are planted as older trees die or need to be removed. Further, tree species are selected to improve the middle layer tree canopy. The long term result will be maintenance of the existing landscape and therefore, habitat for urban and non-game wildlife. Other landscape improvements will be by Boy Scout and Girl Scout conservation projects.

Nest boxes will be constructed for several species, especially those which provide biotic control of insect pests. These species include purple martins, bluebirds, tree swallows and kestrels.

Purple martin house have been installed throughout the developed areas of the Station and are completely utilized. Purple martins are a very desirable species due to their insectivorous habits. Daily, these birds consume many times their own weight in mosquitoes and other insect pests. Therefore, additional purple martin houses will be installed in suitable areas. Suitable areas are open fields or residential yards, close to water, and not subject to disturbance. Figure B-6-1 shows specifications for constructing purple martin houses.

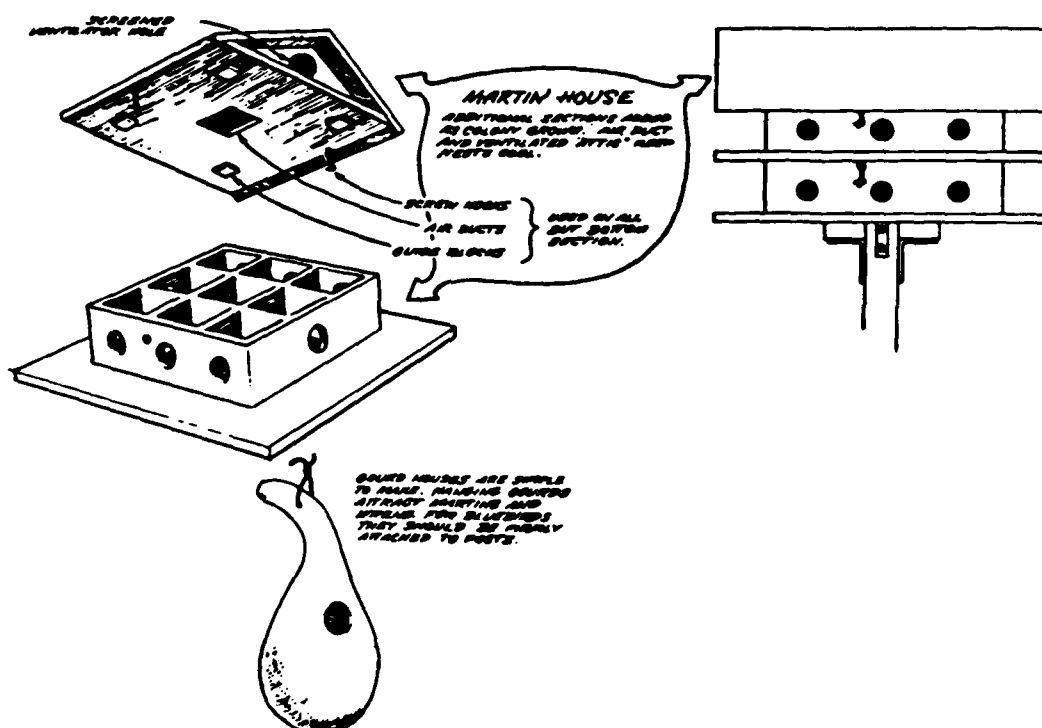


FIGURE B-6-1. PURPLE MARTIN HOUSE SPECIFICATIONS

Bluebird boxes on Station are in need of maintenance or replacement to promote utilization. Bluebirds require open areas with scattered trees. Boxes will be secured to fence post or trees between 5 feet and 15 feet above ground. All boxes will be 300-350 feet apart to avoid fighting between territorial males. Figure B-6-2 shows specifications for constructing bluebird boxes.

Tree swallows can be induced to nest with appropriately constructed and located boxes. Boxes for tree swallows are the same as those for bluebirds (Figure B-6-2), however, when used for tree swallows, they will be located near ponds or marshes, 4 to 9 feet above ground, and on poles 75-100 feet apart. Tree swallows are generally tolerant of human activity so boxes can be located in high use areas. Because tree swallows eat numerous mosquitoes, they are welcome additions to residential areas.

Kestrels, often called sparrow hawks, will nest in boxes illustrated in Figure B-6-3. Boxes will be located in undeveloped areas in isolated trees or posts or along a wooded edge. Boxes will be 20-25 feet above ground with entrance holes facing south or east. Entrances will have a clear flyway. Kestrel boxes should not have a perch. Kestrels are desirable species because they consume nuisance wildlife such as house sparrows, mice, and several insects.

Another aspect of urban wildlife management is animal damage control. Species such as skunks, raccoons, and squirrels in developed areas can become a nuisance. Raccoons and skunks are capable of transmitting rabies to humans and household pets. Squirrels are capable of getting into houses and building nest among floor joists, ceiling joists, or inside soffits. Squirrels often destroy insulation, chew up electrical wire insulation and make access for other pests such as starlings, house sparrows, bees, and others. When they chew up electrical wire insulation, squirrels also create a fire hazard for occupants.

Rabies usually occur in periodic outbreaks and should not be considered a problem unless such an outbreak is prevalent in this area. When rabies are considered a problem, preventative vaccines will be made available. The annual trapping program will also help maintain balanced numbers of raccoons, skunks, and other species.

Squirrels in houses and buildings is a problem and will continue to be unless adequate control techniques are implemented. A trapping effort using live traps will be implemented in high use areas with an abundance of squirrels. It is emphasized that squirrels are reluctant to enter traps when other foods are available. Therefore, highly aromatic baits such as peanut butter or canned dog food mixed with corn meal will be used. Live trapping should be accomplished in fall and winter to avoid litters being left in buildings.

Houses and buildings can be squirrel-proofed, however, the technique is expensive. Squirrels (and chipmunks) can be kept out of houses by closing all entrance openings with 1/4-1/2" wire mesh or with sheet metal. Entrance holes can be located by watching squirrels. Eave openings, other vents, knot holes, vent pipes, and chimneys should be screened or flashed with sheet metal. Loose flashing should be repaired. Trees with branches close to houses should be trimmed back at least 6-8 feet from the house. Squirrel proofing houses and buildings should be completed by early spring to avoid having newborn litters trapped and dying inside the house.

All urban and non-game management projects will be identified as such in the annual work schedule of the Fish and Wildlife Management Plan.

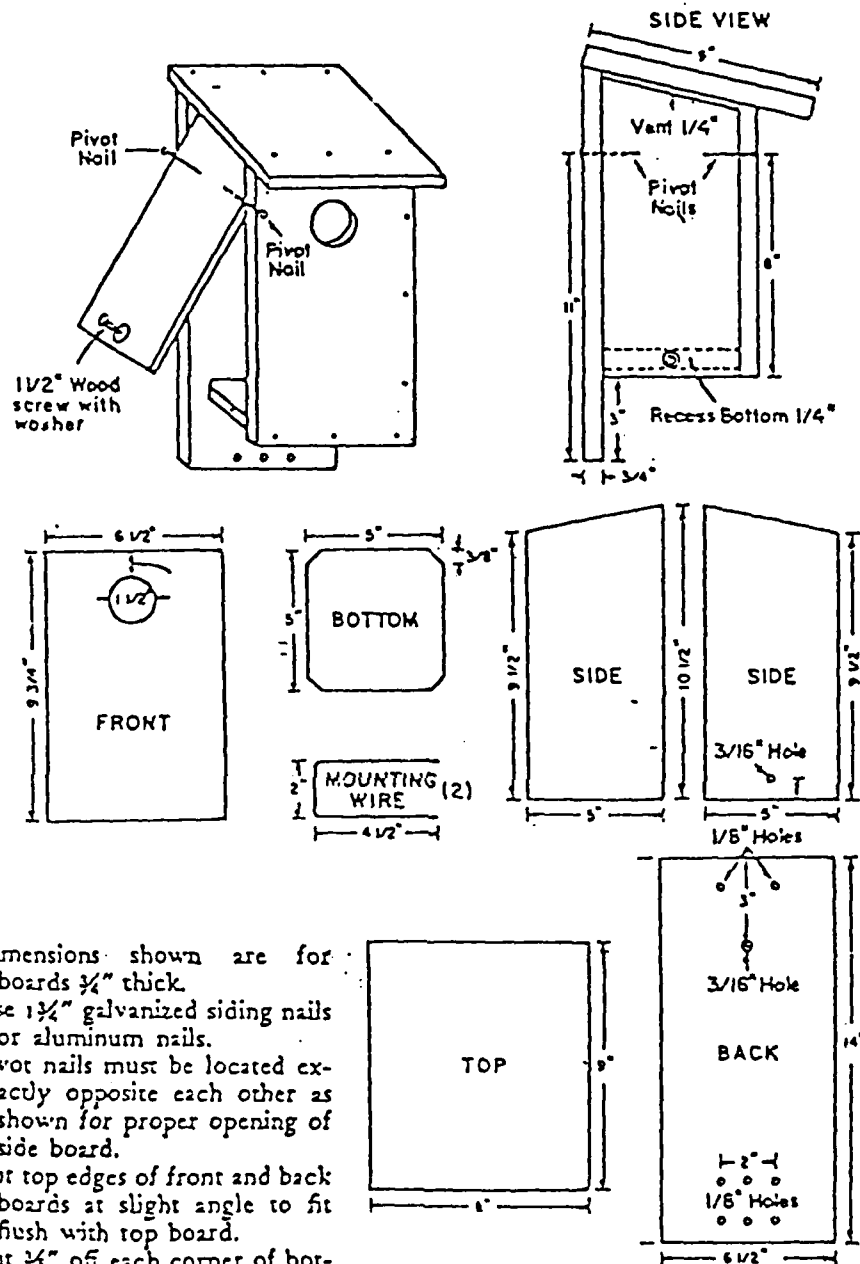


FIGURE B-6-2. PLANS FOR BLUEBIRD/TREE SWALLOW NEST BOX

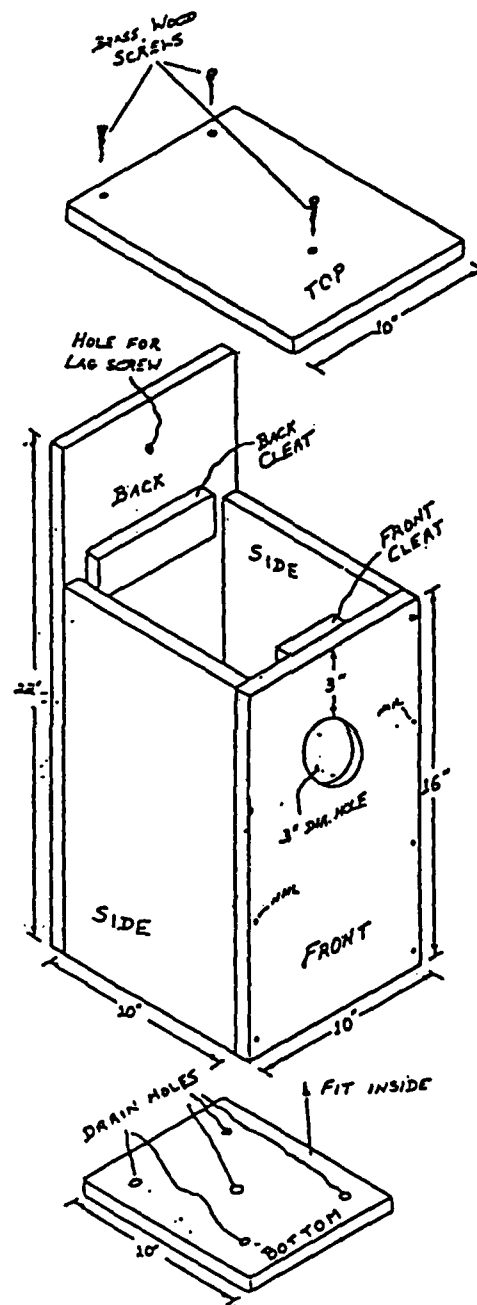


FIGURE B-6-3. PLANS FOR A KESTREL NEST BOX

NSWC MP 84-147

APPENDIX C
PRESCRIBED BURNING PLAN

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PRESCRIBED BURNING PLAN

INTRODUCTION

Prescribed burning is a standard technique for improving timber stands and wildlife habitats. The ultimate goal for timber stand improvement (TSI) is to kill off invading hardwoods and other woody vegetation in pine forests. This technique works because pines are bark insulated and therefore, fire resistant (excluding uncontrolled forest fire), while hardwoods are not. By killing off invading hardwoods and woody vegetation, the more merchantable pines are "released" from competition for soil nutrients. Wildlife benefit from prescribed burns because the leaf litter and pine straw is burned off and the understory canopy is removed. This results in exposing the forest floor to sunlight and allowing grasses, forbs, and other nutritionally superior wildlife foods to grow. Both TSI and wildlife habitat improvements are accelerated when prescribed fires follow selective tree cuts.

Open fields can also be maintained with prescribed fire by killing off invading shrub-scrub vegetation. The maintenance of open fields along wooded edges and within the forests are also wildlife habitat improvements.

DESCRIPTION OF THE AREA

The areas of primary concern are the pine forests, pine plantations, and open fields of Mainside and Tetotum Flats (Figures C-1 and C-2).

Existing pine forests contain undergrowth which is too thick to safely burn. Dense undergrowth creates a fire hazard because the chances of a prescribed fire becoming an uncontrolled forest fire is increased. Therefore, pine forests of NSWC must be thinned by selective tree harvests before they can be managed with prescribed fire.

Open fields which need burning are the active runway clear zone of Mainside and the Finger Fields (see Appendix B-4) of Tetotum Flats. These areas are currently overgrown with scrubby vegetation and cedar (Juniperus virginianus) and sweet gum (Liquidambar styraciflua) saplings.

Additional areas in need of burning will be identified on a case by case basis.

All burns shall be closely coordinated with EOD for clearing dud ordnance hazards and with the Fire Department to insure fires are kept under control.

PRESCRIBED BURNING

Pine forests and sapling to pole sized pine plantations will be burned on a three year rotation. The first year following a selective tree harvest, the cut-over area will be burned. Then, these areas will be allowed to grow up for two more years before being burned again. Therefore, pine forests and plantations burned in 1983 will be burned again in 1986.

FOREST TYPE MAP
OF
COMPARTMENTS
A and B
NSWC DAHLGREN, VA.

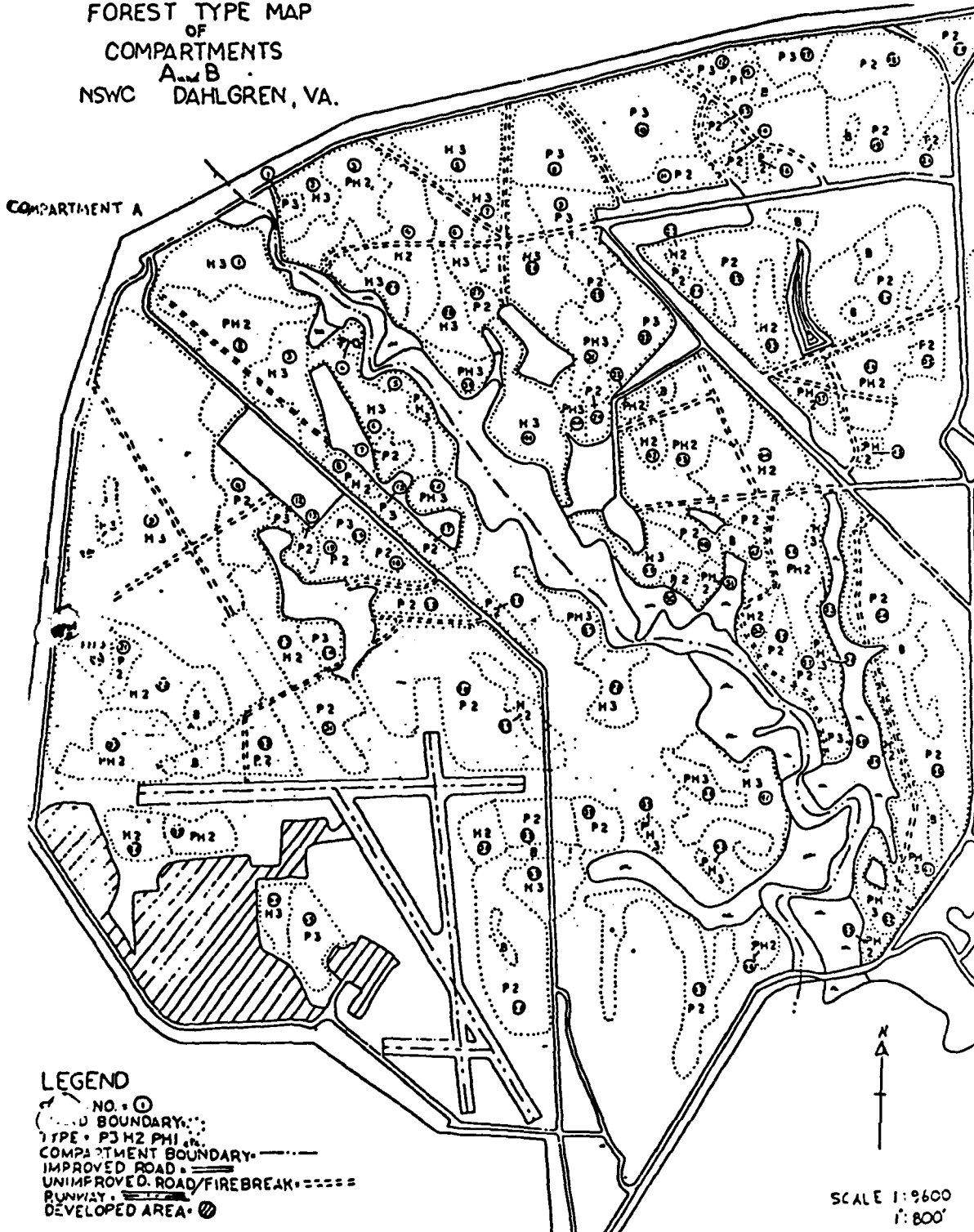


FIGURE C-1. MAINSIDE

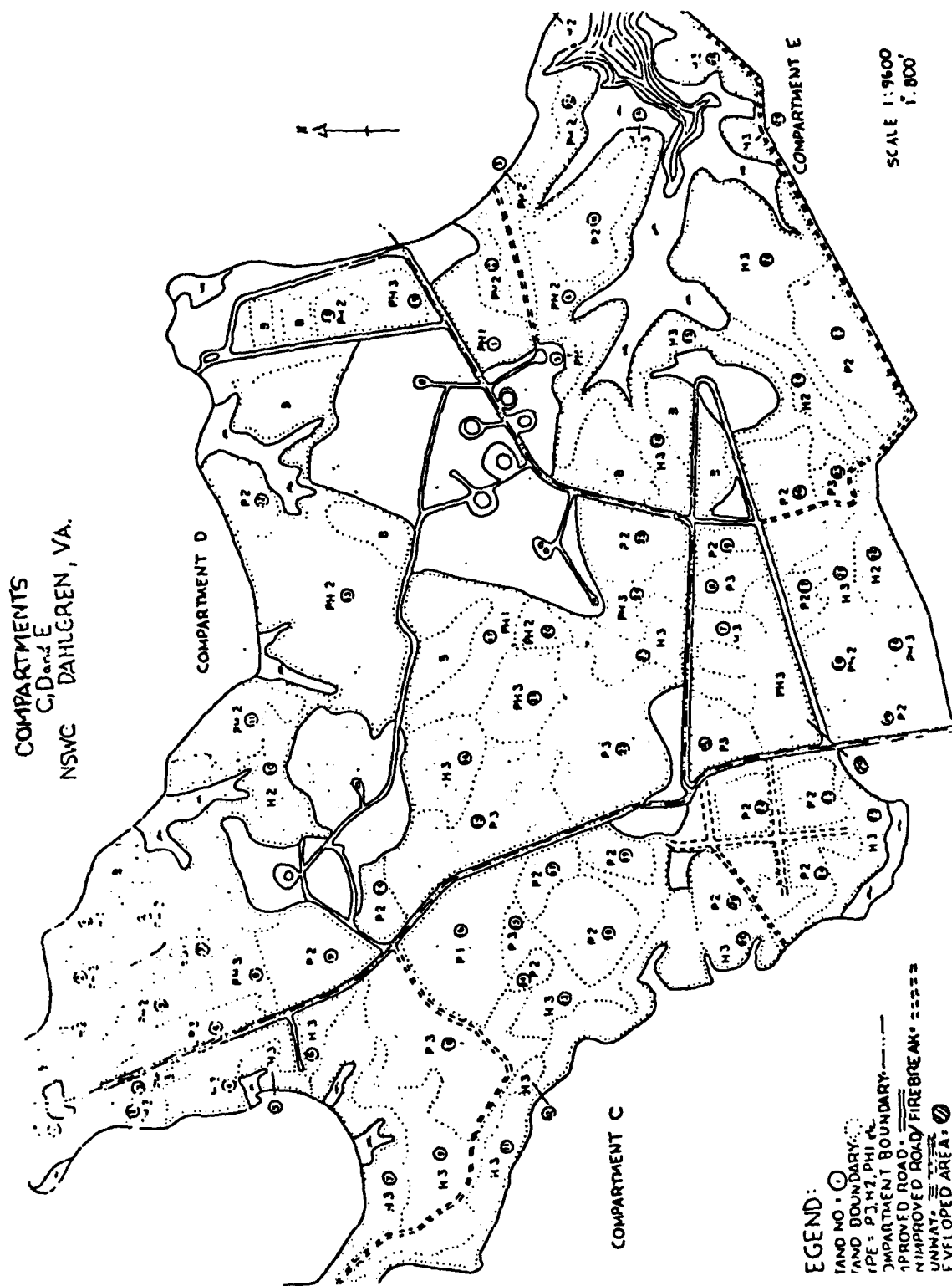


FIGURE C-2. TETOTUM FLATS

All burns will begin in February and will be completed by April 1 each year.

Where possible, existing firebreaks, roads and creeks will define boundaries of burning units. Other areas will require fire plow lines in order to contain fires within each burning unit.

Open fields will require fire plow or disc lines along hedgerows and wooded edges to contain fires inside the fields. Desirable hardwoods growing in the fields may also be protected from the fire with fire plow lines.

Figure C-3 identifies areas to be burned in February 1983. This figure is subject to continuous change until all burn units are identified. Identification of all burn units will be based on timber harvest locations, age classes of reforested areas, and compatibility of burning with mission requirements.

All burns will be financed with Forestry funds and identified as both TSI and wildlife habitat improvement in the annual work schedule of the Fish and Wildlife Management Plan.

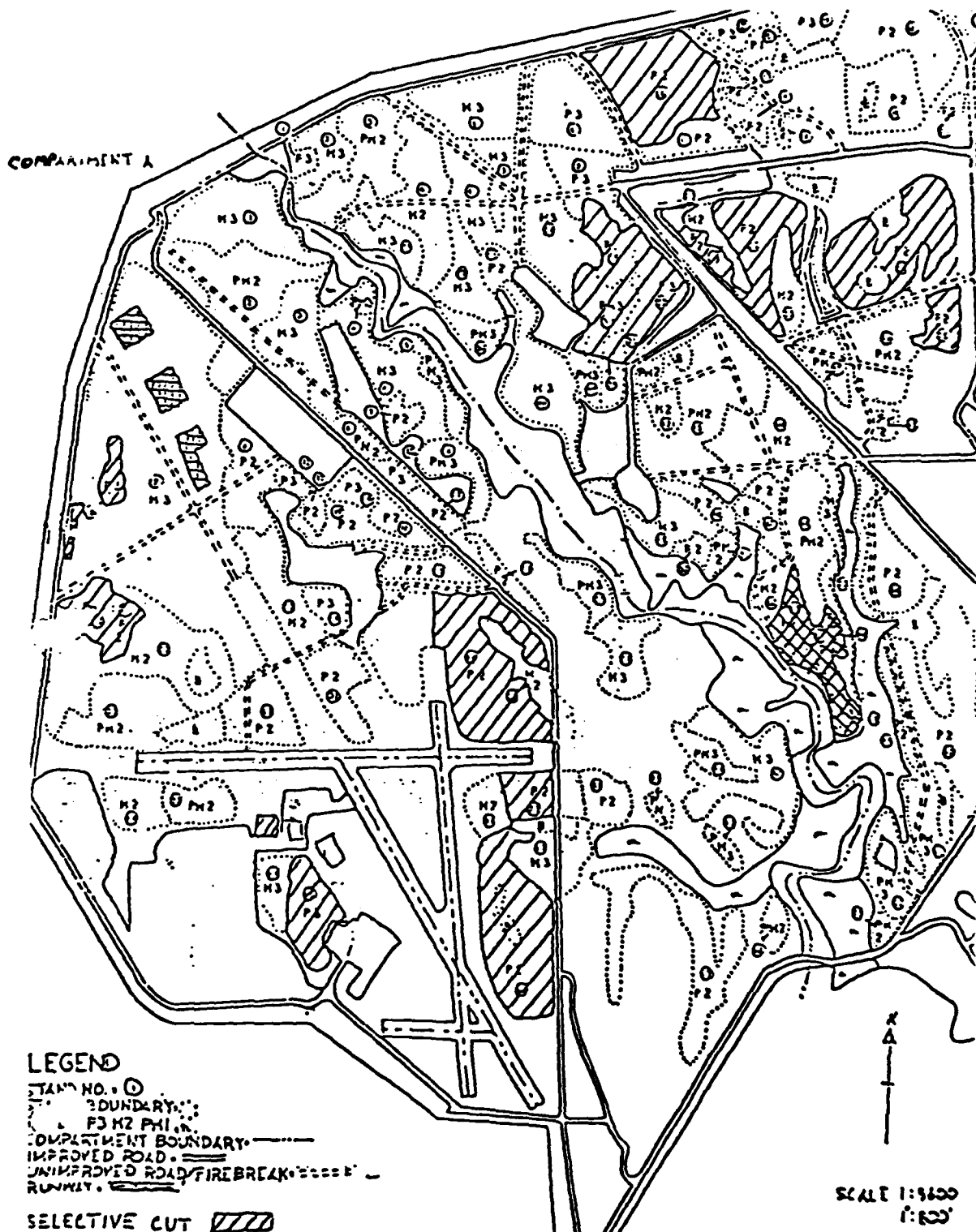


FIGURE C-3. 1982 PRESCRIBED BURNING AREAS

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NSWC MP 84-147

APPENDIX D
HARVEST DATA FORMS

D-1/(D-2 blank)

SMALL GAME KILL DATA HUNTING SEASON _____

HUNTING SEASON

D-4

NSWC Dalhgren Site

Hunting Season ____ - ____ Summary

1. Number of Licensed Hunters:	<u>Employees/Residents</u>	<u>Guests/Public</u>
<u>Mainside and EEA</u>	:	
<u>EEA ONLY</u>	:	
<u>TOTAL</u>	:	
2. Man-days of Hunting	<u>Employees/Residents</u>	<u>Guests/Public</u>
<u>Mainside</u>	:	
<u>EEA</u>	:	
<u>TOTAL</u>	:	
3. Small Game Harvest	<u>Species</u>	<u>Number</u>
	Squirrel	
	Rabbit	
	Dove	
	Quail	
	Woodcock	
	Snipe	
4. Deer Harvest	<u># Bucks</u>	<u># Does</u>
<u>Mainside</u>	:	
<u>EEA</u>	:	
<u>TOTAL</u>	:	
5. Turkey Harvest**	<u>Number Taken During Spring Bearded Hunt</u>	<u>Number Taken During Fall Hunt</u>
<u>Mainside</u>	:	
<u>EEA</u>	:	
<u>TOTAL</u>	:	

**See Appendix B-3 for Harvest Data Requirements.

NSWC MP 84-147

FOREST RESOURCE MANAGEMENT PLAN

FOR

NAVAL SURFACE WEAPONS CENTER

DAHLGREN SITE

DAHLGREN, VIRGINIA.

