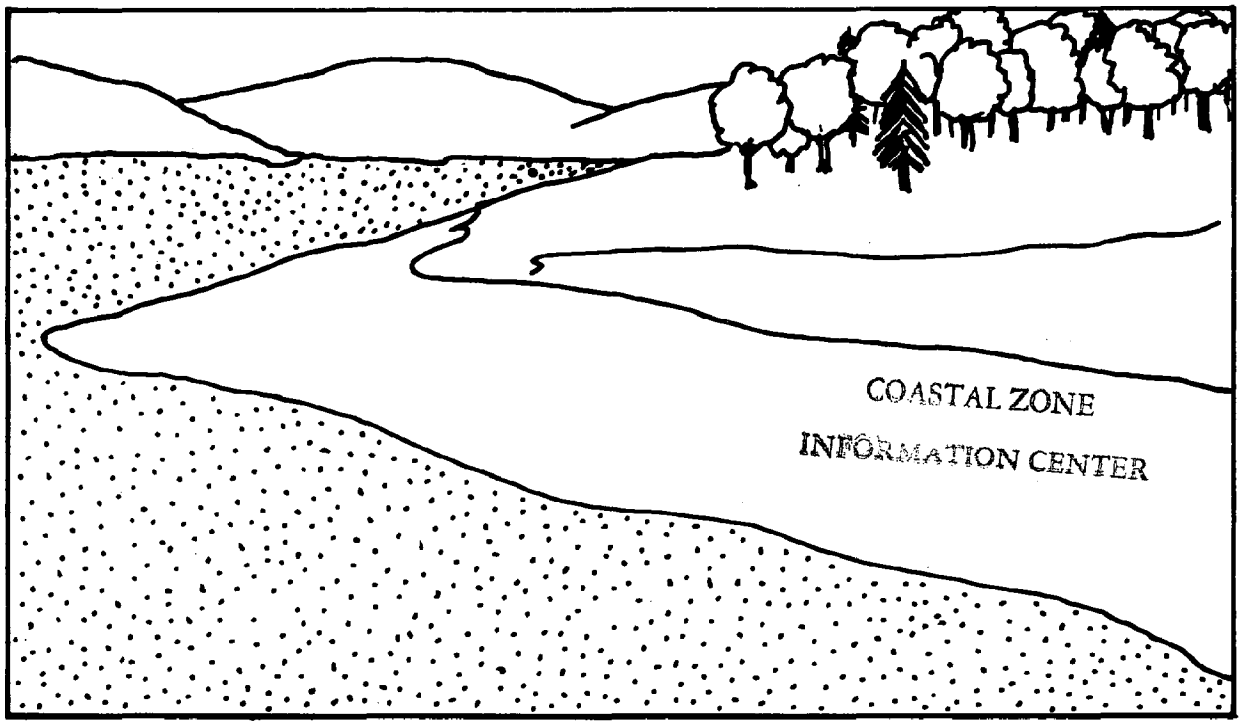
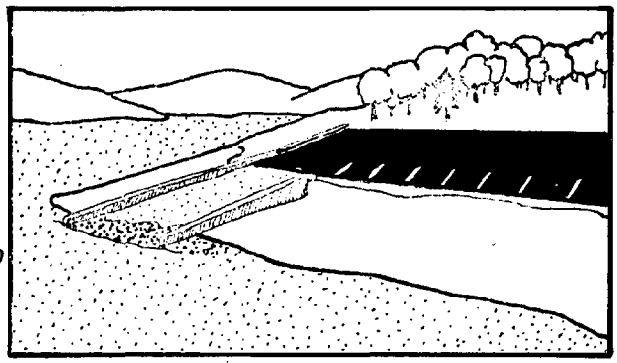
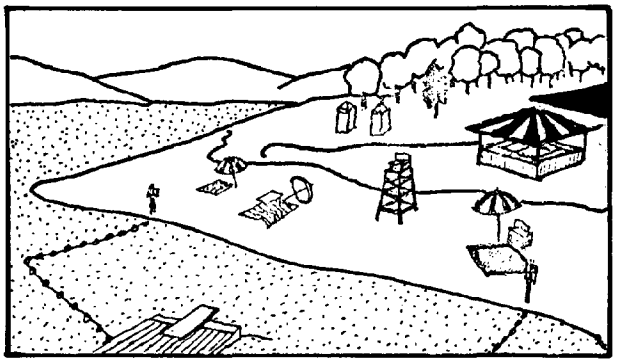
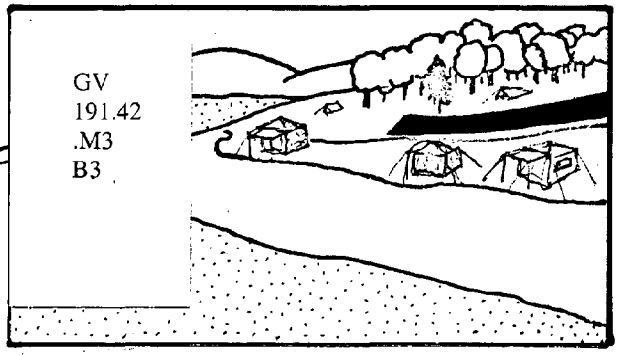
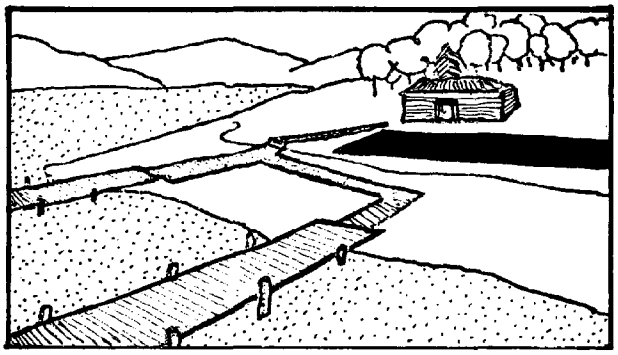
BAY ACCESS PARK STUDY











PREFACE

The Bay Access Park Study was initiated in the spring of 1979 and was designed to partially fulfill the requirements of the Coastal Zone Management Act, as amended in 1976. The methodology used in this study was based on the Upland Natural Areas Study of 1976. The fundamentals of this methodology are described in the opening chapters of this manual.

An effort was made initially to obtain input into the methodology from potential users of this study and from experts in the various subject areas for which site information was to be obtained.

Approximately 44 sites were sampled on the Western and Eastern Shores of the Chesapeake Bay during the summer of 1980. The results of this inventory will be made available in computer format for potential data users.

The User Manual incorporated in this report represents the methodology utilized by the Coastal Resources Division (CRD) for sampling waterfront access sites in the State's coastal region. In addition, this manual describes the data available on each site and the techniques for retrieval of this data. This manual is intended to serve as a tool for potential users who may be interested in providing additional public waterfront access within Maryland.

ACKNOWLEDGEMENTS

This study would not have been possible without the information and assistance of many individuals. Special thanks are due the following: Tom Chaney, U. S. Water Resources Council and Margaret Johnston, Chesapeake Bay Commission for their continuous support and technical guidance during the early stages of this study; John Williams, Tidal Fisheries Division, for his patient guidance in our challenge of the Statistical Analysis System; Wayne Klockner, Nature Conservancy (MD Chapter), for his technical assistance to the field crew and information on the UNAS field site process; and to the numerous county representatives of the planning and zoning office and recreation and parks who kindly met with us in order to facilitate the final site selection process.

It is such cooperation and assistance that will make the Bay Access Park Study a successful endeavor to provide public shorefront access to Maryland waters. To you all, a hearty thanks.

PERSONNEL

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INTRODUCTION

The Bay Access Park Study (BAPS) is a major Coastal Resources Division effort to increase the amount of available public recreational opportunities in Maryland's coastal zone region. The basic function of the BAPS is to consolidate the various inventories of open space areas which have potential for use as waterfront access sites.

The BAPS was initiated in response to a request by the Federal Office of Coastal Zone Management (OCZM) for Maryland's Coastal Resources Division to increase its efforts in provision of public access to the Chesapeake Bay and its tributaries. In response to specific objectives of Maryland's Coastal Zone Management Program document, BAPS is geared to:

1. protect, maintain and improve the quality of the State's tidal waters for propagation of wildlife, fish and aquatic life, and for human use and enjoyment; and

2. to promote increased recreational opportunities in shoreland areas, to promote increased public access to tidal waters, and to assure that these occur in a manner which protects the quality of coastal resources and which maintains public health and safety.

The first phase of the BAPS was the identification of existing waterfront sites which provided some degree of public access. This list includes State-owned lands, marinas and boat launching ramps. This county-by-county inventory is available through the Coastal Resources Division office in Annapolis.

The second phase of the BAPS included review of existing inventories for a listing of potential shorefront access sites. The ownership and development status of these sites were then checked with the assistance of the individual county planning and zoning offices and recreation and parks offices.

Following input from the counties, a final listing of potential sites was established and an on-site field study was conducted. The data obtained for each site was gathered using the methodology for the Upland Natural Areas Study (UNAS). This was done in an effort to make the two studies homogeneous.

After the site data was assimilated and coded, a computer program was designed through use of the Department of Natural Resources' Statistical Analysis System (SAS). This effort will facilitate retrieval of the data and any additions and/or corrections which must be made to the system.