1979 - 1988

Prepared in Cooperation with: PUBLIC WORKS OFFICE
NAVAL SURFACE WEAPONS CENTER

AND

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.

I have read many definitions of what is a conservationist, and written not a few myself, but I suspect that the best one is written not with a pen, but with an axe. It is a matter of what a man thinks about while chopping, or while deciding what to chop. A conservationist is one who is humbly aware that with each stroke he is writing his signature on the face of his land. Signatures of course differ, whether written with axe or pen, and this is as it should be.

....Aldo Leopold
A Sand County Almanac

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INTRODUCTION

As a steward of public lands, the U. S. Navy is responsible for managing its portion of these lands in the best public interest while maintaining environmental conditions consistent with the military mission of the individual installations.

To encourage forest resource management on all Department of Defense lands, the U. S. Congress annually provides funds for this purpose. The legal basis and modus operandi for the Department of Defense Forest Resource Management Program as it pertains to NSWC, Dahlgren, Virginia are spelled out in the following statutes.

1. U. S. Code, Title 10, Para. 2665 as amended by Sec. 610 of PL 95-82, 1 August 1977.
2. DOD INST. 7310.1, 10 July 1970
3. SECNAV INST. 4100.7, 4 August 1972
4. OPNAV INST. 11015.1B, 6 November 1972
5. OPNAV INST. 6240.3E, 5 July 1977
6. NAVCOMPT Manual, Vols. 2, 3, and 4
7. NAVFAC INST. 11015.9A, 23 January 1973
8. NAVFAC P-73, June 1976
9. CHESDIV INST. 11015.2A, 10 January 1974

The purpose of this Plan is to provide for the orderly, scientific management of the NSWC woodlands for the conservation and protection of the natural resources and the production of a sustained yield¹ of forest resources consistent with the Station's military mission.

¹Sustained-yield management, as the term is most accurately and commonly employed, means continuity of harvest. Whether reckoned by years or by longer periods, the purpose is to obtain a sustained flow of products, a flow that may be currently increased or diminished in accordance with the purpose of management and the condition of the forest, but which may be continued indefinitely even though often at variable levels. The whole body of forest regulatory techniques is aimed at organization of a forest to bring about this sustained yield of harvest products in an efficient and orderly manner. Current harvest does not necessarily equal current growth, although in the long run and on the average it must. (Davis, 1966)

The production of timber crops is a long-term investment, taking as much as 40 years from the establishment of seedling trees to the first economic return. In the Mid-Atlantic States, forests mature between the ages of 50 to 100 or more years. In managed forests, final timber harvests are generally delayed until maturity. Thus the need for long range management planning is imperative for continuity through a series of managers and administrators.

This plan contains work schedules by forest compartments for the next 10 years. Most recommendations and data presented are approximate and subject to change. Final prescriptions will be made in the Forestry Annual Incremental Plans. Annual Plans for final action plans due 1 May at Chesapeake Division, Code 243 for the following fiscal year.

The data base for this plan is the CHESDIV Forest Inventory Report for NSWC, Dahlgren, Va. 1978. The CHESDIV Forest Inventory System and Computer Program were used in gathering, summarizing, and tabulating by forest cover types, species, and size, the stocking, merchantable and total cubic wood volumes. A ten-year (1979-1988) growth projection for each forest type is also contained in the inventory report.

The data was collected on 126 systematically located sample points. Sixty-six of these points are "permanently" marked in the field and their locations pinpointed on aerial photo mosaics at Chesapeake Division. To determine actual net growth and the impact of natural occurrences, timber harvesting, and other human activity on the Station's forest, these same points will be revisited during or before 1988. Samples of the tally forms used to record the Forest Inventory data are at Appendix D. The Forest Inventory Report is available from CHESDIV, Code 243.

DESCRIPTION OF THE AREA

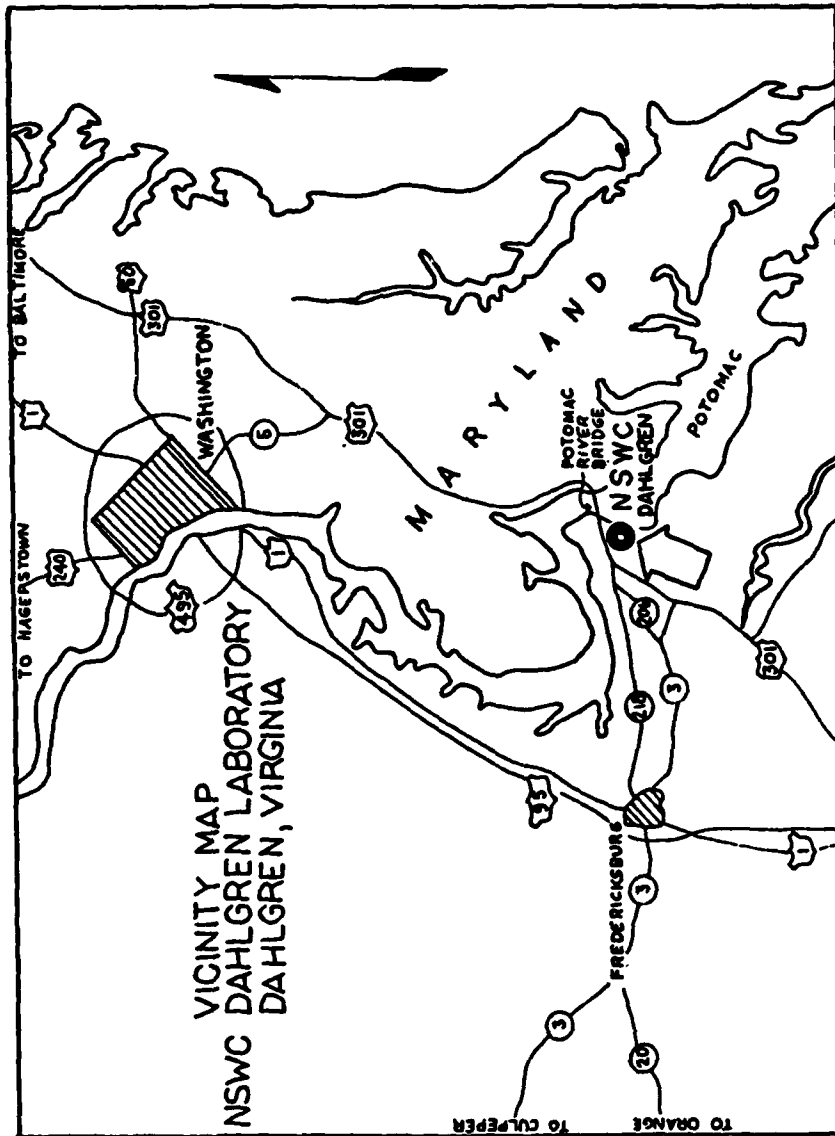
LOCATION

Figure 1 shows the location of the Naval Surface Weapons Center, Dahlgren, Virginia.

CLIMATE

The area has a continental climate with well defined seasons. The climate is influenced by the Potomac River and nearby tributaries. Annual precipitation averages 43 inches. The monthly distribution is fairly uniform during the year being slightly greater during the summer months.

The average growing season is 210 days. The warmest period of the year is during July when the mean daily maximum temperature is 88°F. The coldest period of the year is during January when the mean minimum daily temperature is 30°F.



MILEAGE

DC to NSWC - 55
 FREDERICKSBURG to NSWC - 28

FIGURE 1. VICINITY MAP OF NSWC DAHLGREN, VIRGINIA

TOPOGRAPHY AND HYDROGRAPHIC FEATURES

The topography is generally flat over the entire Station. Main Site is divided in two by Gambo Creek which flows to the Potomac River along a northwest to southeast axis. The Potomac serves as the eastern boundary and Upper Machodoc Creek serves as the southern boundary of Main Site.

At Pumpkin Neck, the Upper Machodoc serves as the northern and western boundaries and the Potomac borders to the east. Black Marsh partially defines the southern boundary of Pumpkin Neck.

Intermittent streams and seasonally wet areas are common to the area. Before Navy ownership, most of the poorly drained areas had been cleared of timber, ditched, planted and cropped or grazed. Some of the ditches are clogged and these areas are wet from late winter through mid-spring.

SOILS

The soils have developed from unconsolidated marine and alluvial deposits. The processes and results are typical for the coastal plain. All Station soils are classed Ultisols.

The Station's Long-Term Soil and Water Conservation Management Plan contains specific U. S. Soil Conservation Service soil descriptions and their locations on indexed maps. The soils are medium to fine textured on silty or clayey deposits. Most Station soils are well-suited for excellent tree/forest growth.

Pocomoke, Dragston, Fallsington, Othello, and Bertie soils are poorly drained. Sassafras, Mattapex, Woodston, and Beltsville are generally well drained. Beltsville soils tend to be wet during winter and spring, whereas Woodston and Sassafras tend to be droughty during periods of dry weather. For more information on suitability of Station soils for tree growing see Appendix B.

ECOLOGY

The Station lies within the Southern Coastal Plain. The domination by Southern hard pine of most of the forest land is typical and well documented. Pine is a subclimax species/type which can be indefinitely maintained by continual, periodic "drastic" disturbances (i.e., wildfire, windthrow, timber harvest, etc.).

On the "best" soils, yellow poplar is a common pine associate and dominant species in hardwood stands. Oak is a valuable component of hardwood stands on the "best" soils. On the poorer soils, oak tends to be a less desirable member, often serving as a reminder that the site is better suited to the less demanding pines.

If undisturbed for long periods of time, pine and yellow poplar forest communities may eventually succeed to oak-dominated forest. However, nature seldom allows this to happen over large areas without considerable effort by man to "protect" the forest from "destructive" natural forces, such as wildfire. Yet these forces or human-controlled actions with similar disturbance effects are responsible for the present forest.

Forest management as proposed in this Plan is an attempt to harness the natural forces which shape the forest, to balance the "destructiveness" of nature with the need of the Station and to harvest renewable resources, which would otherwise be lost to society.

WILDLIFE

Wildlife common to early and mid-successional vegetation stages are indigenous to the Station. Early seral stages of forest provide habitat for deer, rabbit, and red fox; squirrel and gray fox inhabit the later seral stages. The Station's wetlands provided habitat for furbearers such as beaver, muskrat, nutria, otter, and mink. The many terrestrial plant communities found on the Station, mixed with the aquatic environs also provide habitat for numerous species of game and non-game birds. The abandoned agricultural fields on the Station that have been invaded by weed species are ideal habitat for mourning doves. These old fields along with upland pine and upland hardwood stands are also good quail habitat. The bottomland hardwood forests, characteristic of later successional vegetation stages, provide habitat for woodcock and turkey, however these species are scarce in eastern Virginia. Ducks and shorebirds frequent the wetlands areas, while a variety of songbirds can be found throughout the territory. Birds of prey (hawks and owls) are regular inhabitants of NSWC lands indicating an enriched environment with a good supply of prey. The red-shouldered hawk, osprey, and the endangered American bald eagle are known to nest on Station lands.

MANAGEMENT

OBJECTIVES OF FOREST MANAGEMENT

As compatible with the military mission and use, the following are the primary objectives of forest management on the Naval Surface Weapons Center, Dahlgren, Virginia.

1. Promote and achieve a pattern of forest resource uses that will best meet the needs of Society now and in the future.
2. Direct the natural development of the forest ecosystem to provide a varied and sustained output of renewable resources and benefits.
3. Protect known endangered and threatened flora and fauna and critical habitat.
4. Improve the general health and timber productivity of the forest ecosystem while maintaining ecological balance.
5. Improve game and non-game wildlife habitat while ensuring reasonable population levels and balance between indigenous species.
6. Conserve the soil, water and all nonrenewable resources.
7. Minimize short-term adverse impact to, and enhance long-term aesthetic values of the forest.

MULTIPLE USE¹

All management recommendations for specific forest stands will be made with military, aesthetic, wildlife, archaeological, ecological and recreational interests in mind. Although not all areas can provide all benefits simultaneously, the sum of all station woodlands will hopefully provide the greatest sum of social, economic, and spiritual benefits.

Aesthetics

With regard to aesthetics, timber harvesting will be restricted to individual tree selection/removals within 75 or more feet of major roads, buildings, recreational facilities, aircraft runways, and similar high-visibility areas.

Major forest regeneration harvest cuts (see Silvicultural Systems and Cutting Methods) will be dispersed throughout the forest in stands averaging 10 and no larger than 25 acres. Temporary clearings created by timber harvesting will be kept to 5 acres or less. Scheduling several small regeneration cuts in a different forest compartment each year will sufficiently mitigate any adverse visual impact.

In addition to major regeneration cuttings, thinnings, and similar light selective tree removals are planned. Thinnings may improve aesthetics along roads, trails and similar rights-of-ways. Wildflowers are prone to invade the margins of woodlands where the tree canopy is opened up a bit. In some instances, the increased lighting itself improves the aesthetic value of the forest by highlighting the beauty of individual trees.

Wildlife

Most game and nongame species of wildlife should benefit from implementation of this Plan. Although not by itself a substitute for specific wildlife habitat manipulation techniques, forest management will promote a varied and sustained yield of wildlife. Selective timber removals over the next ten years will improve wildlife management options and availability of natural food and cover for resident wildlife populations.

Sustained yield forestry will require major regeneration cutting on a small total area annually. Over time, this relatively conservative forest regeneration program will produce a forest composed of an equal proportion of stands in each age class while maintaining the integrity and spatial arrangement of the present forest

¹Because increasing use demands upon limited forest lands cannot be met without the coordination of uses on specific areas, foresters have developed and applied multiple use. Multiple use is a strategy of deliberate land management for two or more purposes which utilizes, without impairment, the capabilities of the land to meet different demands simultaneously. Properly implemented, multiple use sustains production and avoids environmental deterioration. The multiple-use strategy is applied to forest lands to make effective use of capabilities of diverse portions of a forest to meet current and projected use demands". (Society of American Foresters, 1973)

types. Regenerating the forest on a stand by stand basis within the regulatory framework of the Plan will foster wildlife habitat diversity and "edge".

Thinnings, similar light selective tree removals and prescribed burning pine stands increase the abundance and growth of annual forage and perennial browse vegetation. In stands of 40-60 year old oak, thinning has been proven to increase acorn production by 39 percent (Shaw, 1971) while simultaneously increasing sawtimber production. If prescribed burning is infeasible in some pine plantings, mechanical control of honeysuckle vines is needed to prevent serious damage to trees. While the benefit to wildlife of mechanical vine control is less than prescribed burning, the new honeysuckle sprouts increase browse supply.

Recreation

It is understood that recreational use of the forest will receive attention to other uses of the Station's woodlands. The annual forest management action plans (Forestry Annual Incremental Plans) will be developed with recreational interests in mind and be subject to station approval prior to implementation.

Noise Control

Information on the noise attenuation value of forest vegetation is very general. Most research reports on this subject are controversial at best. No satisfactory techniques are available for quantifying the noise attenuation characteristics of forest. It is known that sound attenuation of a forest "barrier" is not linear. A given width of forest close to the noise sources is more effective than the same width farther away. Also, loosely packed grass or litter-covered soils absorb a large proportion of incident sound.

While serving to mitigate the visual impact of timber harvesting, 75-foot reserve strips will help buffer noise produced by aircraft. The reserve strips will be managed on an individual tree basis. This will foster good vertical continuity of vegetation from forest floor to tree top level. As single sawtimber size trees are removed, tree, shrub, and vine seedlings will fill the void in the horizontal plane and gradually progress through the vertical plane.

Forest regeneration cutting throughout the forest will create a mosaic of stands at various stages of development (seedling through sawtimber). Eventually each stage will be equally represented in an area. If a particular forest type, age class or other condition class is found to be particularly well-suited for noise control purposes, Dahlgren will have at least a fair representation.

Cooperation

There are numerous documented examples of the multiple benefits of wise forest management. The direction in this plan is amply broad and flexible to allow for the beneficial management of timber, wildlife, aesthetics, and other forest resources. In order for the plan to work, the main requirement will be cooperation between the various individuals responsible for the management of the Station's forestland. Formulation and approval of Forestry Annual Incremental Plans will require some

give and take between responsible individuals. Implementation of this Plan will produce a net gain for all forest resources across the board.

FORESTLAND ZONES

Security/Safety Zone

Forestland adjacent to, and in many cases surrounding, restricted access facilities serves as insulation. The existing cover (Table 1) may be desired to partially conceal the facility or contain an explosion. Some areas are off-limits to most activities because of probable contamination by unexploded ordnance or to reduce the risk of fire.

Where safety to personnel is not a factor, management will be directed towards maintaining existing vegetation to the extent possible. Where biotic factors threaten the well-being or survival of the tree community, appropriate silvicultural prescriptions (e.g., tree removals) will be proposed and approved by the Station PWO prior to implementation.

TABLE 1. GENERAL FOREST COVER TYPE ACREAGE,¹
NSWC, DAHLGREN, VIRGINIA

Forest Cover Type	Main Site Subtotal (Acres)	Pumpkin Neck Subtotal (Acres)	Forest Type Totals (Acres)	Percent of Forest Acreage
Pine	370.8	367.9	738.7	40.4
Pine-Hardwood	175.8	230.0	405.8	22.2
Hardwood	320.9	363.5	684.4	37.4
TOTALS	867.5	961.4	1828.9	100.0

¹Excludes swamp hardwoods at Pumpkin Neck and small isolated groups of trees.

These general forest cover types have been further subdivided into three size categories (1) seedling/sapling, (2) poletimber (tree generally less than 12" diameter at breast height), and sawtimber (trees generally 12" or greater (dbh) in the following discussion. Appendices A through K provide more detailed numerical and verbal descriptions of each forest cover type discussed below.

Forest Recreation Zone

This zone includes areas set aside exclusively for recreational use. Other activities/uses including most timber and wildlife management practices will be excluded. Much of the station's forestland is ecologically well-suited for recreational use. However, few areas devoted solely to recreational uses are needed. Such sites (i.e., camping, picnic, field archery areas, etc.) are shown on Figure 2 as the Forest Recreation Zone.

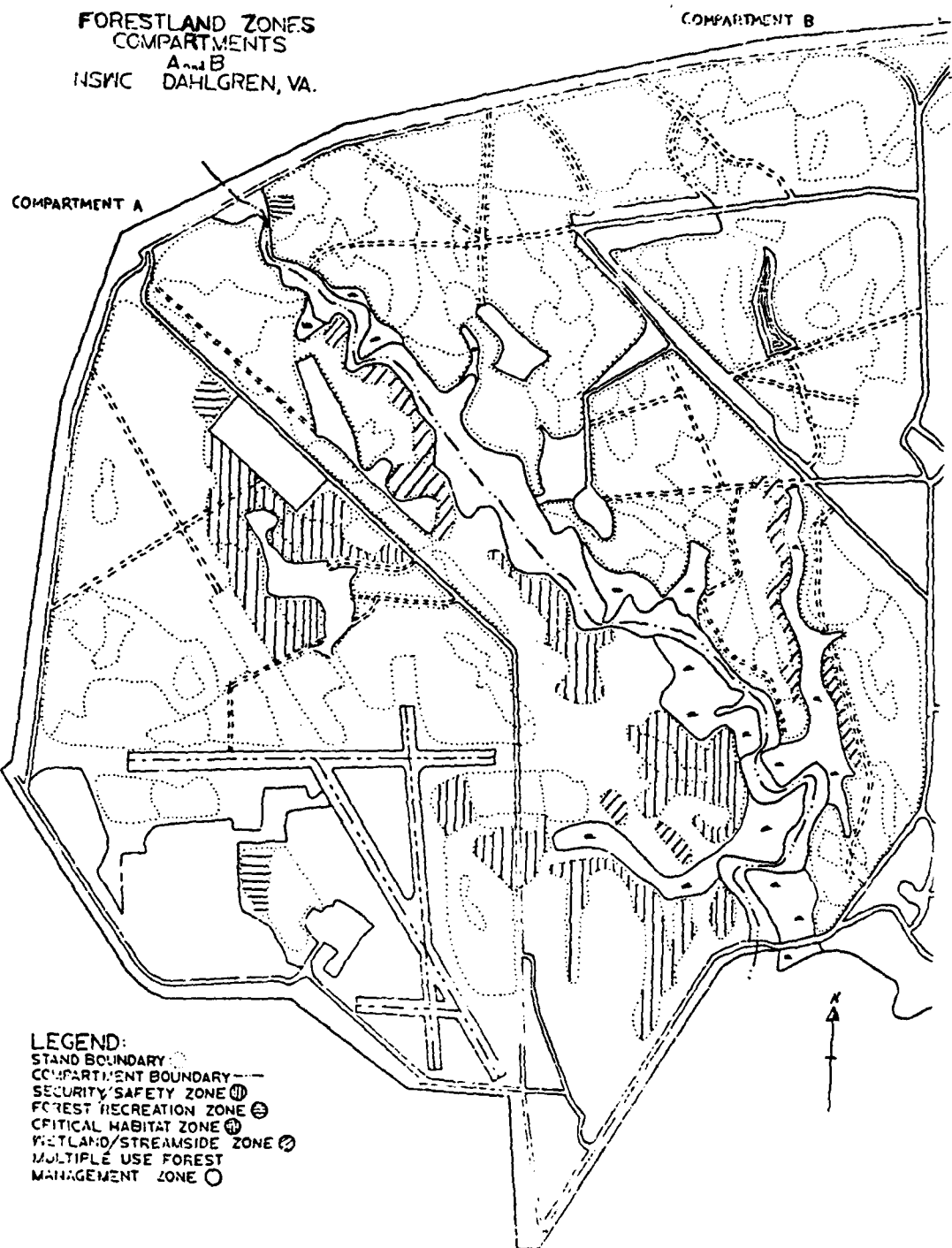


FIGURE 2. FORESTLAND ZONES (A AND B) (Sheet 1 of 2)

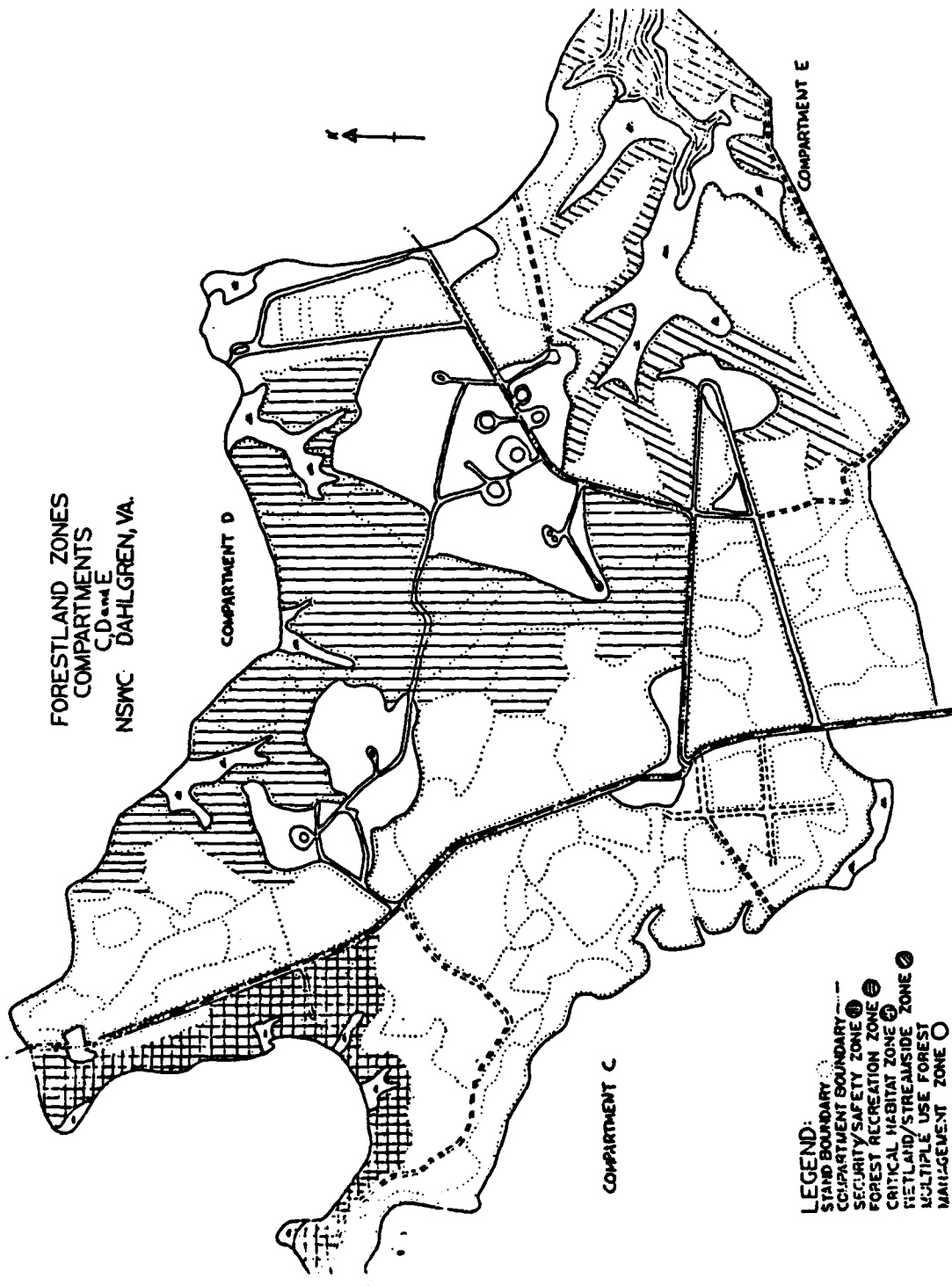


FIGURE 2. FORESTLAND ZONES (C, D, and E) (Sheet 2 of 2)

Maintenance of areas within this zone will include actions necessary to keep the tree canopy and understory vegetation healthy, prevent soil erosion, and preserve aesthetic values. Whereas selective tree removals may occasionally be necessary, regular, periodic timber harvesting is not planned or anticipated.

Hunting, fishing, jogging, hiking, birding, nature observations, etc. do not normally require exclusion of other forestry activities. Most of the forestland suitable for these forms of recreation is within the Multiple Use Forest Management Zone. Moderately intensive timber and wildlife management are compatible with these activities. Management recommendations for the Multiple Use Forest Management Zone reflect special consideration for recreational use. Minimal short term interference with recreational activities will be offset by long term gains for forest recreation. The dispersed, cyclic, and small nature of most forestry activities will ensure a minimal impact on recreational use of the forest.

Critical Habitat (Endangered/Threatened Species) Zone

Primary responsibility in these areas is to maintain or improve the ecosystem for the endangered/threatened species. This responsibility includes minimizing human interference with the protected species. At present, the endangered American bald eagle is known to nest on the Station. Critical habitat has been delineated and a management plan has been tentatively approved by member of the Chesapeake Bay Eagle Recovery Team. No regular, periodic timber harvesting is proposed for the critical habitat. However, to perpetuate the preferred nesting and perching trees of the eagle, selective cutting may be necessary at infrequent intervals. The management plan for the bald eagle critical habitat is in Appendix I.

Wetlands/Streamside Protection Zone

This zone requires management to ensure minimal disturbance. Generally, logging will be excluded from wetland areas. Management objectives are to (1) prevent erosion and subsequent sedimentation of streams, (2) protect the soil structure and hydrological functioning and (3) preserve the nesting habitat of waterfowl, shorebirds and other birds indigenous to wetland areas.

In addition to the areas delineated on the map (Figure 2) reserve strips of trees will be left along all streams and ponds. Generally, (but not always!) only selective cutting will be recommended within 100 feet of surface waters. Width of the reserve strip will vary according to site characteristics. Nest trees will be maintained at all costs.

Multiple Use Forest Management Zone

This is the largest of forested zones. Although timber and wildlife production are major management objectives, other forest uses are not precluded. As discussed in the Multiple Use section, moderately intensive forest management will provide the largest sum of social, economic, and spiritual benefits.

In addition to an increase in both timber and wildlife productivity, maintenance of the forest in a healthy, ecologically resilient condition is of paramount concern. Maintenance of species diversity and age class distribution between small stands of trees via timber harvesting as proposed in this Plan will ensure the well-being of the forest ecosystem.

FORM OF MANAGEMENT, ROTATION AND FOREST REGULATION PLAN

Form of Management

At the forest level, management will appear to be uneven-aged. Under the proposed regulation cutting schedule, the forest will remain a mosaic of many small intermingled, even-aged stands. All age classes will have equal representation on an area basis and be dispersed throughout the forest. The age differences will be between small groups of trees rather than between individual trees.

Rotation

Average rotation ages of 75 years for hardwood and pine-hardwood are administratively, economically and biologically desirable and feasible. Management of the forest will be based on the individual characteristics of each forest stand. A healthy, productive 76+ year old stand does not have to be harvested to meet a schedule. Nor does a poorly-stocked 50 year old stand have to be maintained until age 75. The recommended rotation ages will serve as guidelines only.

Forest Regulation Plan

Eventually, careful regeneration cutting will bring about a balance between forest and stand age classes, (See Figures 3 and 4). For a sustained yield of forest resources to be practical, this is a necessity. A balanced situation will allow for a perpetual annual harvest of merchantable timber. Over the next 10 years, considerable progress towards balancing the age classes can be made by regenerating approximately 6.7 acres of pine and 21.5 acres of pine-hardwood and hardwood combined per year.

All timber harvesting will be scheduled for a different forest compartment each year. Once every 5 years the same compartment will provide the annual harvest. The annual regulation/regeneration cutting will normally be scheduled in geographically separated stands.

At present, there is a disproportionately large quantity of mature timber being maintained at the expense of young growth, (See Figures 5 and 6 and Table 2). The proposed regeneration cutting schedule will bring the forest closer to full regulation (See Figures 7 and 8 and Table 3).

It will take an average of 5 years following regeneration for a new seedling stand to develop. This 5 year lag time is accounted for in the regulation graphs (Figures 3 and 4). The regulatory rotations are simply rotation age plus 5 years.

NSWC, DAHLGREN, VIRGINIA
FOREST REGULATION GRAPH FOR PINE
1979 - 1988

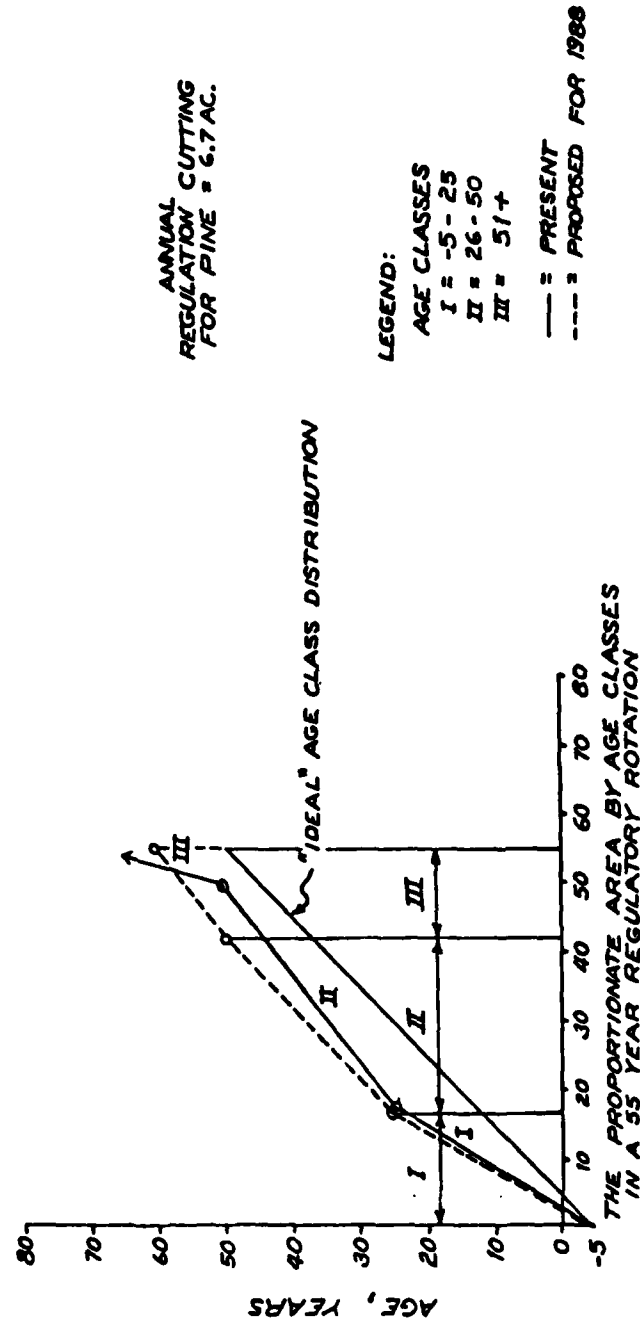


FIGURE 3. FOREST REGULATION GRAPH FOR PINE (1979-1988)

NSWC, DAHLSEN, VIRGINIA
FOREST REGULATION GRAPH FOR HARDWOOD
AND PINE-HARDWOOD
1979 - 1988

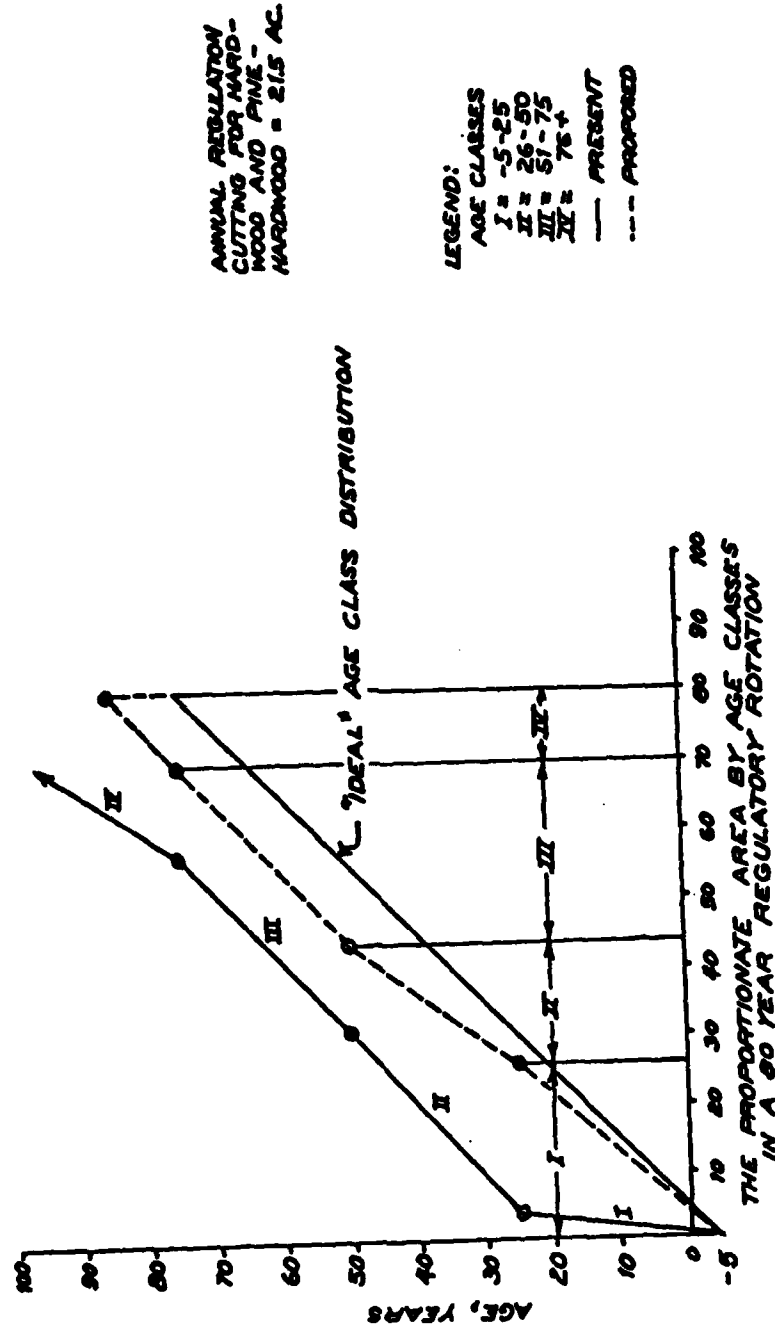


FIGURE 4. FOREST REGULATION GRAPH FOR HARDWOOD AND PINE-HARDWOOD (1979-1988)

PRESENT AGE CLASS DISTRIBUTION AND
AREA OF PINE STANDS IN THE
REGULATION PLAN

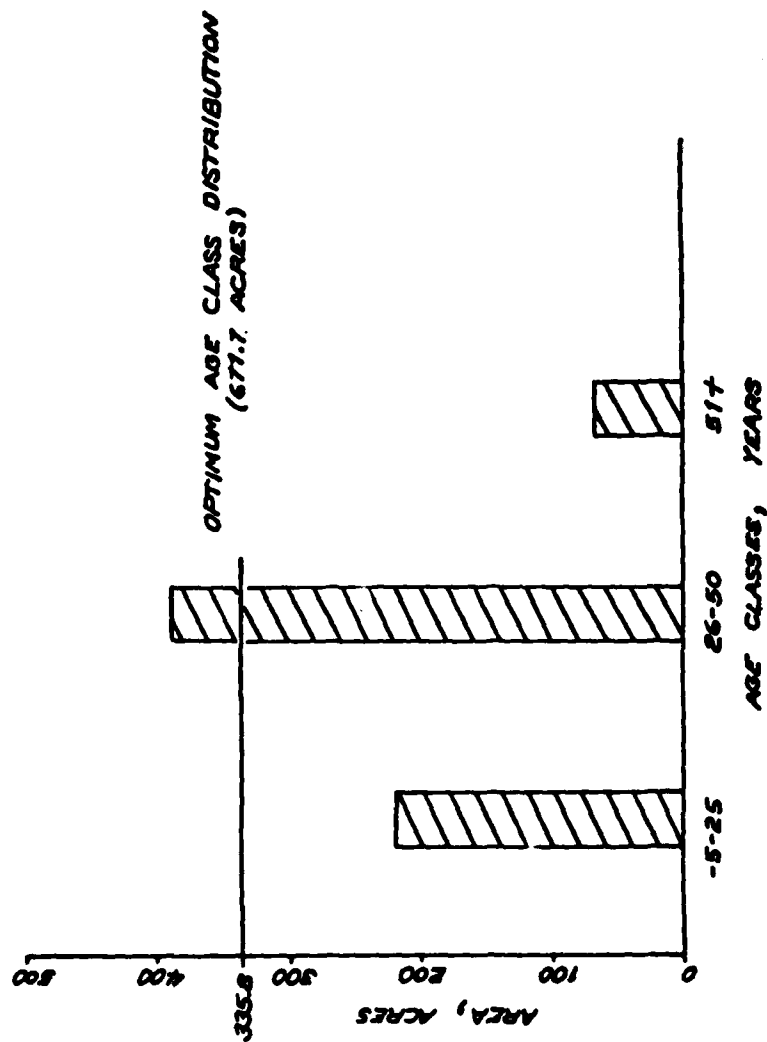


FIGURE 5. PRESENT AGE CLASS DISTRIBUTION AND AREA OF PINE STANDS
IN THE REGULATION PLAN

PRESENT AGE CLASS DISTRIBUTION AND
AREA OF HARDWOOD AND PINE-HARD-
WOOD STANDS IN THE REGULATION PLAN

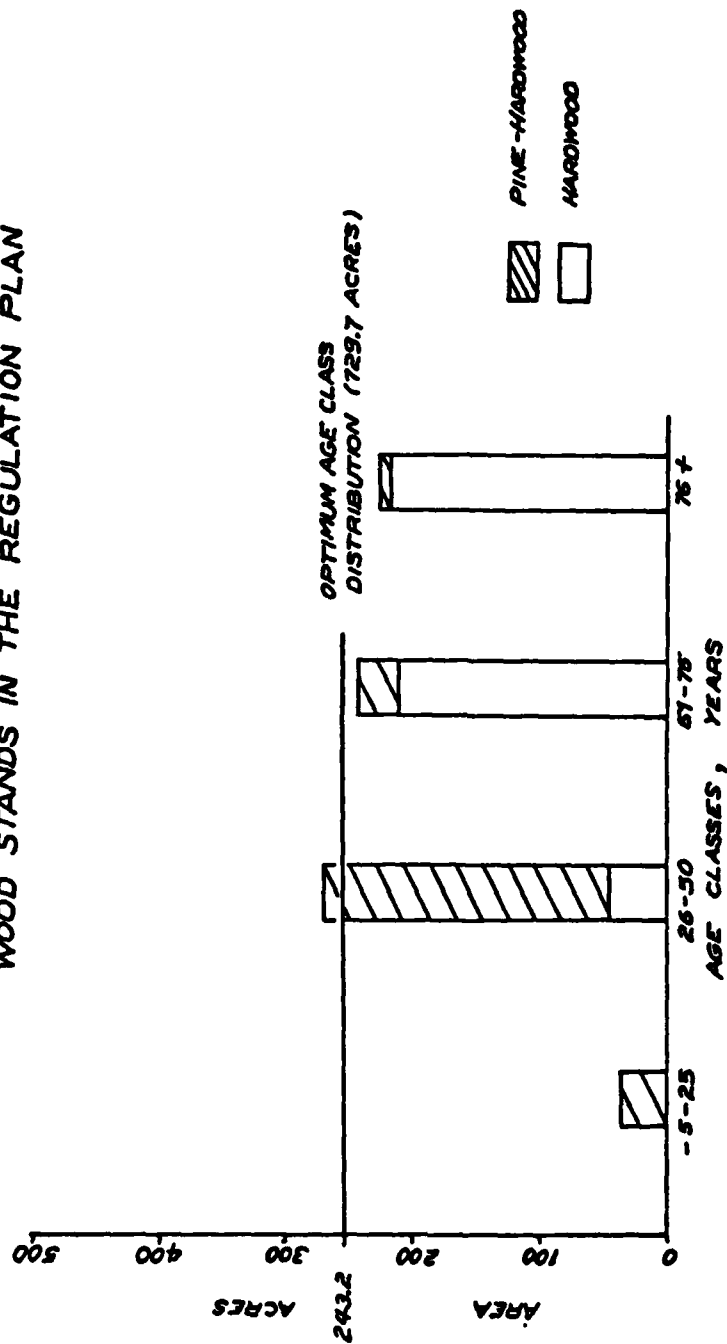


FIGURE 6. PRESENT AGE CLASS DISTRIBUTION AND AREA OF HARDWOOD AND PINE-HARDWOOD STANDS IN THE REGULATION PLAN

TABLE 2. PRESENT TOTAL ACREAGE OF FOREST COVER TYPES AND AGE CLASSES FOR STANDS WITHIN THE FOREST REGULATION PLAN

Forest Cover Type	I (-5-25)	II (26-50)	III (51-75) ¹	IV (76+)	Totals
Hardwood	0.0	43.0	203.1	210.6	456.7
Pine Hardwood	34.8	203.7	30.4	4.1	273.0
Pine	218.1	387.1	66.5	--	671.7
Totals	252.9	633.8	300.0	214.7	1401.4

¹51+ years for pineForest Regulation and Wildlife Management

To maintain sufficient acorn production and a balanced habitat for forest wildlife, no less than 50% of the combined acreages of hardwood and pine-hardwood types should be 40 or more years old. Distribution of the older hardwood stands should be fairly even throughout the forest. Where isolated or adjacent hardwood stands are scheduled for regeneration, marginal reserve strips of hardwood trees will be preserved. In addition, hardwoods along streams, wetlands, and roads will be retained to serve wildlife habitat requirements as well as to protect the watershed and aesthetic values.

No more than 215 acres of hardwood and pine-hardwood combined will be regenerated over the next 10 years. The age class distribution of the forest stands included in the regulation cutting schedule will be as shown in Figures 3, 4, 7, and 8 and Table 3. Approximately 53% of the hardwood and pine-hardwood stands will be 40+ years old in 1988 if the cutting schedule is followed.

Forest Compartments

Five forest compartments have been delineated on the enclosed maps, (See Figure 9. A forest compartment is an organization unit or small subdivision of forest area for purposes of orientation, administration, and silvicultural operations, and defined by permanent boundaries either of natural features or artificially marked (Davis, 1966). A forest compartment is composed of from one to many forest stands.

"Cutting" Cycle

Timber harvesting and most other forest operations will be scheduled on a five year cyclic basis as shown in the General Work Schedule; (1979-1988) (Table 4). For each operation/activity one compartment will be visited in sequential order every five years. Appendix E contains a timber cruise tally form and timber volume summary forms for specific silviculture prescriptions.

**FUTURE AGE CLASS DISTRIBUTION
AND AREA OF PINE STANDS IN THE
REGULATION PLAN**

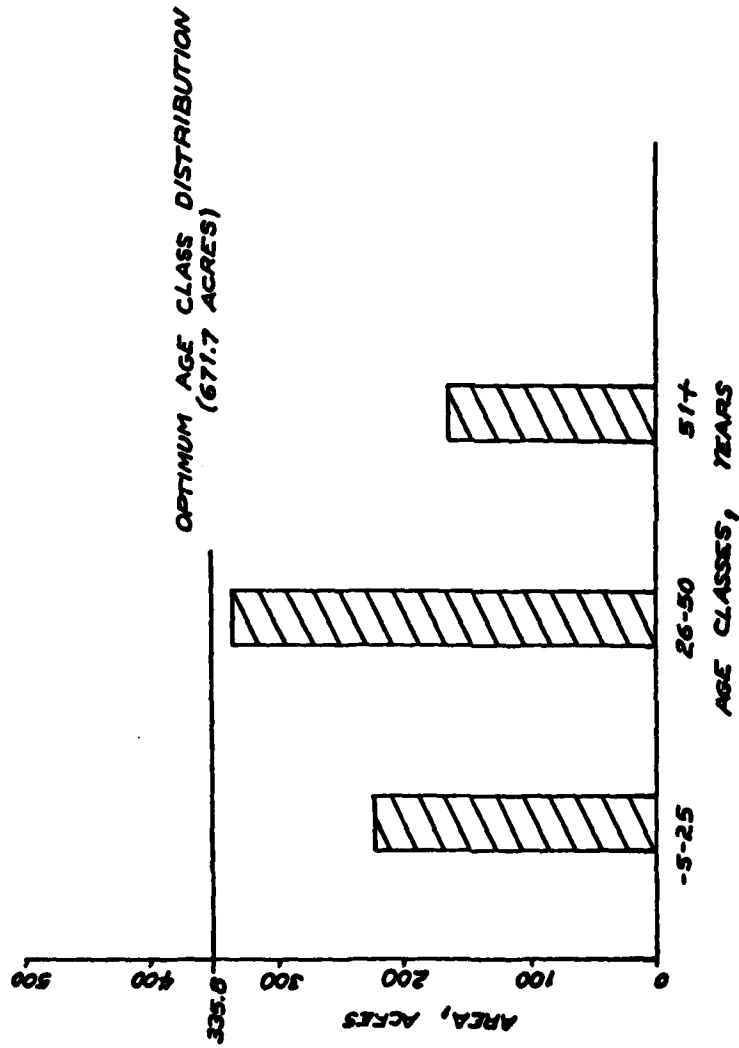


**FIGURE 7. FUTURE AGE CLASS DISTRIBUTION AND AREA OF
PINE STANDS IN THE REGULATION PLAN**

FUTURE AGE CLASS DISTRIBUTION AND
AREA OF HARDWOOD AND PINE-HARD-
WOOD STANDS IN THE REGULATION PLAN

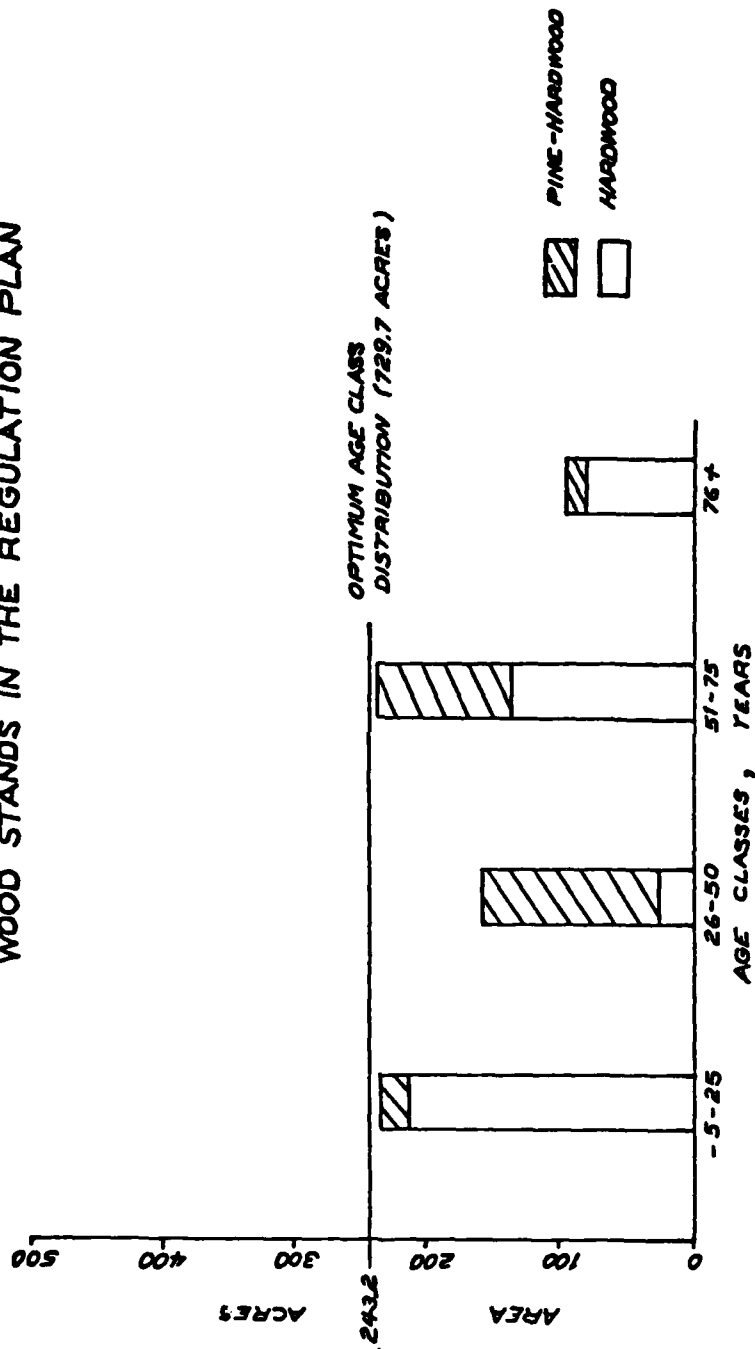


FIGURE 8. FUTURE AGE CLASS DISTRIBUTION AND AREA OF HARDWOOD AND PINE-HARDWOOD STANDS IN THE REGULATION PLAN

TABLE 3. FUTURE (1988) TOTAL ACREAGE OF FOREST COVER TYPES AND AGE CLASSES FOR STANDS WITHIN THE FOREST REGULATION¹

Forest Cover Type	I (-5-25)	II (26-50)	III (50-75) ²	IV (76+)	Totals
Hardwood	210.6	25.8	139.1	81.2	456.7
Pine-Hardwood	27.3	133.8	99.7	12.2	273.0
Pine	211.9	305.0	154.8	----	671.7
Totals	449.8	464.6	393.6	93.4	1401.4

¹Excludes reforestation of presently open areas.²51-60 years for pine.