As a supplement to the computerized system, a Statewide priority ranking will be done based upon Maryland's Outdoor Recreation and Open Space Plan ranking system which will be modified to be applicable to shorefront access needs. Once these needs are identified, the sites will be evaluated using the guidelines and criteria which have been developed by relevant State acquisition agencies (Land Planning Service, Capital Program Administration, Maryland Park Service, etc.) A priority listing of sites recommended for acquisition at the state level will result.
Such coordination is essential since the CRD is not an acquisition agency and does not have the principal authority for the provision of recreation and open space opportunities in the State.

In addition, a county priority ranking will be conducted on an individual basis with consideration for each jurisdication's special needs and guidelines. This will also be done in a manner compatible with Maryland's Outdoor Recreation and Open Space Plan.

The user manual is made available to facilitate the use and understanding of the BAPS data collection, methodology and computer system. It will also hopefully emphasize the concern of the Coastal Resources Division to increase public access to Maryland's shoreline areas. In addition, this manual should provide potential users with the information they will need to get involved in this concerted effort. Provision of public shorefront access and recreational opportunities is an important management objective of coastal zone planning; therefore, the BAPS should be identified as an important tool in accomplishing this task.

In summary, the important features of the BAPS are:

1. The consistency and uniformity of the data collected,

2. The methodology is designed to fulfill the information needs of potential users. Since the users were included in the development stages of the study, they are more likely to use the data collected,

3. The sampling techniques are easily replicated so that new sites can be added and the study can be continuously updated, and

4. The public waterfront access sites information is readily available to potential users.

STUDY AREA

The State of Maryland is divided into four regions: Western Shore, Eastern Shore, Piedmont Province and Appalachian Province. The Bay Access Park Study was limited to just the Western Shore and Eastern Shore. However, this users guide includes a description of all four regions for future reference.

WESTERN SHORE

The Western Shore of the Chesapeake includes the Potomac River up to the District of Columbia and Cecil County. The inland boundary essentially follows a line corresponding to Interstate 95.

Maryland's Coastal Plain falls within the northern embayed portion of the Atlantic Coastal Plain physiographic province. This embayed portion of the Coastal Plain is characterized primarily by the presence of drowned river systems and barrier beaches (ocean coast). The Bay itself represents the drowned portion of the Susquehanna River and its tributaries.

The rolling uplands of the Western Shore Coastal Plain are generally bounded by deep stream valleys. These uplands are underlain by a series of southeasterly dipping layers of relatively unconsolidated sand, clay and gravel. These sediments range in age from early Cretaceous to Holocene and represent deposition in a variety of marine environments. Fossils are abundant in many of these formations, particularly in the Calvert Cliffs area. (The first fossil to be described in North America came from these formations.)

Nine major soil associations occur in the study area. Because of the nature of the parent material these soils are usually sandy and often have significant amounts of silt and clay mixed in. Medium to moderately coarse textured soils predominate throughout the Western Shore. Of note are the Beltsville soils which cover much of Southern Maryland. These soils are characterized by a deep, compact fragipan lying below the soil surface. This layer inhibits both water movement and root penetration often causing the vegetation in these areas to represent types associated with arid regions. Othello soils, found throughout the Coastal Plain, develop on the fine silts of lowlands deposits and, therefore, are generally found in level, flat areas bordering the Bay and its tributaries.

Mixed hardwood forests originally covered most of the Western Shore uplands. These forests are characterized by oaks, hickories, maples, beech and gum. Dogwood, sassafras and holly are characteristic understory species. Because of intensive agricultural practices and logging, few remnants of Maryland's original forests remain. Typical forest stands today are second and third growth stands. This extensive clearing also accounts for the increase in the percent of pine forests throughout the region. The pines represent an early successional stage which is often maintained because of continued disturbance. Typical pine species include Scrub Pine (Pinus virginfana) and Loblolly Pine (Pinus taeda) (Shreve, et al, 1910).

Two vegetation associations can be considered lowland areas, the Gum-Pine association and river swamps. The Gum-Pine association is characterized by Sweet Gum (Liquidambar styraciflua) and Loblolly pines along with red maples and several oaks. The river swamps occur along the flood plain of the rivers. The best example of this vegetative community is Zekiah swamp running along the Wicomico River in Charles County. The dominant trees of this association are Sweet Gum,

River Birch and Swamp Oaks. Southern Maryland lies just within the range of the Bald Cypress (Taxodium distichum) which is represented in a large swamp in Southern Calvert County (Shreve, et al, 1910).

Extensive marshes are found bordering the rivers of Maryland. These grade from typical salt marshes in the lower stream reaches to fresh marshes further upstream and in the northern portions of the Bay. These marshes play an important role in buffering the stream banks from the waves washing against the shore as well as trapping sediments washed from the uplands. Typical species range from Spartina, Scirpus and Juncus for salt marshes to Typha, Potamogeten and Numphaea in fresh marshes.

EASTERN SHORE

The Eastern Shore is considered to be that part of Maryland on the Delmarva Penninsula south of U.S. Highway 40.

The study area lies in the southern embayed section of the Coastal Plain Province, and ranges in elevation from sea level to 253 feet at Mt. Mauldin on Elk Neck. In general, the landscape is flat, with typical elevations ranging between 20 and 60 feet. Several cliffs occur along the northern coast in Kent and Cecil Counties. Several steep, broad-faced scarps--abrupt changes in topography carved out by the advancing and retreating ocean during the Pleistocene Age--occur inland in Queen Anne's, Kent and Talbot Counties.

The soils of the region are generally fine-textured and poorly drained along the Talbot Terrace and more medium to coarse-textured and better drained on the Wicomico Terrace.

Vegetation on the Eastern Shore is more highly diversified than any other part of Maryland. This is due, in part, to the extent and diversity of swamps, natural ponds, marshes and bogs, to the variety of soils, and to the fact that several botanical species approach their northern climatic limit on the Eastern Shore.

The agricultural style of life is predominant on the Eastern Shore. A mosaic of farms and woodlands characterize the northern part of the study area. Farther south, in Kent, Queen Anne's, Talbot and Dorchester Counties, most of the land is in agriculture--a land use pattern which has persisted for years. Talbot County hosts many estates, and is the second richest county in the State. In Talbot County, Route 50 generally divides estates to the west from the large working farms on the east. Approximately 50% of Dorchester County is swamp or marsh. Route 50 separates agrarian lands from marshes and swamps to the south.

The land use of the southern section of the Eastern Shore is a mixture of cropland and chicken farms with large timbered areas of loblolly pine.

Maryland's Piedmont falls within the northern portion of the eastern United States' Piedmont physiographic province. Approximately one-fourth of Maryland's land area lies within this province. The Piedmont is bounded on the east by the Fall Line and on the west by the Blue Ridge (Catoctin Mountain). The region is characterized by gently rolling plateaus with low knobs and ridges rising above the common level. The region is maturely dissected by numerous deep, narrow stream valleys. Floodplains have formed along all of the streams and springs are very common.

The eastern portion of the Piedmont is underlain by a complex series of metamorphic rocks of undetermined age. Due to the variety of rocks and their varying erosion rates, this portion has a very diverse topography. The uplands are formed by gneiss, schist, granite and quartzite (Sugarloaf Mountain). Various intrusions of gabbroic rocks are present and, in certain areas, have been altered to serpentine which develops a very poor soil supporting characteristic, dwarfed vegetation. These distinctive areas have been termed the "Serpentine Barren". Belts of marble form the valleys and the sites of the big, regional reservoirs. The western portion of the Piedmont is underlain by a similar set of metamorphic rocks and, in the Frederick Valley, by Paleozoic limestones and Triassic shales, sandstones and siltstones.

Eleven major soil associations occur in the Piedmont province. These soils are derived from acidic metamorphic and igneous parent materials and are largely well-drained loams and clay loams. The composition of Piedmont soils predominately reflects the parent material due to the varied topography which tends to lessen the effect of the water table on soil formation. Also, the rolling topography accounts for the predominance of well-drained soils. The exception to this is the soils formed from serpentine bedrock. These soils have a clay subsoil which is relatively impermeable to water and surface drainage is strong thus creating xeric conditions. The sandstones and limestones of the western Piedmont form well-drained, acidic, sandy loams and loams.

Mixed hardwood forests predominate in the Piedmont province. Because of intensive agricultural practices and logging, the forests of the Piedmont are second and third growth stands. Several plant associations have been recognized and mapped (Brush, et al, 1976). The occurrence of these associations is based primarily on the availability of water which in turn is a function of soils, topography and geology. The predominant bottomland association in the Piedmont is the Sycamore-Green Ash-Box Elder-Silver Maple association. Other representative species in this association include red maple, white oak, flowering dogwood and grape. On the floodplains of the lower Piedmont and the Potomac River, the River Birch-Sycamore association occurs. Slippery elm, green ash and spicebush also occur in this type. The uplands of the Piedmont are covered by four major associations. In the lower Piedmont and the Frederick Valley, the Tulip Poplar association predominates. Other species of this association include red maple, white oak, mockernut hickory and black cherry. Also in the lower Piedmont are the distinctive "Serpentine Barrens". These areas are characterized by a stunted, xeric vegetation association, Chestnut Oak-Post Oak-Blackjack Oak. Growing on the dry, impermeable serpentine soils, this association is composed of blackjack

oak (Quercus marilandica) and post oak (Q. Stellata). The shrub layer is composed of blueberries, huckleberries and other ericaceous shrubs. The herbaceous flora of the Barrens contains several interesting species which are found nowhere else in Maryland. Two rare grasses, Holygrass (Hierochloe odorata) and Tufted Hairgrass (Deschampsia caespitosa) are confined to the open, prairie-like portions of Soldiers' Delight, a serpentine barren in Baltimore County (Maryland Park Service). Fameflower (Talinum teretifolium) and the type form of Field Chickweed (Cerastium arvense) are two wildflowers which are confined to the Barrens of the Piedmont (Shreve, et al, 1910). On the upper Piedmont, the Chestnut Oak association predominates. Included in this association are other upland oaks, pitch and scrub pines, pignut hickory and flowering dogwood. Serviceberry, american holly, mountain laurel and blueberries are important subcanopy species. On the eastern lower slope of Catoctin Mountain, the forests begin to assume a more northern character. This area is covered by the Sugar Maple-Basswood association which also includes hickories, northern red oak, white ash and flowering dogwood.

APPALACHIAN PROVINCE

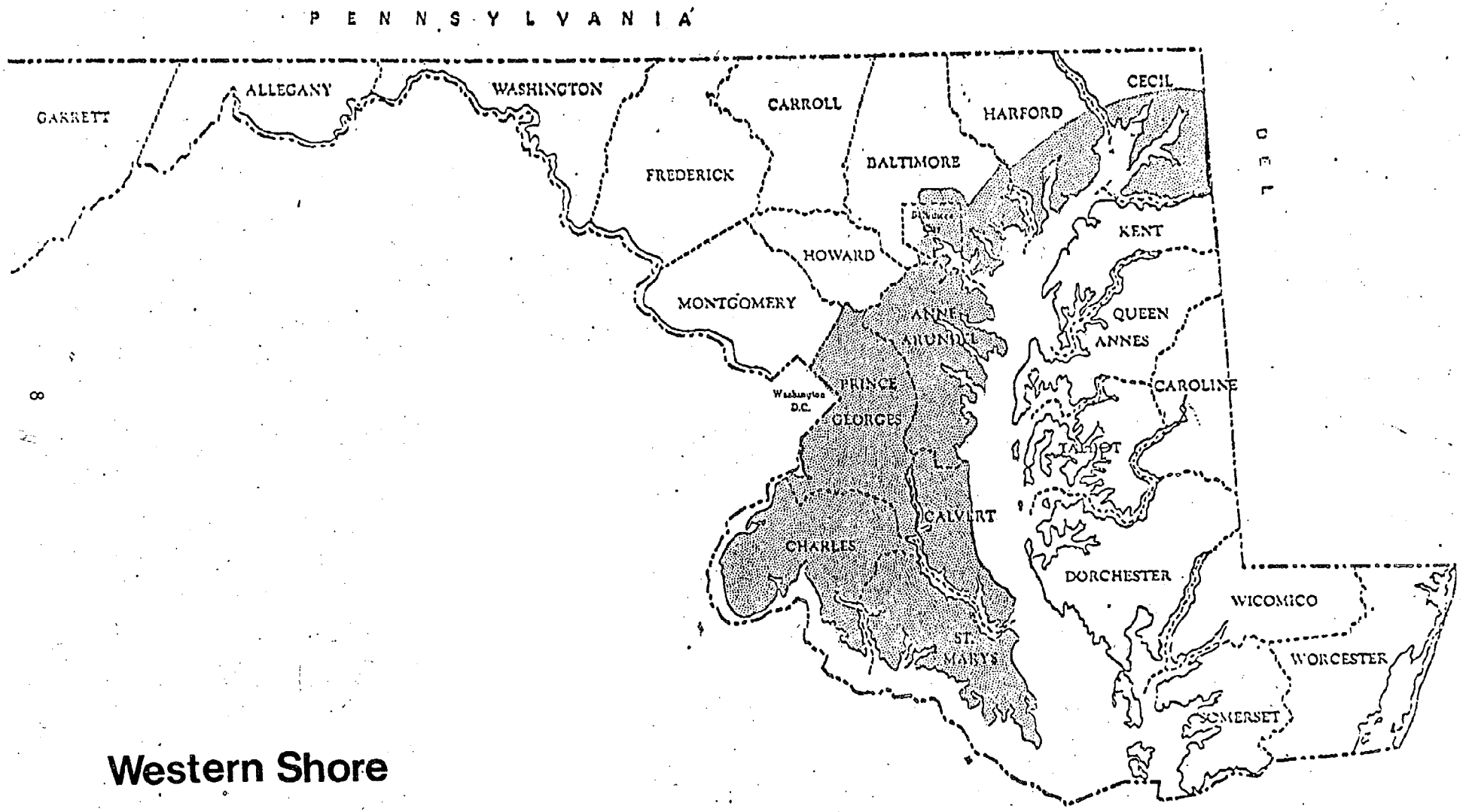
The Appalachian Province includes all of Maryland west of and including Catoctin Mountain. Elevations in this rugged province range from 1500' in the east to 3360' in Garrett County, the highest point in Maryland. One-fifth of Maryland's land area is included in this province.

The Appalachian Province is divided into three sections: the Blue Ridge district, the Valley and Ridge district and the Allegheny Plateau. The Blue Ridge district includes Catoctin and South mountains. These two continuous ridges are formed by erosion resistant quartzite, an early Paleozoic sedimentary deposit. The Middleton Valley, which lies between the ridges, is underlain by metamorphosed volcanic rocks. The Valley and Ridge district includes the land west of the Blue Ridge and east of Dan's Mountain, which forms the Allegheny Front in Alleghany County. In the east is the Hagerstown Valley which is underlaid by early Paleozoic limestones. In the Western portion of the district are the Allegheny ridges, a series of level, continuous ridges formed by resistant Paleozoic sandstones and quartzite. The intervening valleys are underlain by weaker shales and limestone. The Allegheny Plateau includes western Alleghany County and all of Garrett County. The district is characterized by a broad plateau with several parallel ridges crossing it in a NE-SW direction. The elevation of the ridges exceeds 3000' in some areas and the topography is rugged. The western portion of Garrett County is part of the Ohio River drainage. The remainder of the Appalachian Province drains into the Potomac River. An interesting geological feature of the Allegheny Plateau is the presence of coal beds amongst sedimentary sandstones, shales and siltstones.

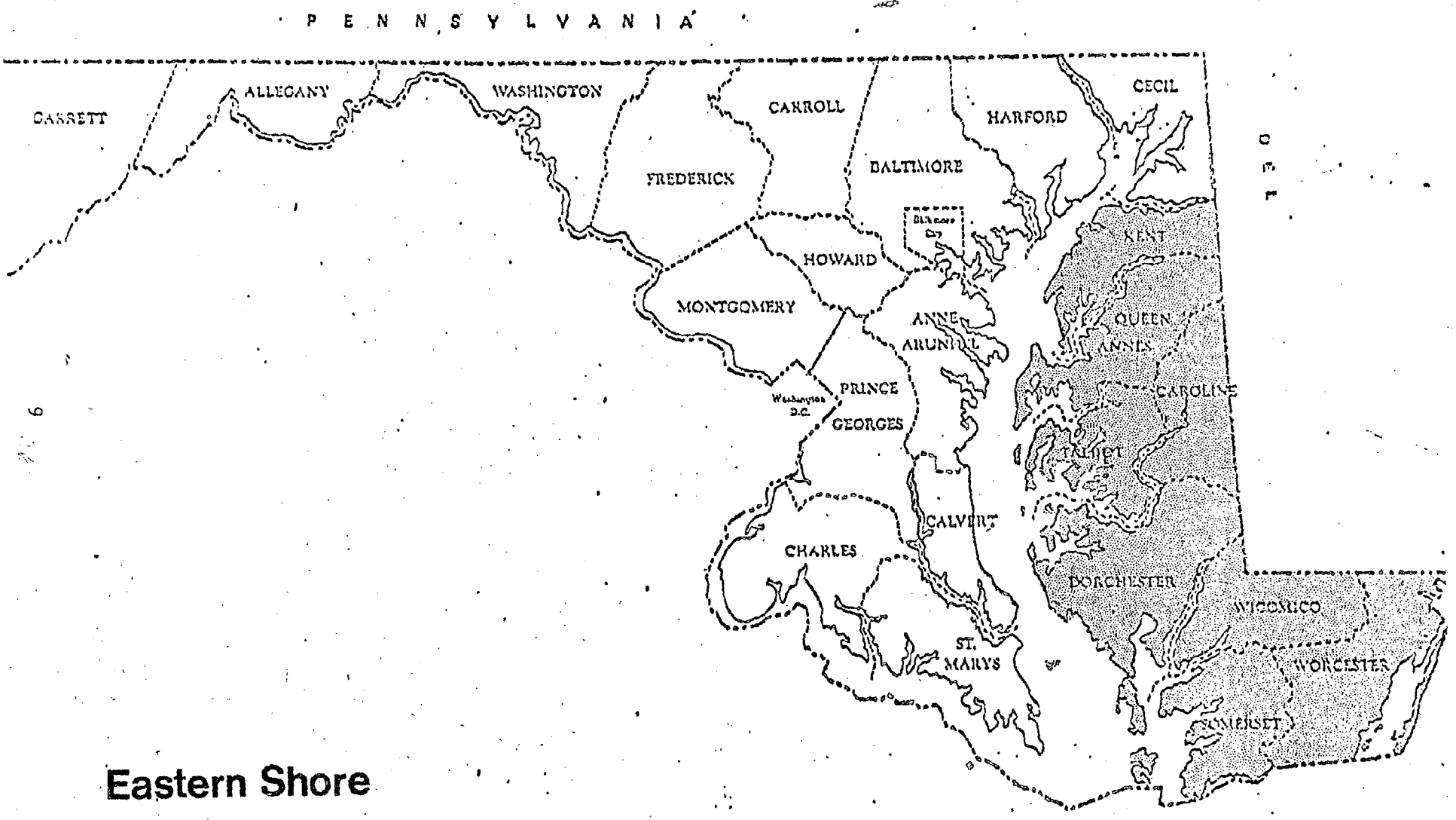
Due to the topography of the Appalachian Province, the soils of the province intimately reflect their parent materials. There are 12 major soil associations in the province. The sandstones and shales give rise to moderately coarse-textured acidic soils. The Valley limestones and shales give rise to medium-textured calcareous soils. Along the Potomac River, complex alluvial soils have been deposited.