SILVICULTURE

Silviculture has been defined as the theory and practice of controlling forest establishment, composition, and growth. To appreciate a discussion of silviculture one must have a clear understanding of the essential unit of silviculture, which is the stand. "...A stand is a contiguous group of trees sufficiently uniform in species composition, arrangement of age classes and conditions to be a homogeneous and distinguishable unit, Smith, 1962." A forester must analyze the natural and socio-economic factors bearing on each stand and then devise and conduct the treatments most appropriate to the objective of management (Smith, 1962).

The discussion below is meant to provide a general overview of pertinent silvicultural methods and their application at NSWC, Dahlgren, Va. Specific stand silvicultural prescriptions will be made in the Annual Forestry Incremental Plans.

Silvicultural Systems and Cutting Methods

"A silvicultural system designates a planned program of silvicultural treatment during the whole life of a stand; it includes not only the reproduction cuttings¹ but any intermediate cuttings². The reproduction methods employed have such a decisive influence on the form and treatment of the stand that the name of the method is commonly applied to the silvicultural system... Smith, 1962". In previously unmanaged, older stands, the reproduction cuttings are even more important and are for all practical purposes, the system. As used in this plan, silvicultural systems, reproduction cuttings and regeneration cuttings are synonymous terms. The reproduction cutting methods are discussed first, followed by brief descriptions of the intermediate cuttings and silvicultural recommendations by forest cover type. Appendices F and H further describe and provide composite illustrations of all cutting methods discussed.

¹Reproduction cuttings--Timber harvests with two purposes; (1) to remove old trees and (2) to create environmental conditions favorable for establishing reproduction.

²Intermediate cuttings--Various cuttings made during the development from the reproduction state to maturity of the forest stand. Somewhat analogous to weeding and thinning in a vegetable garden.

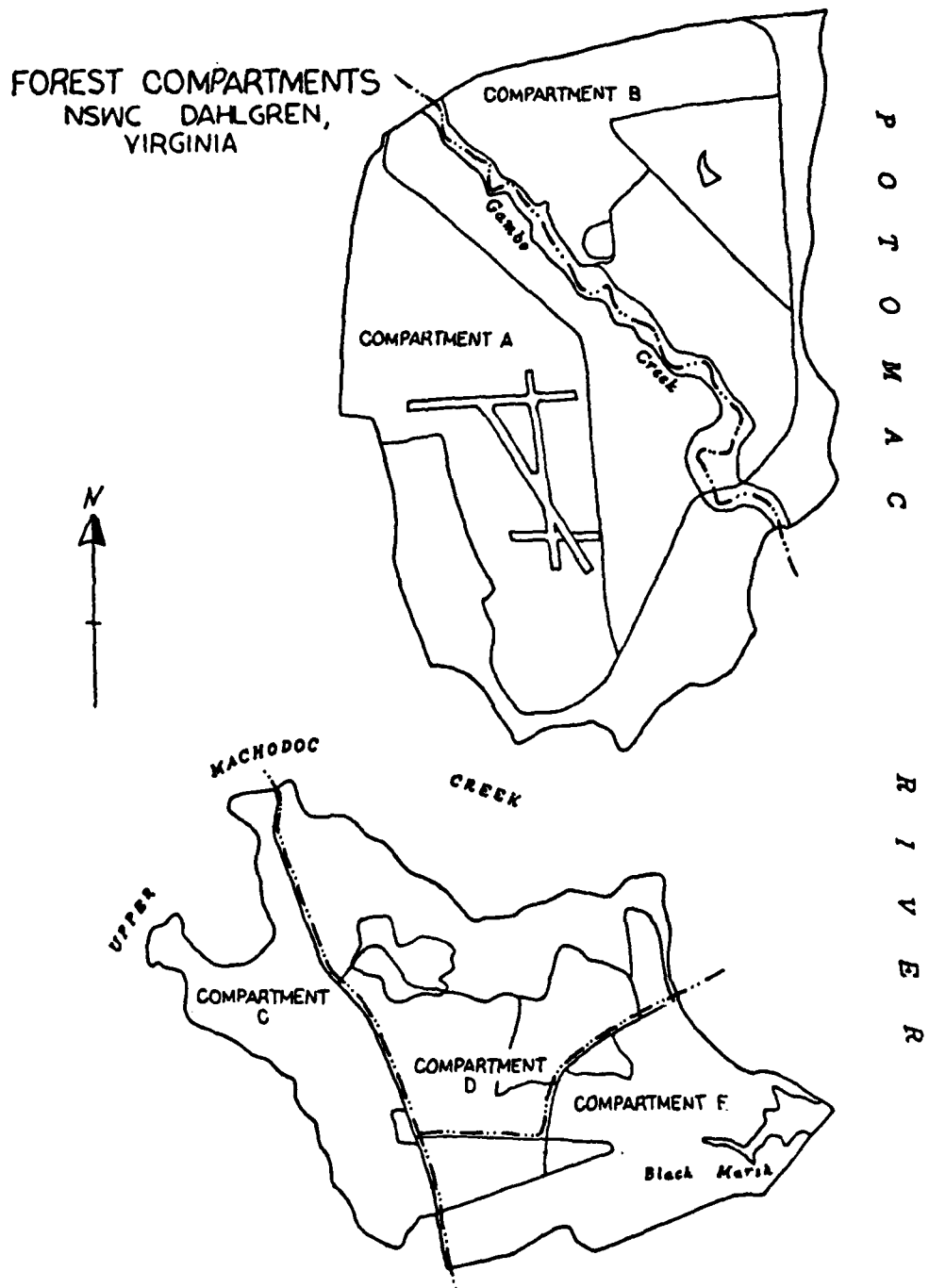


FIGURE 9. FOREST COMPARTMENTS NSWC DAHLGREN, VIRGINIA

TABLE 4. GENERAL WORK SCHEDULE (1979-1988)

Forest Operation Activity	Compartment Schedule									
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1. Timber Harvest	A	C	B	D	E	A	C	B	D	E
2. Timber Stand Improvement	C	A	E	B	D	E	A	C	B	D
3. Site Preparation	-	A	C	B	D	E	A	C	B	D
4. Access Road/Firebreak Work	-	B	D	E	A	C	B	D	E	A
5. Prescribe Burning	B	A	E	C	D	B	A	E	C	D
6. Cruise/Mark Timber	C	B	D	E	A	C	B	D	E	A

Shelterwood System. The shelterwood system is practical in stands that are sufficiently stocked with merchantable timber to support two major timber removals within a 5 to 10-year period. Between 30 and 70 percent of the original stand basal area is removed in the first cutting. The remaining shelterwood of trees is removed soon after adequate regeneration becomes established. The first cutting, called the seed cutting, is to open up enough vacant growing space in a single operation to allow the establishment of reproduction. The second shelterwood cutting, called the removal or final cutting, is to uncover or release the new crop of trees that has become established under the shelter or overwood.

Patch Cutting System. The patch or clearcutting system involves cutting all trees in small 1/2 to 5-acre patches. This system generally favors shade-intolerant pine and hardwood. Yet this system will work equally well in regenerating shade-tolerant species such as oak that require advance reproduction. When there is sufficient stocking of shade-tolerant seedlings, the overstory trees may be removed at once to release the young growth. In addition to creating favorable growth conditions for the seedlings in the cut area, patch cutting may improve environmental conditions for regeneration in surrounding areas. In areas with dense shrub layers, patch cutting may aid the growth of the shrubs at the expense of tree reproduction. In such instances, site preparation will be necessary to ensure adequate stocking and development of the seedling stand.

Seed Tree System. Seed tree cutting is ideal for areas requiring site preparation and species that are adapted to "seeding in" following major disturbance. Some pine stands on the Station will require this regeneration method.

Four to six "genetically" superior seed trees per acre are left after the first cut. The seed trees may be harvested at any time after adequate reproduction is established. However, if removal is delayed too long (5 or more years) damage to the new seedling stand may be unacceptably high.

Silvicultural systems ultimately require removal of the majority of all overstory trees to make room for the new growth. However, recognized den or nest trees and occasionally prolific mast producers may be reserved indefinitely. At least 4 large trees per acre will be left indefinitely in stands adjacent to bald eagle habitat.

Thinnings. Thinnings are intermediate cuttings "... made in immature stands in order to stimulate the growth of the trees that remain and to increase the total yield of useful material from the stand...Smith, 1962." More specific recommendations for these cuttings are made by forest cover types.

Improvement Cuttings. "Improvement cuttings are made in stands past the sapling stage for the purpose of improving composition and quality by removing trees of undesirable species, form, or condition from the main canopy-Smith, 1962". General recommendations for these cuttings are made by forest cover types in the following section.

Silvicultural Recommendations by Forest Cover Types

Pine. The Station's soils and high water tables favor optimum growth and development of loblolly pine. With timely thinnings and improvement cuttings,

sawtimber crops at 50 years are possible. A 50 year rotation will improve pin regeneration chances and keep hardwood sprout and brush competition to a minimum. Refer to Table 5 for a brief description of pine cover types.

TABLE 5. PINE COVER TYPES

		Basal Area (BA) and Number of Trees (#) Per Acre						Dominant Tree Species
		Acceptable Growing Stock ¹		Undesirable Growing Stock ²				
Size Class	Acreage	Average Tree Diameter (Inches)						
			BA	#	BA	#		
Seedling/ Sapling (P-1)	31.0	--	--	--	--	--	Loblolly and Va. Pine	
Poletimber (P-2)	471.8	7.2	111.1	344	13.6	102	Loblolly and Va. Pine	
Sawtimber (P-3)	235.9	8.0	99.3	143	31.9	232	Loblolly and Va. Pine	

¹Acceptable Growing Stock--Trees of good form, quality and species that would be satisfactory crop trees or have the potential of yielding merchantable products in a future intermediate cutting.

²Undesirable Growing Stock (UGS)--Trees that are salable for products or might eventually be salable if left to grow, but because of form, defect, vigor or species, are not wanted in the stand. UGS as used here includes cull trees (trees that are not or never will be salable).

Correctly timed initial thinnings in natural and particularly planted pine poletimber stands are essential. Individual pine tree growth and response to the improved growing conditons created by thinning begins to decline between ages 20 and 30. Initial thinning to 70-80 square feet of basal area per acre is recommended between ages 20 and 25.

If early thinning is not possible, later initial cuttings must be very carefully planned to avoid "opening up" the stand too much. All subsequent thinnings will be at 10-year intervals. Residual stand basal area will be allowed to gradually increase to 90 square feet by age 50.

Prescribed burning and/or mechanical vine control is needed in the planted pine stands. Honeysuckle vines threaten to smother large sections of the Station's pine plantations. Prescribed burning has the added advantages of reducing hardwood understory brush and accumulated dead pine needles, but effective vine control may require labor-intensive practices, like cutting each honeysuckle stem with a tool such as a machete. A complete plan for prescribed burning is included in the Fish and Wildlife Management Plan.

At present, the pine sawtimber stands are growing at less than optimum rates. Cull trees and hardwoods of dubious merchantability account for over a third of the present average basal area of 131 square feet. In previously unthinned stands, thinnings and improvement cuttings will reduce basal area to between 85 and 95 square feet. Only dominant and codominant pine and occasional hardwood trees will be left. Restraint must be exercised so as not to create large gaps in spacing between trees.

Shelterwood or seed tree cuttings are recommended for the 45 to 55 year-old pine stands to promote natural regeneration. Shelterwood cuttings will remove from 1/3 to 2/3 of stand basal area. Seed tree cuttings are recommended where; (1) growth has stagnated, (2) mechanical site preparation for regeneration is necessary, (3) windthrow potential is high or (4) Virginia pine accounts for a large percentage of stand basal area. Four to eight seed trees per acre are advised. For both shelterwood and seed tree systems prescribed burning is recommended to ensure pine reproduction and to reduce undesirable hardwood and brush competition.

Pine-Hardwood. Theoretically, mixtures of pine and hardwood are manageable on 75-year rotations. Early thinnings and improvement cuttings are necessary. If markets don't exist for small hardwoods or there isn't enough pine to economically justify commercial harvest, management is more challenging. See Table 6 for the pine-hardwood cover types.

TABLE 6. PINE-HARDWOOD COVER TYPES

		Basal Area (BA) and Number of Trees (#) Per Acre						
		Average Tree Diameter (Inches)		Acceptable Growing Stock		Undesirable Growing Stock		Dominant Tree Species
Size Class	Acreage			BA	#	BA	#	
Seedling/ Sapling (PH-1)	36.3	--	--	--	--	--	--	Loblolly and Va. Pine, Red Oak, Sweetgum
Poletimber (PH-2)	255.4	6.6	107.5	281	15.0	231		Loblolly and Va. Pine, Red Oak, Sweetgum
Sawtimber (PH-3)	114.1	6.6	102.3	170	33.3	401		Loblolly and Va. Pine, Red Oak, Sweetgum

Thinnings will begin between 20 and 30 years and continue at 10-year intervals. Residual basal areas will be similar to those recommended for pine poletimber stands. Management recommendations will vary considerably from stand to stand. If markets are nonexistent for hardwoods, selective tree killing may be the most practical means of boosting further productivity of pine-hardwood poletimber stands.

Of all stands on the Station, the older pine-hardwood sawtimber stands show the most obvious signs of benign neglect. Improving the spacing between crop trees will increase sawtimber growth and mast productivity. However, care must be taken not to release undesirable shrubs and small trees where they exist as an understory. Allowing this growth and development of the understory to encourage slightly better crop tree growth does not warrant the much higher costs of establishing desirable regeneration at the end of the rotation.

Patch and seed tree cuttings are recommended in stands with dense woody understory vegetation. Mechanical site preparation may be necessary in some instances. Individual tree killing may be more suitable where the understory consists of suppressed or otherwise undesirable trees rather than brush.

Hardwood. Most hardwood stands containing commercial timber are either predominantly yellow poplar or oak. (See Table 7) Final silvicultural prescriptions must be made on a stand-by-stand basis.

TABLE 7. HARDWOOD COVER TYPES

Size Class	Acreage	Average Tree Diameter (Inches)	Basal Area (BA) and Number of Trees (#) Per Acre				Dominant Tree Species
			Acceptable		Undesirable		
			Growing Stock ¹		Growing Stock ²		
			BA	#	BA	#	
Seedling/ Sapling (H-1)	0.0	--	--	--	--	--	--
Poletimber (H-2)	173.6	8.5	60.0	172	10.0	6	Red Oak, Sweetgum, Yellow Poplar, and Red Maple
Sawtimber (H-3)	510.8	8.1	104.8	150	21.4	199	Yellow Poplar, White and Red Oak, and Sweetgum

Hardwood stands dominated by yellow poplar will be thinned as early as 30 years and at 10-year intervals thereafter. Early initial thinnings give better results. Combined thinning and improvement cutting will reduce basal area to within 80 to 90 square feet per acre. Heavy thinning encourages maximum large tree development.

Stands dominated by oak will be thinned as early as 40 years if markets for the thinnings exist. Timber stand improvement (TSI) work in exceptionally promising oak stands may be warranted at an earlier age. TSI consists of selectively killing trees which interfere with the growth and development of the best potential crop trees.

In previously unthinned stands older than 40 years, thinning must not reduce stocking below 70 percent or make large holes in the stands. Subsequent cuttings may reduce stocking to 60 percent. If an oak stand is initially 60 to 80 percent stocked with little or no advance reproduction, thinning is not recommended. The dense understory brush commonly associated with fairly open oak overstories must not be encouraged by further reduction of the overstory. In situations such as this, a decision must be made to either harvest all merchantable timber and prepare the site for regeneration immediately or delay any action until a later date.

Normally, patch or shelterwood cuttings are recommended to regenerate yellow poplar and oak. In stands where oak reproduction is desired, a survey should be made to determine the adequacy of advance regeneration before deciding on the cutting method. (See Appendix G) In view of the difficulty of creating ideal conditions for oak reproduction, a mixture of species is the goal.

Timber Removals in Silvicultural Operations

Table 8 illustrates the approximate amounts of merchantable timber that may be removed from forest stands if silvicultural prescriptions based on the preceding recommendations are applied. The table features average values based on hypothetical stand data. The hypothetical data consist of per acre summaries of average forest type parameters (i.e., number of trees, size, species) from the computer-generated Forest Inventory Report. Cutting volumes for actual stands will vary considerably plus or minus from these amounts. The table is included solely to provide an idea of potential harvests.

TABLE 8. HYPOTHETICAL PER ACRE TIMBER HARVEST VOLUMES
BY FOREST COVER TYPE

Forest Cover Type	Cutting Methods	Pine		Hardwood		Fuel- wood (Cunits)
		Saw- timber (MBF)	Pulp- wood (Cunits)	Saw- timber (MBF)	Pulp- wood (Cunits)	
Pine	Thinning	--	7.5	--	--	--
Poletimber	Regeneration	1.2	18.6	--	--	--
Pine	Thinning/Improvement	--	5.7	--	--	--
Sawtimber	Regeneration	3.5	7.7	--	--	--
Pine- Hardwood	Thinning/Improvement	--	--	--	--	2.0
Poletimber	Regeneration	--	(Nothing)	(Nothing)	--	--
Pine- Hardwood	Thinning/Improvement	1.3	3.6	--	--	2.2
Sawtimber	Regeneration	1.3	4.4	1.7	--	2.2
Hardwood	Thinning/Improvement	--	(Nothing)	(Nothing)	--	--
Poletimber	Regeneration	--	--	--	5.7	3.6
Hardwood	Thinning/Improvement	--	--	--	1.4	3.8
Sawtimber	Regeneration	--	--	4.2	1.4	6.2

PRESENT TIMBER VOLUMES, 10-YEAR PROJECTED GROWTH, 10-YEAR PROJECTED
REGULATION CUTTING VOLUMES AND FUTURE TIMBER VOLUMES

Tables 9-13 are from the CHESDIV Forest Inventory Report for NSWC, Dahlgren, Va.

TABLE 9. TIMBER VOLUMES¹ FOR NSWC MAINSIDE AND PUMPKIN
NECK ANNEX, DAHLGREN, VIRGINIA 1978

<u>Species</u>	<u>Sawtimber</u>	<u>Roundwood²</u>
Pine	3,372 MBF ³	13,695 Cunits ⁴
Hardwood	4,527 MBF	9,059 Cunits
Totals:	7,899 MBF or 12,797 Cunits	22,754 Cunits or 26,769 Cords ⁵
	39,566 Cunits	

¹Timber volumes = Gross timber volumes; unseen, unsound wood may be 20% or more of the volumes given.

²Roundwood = All merchantable timber except sawtimber.

³MBF = 1,000 board feet

⁴Cunit = 100 cubic feet of solid wood

⁵Cord = 85 cubic feet of solid wood

TABLE 10. GROSS¹ PROJECTED 10-YEAR TIMBER GROWTH 1979-1988,
NSWC, DAHLGREN, VIRGINIA

<u>Product</u>	<u>10-Year Growth</u>	<u>Annual Growth Rate %</u>
Sawtimber	5,298 MBF	6.7
Roundwood	9,854 Cunits or 11,593 Cords	4.3
TOTAL	17,911 Cunits	4.5

¹Includes ingrowth (the volume of pulp, or roundwood trees expected to grow into the sawtimber size category/class during the next 10 years), does not include a mortality deduction and assumes present type-age class composition.

TABLE 11. PROJECTED REGULATION CUTTING¹ TIMBER HARVEST VOLUMES
FOR 1979-1988, NSWC, DAHLGREN, VIRGINIA

<u>Product</u>	<u>10-Year Cut Volumes</u>
Sawtimber	3,107 MBF
Roundwood	3,349 Cunits or 3,940 Cords
TOTAL	9,513 Cunits

¹Includes 210.6 acres of hardwood, 4.1 acres of pine-hardwood and 66.5 acres of pine to be finally harvested in accordance with the forest regulation plan over the next 10 years. Intermediate cutting amounts are not included.

TABLE 12. FUTURE TIMBER VOLUMES¹ FOR NSWC,
DAHLGREN, VIRGINIA 1988

<u>Product</u>	<u>1988 Timber Volumes</u>
Sawtimber	10,090 MBF
Roundwood	29,259 Cunits or 34,422 Cords
TOTAL	47,964 Cunits

¹Future Timber Volumes = Table 9 (1978 Volumes) + Table 10 (10-year Growth) - Table 11 (10 Year Regulation Cutting Volumes). Intermediate cutting volumes were ignored in determining the values in Tables 10, 11, and 12. Intermediate cuttings remove trees that would normally die or fail to grow merchantable timber. The space created by their removal contributes to increased growth of adjacent trees, which offsets the small reduction in volume. Therefore, the net effect of such cuttings on future volumes is negligible.

TABLE 13. PRESENT ACREAGE, VOLUMES AND 10-YEAR GROWTH FOR FOREST COVER TYPE 1978

Forest Cover Type	Sawtimber				Roundwood				Total Cubic Wood			
	Acres	Volume (MBF)		Annual Growth Rate %	Volume (Cunits) Pine	Volume (Cunits) Hardwood	Cunits	Annual Growth Rate %	Volume (Cunits)	Volume (Cunits)	Annual Growth Rate %	
		Pine	Hardwood									
Pine Seed- ling/Sap- ling	31.0	0.0	0.0	----	0.0	0.0	----	----	0.0	0.0	----	----
Pine Pole- timber	471.8	580.2	0.0	1746.4	30.1	8762.4	625.2	4578.4	4.9	10785.2	6513.6	6.0
Pine Saw- timber	235.9	1632.4	135.4	802.1	4.5	1817.7	547.1	896.4	3.8	5848.0	2311.8	4.0
Pine Hard- wood Seed- ling Sap- ling	36.3	0.0	0.0	----	0.0	0.0	----	----	0.0	0.0	----	----
Pine-Hard- wood Pole- timber	255.4	304.2	188.0	689.6	14.0	2126.1	1997.1	1736.7	4.2	5468.1	2732.8	5.0
Pine-Hard- wood Saw- timber	114.1	624.3	338.1	253.0	2.6	510.2	394.8	414.0	4.6	2750.8	885.5	3.2
Hardwood Seedling Sapling	0.0	0.0	0.0	----	0.0	0.0	----	----	0.0	0.0	----	----
Hardwood Poletimber	173.6	0.0	107.5	121.5	11.3	0.0	1625.4	798.6	4.9	2031.1	972.2	4.8
Hardwood Sawtimber	510.8	231.0	3757.0	1685.6	4.2	479.0	3869.0	1430.2	3.3	12683.2	4495.0	3.5
TOTALS:	1828.9	3372.1	4526.7	5298.2	6.7	13695.4	9058.3	9854.3	4.3	39566.4	17910.9	4.5

FIRE PROTECTION

The present network of hard surface, gravel, and dirt roads, firebreaks, lanes and trails is adequate for fire access/control. Periodic maintenance will require grading or discing woods roads and firebreaks and repair of culverts and other water diversion systems. Access for four-wheel drive vehicles should be maintained on all present roads and firebreaks.

Management of firebreaks and lanes for wildlife is compatible with the objective of maintaining fire access.

Implementation of this Plan will help to maintain a reduced wildfire hazard. Prescribed burning will reduce the highly volatile litter layers in pine stands. Timber harvesting will interrupt the fuel continuity that presently exists between stands of similar size and understory conditions. Temporary log skid trails through the woods provide additional short term fire access and break the forest ground fuel continuity.

INSECT AND DISEASE CONTROL

INDIRECT CONTROL

Indirect control of native forest insect and disease pests through silvicultural practices is advised. Diversification of species and age classes by and within forest type and the maintenance of vigorously growing trees/stands by timely timber harvest will reduce the probability of a particular pest spreading unchecked through the forest. If indirect control is successful, the use of pesticides and the inherent potential, however remote, of disturbing the biotic balance will be obviated.

Indirect control does not imply a lax control program. Timely aggressive, silvicultural action is essential to create and maintain species and age class diversity and stimulate the vigor of the younger forest stands. Implementation of this Plan, especially the regulation and intermediate cutting recommendations will reduce the risk of depredation of forest resources by insects and disease.

In the primeval forest, diversification was maintained by natural disasters such as wildfire, wind and biotic factors. Planned regeneration cutting will do this without the loss of valuable forest products or major disruption of other activities or programs. Heavy regeneration cuts will average 10 acres in size; small enough to create a mosaic or patchwork of various age and species groupings throughout the forest over time. Different tree age classes and species are not ordinarily subject to injury by the same pests. Via planned timber harvesting, a relatively "pest proof" condition may be induced.

Thinning dense, young forest stands is recommended to maintain tree vigor. Thinning is particularly important on drier sites where severe competition for water may develop and cause growth stagnation. "Conditions in natural stands point strongly to the fact that there is no factor more important in relation to disease

than tree vigor (Boyce, 1966)." A similar correlation exists between insects and tree vigor (Graham and Knight, 1965).

Removal of individual trees that are infested, diseased, badly damaged or physiologically weak will be part of the recommended improvement cuttings. Such trees may serve as staging areas for insect attacks or infection courts for the spread of disease. It may be necessary to chemically or otherwise individually treat such trees if they are not merchantable.

DIRECT CONTROL

Direct control programs aimed at specific pests, particularly exotic species, may become necessary. Plans and recommendations for such problems may be made as needed.

REFORESTATION

Natural regeneration following logging is usually successful if site conditions are favorable and a seed supply is adequate. Artificial reforestation of logged areas is warranted only in instances where nature does not regenerate the area within 5 years.

As old fields and other open areas become available, tree planting should be considered. Generally loblolly pine is recommended for planting.

FORESTRY AND WILDLIFE MANAGEMENT

Every forest-dwelling animal has a specific set of requirements. However, their general needs are much alike. Basically each animal must have a certain variety and quantity of food and protective cover to ensure its survival. The degree to which these requirements are met will determine the diversity and density of animal populations.

The concept of diversity is illustrated by species richness or the number of different species represented in an ecosystem. Thus wildlife management is directed toward the entire community rather than the needs of individual species. Achieving a diverse wildlife population requires a planning approach that ensures vegetative variety.

Efforts will be made to improve the abundance and diversity of wildlife and thereby provide recreation for the hunter-sportsman and naturalist, by managing the Station's forest resources for complexity. Timber management practices, if planned and executed skillfully, are the most practical broad-scale forest habitat-controlling tool available to enhance wildlife habitat.

FOREST WILDLIFE

Most game and non-game forest animals do best in a diversified habitat. Well-planned, properly timed and rotated timber cuttings can best create and maintain this kind of a forest ecosystem on NSWC lands. Although forest management itself is not a substitute for specific wildlife habitat manipulation techniques, the proposals in this plan will help to enhance wildlife populations.

Woodland Game Mammals

The animal species that spend most of their time in and depend on the woodland are the white-tailed deer and gray squirrel. Both species are very popular during the hunting season. The white-tailed deer is the most important big game mammal in the East. Deer prefer the early stages of forest succession, while the gray squirrel inhabits primarily the more mature hardwood stands. The Forest Management Plan for this Station ensures that both early and later successional stages of forest will be sufficiently represented to support satisfactory populations of deer and squirrel.