In contrast to the rest of Maryland, the flora of the Appalachian Province is characterized by plant species which are "northern" in distribution. The Chestnut Oak Association (as described earlier; Brush, et al, 1976) covers the stony ridges throughout the province. In areas of Alleghany and Garrett Counties, the Chestnut Oak-Bear Oak association predominates. This association is

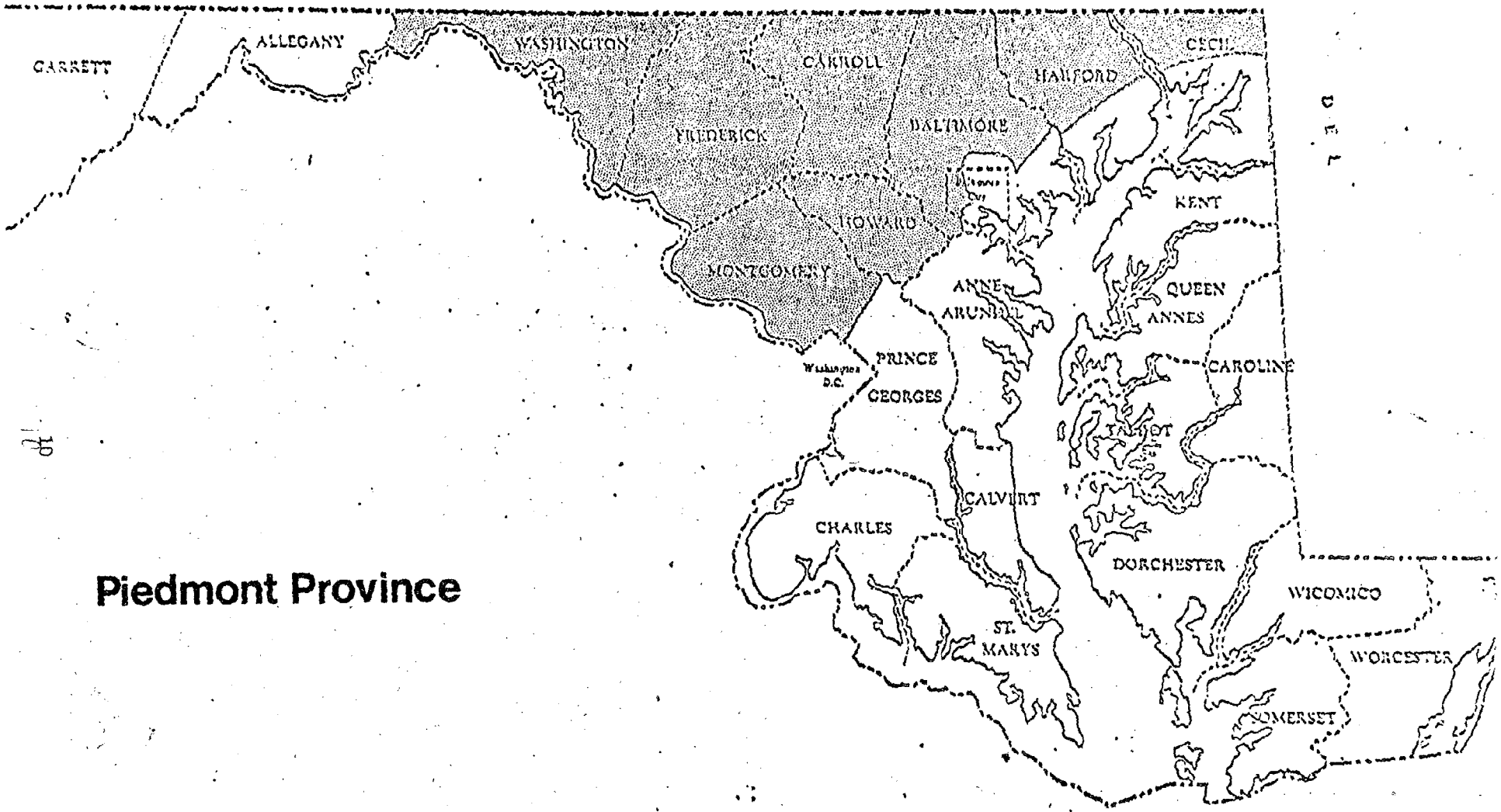
characteristic of xeric conditions such as those found on the "Shale Barrens" of the valley and ridge district. These areas are the result of Devonian shale outcrops, which have very low moisture retention capability and during sunny days, a very high surface temperature. Due to this set of environmental conditions, the Shale Barrens support an endemic herbaceous flora which includes such plants as shale goldenrod (Solidago harrisii) and shale aster (Aster oblongifolius). The broad valleys of the Appalachian Province are covered by the Sugar Maple-Basswood association, and along the floodplains of the valleys east of the Allegheny Front, the Sycamore-Green Ash-Box Elder-Silver Maple association occurs. However, in the steep, narrow stream valleys draining the ridges and the Allegheny Plateau, hemlock is common in a Hemlock-Yellow Birch association. Sweet birch (Betula lenta) and yellow birch (B. lutea) are the common associate species. On the Allegheny Plateau are several wetland areas which are unique in Maryland. These are the upland bogs characterized by larch (Larix laricina), red spruce and other plant species common to bogs of glacial origin in the northern U.S.



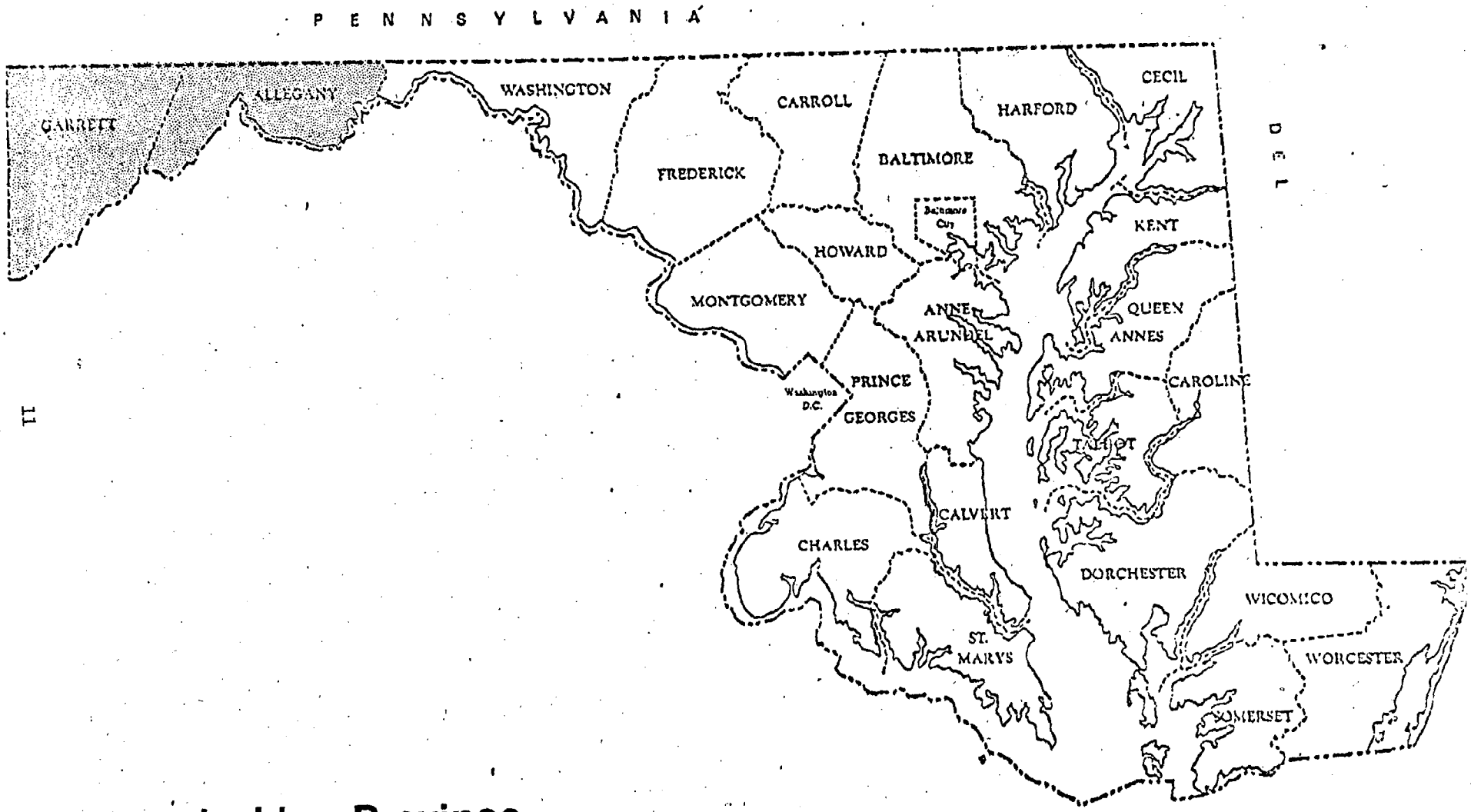
Western Shore



Eastern Shore



Piedmont Province



Appalachian Province

SITE SOURCES

The areas selected as candidates for field investigation were chosen and mapped from the following sources. The initials, preceding each reference are those which are recorded on the site folders to indicate site source and to reference background information.

JA - Jackson, William. 1973. Chesapeake Bay: Inventory of Potential Shoreline Access, Recreation and Open Space Areas. Part I: The West Shore. Maryland Department of Natural Resources, Program Planning and Evaluation section. (Unpublished)

This study was undertaken in the summer of 1972 to identify areas with the potential to provide public recreation, open space, or water access. Sites described and mapped by this study are included for study as potential natural areas.

JAE - Jackson, William. 1973. Chesapeake Bay: Inventory of Potential Shoreline Access, Recreation and Open Space Areas. Part II: The East Shore. Maryland Department of Natural Resources, Program Planning and Evaluation section. (Unpublished)

Companion volume to Part I: The West Shore. Areas in Cecil County are included in this volume.

UNAS - _____. 1976. Maryland Uplands Natural Area Study. Maryland Department of Natural Resources, Coastal Zone Management Program. A study to inventory and assess natural area throughout the State of Maryland.

Recommended for Future Reference

PA - Public lands taken from areas mapped in green on the county topo maps and areas proposed for acquisition by Department of Natural Resources, Land Planning Services.

PLOM - Shreve, Forrest. 1910. The Plant Life of Maryland. Maryland Weather Service, Johns Hopkins Press. This volume describes the distribution of plant life in Maryland.

SM - _____. 1974. Natural Areas of the Chesapeake Bay Region: Ecological Priorities. Center for Natural Areas, Ecology Program, Smithsonian Institution.

Priority for preservation. This survey made use of information already available. Preliminary field checks were made on 30 percent of the designated areas.

SMPA - Smithsonian Center for Natural Areas, 1973. "Areas Currently Protected" mapped on 1:250,000 scale Chesapeake Bay Region map.

SNAACP - _____. 1974. Survey of Natural Areas of the Atlantic Coastal Plain. Center for Natural Areas, Office of International and Environmental Programs, Smithsonian Institution.

This survey mapped and described selected Natural Areas on the coastal plain between Georgia and Massachusetts. Sites were mapped on quad scale maps for use by the National Park Service.

SP - _____. 1975. Compendium of Natural Features Information. Maryland Department of State Planning.

This compendium serves as an update of the Catalog of Natural Areas in Maryland. The Natural Areas were briefly described and mapped at a scale of 1:63,360. These sites were not field checked.

WA - Abbot, Jack. 1976. 1976 Eagle Nest Survey. Cooperative project with Maryland Wildlife Administration. (Unpublished)

Bald eagle nest sites field checked yearly.

WE - _____. 1968. State Wetlands Inventory. Cooperative project, Department of Game and Inland Fish, Department of State Planning. (Unpublished)

Most of these wetlands were not field checked and any information concerning them should be considered unverified.

Brush - Brush, Grace and M. Katherine Poese, 1975 and 1976. Personal Communications. Following a field study of sampling and mapping forest vegetation in Maryland, these areas were nominated for study as potential Natural Areas. Usually, these are mapped as general areas which require further refinement in the field.

CNAM - _____. 1968. Catalog of Natural Areas in Maryland. Maryland State Planning Department. The purpose of this document was to briefly present some basic information on certain Natural Areas within the State of Maryland. Areas having unique historical, geological, or ecological value or a combination of such values were represented in this catalog. "Whenever possible the areas selected had to be in a natural state or near natural condition and not show evidence of recent disturbances that would impair their value." These areas were not field checked.

CT - Maryland Department of Natural Resources, Maryland Forest Service. 1976. State Champion Trees. Personal Communication.

HA - Harris, Herbert S., Jr. 1976. The Natural History Society of Md., Inc. Personal Communication. Know locations of endangered reptiles and amphibians in Maryland.

NA - U. S. Navy, Planning Division, Chesapeake Division. 1975. Personal Communication. Navy bases with significant forested areas to be checked for Natural Areas.

DATA MANAGEMENT

In order for the site information generated by this study to be easily accessed, a data management system was developed to store and retrieve the individual site descriptions. The data management system was designed with two main purposes: (1) to check the data for coding errors and (2) to print the data in an easily readable format. An example of the computer print-out is shown on the following pages. As designed, the management system will also allow retrieval of individual site descriptions or retrieval by individual parameters or groups of parameters. This will allow users of the data to objectively rank areas by evaluating the different parameters in the context of their importance of potential site uses. Wherever possible, the data format has been made compatible with the Department of Natural Resources' Statistical Analysis System.

The printout which follows is from the Bay Access Park Study, summer, 1980.

EAGLE HILL AREA NUMBER - 020599301000 01201 INVENTORY DATE - 07/19/76

SITE TYPE - UPLAND MIXED FOREST
COUNTY - ANNE ARUNDEL
AREA - 324 ACRES

COMMUNITY TYPES - 3
NEAREST TOWN - ARNOLDER
ELECTION DISTRICT - NUMBER 5

GEOLOGY - *MAGOTHY FORMATION
ELEVATION - 60 FEET
WATERSHED - WEST CHESAPEAKE BAY

ONE LINE DESCRIPTION - UNIQUE BOG SURROUNDED BY UPLAND FOREST ON AN UNUSUAL TOPOGRAPHIC FEATURE ALONG COAST

PRIMARY CATEGORY - UNIQUE PLANT COMMUNITY
SECONDARY CATEGORY - HABITAT AREA EXHIBITING OTHER INTERESTING FEATURES
TERTIARY CATEGORY - FOREST

ACCESS TO AREA	EASY
OWNERSHIP	*PRIVATE INDIVIDUAL
CURRENT USE	HUNTING
SECURITY	THREATENED WITHIN 5 YRS
OCCURRENCE	RARE
COMMUNITY DIVERSITY	MEDIUM
NATURAL INTEGRITY	NATURALLY PERMANENT
AQUATIC BUFFER ZONE	ADEQUATE
FOREST EDGE	MODERATE
CONTIGUOUS LAND USE	50% - ROAD 20% - WATERBODY 30% - RESIDENTIAL
AVERAGE WIDTH	GREATER THAN 1200 FEET
VISUAL EXPERIENCE SCORE	15
VISUAL EXPERIENCE	HIGH
WETLAND WILDIFE RATING	NONE

THIS 324 ACRE NATURAL AREA IS LOCATED ON THE NORTH SHORE OF THE MAGOTHY RIVER. THE SITE IS CHARACTERIZED BY A ROLLING TOPOGRAPHY AND AN EXTENSIVE UPLAND OAK-PINE FOREST WHICH COVERS A UNIQUE COASTAL FEATURE: A 120 FOOT HILL RISING FROM THE SURROUNDING FLAT PLAIN. AN IMPRESSIVE FEATURE OF THIS SITE IS A SMALL BOG LOCATED ON THE SOUTHERN EDGE OF THE SITE. THIS BOG IS UNIQUE NOT ONLY FOR ITS VEGETATION, BUT ALSO FOR ITS RELATIVE ISOLATION. IT APPEARS TO BE NATURALLY FORMED. ON ITS PERIMETER, SWEETGUM, SWEETBAY, BLACK GUM, AND RED MAPLE FORM A DENSE BORDER. LEATHERLEAF GROWS THICKLY AROUND THE EDGE WITH CLETHRA AND RED MAPLE ALSO PRESENT. THE HERB LAYER IS RICH AND VARIED WITH SPATULATE-LEAVED SUNDEW, YELLOW-EYED GRASS, MEADOW-BEAUTY, CRANBERRY, SEDGES, AND WATER-LILY. THE BOG'S SUBSTRATE IS PEAT WITH AN UNSTABLE BASE. SWITCHCANE AT ITS NORTHERN LIMIT OF DISTRIBUTION IS ALSO PRESENT IN THE SHADY PERIMETER. THE BOG IS SURROUNDED BY A YOUNG OAK-PINE FOREST. SO. RED OAK, PITCH PINE, VIRGINIA PINE, AND CHESTNUT OAK WITH DBH'S OF 6 TO 9 INCHES FORM THE CANOPY. THE UNDERSTORY CONSISTS OF SWEETGUM, OAKS, AND SASSAFRAS. THE SHRUB LAYER IS DENSE WITH BLUEBERRY, HUCKLEBERRY, AND HOLLY. THE HERB LAYER IS SPARSE. RESIDENTIAL DEVELOPMENT IS OCCURRING ON THE SOUTHWESTERN EDGE OF THE SITE. THE SIZE AND LOCATION OF THIS SITE COMBINE TO FORM A VALUABLE WILDLIFE HABITAT. THE SITE ALSO SERVES AS A BUFFER BETWEEN RESIDENTIAL DEVELOPMENT AND THE RIVER.