White-tailed deer attain their greatest numbers in woodlands interspersed with farmland, grassy fields, and young forest stands. Timber management practices such as patch-cutting and release and improvement cuttings, not only regenerate and maintain the forest, but also benefit the deer. Patch cuttings interspersed throughout the forest will create openings which will supply deer with fresh succulent browse. Improvement cuttings to favor the best formed hardwood trees not only increases sawtimber production, but also improves mast production. When hardwood stands are thinned the best formed trees have less competition for light and soil nutrients, thus allowing their crowns to expand. As the tree canopies develop to take advantage of the newly-created space, mast production is improved and diameter growth increased, benefitting both timber production and wildlife.

Optimum gray squirrel habitat consists of mature hardwood stands with an equal representation of white and red oaks and some hickory, beech, and walnut. A mixture of oak species should be maintained to ensure an annual supply of acorns. The 75-100 year rotation age of hardwood stands plus reserve strips of hardwood trees will supply squirrels with very suitable habitat. Silvicultural recommendations as proposed in this Plan will benefit gray squirrels.

A program of frequent cuttings, systematically applied throughout the woodlands is the best guarantee of satisfactory and reasonably stable populations of white-tailed deer and gray squirrel.

Game Birds

Game birds on the Station included woodcock, turkey, dove, and quail. The American woodcock and wild turkey are forest inhabitants, while the mourning dove and bobwhite quail frequent the edges of woodlands.

The woodcock, a migratory species, and the quail both do well in habitats of early forest successional stages. The mourning dove, which prefers to feed in agricultural fields, depends on pine stands between 10-30 feet tall for nesting sites, while the wild turkey inhabits large mature open oak or oak-pine stands.

Proposed timber harvesting will ensure interspersed stages of various successional stages throughout the forest, a requirement for good game bird habitat.

Fur Bearers

The Station's woodlands provide fair to good habitat for many species of fur-bearing animals. The gray fox is the most dependent on woodlands, preferring to inhabit dense hardwood stands around swamps, while the red fox inhabits more open forest stands. Raccoons, otter, and opossum utilize the woodland areas for den sites and escape cover. Forest stands near streams and ponds provide a source of food and building materials for beaver.

Management of fur-bearers may be discouraged because of the belief that an increase in predatory fur-bearers will reduce the populations of more popular game animals. However, predator control is expensive and the conservation ethic questions whether it is justifiable to kill one species in order to artificially increase another. The best course of action is to provide adequate nesting and brood-rearing habitat to support all segments of the wildlife community.

Forest management practices such as patch cutting, and intermediate cuttings adjacent to waterways, and prescribed burning will improve the fur-bearers' habitat as well as other game and non-game species. Openings created by patch-cutting and thinning operations will encourage growth of grasses and other herbaceous growth that shelter mice and rabbits, the basic foods for carnivores like fox, mink, and weasel. Prescribed burning, especially in areas adjacent to streams, creeks, and swamps will stimulate growth of aquatic vegetation used by beaver, muskrat, and nutria.

Cavity Nesters

Cavity nesters include woodpeckers, wood ducks, owls, squirrels, raccoons, some songbirds, hawks, and vultures. These species usually make their excavations in trees previously injured by insects, disease, fire, or storm. Cavity nesters are seldom responsible for reducing the quality of forest stands. They are an important part of the forest ecosystem.

Forest regulation cutting will promote a forest consisting of many small intermingled, even-aged stands. All age classes will be equally represented on an area basis and dispersed throughout the forest. This will provide den trees of various species and sizes in addition to promoting a diverse forest ecosystem for all wildlife. Den trees and timber management are compatible.

To assure that cavity nesters have adequate nesting habitat, some trees in each compartment will be allowed to reach an age in excess of 100 years. This will be accomplished by leaving reserve strips of trees along roads, around bunker sites, and between cut-over stands. Trees in these areas will be subject to less intensive management than those in stands that will be managed for timber production, thus allowing for development and retention of usable den sites.

In addition, when trees are marked for harvest, known den trees and 3-4 potential den trees per acre will be retained.

Non-Game Wildlife

This category consists predominantly of songbirds. To enhance aesthetic values on the Station, habitat management for songbirds must be concentrated in areas that people frequent; along secondary roads, trails, streams, and especially around recreational sites. Reserve strips of trees (50-100 feet wide) will be maintained around these areas.

The key to attaining a diverse songbird population is to increase the number of niches or variations in habitat. Selection cutting and patch cutting will help. Selection cutting in the buffer strips will open up the canopy and encourage growth of vines, thickets, species with showy flowers, and nut and fruit-bearing vegetation, which are attractive to songbirds. Buffer strips will also provide nest and escape cover for birds that inhabit adjacent grassy areas. Patch cuttings dispersed throughout the Station will provide areas of early forest successional stages, which are more attractive to songbirds than forest stands with little understory vegetation.

Silvicultural recommendations as proposed in this Plan will promote vegetational complexity and variety of growth forms, which will attract songbirds with different diet and cover requirements. Birds will usually occupy newly-created habitat within one to three years.

Endangered and Threatened Wildlife

Although the basic wildlife habitat objective is to achieve a diverse ecosystem with a variety of wildlife species, there are situations when management will be directed to meet the needs of individual species. Habitat for endangered and threatened species, for example, may require certain management techniques to produce or maintain a specific plant or animal community.

Endangered species and their critical habitat will be protected in all circumstances on the Station's lands. There will be active management to foster endangered species that are indigenous to the area, such as the American bald eagle. Active management will include consideration of space for normal growth, movement, or territorial behavior; nutritional requirements; sites for breeding, reproduction, or rearing of young; cover or shelter; and other biological, physical, or behavioral requirements. A management plan for the endangered American bald eagle is at Appendix I.

At present there are no known threatened species inhabiting the Station's lands. There are however some species of birds inhabiting NSWC lands that are of special concern to the State of Virginia. These birds include the great blue heron, red-shouldered hawk, short-billed marsh wren, and the eastern bluebird. Species of special concern should be monitored because they may be rare over a relatively broad range, may become endangered due to the destruction or drastic modification of habitat, or because certain characteristics or requirements make them especially vulnerable to specific pressures. Forest Management as proposed in this Plan is compatible with threatened and endangered species protection.

SUPPORTING MANAGEMENT PRACTICES

Management practices such as brush control, hedgerow planting, and vegetative seeding are techniques that can be used to improve wildlife habitat by enhancing food and cover. Other supporting management practices include nest box programs for wood ducks and eastern bluebirds. These techniques used in conjunction with the forest management practices recommended in this Plan, will be beneficial to both game and non-game wildlife.

Vegetation Control

Thickets of pioneer woody vegetation indigenous to the area are well suited for upland wildlife food and cover, especially if maintained in strips bordering forest stands and fields. These brushy areas can be improved or maintained using mechanical methods. To maintain the desired stage of brush, annual or periodic treatments will be necessary. The best time for brush control is late July and early August. Brush should be cut as close to the ground as possible using mowers, heavy disks, bulldozers, or chain saws.

Vegetative seeding includes planting grasses, legumes, and some shrubs to provide wildlife food and cover and erosion control. The Station's firebreaks could be better suited to stop fires and enhance wildlife populations if the areas between the roadway and forest edge were disked and planted with grasses and legumes such as tall fescue and sericea lespedeza. Wildlife food plots could also be established along the fire lanes. Patches seeded with millet, buckwheat, winter wheat, corn, or a mixture of soybean, millet, and sorghum would do much to benefit game and non-game wildlife.

Artificial Nesting Structures

Some forest areas on the Station have the potential for supporting populations of wood ducks and eastern bluebirds. These species are native to the area, however, their populations have diminished in the past due to the loss of habitat and competition from exotic bird species. Population levels of these birds may be enhanced by erecting artificial nesting structures. Nest boxes must meet the biological needs of the intended user if they are to be beneficial. They must also be properly designed, situated, durable, predator-proof, and economical to maintain. Provision for the retention of den trees is part of the Forest Management Plan for the Station, however to augment this, an artificial nesting program may be implemented.

Wood duck nest boxes should be erected on posts (wood or metal) approximately 10 feet off the ground at the edge of a body of water. The wetland areas in compartments A and E are ideally suited for this. Because wood ducks do not collect nest material, a layer of sawdust or wood shavings 3 inches deep should be placed in the bottom of the box. All wood duck nesting structures should be equipped with predator guards. Wood duck nest boxes should be constructed in accordance with plans at Appendix J.

Eastern bluebird populations are low throughout most of their range due to the lack of acceptable nesting cavities and competition from starlings and house sparrows. The eastern bluebird is an edge species and is ideally suited to an artificial nesting program along with the Station's firebreaks. To reduce competition from starlings and house sparrows, bluebird nesting house should be built as specified in the plans in Appendix J. Bluebird houses placed 5-10 feet off the ground at 50-yard intervals along the Station's firebreaks will increase the bluebird populations dramatically in 3-5 years. Installation of artificial nesting structures is not worthwhile unless maintenance is carried out annually.

SOIL AND WATER CONSERVATION

Generally, professionally planned forestry operations cause minimal soil erosion--considerably less than that caused by conventional agricultural practices. Laymen are more apt to notice logging caused erosion and ignore the far greater contribution to erosion caused by agricultural operations. The relatively short-time negative impacts of timber harvesting must be viewed in light of the periodicity of major timber operations, c. 75 years, and the positive short and long-term gains realized.

Timber harvesting on steep c. 30% or greater slopes, stream bottoms and similar areas with above average erosion potential requires additional forethought and planning. However, harvesting should not be precluded automatically. There are areas where timely timber removals, generally selective in nature, will reduce present erosion/stream sediment deposition.

Selective removal of mature timber along streams generally encourages vigorous, dense regeneration of trees, shrub, vine and annual weed species. New growth more adequately protects the land from erosion than a sparse stand of old trees and a somewhat less than vigorous shrub representation.

Artificial seeding and planting of eroded trail sections and other woodland areas may be successful if environmental conditions are improved by selective timber harvesting.

REVISION OF PLAN

The Annual Forestry Incremental Plans, in effect, are annual revisions of this Plan. However, another 10-year plan will be necessary by 1988 to project long-range goals, policy and planning for another decade. Data on costs, timber harvest volumes, prescribe burning maps and wildlife maps should be kept current on the Station for historical reference in future Plans. The Annual Incremental Plans automatically become part of Appendix K.

GLOSSARY

1. Advance regeneration: Young trees that have become established naturally before the final harvest cut is made.
2. Advance reproduction: See advance regeneration.
3. Age Class: One of the intervals into which the age range of trees is divided for classification.
4. Artificial seeding: Application of forest tree seeds over an area by artificial means.
5. Basal area: The area of the cross-section of a tree stem near its base, generally at breast height and inclusive of (including) bark.
6. BAF (basal area factor): A factor computed for a wedge prism or angle gauge that gives basal area per acre when multiplied by the number of trees at a given point.
7. Biotic balance: A natural equilibrium which, on the average, prevents an organism from increasing to destructive levels.
8. Biotic factor: Interactions between organisms which contributes to the sum of environmental factors that tend to reduce the multiplication of any organism.
9. Board foot: The amount of timber equivalent to a piece of wood 1 X 1 foot and 1-inch thick.
10. Brush chopping: A form of mechanical site preparation done with specialized machinery. To aid the germination, growth, and establishment of tree seedlings.
11. Compartment: The basic territorial unit of a forest permanently defined for purposes of location, description, and record and as a basis for forest management.
12. C.F.I. (continuous forest inventory): The establishment of permanent points within the forest from which measurements can be taken periodically throughout the life of the forest. These measurements are used to assess the growth, mortality, and changes in general condition of the forest.
13. Crop: The vegetation growing on a forest area, more particularly, the major woody growth.
14. Crop tree: Any tree forming or selected to form a component of the final crop. Generally a tree selected in a young stand for carrying through to maturity.
15. Crown: The upper part of a tree or other woody plant, carrying the main branch system and foliage.
16. Crown canopy: The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees and other woody growth.

17. Cull: A tree picked for relegation or rejection because it does not meet certain specifications as regards usable content.
18. Cultural treatment: A general term for work undertaken to improve the stand.
19. Cutting cycle: Cutting interval. The planned, recurring lapse of time between successive cuttings in a stand.
20. D.B.H. (diameter breast height): Diameter of a tree bole, 4.5 feet from the tree base.
21. Direct Control: Operations aimed directly at an insect or disease pest for the purpose of immediate suppression.
22. Discing: A form of mechanical site preparation done with a heavy disc. To aid tree regeneration.
23. Ecology: The study of plants and animals in relation to their environment.
24. Ecosystem: Any complex of living organisms with their environment.
25. Edge: The more or less well defined boundary between two or more elements of the environment, e.g., field/woodland.
26. Environment: All the biotic and abiotic factors of a site. Surroundings.
27. Establishment: The stage at which young trees are relatively safe from normal adverse influences.
28. Even-aged: Applied to a forest stand in which relatively small differences in age exist between individual trees. The maximum difference in age permitted in an even-aged stand is usually 10 to 20 years, though, where the stand will not be harvested until it is 100 or more years old, larger differences up to 30 percent of the rotation age may be allowed.
29. Even-aged management: Form of forest management which maintains or creates a forest consisting of essentially even-aged stands. Major class differences exist between stands instead of between individual trees within the stands.
30. Even aged stands: See even-aged.
31. Exotic: Not native.
32. Final crop: The portion of the growing stock kept to maturity.
33. Final harvest: Generally the removal of the last trees left in a stand.
34. Forest: Generally an ecosystem characterized by a more or less dense and extensive tree cover.
35. Forest compartment: See compartment.
36. Forest Ecosystem: See forest.

37. Forester: A general term for anyone engaged in the profession of forestry.
38. Forest management: The practical application of scientific, economic, and social principles to the administration and working of a forest for specified objectives.
39. Forest regeneration: The renewal of a tree crop whether by natural or artificial means.
40. Forest resources: All resources renewable and non-renewable within a forested area.
41. Forestry: A profession embracing the science, business, and art of creating, conserving, and managing forests and forest lands for the continuing use of their resources.
42. Forest stand: A community, particularly of trees possessing sufficient uniformity as regards composition, constitution, age, spatial arrangement or condition, to be distinguishable from adjacent communities. There is no connotation of age.
43. Forest type: A category of forest defined by its vegetation and/or locality factors.
44. Growing stock: All the trees growing in a forest or specified part of it, generally expressed in terms of number or volume.
45. Habitat: The abode, natural or otherwise, of a plant or animal considered particularly in relation to all the environmental influences affecting it.
46. Habitat diversity: The interspersion and complexity of food, cover and other elements of habitat within the home range of an animal species.
47. Improvement cutting: The elimination or suppression of less desirable trees in favor of more valuable trees. Removal of diseased, dying or insect-infested trees may be included in this category.
48. Indirect control: Operations designed to modify environmental factors to secure ultimate limitation of insect numbers and disease occurrence.
49. Infection court: The site of infection by a pathogen.
50. Ingrowth: Volume of trees that enter a size/product category during a specified time period.
51. Intermediate cutting: Any removal of trees from a stand between the time of its formation and regeneration cuttings. Includes cleaning, thinning, liberation, improvement, and salvage and sanitation cuttings.
52. Intolerant: Inability of a tree to develop and grow in the shade of, and in competition with other trees.
53. Maturity: The stage at which a forest stand fulfills the purpose(s) for which it was maintained.

54. Mesic: Intermediate moisture conditions, neither decidedly wet nor dry.
55. Multiple use forest management: Any practice of forestry fulfilling two or more objects of management, such as production of wood products, forage, and browse for domestic livestock, proper environmental conditions for wildlife, landscape effects, protection against floods and erosion, recreation production, and protection of water supplies and national defense.
56. Native: Not exotic, indigenous.
57. Natural regeneration: Natural reproduction, volunteer growth.
58. Net growth: Gross growth minus mortality and cut volumes. Includes ingrowth.
59. Nonrenewable resource: A resource that, when used, is gone forever for all practical purposes.
60. Natural regeneration: See regeneration.
61. Overmaturity: The stage beyond maturity generally marked by a decline in vigor.
62. Overstocked: A condition of overcrowding in a stand, leading to retarded growth.
63. Patch cutting: A modification of the clearcutting method, where the size of the openings created are less than 5 acres.
64. Point sampling: Variable radius plot sampling method where the probability of selection of a tree for measure is proportional to tree diameter.
65. Poletimber (Pole): Young tree or stand, from the time the lower branches begin to die, up to the time when the rate of height growth begins to slow down and crown expansion becomes marked.
66. Prescribed burning: Controlled application of fire under such condition of weather, fuel moisture, soil moisture, etc., as to allow the fire to be confined to a predetermined area and at the same time to produce the intensity of heat and rate of spread required to further certain planned objectives of silviculture, wildlife management, grazing, fire hazard, reduction, etc.
67. Overstory: That portion of the trees in a forest stand forming the upper crown cover.
68. Prism: Instrument used in point sampling.
69. Projected gross growth: An estimate of gross increment based on present stock without deducting mortality or timber harvest volumes.
70. Pulpwood: Wood cut and prepared primarily for manufacture into wood pulp.
71. Reforestation: Reestablishment of a tree crop on forest land.

72. Regeneration (Reproduction): Renewal of a forest stand by natural or artificial means.
73. Regeneration cutting: Any removal of trees intended to assist regeneration.
74. Regeneration system: A procedure by which a stand is established or renewed.
75. Regulation (forest regulation): The organization of a forest property to provide a sustained flow of harvested products.
76. Renewable resource: A resource that can be replenished.
77. Residual basal area: The quantity of timber remaining after timber harvest, expressed in cross-sectional area of trees at 4-1/2 feet from the ground.
78. Residual stand: The trees remaining after timber harvest.
79. Rotation: The planned number of years between the formation or regeneration of a crop or stand and its final cutting at a specified stage of maturity.
80. Roundwood: General term for timber products sold in the round by cubic volume or weight measure.
81. Rotation age: Age of stand at the time of the final harvest.
82. Sapling: A loose term for a young tree no longer a seedling but not yet a pole.
83. Sawtimber: Round timber fit to yield lumber.
84. Seedbed: The soil or forest floor on which seed falls.
85. Seedling: Generally a young tree, shrub, etc., grown from seed, from its germination up to the sapling stage.
86. Seed tree: A tree selected, and often reserved for seed collection.
87. Seed tree cutting method/system: Removal, in one cut, of the mature timber from an area, save for a small number of seed bearers.
88. Shade tolerant: Ability of a tree to grow satisfactorily in the shade of and in competition with other trees.
89. Shelterwood system/method: Silvicultural system in which in order to provide a source of seed and/or protection for regeneration, the old crop (the shelterwood) is removed in two or more successive shelterwood cuttings, the first of which is ordinarily the seed cutting and the last is final cutting. Intervening cuttings being termed removal cuttings. Where adequate regeneration is already present the old crop may be removed in a single cut.
90. Silvics: The study of the life history and general characteristics of forest trees and stands with particular reference to locality factors as a basis for the practice of silviculture.

91. **Silviculture:** Generally the science and art of cultivating (i.e., growing and tending) forest crops based on a knowledge of silvics. More particularly, the theory and practice of controlling the establishment, composition, constitution, and growth of forests.
92. **Silvicultural system:** A process following accepted silvicultural principles, whereby the crops constituting forests are tended, harvested, and replaced, resulting in the production of crops of distinctive form. Note: Systems are conveniently classified according to the method of carrying out the fellings that remove the mature crops with a view to regeneration.
93. **Site:** An area considered in terms of its environment, particularly as this determines the type and quality of the vegetation the area can support.
94. **Site class:** A measure of the relative productive capacity of a site for the crop or stand under study based (e.g.) on volume of height that is attained at a given age.
95. **Site Index:** A particular measure of site class based on the height of the dominant trees in a stand at age 50 years.
96. **Site preparation:** Generally, to mechanically improve seedbed conditions for tree reproduction.
97. **Slash:** The residue left on the ground after timber felling and/or accumulating there as a result of storm, fire, natural death/decay or other natural phenomena.
98. **Stand:** A community, particularly of trees, possessing sufficient uniformity as regards composition, constitution, age, spatial arrangements, or condition, to be distinguishable from adjacent communities so forming a silvicultural or management entity. Note: The concept includes both natural and artificial crops and carries no connotation of a particular age.
99. **Stand table:** A table showing the number of trees by species and diameter classes, generally per unit area.
100. **Sustained yield management:** Management of a forest property for continuous production with the aim of achieving at the earliest practicable time, an approximate balance between net growth and harvest either by annual or somewhat longer periods.
101. **Thinning:** A felling made in an immature stand in order primarily to accelerate diameter increments but also by suitable selection to improve the average form of trees that remain without permanently breaking the canopy.
102. **Type map:** A map showing the distribution of various types of soil, vegetation, or site throughout the forest.
103. **Understocked:** A stand in which the growing space is not effectively occupied by crop trees.

104. Uneven aged: Of a forest or stand composed of intermingling trees that differ markedly in age. A minimum range in ages of 10 to 20 years and up to 30 percent of a 100+ year old stand.

105. Wildlife management: The practical application of scientific and technical principles to wildlife population and habitat so as to maintain such populations essentially for recreational, ecological and/or scientific purposes.

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NSWC MP 84-147

APPENDIX A

FOREST COVER TYPE/SIZE CLASS DESCRIPTIONS

A-1/(A-2 blank)

FOREST COVER TYPE/SIZE CLASS DESCRIPTIONS

PINE

Pine Seedling/Sapling (P-1), 31.0 acres

Although now only a very small percentage of the total forest area under more intensive management, pine seedling/sapling will become more common. At present, only 2.5 acres of planted loblolly pine seedlings exist at Main Site. At Pumpkin Neck, there are 28.5 acres of naturally regenerated pine seedling/sapling.

Pine Poletimber (P-2), 471.8 acres

Pine poletimber averages 124.7 square feet of basal area per acre. There are 446 trees per acre 1.6 inches in diameter at breast height (dbh) or larger. The diameter of the tree of average basal area (average diameter) is 7.2 inches. Loblolly pine is 72% of basal area and 57% of the total number of trees. Virginia pine is 16% of basal area and 19% of the total number of trees. The remaining basal area (11%) and trees (23%) are small hardwoods and undesirable trees.

Sound wood fiber volume per acre averages 2,285 cubic feet, of which 1,989 cubic feet is suitable for pulpwood or other roundwood product manufacture. The remaining 296 cubic feet (1,230 board feet) is suitable for lumber manufacture. Total cubic volumes on point sample plots established during the 1978 CHESDIV Forest Inventory range from 462 to 4,087 cubic feet per acre. Sawtimber volumes range from 0 to 9,300 board feet per acre.

Average wood fiber growth for this size class exceeds those of all other forest cover types/size classes at 138 cubic feet per acre per year. Of this total, 97 cubic feet is wood fiber suitable for pulpwood or other roundwood products manufacture/use. The remaining 41 cubic feet (370 board feet) is wood fiber suitable for lumber manufacture. Sawtimber growth should gradually increase to and peak at 500-550 board feet per acre per year between ages 40 and 45. Implementation of the recommendations in this Plan will ensure maximum sawtimber growth. While sawtimber growth is increasing, total cubic growth will decline slowly after age 30, as would be the case regardless of management.

Pine Sawtimber (P-3), 235.9 acres

The pine sawtimber size class averages 131 square feet of basal area per acre. There are 375 trees per acre 1.6 inches dbh or larger. The average diameter is 8.0

inches. The dominant species in this size class is loblolly pine. Significantly, loblolly pine is 49% of basal area while only 19% of the total number of trees. Virginia pine is 23% of basal area and 19% of the total number of trees.

Small hardwoods, of dubious value in pine sawtimber stands are 11% of basal area and 10% of the total number of trees. Cull pine and hardwood combined account for 24% of basal area and 62% of the total number of trees. Generally, cull and small hardwood trees must be removed or killed shortly after regeneration cutting is scheduled for a pine stand to ensure adequate stocking and property development of pine and desirable hardwood seedlings and sprouts.

Sound wood volume averages 2,479 cubic feet/acre, of which 1,002 cubic feet is suitable for pulpwood or other roundwood product manufacture--provided a local market exists. The remaining 1,477 cubic feet (7,490 board feet) is suitable for lumber manufacture. Total cubic volumes range from 834 to 4,630 cubic feet per acre. Sawtimber volumes range from 0 to 19,750 board feet per acre.

Average total cubic volume growth is 98 cubic feet per acre per year. Of this total, 38 cubic feet is wood fiber suitable for pulpwood or other roundwood product manufacture and 50 cubic feet (340 board feet) is suitable for lumber manufacture.

As discussed in the description of pine poletimber, growth of managed pine stand should increase gradually and peak at 500+ board feet per acre per year between ages 40 and 45. Since all pine sawtimber stands are at least 26 years old and the average age is near 40, it is obvious that there is little chance that many present sawtimber size pine stands will produce at or near 500 board feet per acre per year. The challenge is to manage the younger pine stands so that at age 40 they'll be growing 500+ board feet per acre per year.

PINE-HARDWOOD

Pine-Hardwood Seedling/Sapling (PH-1), 36.3 acres

All the acreage in this size class is located at Pumpkin Neck in areas presently inaccessible due to possible contamination by unexploded ordnance. More intensive management will increase the acreage of this size class.

Pine-Hardwood Poletimber (PH-2), 255.4 acres

This size class averages 122.5 square feet of basal area per acre. There are 512 trees per acre 1.6" dbh and larger. The average diameter is 6.6 inches. Loblolly and Virginia pine combined are 47% of basal area and 27% of the total number of trees. The remaining "desirable" growing stock (41% basal area and 28% of total trees) consists of yellow poplar, sweetgum, red and white oaks and miscellaneous hardwood species. Finally, undesirable hardwood trees comprise 12% of basal area and 45% of the total number of trees. Most of these trees are small yet their relative abundance may affect silvicultural prescriptions for some stands in this size class.

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GROUNDS CONSERVATION MANAGEMENT PLAN (1982-1991) FISH
AND WILDLIFE MANAGE. (U) NAVAL SURFACE WEAPONS CENTER
DAHLGREN VA JUN 85 NSWC/HP-84-147

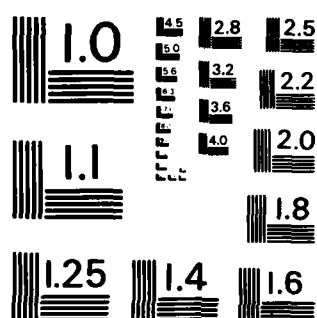
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Sound wood fiber volume averages 2,141 cubic feet per acre, of which 1,614 cubic feet is suitable for pulpwood or other roundwood manufacture use. The remaining 527 cubic feet (1,930 board feet) is suitable for lumber manufacture. Total volumes vary from 844 to 3,252 cubic feet per acre. Sawtimber volumes range from 0 to 10,770 board feet per acre.