SITE SOURCE: WE
JA

PEOPLE CONTACTED: NONE

EAGLE HILL

02059230100001201

	01	02
SUBSECTION SAMPLED & SIMILAR SS	--------	--------
AREA OF SUBSECTION	2 ACRES	322 ACRES
SOIL TYPE & NATURAL SOILS GROUP		CN; B 1
RUNOFF POTENTIAL	--------	-------- SLIGHT (B)
DEPTH TO WATER TABLE	--------	-------- 4-5 FT
WELL DRAINED SOILS	-------- NO	-------- YES
TOPOGRAPHY & SOIL ERODIBILITY	FLAT ;	ROLLNG; MEDIUM (.32)
EASE OF PASSAGE	-------- DIFFICULT	-------- EASY
DISTANCE TO WATER BODY	-------- WATER INSIDE	-------- 1-10 FEET
TYPE OF WATER BODY	DOG	SUB-ESTUARY
WATER BODY SIZE AND DEPTH	1 ACRE - ; 1 FOOT +	30 ACRES ; 1 FOOT +
TYPE OF BOTTOM MATERIAL	-------- PEAT	-------- SAND
BEACH LENGTH AND WIDTH	N/A ; N/A	1000-1500 FEET; 1-10 FEET
BEACH TYPE	-------- N/A	-------- BANK
PERCENT OF STREAM SHADED	-------- N/A	-------- N/A
PRIMARY DISTURBANCE	NONE	SELECT CUTTING
SECONDARY DISTURBANCE	PAPER LITTER	POSTAGRICULTURE
DEGREE OF DISTURBANCE	-------- LOW	-------- LOW
COVER TYPE	GRASSES, SEDGES, RUSHES	VIRGINIA PINE-SOUTH. RED OAK
TOTAL AVERAGE COVER BY LAYER	C=00% U=10% S=20% H=80%	C=60% U=40% S=60% H=10%
AVERAGE BASAL AREA PER ACRE	-------- NO DATA	-------- 80.0

KEY TO VEGETATION

LA-LAYER
- C-CANOPY
- U-UNDERSTORY
- S-SHRUB
- H-HERB

COV-AVERAGE PERCENT COVER

I-IMPORTANCE
- R-RARE OR UNIQUE
- E-ENDANGERED

DBH-DIAMETER AT BREAST HEIGHT

LA	VEGETATION	COV	I	DBH
U	SWEET GUM	00		
U	SWEET BAY	00		
U	BLACK GUM	00		
U	RED MAPLE	00		
S	LEATHERLEAF	20	R	
S	SWT.PEPPERBUSH	00		
S	RED MAPLE	00		
H	YLW-EYED GRASS	10		
H	A. CRANBERRY	10	R	
H	SUNDEW	10	R	
H	DEERGRASS	10		
H	FRGNT WT LILLY	20		
H	SW. LOOSESTRF.	00		
H	SPHAGNUM	10		
H	UNKNOWN SEDGE	00		
H	ST. JOHNS WORT	00		
H	UNKNOWN SEDGE	00		
H	BRAKE CANE	00	R	

LA	VEGETATION	COV	I	DBH
C	PITCH PINE	10		6-9
C	VIRGINIA PINE	10		6-9
C	S. RED OAK	30		6-9
C	CHESTNUT OAK	00		6-9
C	SWEET GUM	00		6-9
C	WHITE OAK	00		6-9
U	S. RED OAK	10		
U	BLACK GUM	00		
U	CHESTNUT OAK	10		
U	SWEET GUM	10		
U	WT. SASSAFRAS	00		
S	VACCINIUM	20		
S	CHINQUAPIN	10		
S	AMER. CHESTNUT	00		
S	AMER. HOLLY	10		
S	BLK. HUCKLEBRY	10		
S	BAYBERRY	00		
H	GROUND LAUREL	00		
H	COM.GREENBRIER	10		
H	SAWBRIER	00		
H	EBONY SPLNWORT	00		
H	LADIES SLIPPER	00		
H	PINE SAP	00		

KEY TO ANIMALS

S-SOURCE
- O-OBSERVED
- R-REPORTED
- D-DEN,NEST,SPOOR

F-FREQUENCY
- A-ABUNDENT
- C-COMMON
- R-RARE
- E-ENDANGERED
- U-UNKNOWN

RES-RESIDENCE
- BR-BREEDING
- MI-MIGRATORY
- WC-WINTER CONCENTRATION
- YR-YEAR AROUND RESIDENT
- UN-UNKNOWN

X- ANY "X" MEANS INPUT ERROR

ANIMAL	S	F	RES
GT. BLUE HERON	O	C	YR
BRD-WN. HAWK	O	C	BR
YEL-BLD CUCKOO	O	A	BR
YELLOWTHROAT	O	A	YR

ANIMAL	S	F	RES
YEL-BLD CUCKOO	O	A	BR
TUFT. TITMOUSE	O	A	YR
G-CR FLYCTHR	O	A	BR
PINE WARBLER	O	C	YR
RUF-SD TOWHEE	O	C	YR

PARAMETERS

The Bay Access Park Study (BAPS) used essentially the same parameters as the Upland Natural Area Study. This was done to keep these studies as compatible as possible. However, BAPS did make a few deletions and additions. It should also be noted that BAPS is geared toward bay access and the guide is geared toward inclusion of any future natural area, bay access or potential park site. A list of parameters sampled on the sites follows in the order in which they appear on the sample form.

Parameters

Card 1	Area Number
	Area Name
	Date
	Nearest Town
Card 2	Elevation
	Geology
	Ownership
	Bibliography
	Current Use
	Security
	Access
	Site Type
	Integrity
	Occurrence
	Size
	Average Width
	Forest Edge
Card 3	Contiguous Land Use
	Aquatic Buffer
	# of Community Types
	Community Diversity
	Categories
	One Line Description
	Zoning
Card 4	One Line Description (continued)
Card 5	Text
Card 6	Names

Card 7	Subsection Number
	Similar Subsections
	Area of Subsection
	Waterbody Distance
	Waterbody Type
	Waterbody Size
	Waterbody Depth
	Waterbody Bottom Material
	Beach Type
	Beach Length
	Beach Width
	% of Stream Shaded
	Soil Type
	Soil Drainage
	Vegetation Type
	Topography
	Source of Disturbance
	Degree of Disturbance
	Passage
	Animals - species, source, residency, frequency
	Waterbody Contour Distances
Card 8	Number of Samples
	Total % Cover - canopy
	Total % Cover - understory
	Total % Cover - shrubs
	Total % Cover - herbs
	Vegetation Species
	Average DBH
	Layer
	Import
	% Cover - species

SURVEY PROCEDURE

The following section describes the technique to be used in the field inventory. The objective of the procedure is to obtain information to characterize the Bay Access Area or Natural Area and to paint a mental picture of the area through the use of words. It is not intended to generate data for any specific scientific purpose but rather to identify areas of potential importance as Bay Access Areas or Natural Areas and to provide information for evaluation of possible compatible uses. In order for the information acquired for different areas to be comparable for these evaluations it is important that application of the sampling methodology be standardized for different areas and sampling crews. The following methodology attempts to draw the guidelines for achieving this standardization.[1]

Familiarization

Review all aerial photos, soil surveys and topographic maps of the site area to become familiar with the topography, soil moisture, location of water bodies and watercourses and the contiguous land uses. Review all material in the site folder pertaining to the site.

Preliminary Delineation

On the basis of this review make a preliminary determination as to whether the site delineations shown on the county map are appropriate. In some cases, overlapping areas drawn from separate sources were mapped as one area. You may find it desirable to subdivide large areas so as to facilitate description of the site to more accurately describe distinct features, or to assign additional importance to a specific area. Similarly, it may be desirable to aggregate areas where the character of the land is sufficiently similar and which are in close proximity to each other. In any cases where sites are divided or aggregated, follow the instructions for numbering the new areas contained under the tab "Card 1."

Vegetation Type Delineation

Using the soil survey and aerial photos, carefully delineate plant communities which appear different on the aerial photographs. Soil types give an excellent indication of the vegetation one may encounter. These are subsections of the site. Generally, a subsection should not constitute less than 5% of the site or 10 acres, whichever is smaller. Exceptions should be made for small communities or features which are unusual or of special significance to the site. Enclosed open water portions of the site should not be designated as subsections unless they include significant floating or emergent vegetation.