Average wood fiber growth for this size class is second only to pine-poletimber at 107 cubic feet per acre per year. Of this total, 68 cubic feet is wood suitable for roundwood manufacture/use. Thirty-nine cubic feet (270 board feet) is suitable for lumber manufacture.

Pine sawtimber growth will gradually increase and peak between ages 40 and 45. Hardwood sawtimber growth will increase more slowly and attain maximum board foot growth between ages 70-80 depending on site quality. As with pine poletimber stands, total cubic volume growth will begin to decline in total cubic volume growth after age 30 whereas the slow-down in the growth of the hardwood component will begin after age 50.

Pine-Hardwood Sawtimber (PH-3), 114.1 acres

This size class of mixed pine-hardwood species composition averages 135.6 square feet of basal area per acre. There are 572 trees per acre 1.6 inches dbh and larger. The average diameter is 6.6 inches. The relatively small average diameter reflects the great percentage of small trees in the understories of these stands.

Fifty-six percent of basal area and 93% of the total number of trees are less than 10 inches in diameter. Cull trees alone account for 33.3 square feet or 24.5% of the total basal area and 401 (70%) of the total number of trees per acre. The overabundance of cull trees has kept timber productivity low and will be a major consideration when making silvicultural prescriptions for regenerating the oldest stands.

Sound wood volume averages 2,392 cubic feet per acre, of which 787 cubic feet is suitable for pulpwood or other roundwood product manufacture, depending on local market conditions. The remaining 1,605 cubic feet (8,370 board feet) is suitable for lumber manufacture. Total volumes vary from 562 to 3,791 cubic feet per acre. Sawtimber volumes range from 3,340 to 15,750 board feet per acre on sample plots measured in 1978.

Average total cubic volume growth is 77 cubic feet per acre per year. Thirty-six cubic feet of growth is wood fiber suitable for roundwood product manufacture and 41 cubic feet (220 board feet) is suitable for lumber manufacture.

As with pine sawtimber stands on the Station, pine-hardwood sawtimber stands are too old to respond to intensive management aimed at increasing growth. A few of the younger (26-50 years) pine-hardwood sawtimber stands are capable of increased growth under more intensive management. The oldest stands must be cut to make room for young more productive groups of pine-hardwood trees.

HARDWOOD

Hardwood Seedling/Sapling, (H-1), 0.0 acres

Presently, there are no areas of this type/size class large enough to be considered as separate entities (forest stands) for management purposes. Forest management will achieve a fair representation of hardwood seedling/sapling stands in the next 10 years.

Hardwood Poletimber, (H-2), 173.6 acres

This size class averages 70 square feet of basal area per acre. There are 178 trees per acre 1.6 inches in diameter or greater. The average diameter is 8.5 inches. Various hardwoods account for 86% of the basal area and 96% of the number of trees. The remaining 14% of basal area is undesirable hardwood stems.

Sound wood fiber averages 1,170 cubic feet per acre of which 936 cubic feet is suitable for roundwood product conversion and 234 cubic feet (620 board feet) is suitable for lumber manufacture. Total cubic volumes range from 705 to 1,840 cubic feet per acre on measured sample points. Sawtimber volumes range from 0 to 2,480 board feet per acre.

Growth for hardwood poletimber is half that of pine-hardwood poletimber. Total cubic growth is 56 cubic feet per acre per year. Of this, 46 cubic feet is suitable for roundwood product conversion and 10 cubic feet (70 board feet) is suitable for lumber manufacture.

Sawtimber growth will increase slowly with age and attain near maximum board foot production at age 70. Total cubic volume growth will decline slowly after age 50. In stands dominated by yellow poplar, board foot production will peak earlier.

Hardwood Sawtimber, (H-3), 510.8 acres

This size class averages 126.2 square feet of basal area per acre. There are 349 trees per acre 1.6" dbh or larger. The average diameter is 8.1 inches. Loblolly and Virginia pine account for 7% of basal area and 5% of the total number of trees. Cull trees account for 17% of basal area and 57% of all trees.

Sound wood fiber volume averages 2,483 cubic feet per acre of which 851 cubic feet is suitable for roundwood conversion and 1,632 cubic feet (7,810 board feet) is suitable for lumber manufacture. Total cubic volumes range from 401 to 6,689 cubic feet per acre on measured sample points. Sawtimber volumes range from 0 to 36,000 board feet per acre.

Average growth is 88 cubic feet per acre per year. Of this, 28 cubic feet is roundwood product material and 60 cubic feet (330 board feet) is suitable for lumber manufacture. Since over half of all hardwood sawtimber stands are 76+ years old and the rest are 51-75 years old, sawtimber growth is not expected to change. Sawtimber productivity would have been considerably greater if early thinnings and improvement cuttings had been made.

NSWC MP 84-147

APPENDIX B
WOODLAND SUITABILITY GROUPS

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WOODLAND SUITABILITY GROUPS

Refer to the Station's Long-Term Soil and Water Conservation Management Plans for more specific information on the soils and their suitability for forest management. The numbers in parentheses at the end of each soil suitability group refer to numbers given soils in the Soil and Water Plan.

WOODLAND SUITABILITY GROUP 1

Members of this grouping are well-drained flood plain soils. The water table is at or near the surface making the areas with these soils subject to ponding during the winter and spring seasons. Fertility is moderate to high. Maximum timber production is possible if these areas are forested with yellow poplar, loblolly pine, sweetgum, and red and white oaks. (14)

WOODLAND SUITABILITY GROUP 2

Group 2 soils are very poorly to moderately well-drained with high moisture supplying capacity and moderate fertility. Maximum timber production may be achieved if these areas are forested with loblolly pine, yellow poplar, and sweetgum. White oak, and sycamore also do well on these sites. (13, 32, 50, 55, 251)

WOOD SUITABILITIY GROUP 3

These are deep well-drained soils with moderate to high moisture supplying capacity and low to moderate fertility. Loblolly pine and yellow poplar are best suited to grow on these soils. (10)

WOOD SUITABILITY GROUP 4

Soils in this group are very poorly to moderately well-drained with low to high moisture-supplying capacity and very low to moderate fertility. Loblolly pine is the preferred timber species on these soils. (31, 58)

WOODLAND SUITABILITY GROUP 5

These soils are moderately well to well-drained with dense fragipan or fine clayey subsoils and low to moderate moisture-supplying capacity. Fertility is low. Loblolly pine does fairly well on these soils. (42)

NSWC MP 84-147

APPENDIX C
FOREST STAND LISTING

C-1/(C-2 blank)

NSWC MP 84-147

FOREST STAND LISTING

COMPARTMENT A

<u>Stand</u>	<u>Age</u>	<u>Cover Type</u>	<u>Total Acreage</u>	<u>Regulation Cut Acreage</u>
1	76+	H3	15.1	15.1
2	26-50	PH3	20.0	20.0
3	76+	H3	13.0	13.0
4	51-75	PH3	1.0	--
5	51-75	PH3	8.7	--
6	76+	H3	9.4	9.4
7	-5-25	P3	2.6	2.6
8	25-50	PH2	2.6	2.6
9	76+	H3	64.2	64.2
10	51+	P3	2.3	2.3
11	-5-25	P2	10.1	--
12	51+	P3	1.3	--
13	-5-25	P2	1.6	--
14	26-50	P3	3.5	--
15	26-50	P3	1.8	1.8
16	76+	PH3	8.7	--
17	-5-25	P2	3.4	3.4
18	-5-25	P2	2.9	2.9
19	-5-25	P2	5.6	--
20	76+	PH3	4.1	4.1
21	-5-25	P2	2.8	2.8
22	51-75	H2	24.0	24.0
23	51-75	H2	8.9	--
24	51+	P3	4.0	--
25	-5-25	P2	5.0	5.0
26	-5-25	P2	3.7	3.7
27	51-75	PH3	5.0	--
28	76+	H3	8.4	--
29	51-75	H2	4.4	4.4
30	-5-25	P2	24.2	24.2
31	-5-25	P2	8.7	8.7
32	-5-25	P2	7.5	7.5
33	26-50	H2	15.4	15.4
34	51-75	H2	6.0	6.0
35	51-75	PH2	5.4	5.4
36	51-75	H2	5.3	--
37	-5-25	P2	5.7	5.7
38	-5-25	P2	4.8	4.8
39	76+	PH3	1.3	--
40	76+	PH3	7.6	--
41	76+	H3	14.0	--
42	76+	PH3	1.9	--

COMPARTMENT A (Continued)

<u>Stand</u>	<u>Age</u>	<u>Cover Type</u>	<u>Total Acreage</u>	<u>Regulation Cut Acreage</u>
43	76+	H3	7.6	--
44	76+	H3	4.1	--
45	51+	P3	7.8	7.8
46	-5-25	P2	20.0	20.0
47	-5-25	P2	15.6	--
48	26-50	PH2	3.4	--
TOTAL			404.1	286.8

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COMPARTMENT B

<u>Stand</u>	<u>Age</u>	<u>Cover Type</u>	<u>Total Acreage</u>	<u>Regulation Cut Acreage</u>
1	51+	P3	1.8	1.8
2	51-75	H3	5.3	5.3
3	26-50	PH2	10.4	10.4
4	51-75	H2	14.8	14.8
5	51-75	H3	12.0	12.0
6	51-75	H3	7.0	7.0
7	51-75	H3	5.0	5.0
8	26-50	P3	14.2	14.2
9	26-50	P3	9.4	9.4
10	26-50	P3	25.1	25.1
11	-5-25	P2	5.4	5.4
12	26-50	P3	2.9	2.9
13	26-50	P2	2.0	2.0
14	26-50	P2	1.3	1.3
15	-5-25	P1	2.5	2.5
16	26-50	P2	1.1	1.1
17	26-50	P3	7.5	7.5
18	26-50	P2	14.5	14.5
19	26-50	P2	11.0	11.0
20	26-50	P2	4.5	4.5
21	26-50	P2	1.9	--
22	26-50	P2	14.7	14.7
23	51-75	H2	3.8	3.8
24	26-50	P2	4.4	4.4
25	-5-25	P2	4.8	4.8
26	76+	H3	17.0	17.0
27	26-50	P2	2.3	2.3
28	76+	H3	7.3	7.3
29	76+	H3	5.7	5.7
30	51-75	PH3	4.5	4.5
31	51-75	PH3	5.1	5.1
32	26-50	P3	10.3	10.3
33	51-75	H2	4.3	4.3
34	-5-25	P2	18.2	18.2
35	-5-25	P2	6.3	6.3
36	26-50	PH2	13.5	13.5
37	26-50	PH2	5.6	5.6
38	26-50	PH2	1.3	1.3
39	26-50	P2	2.3	2.3
40	51-75	PH3	3.1	3.1
41	76+	H3	14.1	14.1
42	26-50	H2	3.5	3.5
43	26-50	PH2	27.0	27.0
44	26-50	H2	16.2	16.2
45	26-50	PH2	1.6	1.6
46	51-75	PH3	10.1	10.1
47	26-50	P2	3.2	3.2

COMPARTMENT B

<u>Stand</u>	<u>Age</u>	<u>Cover Type</u>	<u>Total Acreage</u>	<u>Regulation Cut Acreage</u>
48	26-50	P2	2.9	2.9
49	76+	H3	9.4	9.4
50	26-50	P2	1.3	1.3
51	26-50	PH2	1.9	1.9
52	51-75	H2	4.4	4.4
53	76+	H3	3.8	--
54	-5-25	P2	12.3	12.3
55	26-50	P2	7.6	7.6
56	51-75	PH3	2.2	2.2
57	-5-25	P2	2.9	2.9
58	26-50	P3	1.2	1.2
59	51-75	H2	4.4	--
60	-5-25	P2	26.1	26.1
61	26-50	PH3	6.0	6.0
62	26-50	PH3	5.4	5.4
63	-5-25	PH2	1.7	1.7
TOTALS:			463.3	453.2

COMPARTMENT C

<u>Stand</u>	<u>Age</u>	<u>Cover Type</u>	<u>Total Acreage</u>	<u>Regulation Cut Acreage</u>
1	51-75	H2	7.5	--
2	26-50	PH2	8.4	--
3	26-50	PH3	3.5	3.5
4	76+	H3	13.8	18.3
5	76+	H3	3.7	--
6	51-75	H3	5.6	--
7	76+	H3	24.1	--
8	26-50	PH2	8.2	8.2
9	51-75	H3	26.4	26.4
10	51+	P3	37.7	37.7
11	76+	H3	27.2	27.2
12	51-75	H3	3.2	3.2
13	51-75	H3	15.9	15.9
14	-5-25	P2	2.6	2.6
15	26-50	P3	3.7	3.7
16	-5-25	P1	28.5	28.5
17	26-50	F2	7.0	7.0
18	26-50	P2	17.3	17.3
19	26-50	P2	8.7	8.7
20	75+	H3	9.7	9.7
21	26-50	P2	12.0	12.0
22	26-50	P2	7.5	7.5
23	26-50	P2	9.8	9.8
24	26-50	P2	11.2	11.2
25	76+	H3	9.1	9.1
TOTALS:			321.3	249.2

COMPARTMENT D

<u>Stand</u>	<u>Age</u>	<u>Cover Type</u>	<u>Total Acreage</u>	<u>Regulation Cut Acreage</u>
1	26-50	H2	16.7	16.7
2	26-50	PH2	3.5	3.5
3	-5-25	H1	5.1	--
4	26-50	PH2	13.0	13.0
5	26-50	PH2	13.0	13.0
6	26-50	P3	7.9	7.9
7	-5-25	PH1	3.1	3.1
8	26-50	PH3	7.6	7.6
9	26-50	P2	17.2	17.2
10	26-50	H2	29.8	--
11	-5-25	PH2	10.0	--
12	26-50	P2	9.2	--
13	26-50	PH2	47.6	--
14	26-50	P2	5.4	5.4
15	26-50	P3	34.9	34.9
16	51-75	H3	16.9	16.9
17	-5-25	PH1	17.2	--
18	26-50	PH2	4.1	4.1
19	26-50	PH3	8.4	8.4
20	26-50	PH2	4.1	4.1
21	26-50	PH3	13.1	--
22	26-50	P3	36.1	36.1
23	51-75	H3	10.9	--
24	26-50	PH3	7.6	--
25	26-50	P2	14.2	--
TOTALS:			356.8	192.1

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COMPARTMENT E

Stand	Age	Cover Type	Total Acreage	Regulation Cut
				Acreage
1	-5-25	PH1	12.0	12.0
2	-5-25	PH2	4.4	4.0
3	-5-25	PH2	2.3	2.3
4	-5-25	PH2	7.3	7.3
5	-5-25	PH1	4.0	4.0
6	51+	P3	9.7	9.7
7	76+	H3	9.4	9.4
8	51+	P3	7.2	7.2
9	26-50	P2	4.5	4.5
10		H3	19.2	--
11	-5-25	P2	17.2	17.2
12	26-50	PH2	7.5	7.5
13	26-50	H2	3.8	--
14	26-50	P2	17.0	17.0
15	26-50	P2	4.0	4.0
16	26-50	PH2	12.0	12.0
17	26-50	P2	11.7	11.7
18	26-50	PH2	12.0	12.0
19	26-50	P2	11.7	11.7
20	26-50	PH3	7.9	7.9
21	51-75	H3	10.7	10.7
22	26-50	H2	6.6	6.6
23	26-50	P3	5.6	5.6
24	26-50	H2	9.2	--
25	26-50	P2	20.1	20.1
26	51-75	H3	39.0	39.0
27	51-75	H3	3.4	--
28	51-75	H3	12.9	--
29	51-75	PH3	20.7	20.7
TOTALS:			293.3	220.1

NSWC MP 84-147

APPENDIX D
FOREST INVENTORY TALLY FORMS

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FOREST INVENTORY TALLY

DATE _____
 LOCATION _____
 LINE _____ PLOT _____
 NAMES _____
 FOREST TYPE _____ DENSITY _____ BAF _____

PLOT WITNESS TREES
 Bearings/distance
 /
 /

SITE INDEX TREE

TREE	DBH	SPP	PRODUCT		TREE	DBH	SPP	PRODUCT	
N-E			Now	Fut.	N-E			Now	Fut.
1					7				
2					8				
3					9				
4					10				
5					11				
6					12				

Spp. _____ # _____
 Spp. Grp. _____
 Crown _____
 T. Ht. _____
 DBH _____
 Age _____

Crown Closure % _____ Stand Layers _____
 Mortality (5 yrs.) _____ Stand Health/Damage _____
 Past Treatment _____
 Tree Repro. (1/500 ac. - 5.2' rad.) _____
 Understory/Ground Veg. _____
 Drainage _____ Erosion Potential _____ Slope _____ Aspct _____
 Other _____

1. Final Cut _____	4. Selection _____	7. Salvage _____
2. Shelterwood _____	5. Thinning _____	8. Px Burn _____
3. Seed Tree _____	6. Release _____	9. Other _____
		10. Nothing _____

Directions To Plot _____

 INDIVIDUAL TREE MEASUREMENTS
 (Dendrometry)

Name _____	Product Type _____	Species _____
Date _____	DBH _____	Species Group _____
Crown Class _____	Bark Thick. _____	Age _____
10 Year Radial _____	Plot # _____	Total Height _____
Growth _____	Tree # _____	Site Index _____

#	Hght read	Diam.		Snd %	Merch	Sect. lngh	IT	#	Hght read	Diam.		Snd %	Merch	Sect. lngh	IT
		bot	top							bot	top				
1								11							
2								12							
3								13							
4								14							
5								15							
6								16							
7								17							
8								18							
9								19							
10								20							

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APPENDIX E

TIMBER CRUISE TALLY AND HARVEST VOLUME SUMMARY FORMS

E-1/(E-2 blank)

DATE _____

NAMES _____

LOCATION _____

COMPARTMENT _____ STAND _____

FOREST TYPE _____ DENSITY _____ BAF _____

TIMBER CRUISE TALLY

TREE	DBH	SPP	PRODUCT		TREE	DBH	SPP	PRODUCT	
N-E			Now	Fut.	N-E			Now	Fut.
1					7				
2					8				
3					9				
4					10				
5					11				
6					12				

SITE INDEX TREE

Spp. _____ # _____

Spp. Grp. _____

Crown _____

T. Ht. _____

DBH _____

Age _____

Bark Thk. _____

10 YR. Radial _____

Growth _____

Stand Layers _____ Mortality _____

Stand Health/Vigor _____

Past Treatment _____

Erosion Potential _____ Slope _____ Aspect _____

Other _____

1. Final Cut _____ 4. Selection _____ 7. Salvage _____

2. Shelterwood _____ 5. Thinning _____ 8. Px Burn _____

3. Seed Tree _____ 6. Release _____ 9. Other _____

10. Nothing _____

	ACREAGE	APPROXIMATE PER ACRE AND TOTAL HARVEST VOLUMES				
		PINE		HARDWOOD		
		Sawtimber (MBF)	Pulpwood (CUNITS)	Saw- timber (MBF)	Pulp- wood (CUNITS)	Fuel wood (CUNITS)
a. THINNING AND IMPROVEMENT CUTTING						
1) Pine Poletimber						
2) Pine Sawtimber						
3) Pine-Hardwood Poletimber						
4) Pine-Hardwood Sawtimber						
5) Hardwood Poletimber						
6) Hardwood Sawtimber						

	ACREAGE	APPROXIMATE PER ACRE AND TOTAL HARVEST VOLUMES				
		PINE	HARDWOOD			
		Sawtimber (MBF)	Pulpwood (CUNITS)	Saw- timber (MBF)	Pulp- wood (CUNITS)	Fuel wood (CUNITS)
b. REGENERATION HARVESTING						
1) Pine Poletimber						
2) Pine Sawtimber						
3) Pine-Hardwood Sawtimber						
4) Hardwood Sawtimber						

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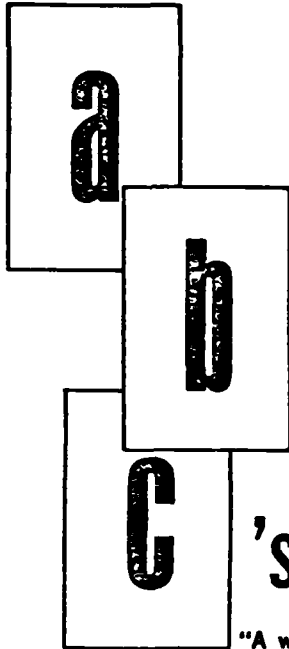
APPENDIX F

ABC's OF EVEN-AGED MANAGEMENT

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's of Even-Aged Management

"A well-managed forest can be a thing of beauty and serve many uses"

by Kenneth P. Davis

The purpose of this article is to give better understanding of even-aged forest management in the United States with particular attention to clear-cutting practices. The management of forested lands in the United States is receiving close public scrutiny. This is encouraging as it attests to the importance of forests; that they do indeed produce many goods and services. Foresters are also, and properly, on the spot professionally to manage lands productively and in consonance with maintenance of environmental quality.

Although the emphasis here is on the application of even-aged management methods, it is necessary to consider them in relation to the nature and structure of forests and

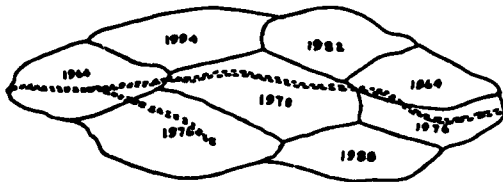
management alternatives on an uneven-aged basis as well. Not so doing can and has resulted in much misunderstanding and lack of perspective. One must also recognize the controlling importance of purposes of management. Forests are many things to many people; the questions are what is wanted from them and in what balance.

IN A discussion of forest management, one starts with trees. They are truly remarkable plants in size, persistence, and longevity with a characteristic woody structure very useful to man. There are many species each with individual biological capacities and requirements growing in forests of great diversity. Trees are extremely competitive with each other and with other plants for space in which to reproduce and grow. The practice of silviculture centers on the provision and control of growing space

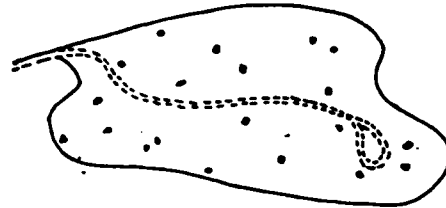
for desired trees and their reproduction.

Forests can be grouped into two general categories; those that are dominantly composed of even-aged areas or stands, and those that are composed of uneven-aged stands. An even-aged stand is a community of trees on an area where the predominating tree species originated at about the same time and have grown under essentially full-light conditions. An uneven-aged stand is one in which the trees originated at different times. There are also many intermediate conditions making it often difficult to categorize a particular stand as either even- or uneven-aged. Appearances are often deceiving; smaller trees in a stand are often not younger but merely suppressed trees often incapable of good growth if released.

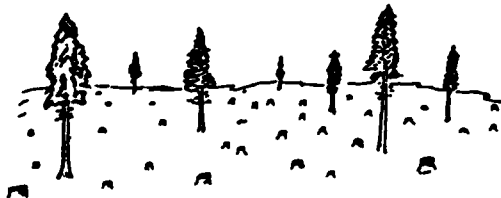
Due to the often crude but effective reproduction methods of nature in releasing growing space for new

**CLEAR-CUTTING METHOD**

Blocks progressively cut and regenerated

**SEED-TREE METHOD**

Clear-cut except for seed trees

*Illustrations by Dick Johnson, U. S. Forest Service*

trees via fire, storm, insects and diseases, forests composed of essentially even-aged stands are by far the most common in the U.S. Forests of dominantly all-aged stands are scarce, much more so than commonly supposed. They are difficult to maintain because growing space for new tree establishment is scanty and many of the most desired species cannot successfully reproduce without forest openings of substantial size.

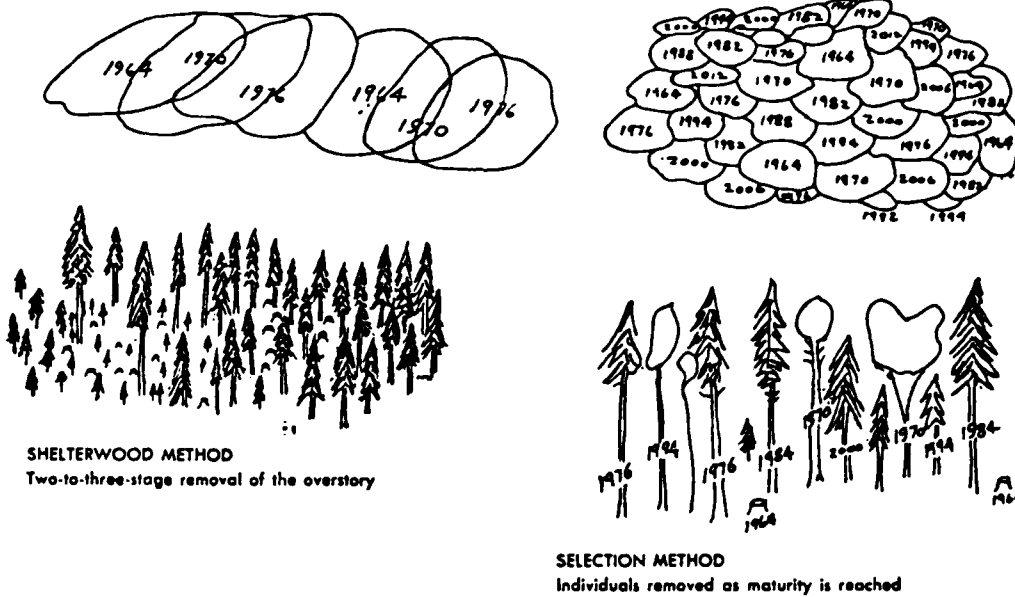
The area of a forest stand which can be considered as even-aged or uneven-aged is important and occasions much misunderstanding. An area as small as an acre or two silviculturally can be an even-aged stand and so treated. Under either even-aged or uneven-aged forms of management forest openings of sufficient size to give sufficient growing space for the successful establishment and growth of desired tree species must be provided to maintain the forest. If man doesn't provide them nature will and often very crudely. It is consequently inaccurate to think of a large forest area generally mixed in age class

structure as being uniformly all-aged. Stand by stand, area by area, this is seldom true. Due to cutting or other forest disturbances over past time new trees largely become established in even-aged patches of varying size. This is particularly true with the widely distributed ponderosa pine of the West in either its pure form or growing with associated species. It is difficult to categorize many forest areas as either even- or uneven-aged; they are a mixture of both.

For a forest area of substantial size to be organized on an even-aged basis, the individual component stands need to be of sufficient size to be identified by age classes that can practicably be mapped and inventoried as such. If this is not practicable, the forest may be organized on an uneven-aged basis from a regulation of total cut standpoint although stand regeneration by areas or stands may be obtained by even-aged methods.

It should also be clearly recognized that, whether stands are dominantly even- or uneven-aged, various

partial cuttings can be made within them for timber harvest, to capture mortality, to remove decadent or otherwise unwanted trees, and to maintain or enhance stand growth and vigor. Such cuttings are not directed at stand regeneration. The basic and continuing need arises, however, to replace whole stands or parts of them through reproduction of desired trees, by seeding, planting, or sprouting, that can grow successfully under the ever-present competition for space. Methods of providing this space is where even- and uneven-aged management methods differ in the general form or kind of forest produced. Both are ecologically sound and result in attractive growing forests. Choice is a matter of purpose and balance to meet human needs for recreation and esthetics, wood, wildlife—and economics. No one method can serve all purposes and forest species associations are too diverse to permit it. It should also be clearly recognized that forests may be cut beyond their sustained yield capacity under even- or uneven-aged management. There



is no basis for distinction on this point.

The foregoing is needed for understanding of even- and uneven-aged composition of forests and to clear the way for consideration of even-aged forest treatment focusing on regeneration methods. These are shelterwood, seed tree, and clear-cutting. Each has a place but it must be recognized that in many forest situations they are not practicable alternatives.

Shelterwood and seed tree methods. The shelterwood method, as its name suggests, means reproducing a stand by making two or more harvest cuttings to open the stand sufficiently to stimulate natural reproduction under partial cover, and when it is established to remove the shelterwood. The seed tree method, essentially a variation of the first, is to leave only enough trees of desired species to provide seed which are removed when this purpose is accomplished.

The shelterwood method is esthetically desirable and generally effective in getting regeneration although

control of species composition is often poor. Invasion of non-tree shrubby species may be strong, especially on good sites, and prevents or delays good tree regeneration. Also, and depending on age, species composition, and condition, there may be windthrow and other damage to the shelterwood stand during the regeneration period and damage to the new stand underneath when it is removed. The seed tree method is generally less effective than the shelterwood approach in getting good regeneration. Further, it is limited as to areas in which it can be applied and costly when one considers frequent loss of seed trees which may not be economic to capture, and frequently delayed and unsatisfactory new tree regeneration.

Clear-cutting. As a recognized silvicultural term strictly taken, clear-cutting means "the removal of the entire standing crop." Such cuttings are made on selected areas where they are adjudged desirable. Applied to a forest unit managed for sustained yield on this basis, the area so treated each year is determined

by the desired average tree age at harvest time (the rotation). For example, if this harvest age or rotation is 50 years, the average annual area clear-cut would be $1/50$ or 2 percent of the total management unit. Normally, this total area would be well dispersed over the management unit; certainly not all in one place.

Regeneration of clear-cut areas is accomplished in several ways. It may be by natural seeding in from the sides, seed already on the ground or in the slash from the stand removed, or artificially by direct seeding or planting. In practice, there are some situations in which adequate regeneration already exists under the parent crop removed or will result from sprouting. Artificial methods are the most applied because they are prompt, assure well-distributed new trees over the area, and give strong species control. Planting or seeding is most effective and practicable with coniferous species. Some hardwood species particularly poplars (*Populus* genera),

ABC's of Even-Aged Management

the tulip poplar (*Liriodendron tulipifera* and not a poplar), sycamore, and some other species are grown in plantation culture. Forest planting or seeding of hardwood species is not generally practiced although some fill-in planting and seeding under existing stands is increasingly done to supplement natural regeneration, which is usually abundant. Hardwood forest stands are usually composed of a number of species and are generally difficult to regenerate artificially.

Clear-cutting followed by regeneration is widely applied for a number of reasons. To summarize:

1. It follows a method common with nature resulting from forest mortality by fire, storm, insects, and diseases which can occur intensively over large areas. Natural forests in the U.S. are much more often even-aged than is recognized.

2. The method is in general prompt, effective, and economical in getting regeneration as compared to others.

3. The method gives strong control over species composition of forest stands and hence is favored for timber production which is and remains a major economic use of forest lands.

The preceding is to orient and establish even-aged management using

clear-cutting and other regeneration methods as recognized forest practice desirable and necessary in many situations. Clear-cutting in particular is the subject of much current public scrutiny and criticism. Why is this so? There are a number of reasons frankly to consider.

1. *There is a problem of balance and perspective.* People want many things from forests. They want and use wood in prodigious quantities in homes and in their daily living. Increasingly urbanized people want and need amenities in which forested lands figure very strongly—from open space near home to wilderness areas. They are also deeply concerned about maintenance and improvement of environmental quality in which forests are extremely important. Forests have great capacity to satisfy many needs. Just the same, choices have to be made and all desires cannot be met. A favorite thesis of mine is that a well-managed forest can be a thing of beauty and also serve many uses.

2. *Biological-ecological.* These include a wide range of considerations such as damaging factors of fire, insects, and diseases; soil and water relations; effects of forest uses for recreation, game, fish, forage, and timber. There is nothing inherently undesirable about even-aged man-

agement, including clear-cutting, in relation to these factors. It is a matter of good application in relation to purposes. In a well-managed forest operated on a sustained yield basis, for example, new age classes are always being established creating forest openings and maintaining cover and subordinate vegetation generally beneficial to wildlife.

3. *Esthetics.* Clear-cutting is often not and cannot be pretty and it may be unduly conspicuous to the public. Concerns range from dislike of cutting any tree to understandable affront at what looks like, and literally is at the time, forest destruction which can be extremely visible along roads and on slopes. The

frequently necessary purpose and the relatively short time to establishment of a new stand is often not recognized and some tolerance is needed. People like trees and forested areas ranging from parks, thrifty plantations, and well-managed forests, to the forest primeval depending on their taste and understanding.

4. *Size and location of cuttings.* The size, location, and dispersal of clear-cutting areas has close relation to items 1 and 2 above and some misapplications have occasioned much of the criticism about clear-cutting. Technically, clear-cutting can range from an acre or two to a thousand or more. The smaller cuttings are often termed patch or group cuttings. Much can be done by judicious control of size, location, and distribution of cuttings to meet reasonable objections.

5. *Time.* There are two important aspects to the time dimension. First is the time it takes to conduct a clear-cutting operation from the cutting through area cleanup to visible establishment of a new stand. The shorter the time the better for both esthetic and economic reasons. Requisite time naturally varies with the situation.

Second, is the need to recognize that much of the present need for clear-cutting is transitory and stems from the need to treat large forest areas in presently unsatisfactory condition. Future stands will be younger and can be managed with less forest disruption.

6. *Waste.* Apparent wood waste in cutting operations and particularly obvious in many clear-cuttings concerns many people. It is a technological-economic problem the subject of much research. Progress is being made. All wood volume is not economic wood volume, however, and no general and simplistic utilization requirements can reasonably be established.

7. *Purposes of management.* Finally, purposes of management must frankly be considered together with their costs. In the past, forest treatment operations have been made primarily from the standpoint

of timber production which is in total the principal directly measurable economic use of forest land. Now, we are concerned not only with efficient timber production but with the larger dimension of environmental quality which adds additional constraints and costs. The cost of balanced, harmonized, multiple use—whatever term best describes—management of forested lands is not cheap; a fact to be reckoned by private and public land owners alike.

It should be evident that no simplistic dictums or prescriptions about forest cuttings practices are possible in the United States. It is continental in size and forest conditions are too diverse as are purposes of management by public and private owners.

Clear-cutting, not a consistently understood term, has drawn criticism and some is warranted. It can be and has been misapplied and steps are being taken to correct malpractice. Another term, selective cutting, is often popularly used in contrast as indicating "desirable" forest practice. There is a long history of forest exploitation behind the development of this term. In accepted present forestry terminology it means: "Selective logging, culling or high grading. A type of cutting that removes only certain species (a) above a certain size, (b) of high value, known silvicultural requirements and/or sustained yields being wholly or largely ignored or found impossible to fulfill." Clear-cutting and selective cutting can be equally undesirable when misapplied.

Public concern about forest cutting and other forest land use practices is heartening and it is hoped will strongly continue. There are continuing problems in working out a desirable balance and "mix" in forest land uses in a changing economy. In a political democracy such as ours this requires informed and discriminating public pressures. It is hoped that this article will contribute both to better understanding and application of forest cutting practices. ■

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APPENDIX G

EVALUATING THE ADEQUACY OF OAK ADVANCE REPRODUCTION

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EVALUATING THE ADEQUACY OF OAK ADVANCE REPRODUCTION

To evaluate whether the oak advance reproduction can adequately reproduce the stand a survey must be made. This survey can be made at the same time that the inventory to determine stand stocking and quality is made. In fact, the number of overstory trees per acre from the stand stocking inventory is needed to estimate the number of stump sprouts per acre necessary to compensate for oak advance reproduction deficiencies. The sample form (fig. 8) can be used to record the tree count needed for estimating number of overstory trees per acre.

Use the following procedure developed by Sander *et al.* (1976) for evaluating oak advance reproduction:

1. Take 10 or more 10-factor angle gauge sample points in the stand being examined. At each sample point tally the trees on a 1/20-acre plot by species and size class (overstory inventory, see sample form, figure 8).

2. Select the number of 1/735-acre plots (4.3 feet in radius) to use in the advance reproduction inventory from the following tabulation according to the acreage of the stand being examined:

For stand size (acres)	Use this number of 1/735-acre plots
< 10	25
10 to 30	40
30 to 50	60

3. Distribute these 1/735-acre plots uniformly throughout the stand.

4. On each 1/735-acre plot look for oak reproduction stems 4.5 feet tall or taller and less than 2.0 inches in diameter at the ground line or not over 1.5 inches d.b.h. (stems larger than this should be considered part of the overstory and tallied as such, even if below the main canopy). If at least one such stem is present, record the plot as stocked. If no such stem is present, record the plot as not stocked (see right margin of sample form, figure 8).

5. Compute the percent of plots stocked. If 59 percent or more are stocked, there is adequate oak

advance reproduction present; no further calculations are necessary and the stand may be harvested.

6. If fewer than 59 percent of the plots are stocked, oak advance reproduction is inadequate to reproduce the stand if it is cut. But the stand could still be reproduced if enough stumps of the overstory oaks will sprout after they are cut. An example of how to compute the expected number of stump sprouts follows:

a. Assume that the inventory of plots provides the data on the sample worksheet (fig. 8).

b. Note that there are 26 black oaks 2 to 5 inches in diameter per acre. Multiply 26 by 0.85 (from table 20) to find how many of the 26 stumps would be expected to sprout. $26 \times 0.85 = 22$. Note that 22, number of expected stump sprouts per acre for 2- to 5-inch black oaks, is listed at the bottom of figure 8.

c. Similarly, compute the expected number of stump sprouts for the other size classes of black oak (5 for the 6- to 11-inch class, 4 for the 12- to 16-inch class) and note that all these classes sum to 31. Do the same for all oak species.

d. Summing size classes for all oaks gives a total of 124 expected oak stump sprouts per acre (fig. 8).

7. Note that the sample data from figure 2 gave 17 plots stocked of a total of 40, or 43 percent of plots stocked (determined under point 4 above). Go to the tabulation below and find the number of stump sprouts required in combination with

Table 20. - Expected percentage of oak stumps that will sprout after cutting¹

Size class ²	Black oak	Scarlet oak	Northern red oak	White oak	Chestnut oak
2-5	85	100	100	80	100
6-11	65	85	60	50	90
12-16	20	50	45	15	75
17+	5	20	30	0	50

¹ Adapted from Roth and Hepting (1943), Wendel (1975), Johnson (1975), and unpublished data at Columbia, Missouri.

² D.b.h. class of parent tree.

stocked plots to meet minimum stocking requirements at the next lowest percent down from 43 (i.e., 40). Opposite 40 note that 95 stump sprouts are needed to make up the deficiency in advance reproduction.

Stocked 1/735-acre plots (Percent ³)	Stump sprouts required (Number per acre)
59	0
55	19
50	44
45	69
40	95
35	120
30	145
25	170
20	196
15	221
10	246

8. Because the computed value (124) exceeds the tabulation value (95), there will be enough oak stump sprouts to make up the advance reproduction deficiency. Thus, the oak component of the new stand will be adequate and the old stand can be harvested.

9. If the number of expected stump sprouts does not compensate for advance reproduction deficiencies, harvesting should be delayed until adequate oak advance reproduction is established and reaches the minimum size of 4.5 feet in height.

10. Unless the stand is protected or the wildlife controlled, it will probably be impossible to get adequate natural oak reproduction in areas where deer browsing is heavy and where there are high populations of acorn-consuming wildlife. The alternative is to plant oak seedlings and protect them from wildlife.

³If the percent of stocked plots lies between the 5-percent intervals, use the lower figure, e.g., 43 percent stocked plots should be considered 40 percent.

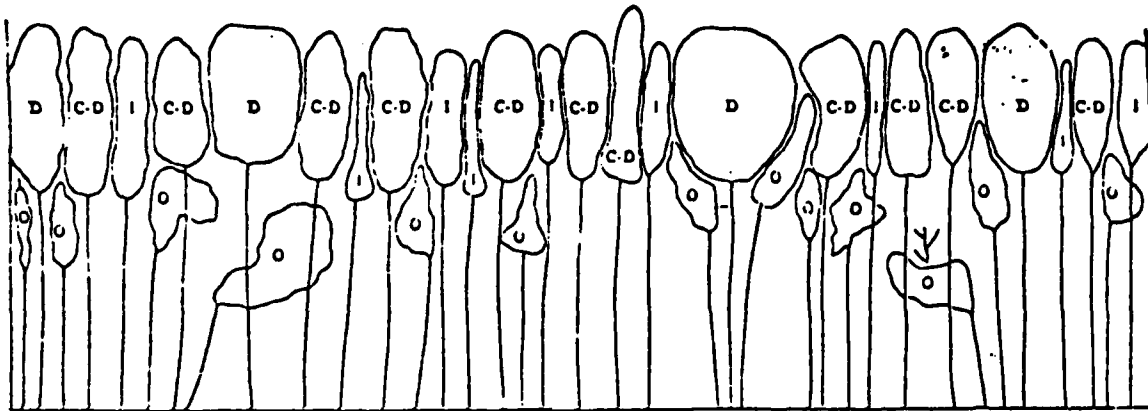
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APPENDIX H
ILLUSTRATIONS OF SILVICULTURAL PRESCRIPTIONS

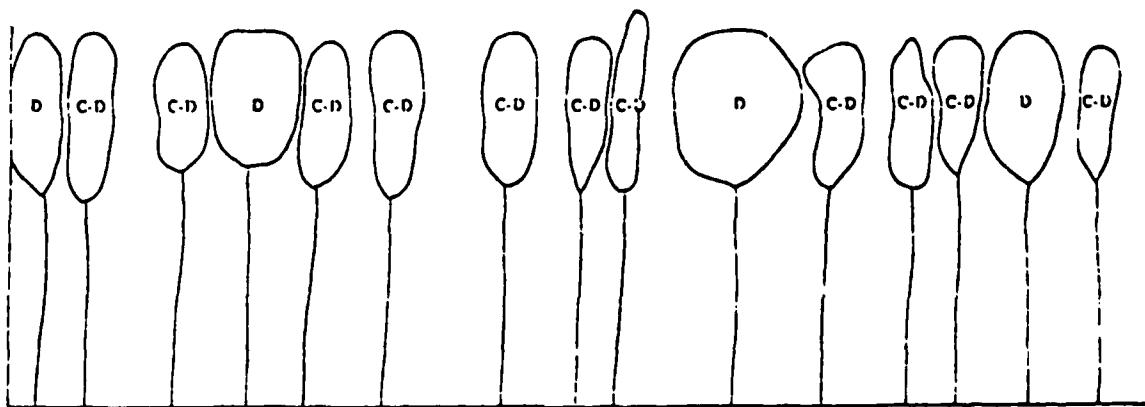
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THINNING

A 50 year old stand of hardwoods before thinning. The letters indicate the crown classes of the trees.



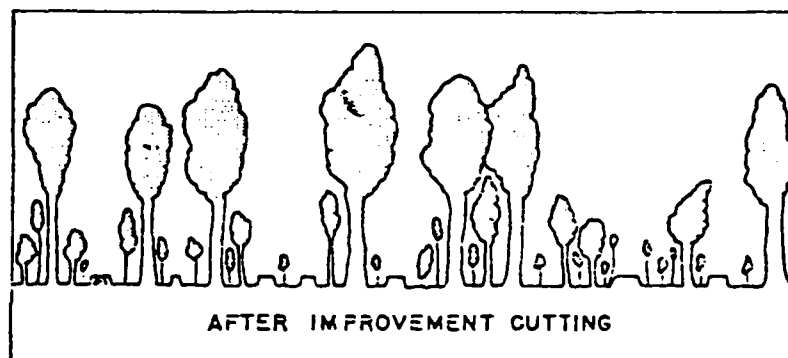
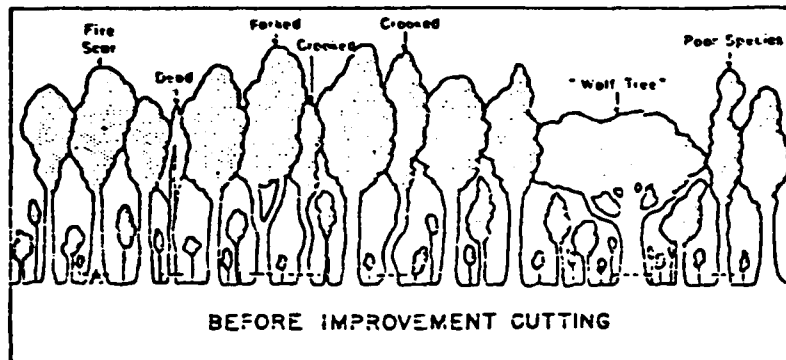
Same stand after a conservative thinning. All overtopped and intermediate trees were removed.



Source: Smith, D. M., 1962, Practice of Silviculture.

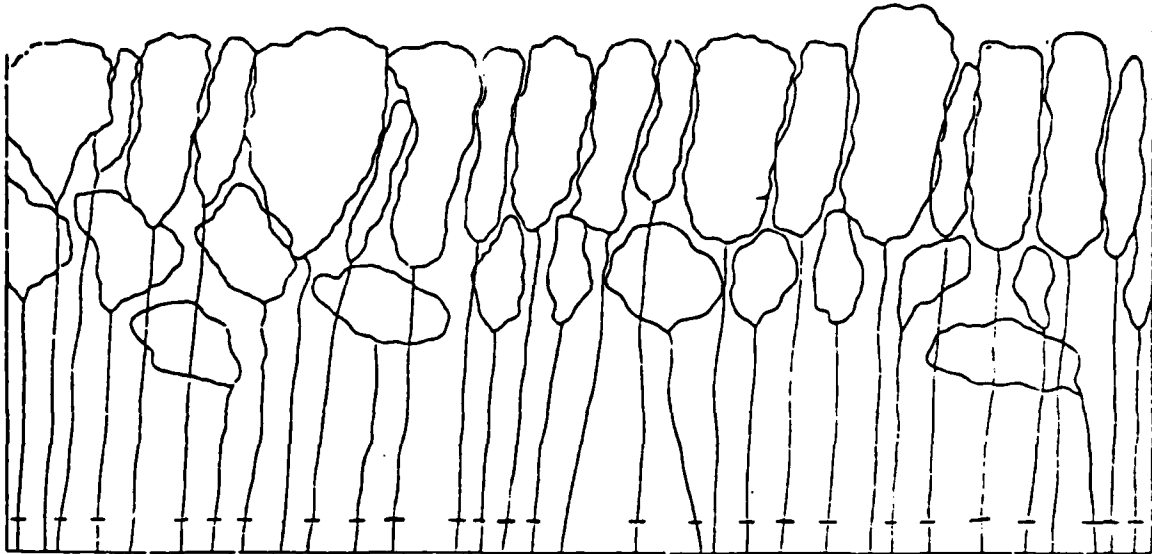
What to take out to improve the forest.

CONTROL OF UNDESIRABLE TREES

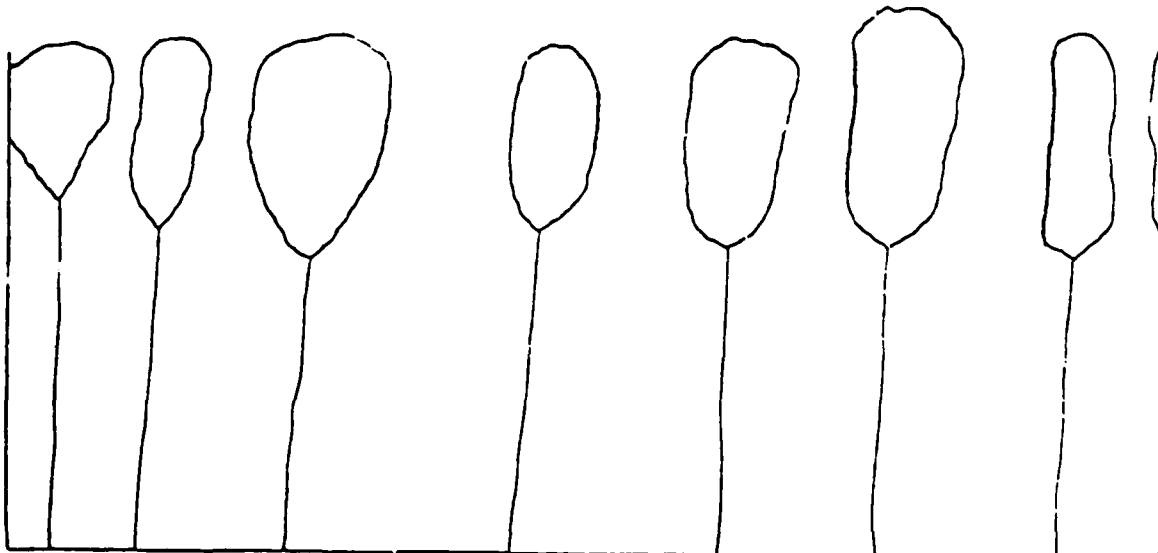


SHELTERWOOD SYSTEM

An unthinned, 75 year old hardwood stand that is to be reproduced by the shelterwood method. Trees to be removed in the first of two cuttings are indicated by dashes and are of the overtopped, intermediate and codominant classes.



The same stand three years after the first shelterwood cut.



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APPENDIX I

BALD EAGLE MANAGEMENT PLAN

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MANAGEMENT PLAN FOR BALD EAGLES ON NSWC D/L LANDS

Description of the Area

The eagle nesting habitat of primary concern is located along the Upper Machodoc Creek, Pumpkin Neck Annex, NSWC, Dahlgren, Virginia. Pumpkin Neck is an isolated weapons testing facility with few man made structures. Uses are restricted to explosive ordnance testing and occasional recreational uses such as hunting and fishing.

Potential eagle nesting habitat is located adjacent to Gambo Creek, Main Site, NSWC D/L. These areas are delineated on Figure I-1.

Nest Site Characteristics

The 1978 active nest is approximately 100 feet high in a loblolly pine tree located on a bluff at the edge of the Upper Machodoc Creek. The nest bearing tree has been struck by lightning, however it seems in stable condition. The surrounding forest area is composed predominately of loblolly pine, yellow poplar, American beech, and white and red oaks. Major understory vegetation includes American holly and mountain laurel.

Two inactive nests were also discovered at Pumpkin Neck. One is located in a pine stand adjacent to the rocket launching facility. This nest is thought to be atypical and does not require management as do the other nests. Another nest, probably the oldest on Pumpkin Neck is located approximately 90 feet high in a yellow poplar tree, on a bluff in the same hardwood stand as the 1978 active nest. This nest has been active on and off since 1962 and is thought to be alternate nest site. Nest locations are shown on Figure I-2.

Pair Behavior

The eagles observed in the 1978 active nest seemed at first to be very sensitive to human intrusion. However, as the nesting season progressed the incubating eagles became more accustomed to human encroachment. It seems that the nesting pair of eagles also became habituated to the explosives ordnance testing, which is the major use of Pumpkin Neck Annex. Testing took place throughout the critical nesting period with no noticeable adverse effects.

It was necessary for the Chesapeake Division natural resource staff to observe the eagles and their habitat at close range to determine what factors should be included in the management plan. However, in the future there should be no human intrusion into the primary nesting zone during the critical nesting period, as discussed in the Management Constraints Section.