[1]The Study was organized in the following manner to carry out the sampling. Summer students were hired who had demonstrated experience in some type of vegetation analysis. These field crew members then participated in a one week training session to familiarize them with the sampling procedure and to achieve consistency between individuals. The crew was then divided into teams of two and each team was given the responsibility for sampling all the sites in a county. A field manager visited each team at regular intervals to help maintain the consistency of sampling techniques between teams and solve problems relating to the sampling procedure.

Field Sampling

Make a field reconnaissance of the different plant communities you have delineated. In the course of the survey adjust subsection boundaries to more accurately describe distinct vegetation communities or natural features. Add or combine subsections where appropriate. Sampling stations should be located, basal area and vegetation sampled and resulting information recorded on a "Vegetation Sampling Form" for each subsection. Follow the instructions for sampling found under the tab titled Vegetation Sampling. During the course of the field sampling, record by subsection any species of mammals, birds, reptiles, or amphibians which are observed or heard or for which a nest or sign is found.

Where an area recorded on the site map cannot be found or it has been altered to the extent that it cannot be considered as a BAPS or UNAS site; write "Not Found" or "Rejected" on the site folder and list the reason it has been excluded from the survey.

Post Reconnaissance Review

Following the reconnaissance, review all Vegetation Sampling Forms making certain that all pertinent portions are completed. Complete the remaining data forms according to the following encoding instructions being careful that the recorded information accurately describes the site. Complete a "Card 7" form for each subsection. Subsections which have similar vegetational and physical characteristics may be grouped as "similar subsection". For each set of similar subsections, complete one "Card 7" form and a "Vegetation Sampling Form" for each component subsection.

Staple the completed data forms together in numerical order according to their card numbers. Group each set of Card 7 and Cards 8 by subsection. Do not include the "Audio-Visual Experience/Wetland Wildlife Rating" form in the stapled packet but include it in the folder.

Air Photos

Record the numbers of all air photos on which the site is delineated in the space provided on the sampling forms. Check to be sure that all site boundaries and subsection boundaries are properly drawn on these photos. Label each site and subsection by number on each photo. Upon completion, return the photos to the stack of county photos.

Where aerial photos are not available for the site, record the previous information on the soil survey photos and record the appropriate sheet numbers on the data form.

Knowledgeable Persons

Be constantly alert for persons who may have knowledge about the natural features or history of the site. These may include hunters, fishermen, birders, school teachers and others. In conversation make it a point to collect names of others and set up appointments to interview the people on rainy days. Record the names of any such persons on the Names form for each site.

ENCODING INSTRUCTIONS

CARD 1

BAY ACCESS PARK STUDY DATA FORM

Photo Number (s): AHT-5MM-16

Card #1 — Area Number: T / 2507938102201 1107 — * Area Name: #SINGLETON CREEK WOODS — Date: 052076 — Nearest Town: SINGLETON

Month: 05. May 06. June 07. July 08. August 09. September 10. October

Card #2 — Elevation: b 40 — Geol.: 06 — Owner: 1 — Bibliography: 2 0 2 5 2 1 — Current Use: 04 — Security: 2 — Access: 2 — Site Type: 2 — Integrity: 1 — Occurrence: 1 — Size: 6 0 4 — Avg. Width: 1 — Forest Edge: — Site: 3 8

GEOLOGY

01. bgb, Baltimore Gabbro Complex
02. jg, James Run Gneiss
03. Km, Magothy Formation
04. Kma, Matawan Formation
05. Kmo, Monmouth Formation
06. Kp, Potomac Group
07. pCbg, Baltimore Gneiss
08. Pzgg, Gunpowder Granite
09. Pzpd, Port Deposit Gneiss
10. Qtu, Quaternary Deposits
11. Ql, Lowland Deposits
12. Qtu, Qu, Upland Deposits
13. Sf, Setters Formation
14. Ta, Aquia Formation
15. Tc, Calvert Formation
16. Tch, Choptank Formation
17. Tn, Nanjemoy Formation
18. Ts, St. Mary's Formation
19. Vc, Volcanic Complex
20. wbg, Boulder Gneiss
*. more than one formation

OWNERSHIP

1. Private Individual
2. Corporation
3. Educational Institution
4. Private or Non-Profit Public Org.
5. Local Government
6. State Government
7. Federal Government
8. Unknown
*. More than one owner

BIBLIOGRAPHY

034-Brush, 216-CNAM, 297-CT, 194-NA, 204-JA, 206-JAE, 303-NA, 280-PA, 302-PLOM, 310-SM, 308-SMPA, 311-SNAACP, 220-SP, 120-WA, 252-WB

CURRENT USE

01. Recreation
02. Vehicular Traffic (i.e. motor bikes)
03. Trails
04. Hunting
05. Wildlife Management
06. Timber Management
07. Single Home
08. Several Homes
09. Swimming
10. Fishing
11. Boating
12. Pasture
13. Agriculture
14. Woodlots
15. Dumping
16. Other
17. None

SECURITY

1. Threatened with destruction within five years.
   a. areas currently being disturbed by man (i.e. channalization, siltation, logging, construction)
   b. areas currently under plan to be altered (i.e. sewer lines, homes)
   c. areas contiguous with new development, highway interchanges
   d. areas zoned commercial, residential, industrial
2. Areas safe for five years.
   a. areas not currently threatened with destruction, but not currently protected
3. Areas safe indefinitely.
   a. areas owned by conservation organizations, designated as wildlife management areas or parks.
4. Unknown

ACCESS

1. Easy - Major highway or road to site
2. Moderate - Trail to site
3. Difficult - Isolated area, no road or trail to the site

SITE TYPE

1. Water Body
2. Upland Deciduous Forest
3. Lowland Deciduous Forest
4. Upland Evergreen Forest
5. Lowland Evergreen Forest
6. Upland Mixed Forest
7. Lowland Mixed Forest
8. Cultural Site
9. Champion Tree

INTEGRITY

1. Naturally Permanent - Vegetation or physical feature is relatively stable as revealed by the pattern of regeneration or the absence of physical deterioration. Disturbance is insignificant although some natural disturbance may be in evidence. Vegetation is mature or relatively stable because of its ability to resist succession.
2. Naturally Transitory - Vegetation or physical feature is changing due to plant succession either as a consequence of man-made or natural disturbance such as fire, erosion or flooding. Vegetation is relatively young and dynamic.
3. In Need of Management - Area will require management to maintain present character.
4. Uncertain - Possible source of change is not evident.

OCCURRENCE

1. Common - Physical features or organism frequently encountered in the region.
2. Infrequent - Physical features or organism not commonly found are present; however, none are rare, endangered or unique.
3. Rare - Natural area containing an unusual physical feature or organism which is rare, endangered or at the geographic limit of its distribution.
4. Singularly Unique - Natural area containing a physical feature, organism or special habitat for an organism for which the area is the only known location in which it occurs.

AVERAGE WIDTH

1. Disjunct - Area is broken into segments
2. Less than 200 feet
3. 200-400 feet
4. 400-600 feet
5. 600-800 feet
6. 800-1000 feet
7. 1000-1200 feet
8. Greater than 1200 feet

FOREST EDGE

1. Minimal - Forested portions of the site occurring essentially as a single block with a minimum of forest/opening edge.
2. Moderate - Forested portions of the site somewhat dissected or occurring as a single block with internal openings resulting in a moderate amount of forest/opening edge.
3. High - Forested portions of the site highly dissected, occurring in narrow strips and/or including numerous enclosed openings resulting in a substantial amount of forest/opening edge.
4. Not Applicable - No forested subsections.

Card 1, spaces 3-20.

Site numbers are recorded on the county scale site maps and on the folders which correspond to each site. Record this number on the data form. Where the number is incomplete or a new site is designated, assign numbers according to the following directions.

County Numbers

Indicate the county which contains the major portion of the site.

01. Allegany	09. Charles	17. Prince Georges
02. Anne Arundel	10. Dorchester	18. Queen Anne's
03. Baltimore	11. Frederick	19. St. Mary's
04. Baltimore City	12. Garrett	20. Somerset
05. Calvert	13. Harford	21. Talbot
06. Caroline	14. Howard	22. Washington
07. Carroll	15. Kent	23. Wicomico
08. Cecil	16. Montgomery	24. Worcester

Election District

Indicate the Election District which contains the major portion of the site. This information is available on the County Topographic Maps.

Source

We are considered by State Planning's MAGI computer system to be information source #9.

Site Number-County Site and Field Site

Sites have been delineated and numbered on each County site Map. Record the number indicated on the map of folder.

Sites are given a 4-digit number. The first two digits refer to the County Site Number. The second two digits refer to the Field Site Number. County sites are numbered sequentially within the county. Field sites are numbered sequentially within a county site. County sites are separate site areas within a county. Field sites designate contiguous areas within a county site which for the purposes of this study, are described as discrete areas.

Where a new site is designated within a county, assign it a new county site number as the next number in the sequence of County sites. Where a site designated as one site area is determined to be two or more site areas, assign them Field Site Numbers as the next numbers in the sequence of field sites with the County Site Number remaining unchanged. Where two or more sites designated as separate county or field sites are determined to be one site area, combine them under one County Site Number and assign the composite the next Field Site Number in the sequence of field sites.

Watershed Number

Each watershed and sub-watershed has been numbered by the Maryland Department of Natural Resources Water Resources Administration. See the attached list and record the watershed number for each site.

More Than One Watershed

Where a site occurs in more than one watershed, mark an asterisk (*) in space 20.