Nesting History

Eagles have been observed nesting at Main Site and Pumpkin Neck Annex in the past. The forest bordering Gambo Creek at Main Site has supported active eagle

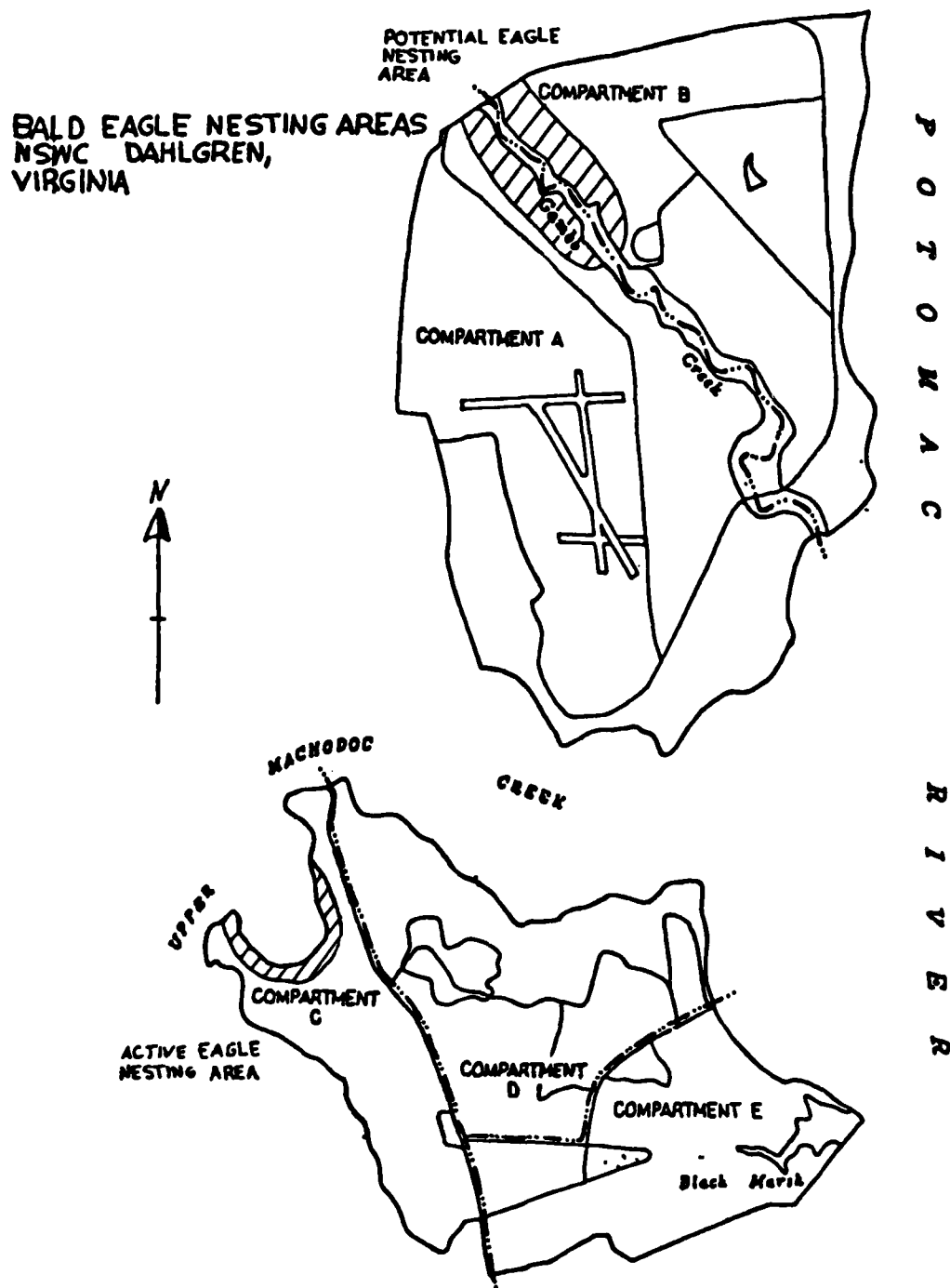


FIGURE I-1. BALD EAGLE NESTING AREAS, NSWC, DAHLGREN, VIRGINIA

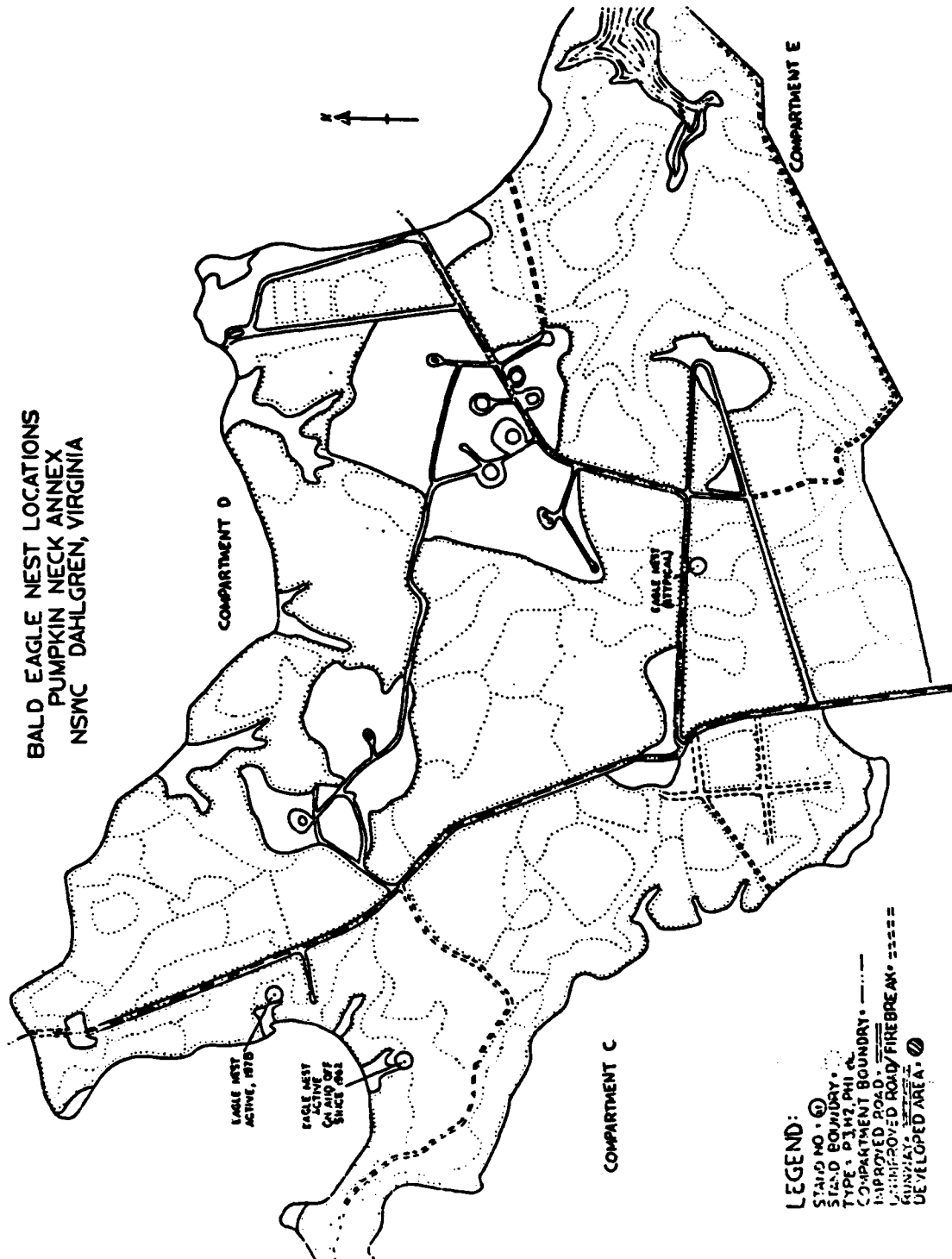


FIGURE I-2. BALD EAGLE NEST LOCATIONS, PUMPKIN NECK ANNEX, NSWC, DAHLGREN, VIRGINIA

nests on and off since 1961, however no active nests have been seen recently and no currently used nest have been found.

The inactive nest at Pumpkin Neck Annex has been used on and off since 1962. It is possible that this is an alternate nesting site. Eagles sometimes use a different nest each year, rebuilding old ones if necessary.

Management Constraints

The eagles nesting territories are divided into a primary and secondary zone. Certain activities are restricted in each zone at different times of the year. Management techniques apply equally to all nests within the nesting territory, even though a particular nest may not be used for 1 or more years.

The primary zone is the most critical area around the nest. The size of the primary zone and the activities that may take place within it will vary depending on the time of year. From July 16 to February 14 the primary zone will extend 100 yards in every direction from the nest tree. During the critical nesting period, which extends from February 15 to July 15 the primary zone will extend 300 yards in every direction from the nest tree. Year round restrictions within the primary zone include logging, building development, road construction and use of toxic chemicals. All human activities should be restricted during the critical nesting period. Critical period restrictions apply only to active nesting sites.

The secondary zone is an area outside the primary zone managed to further minimize disturbance to the eagles and to possibly provide future nesting sites. Size of the secondary zone is variable, depending on local topography and forest type boundaries. The secondary zone at Pumpkin Neck is composed of a hardwood stand bordering the Upper Machodoc Creek. This area is approximately 46 acres in size. Year round restrictions within the secondary zone include building development, permanent road construction, and use of toxic chemicals. Restrictions during the critical nesting period include logging, low level aircraft operations, use of firearms, camping, and picnicking. Occasional and limited human intrusion such as solitary hiking, bird watching, and fishing will not be disturbing in most cases. Management zones are delineated in Figure I-3.

Potential Nest Sites

Chesapeake Division natural resource personnel are planning selective tree harvests in the secondary zone, to commence within the next 2-3 years. This practice will ensure that there are adequate numbers of potential nesting trees in the secondary zone. Selective tree harvesting will encourage the growth of dominant and codominant (potential nesting and perching) trees and also provide for their regeneration. Any tree felt to be potential nesting or perching tree will not be cut.

In addition, the seedtree harvesting technique, as used in the pine stand bordering the secondary zone, is ideally suited for the regeneration of loblolly pine and for providing possible nesting and perching sites. The seedtree regeneration system will be used to harvest pine trees in and adjacent to the secondary zone.

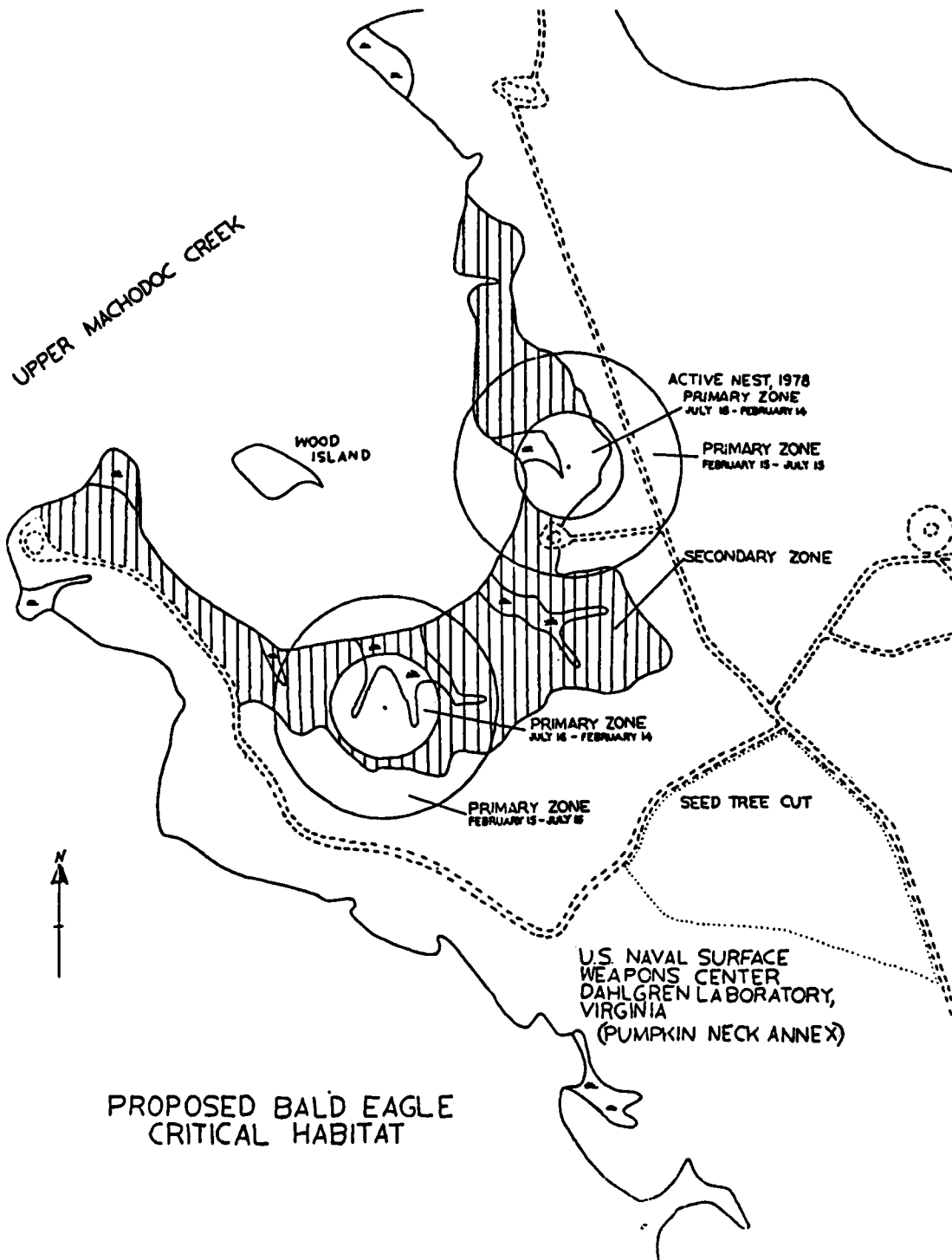


FIGURE I-3. PROPOSED BALD EAGLE CRITICAL HABITAT

Timber harvesting as planned and approved by Dr. M. Byrd, member Chesapeake Bay Bald Eagle Recovery Team, will not adversely affect the eagles habitat and will provide potential nesting and perching sites.

If an eagle nest other than the ones shown on Figure I-2 is discovered, Chesapeake Division should be notified.

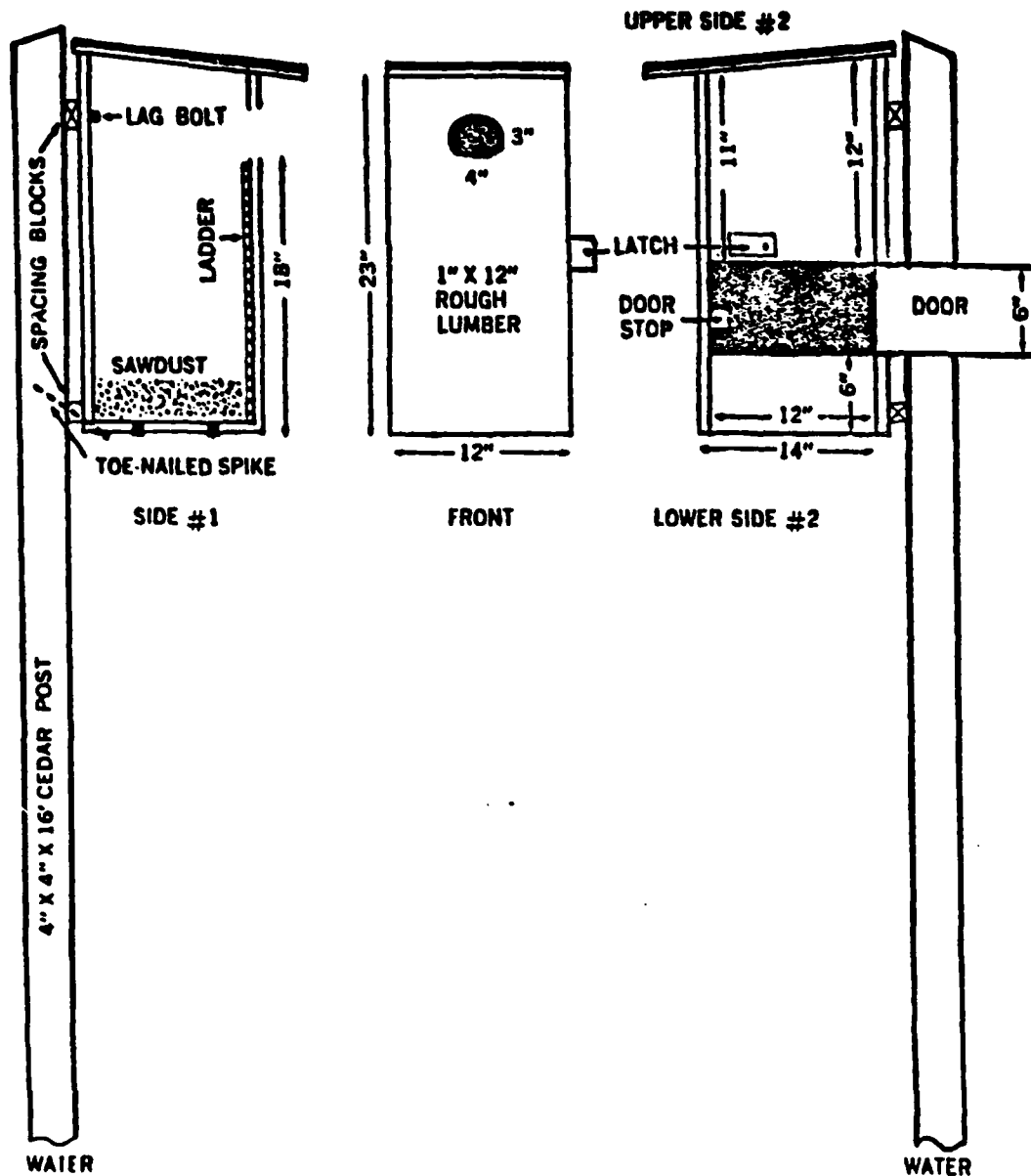
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APPENDIX J
NESTING BOXES

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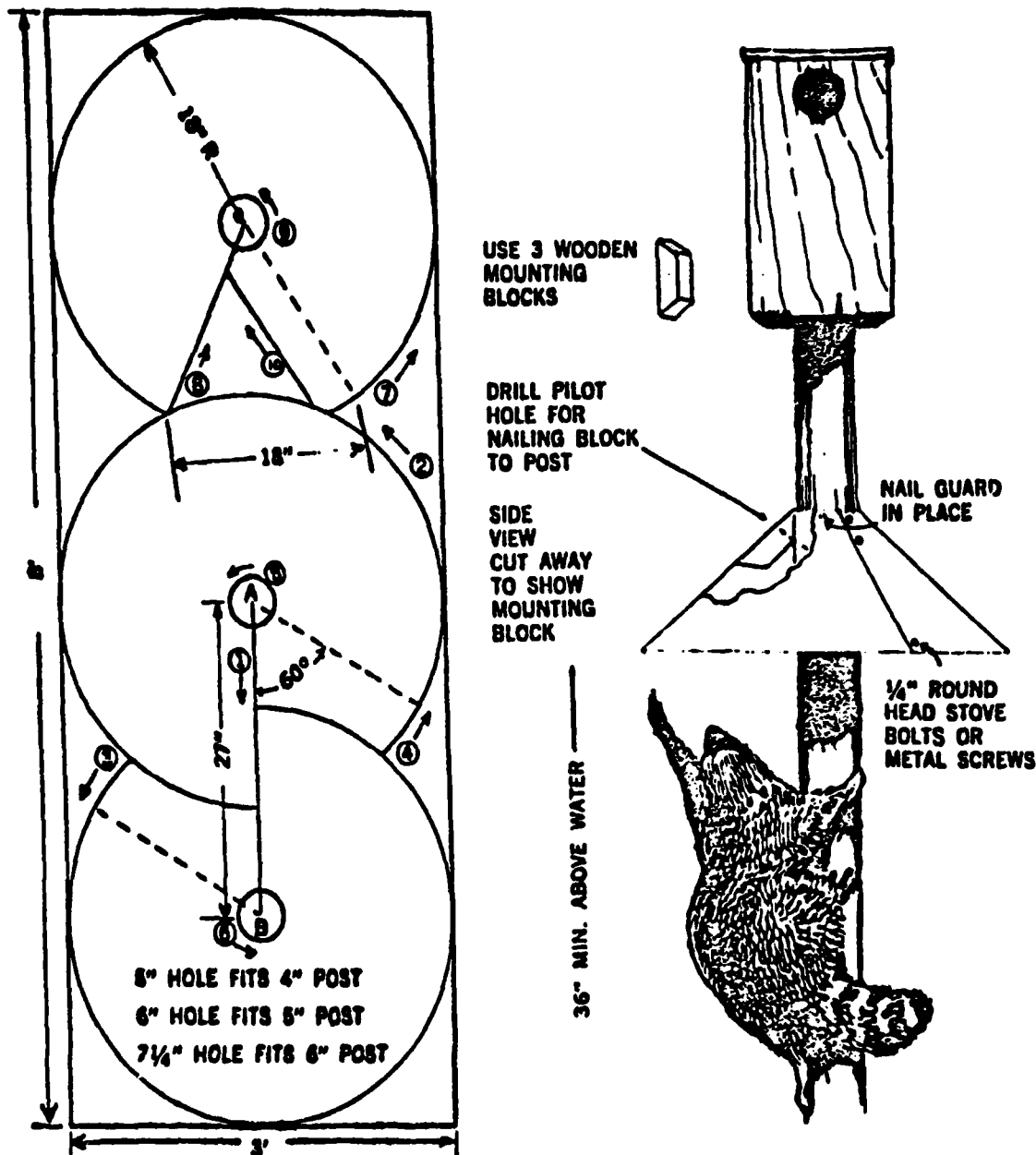
STANDARD WOOD DUCK NESTING BOX

This nesting box is cheap to build, easy to maintain and, properly safe-guarded, inaccessible to such nest predators as raccoons, snakes, and squirrels.

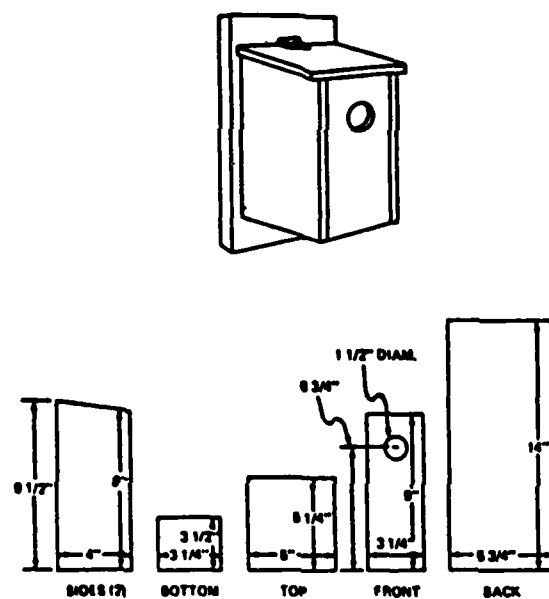


This box should be constructed of unplanned cedar, cypress, or other weather-resistant lumber. It should NOT be painted, stained, or creosoted. As the diagram indicates, the entrance should be oval-shaped with the broadest distance horizontal. On the inside front of the box, beneath the hole, a strip of screen or hardware cloth should be tacked to provide the ducklings a means of escaping the box.

PREDATOR GUARD



Cone-shaped, sheet-metal guard for protecting nest structures from predators. At right is layout for cutting 3 predator guards from a 3' x 8' sheet of 26-gauge galvanized metal. When installing the guard, overlap the cut edge to the dotted line. To facilitate cutting (on solid lines only) follow the sequence of numbers. Make circular cuts in counterclockwise direction. To make initial cut on line A-B, make a slot at A with a cold chisel. Use tin snips and wear leather gloves.



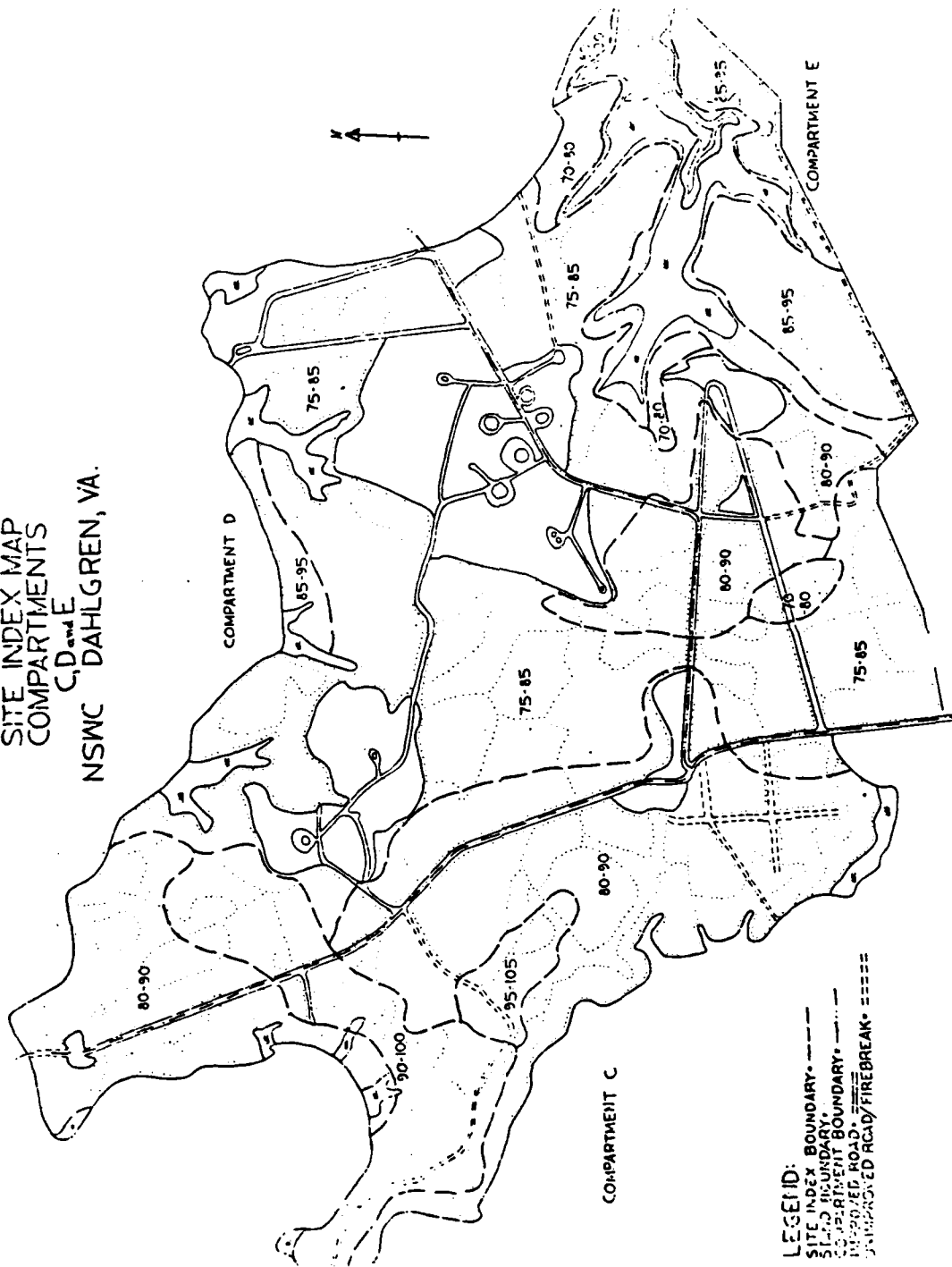
--Design of a bluebird box (Missouri Conservation Commission, n.d.).
The top is hinged to facilitate cleaning. Place bird box 2-5 m from
ground in a sunny place along a roadside.

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APPENDIX K
ANNUAL FORESTRY INCREMENTAL PLANS

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SITE INDEX MAP
COMPARTMENTS
CD and E
NSWC DAHLGREN, VA.



LEGEND:
SITE INDEX BOUNDARY. ———
LAND BOUNDARY. - - - - -
COMPARTMENT BOUNDARY.
IMPROVED ROAD. = = = = =
UNIMPROVED ROAD/FIREBREAK. - - - - -

END

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