Card 1, spaces 21-57.

Sites Already Named

Where a site already has a name it should be recorded as given on the file folder or in secondary sources of information.

Sites Without Names

Sites with no names should be given a name which reflects the salient characteristics of the site. Where a site is assigned a name in the field it should be indicated as such with an asterisk before the name. Leave a space between words.

For example:

1. *MIXED FOREST WITH RHODODENDRONS
2. *WICOMICO CREEK FRESHWATER MARSH
3. *TALBOT SCARP
4. *PLAINFIELD NATURAL SPRINGS
5. *NATURAL UNDISTURBED LOBLOLLY PINE STAND
6. *REGENERATING BALD CYPRESS FOREST
7. *NORTHERN LIMIT OVERCUP OAK STAND
8. *ELK NECK CLIFFS

DATE

Card 1, 58-63.

Indicate the month, day and year on which the site was field checked.

Month

05. May
06. June
07. July
08. August
09. September
10. October

NEAREST TOWN

Card 1, spaces 64-80

Using a county scale map as a source, find the town nearest to the site by straight line distance. Print the name in the spaces provided, using abbreviations when necessary.

CARD 2

BAY ACCESS PARK STUDY DATA FORM

Photo Number (s): AHT-5MM-16

Card #1

Area Number	*	Area Name	Date	Nearest Town
1		#SINGLETON CREEK WOODS	052076	SINGLETON

Card #2

Elevation	Geol.	Owner	Bibliography	Current Use	Security	Access	Site Type	Integrity	Occurrence	Size	Avg. Width	Forest Edge
2	0	1-0	0 6	1 *	2	5 2	0 4	2	2	2	1	1	6 0 4	1

Month 05. May 08. August
06. June 09. September
07. July 10. October

GEOLOGY

01. Mzb, Baltimore Gabbro Complex
02. Jg, James Run Gneiss
03. Mm, Wissahickon Formation
04. Mka, Arkansas Formation
05. Mkm, Mammoth Formation
06. Kp, Potomac Group
07. pCbg, Baltimore Gneiss
08. Pzgp, Gunpowder Granite
09. Pzpp, Port Deposit Gneiss
10. Qal, Quaternary Deposits
11. Ql, Lowland Deposits
12. Qlu, Ql, Upland Deposits
13. Sf, Setters Formation
14. Ta, Aquia Formation
15. Tc, Calvert Formation
16. Tch, Choptank Formation
17. Tm, Manjemoy Formation
18. Tz, St. Mary's Formation
19. Vc, Volcanic Complex
20. vbg, Boulder Gneiss
*. more than one formation

OWNERSHIP

1. Private Individual
2. Corporation
3. Educational Institution
4. Private or Non-Profit Public Org.
5. Local Government
6. State Government
7. Federal Government
8. Unknown
*. More than one owner

BIBLIOGRAPHY

001-Brush	280-PA
002-CHAM	302-PLOM
003-CT	306-CHPA
004-MA	314-CHAACP
005-PA	220-SP
006-MAE	120-WA
007-WA	252-WE

CURRENT USE

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15. Dumping
16. Other
17. None

SECURITY

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   a. areas currently being disturbed by man (i.e. channelization, siltation, logging, construction)
   b. areas currently under plan to be altered (i.e. sewer lines, homes)
   c. areas contiguous with new development, highway interchanges
   d. areas zoned commercial, residential, industrial
2. Areas safe for five years.
   a. areas not currently threatened with destruction, but not currently protected
3. Areas safe indefinitely.
   a. areas owned by conservation organizations, designated as wildlife management areas or parks.
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7. 1000-1200 feet
8. Greater than 1200 feet

FOREST EDGE

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3. High - Forested portions of the site highly dissected, occurring in narrow strips and/or including numerous enclosed openings resulting in a substantial amount of forest/opening edge.
4. Not Applicable - No forested subsections.

ELEVATION

Card 2, spaces 3-6.

Using the county topographic maps, indicate the elevation of the site in feet. Where one contour interval crosses the site, record its number as the elevation. Where more than one interval crosses the site or the site falls between contour intervals, record the average as the elevation.

Right justify the elevation, leaving blanks before the numbers.

GEOLOGY

Card 2, spaces 7-9.

Indicate the predominant geological formation which underlies the site using the Geologic Map of Maryland, 1968. Record the code number in the first two spaces. If more than one formation underlies the area, place an asterisk (*) in the third space.

Coastal Plain Formations

01. Kp, Potomac Group
02. Ql, Lowland Deposits
03. QTu, Upland Deposits
04. Qu, Upland Deposits
79. Km, Magothy Formation
80. Ts, St. Mary's Formation
81. Kma. Matawan Formation
82. Kmo. Monmouth Formation
83. Qdu. Quaternary Deposits
84. Ta. Aquia Formation
85. Toh. Choptank Formation
86. In. Nanjemoy Formation
87. Yorktown Formation
88. Tc, Calvert Formation
89. Pf, Piney Formation
90. Bf, Brightseat Formation

Eastern Piedmont Plutonic Rocks

05. mgb, Metagabbro and Amphibolite
06. ug, Ultramafic and Gabbroic Rocks
07. gm, Georgetown Mafic Complex
08. Pzr, Relay Quartz Diorite
09. um, Ultramafic Rocks
10. bgb, Baltimore Gabbro Complex
11. Pzmg, Muscovite Quartz Monzonite
12. Pzw, Woodstock Quartz Monzonite
13. Pzg, Guilford Quartz Monzonite
14. Pze, Ellicott City Granodiorite
15. Pzn, Norbeck Quartz Diorite
16. Pzpd, Port Deposite Gneiss
17. Pzk, Kensington Quartz Diorite
18. Pzgg, Gunpowder Granite

Eastern Piedmont Metasedimentary Rocks

19. pbs, Peach Bottom Slate
20. cc, Cardiff Metaconglomerate
21. wu, Wissahickon Formation
22. wups, Upper Pelitic Schist
23. wmg, Metagraywacke
24. wmc, Metaconglomerate
25. wbg, Boulder Gneiss
26. wlps, Lower Pelitic Schist
27. cm, Cockeysville Marble
28. sf, Setters Formation
29. pCbg, Baltimore Gneiss
30. vc, Volcanic Complex of Cecil Co.
31. jg, James Run Gneiss

Western Piedmont Metasedimentary Rocks

32. uf, Urbana Formation
33. sq, Sugarloaf Mt. Quartzite
34. lmr, Libertytown Metarhyolite
35. scm, Sams Creek Metabasalt
36. wm, Wakefield Marble
37. srl, Silver Run Limestone
38. if, Ijamsville Formation
39. ms, Marburg Schist

South Mountain Anticlinorium and Frederick Valley

40. Trd, Diabase Sills
41. Trg, Gettysburg Shale
42. Trno, New Oxford Formation
43. Trlc-Trqc, New Oxford Formation
44. OCg, Grove Limestone
45. Cf, Frederick Limestone
46. Ct, Tomstone Dolomite
47. Ca, Antietam Formation
48. hf, Harpers Formation
49. wf, Weverton Formation
50. lf, Loudoun Formation
51. pCmv, Metarhyolite and Assoc. Pyroclastic Sediments
52. pCc, Catoctin Metabasalt
53. pCsr, Swift Run Formation
54. pCg, Granodiorite and Biotite Granite Gneiss

Allegheny Plateau and Valley and Ridge

55. Pd, Dunkard Group
56. Pm, Monongahela Formation
57. Pc, Conemaugh Formation
58. Pap, Allegheny-Pottsville Formation
59. Mmc, Mauch Chunk Formation
60. Mg, Greenbrier Formation
61. Mp, Pocono Group
62. Dh, Hampshire Formation
63. Dch, "Chemung" Formation
64. Dhn, Hamilton Group
65. Do, Oriskany Group
66. DShk, Helderberg Formation
67. Stl, Tonoloway Limestone
68. Swb, Wills Creek Shale-Bloomsburg Formation
69. Sm. McKenzie Formation
70. Sc, Clinton Group
71. St, Tuscarora Sandstone
72. Oj, Juniata Formation
73. Om, Martinsburg Formation
74. Ocs, St. Paul Group-Chambersburg Limestone
75. Ops, Orr, Os, Beekmantown Group
76. OCc, Conococheague Limestone
77. Ce, Elbrook Limestone
78. Cwb, Waynesboro Foundation

Card 2, spaces 10 and 11.

Indicate who is the principal owner by recording the appropriate code in the left space. If the area is owned by more than one party, indicate by placing an asterisk (*) in the second space on the right.

Owership

1. Private Individual
2. Corporation
3. Educational Institution
4. Private or Non-Profit Public Organization
5. Local Government
6. State Government
7. Federal Government
8. Unknown

*. More than one owner

Card 2, spaces 12-29.

DO NOT ENCODE ANYTHING IN THESE SPACES

If you become aware of other studies not listed in the folder with information pertaining to the site, record the citation as shown in the enclosed sample and give it a discrete number according to the county as follows:

County

401-430	Anne Arundel
431-460	Baltimore
461-490	Baltimore City
491-520	Calvert
521-550	Cecil
551-580	Charles
581-610	Harford
611-640	Prince Georges
641-670	St. Mary's

CURRENT USE

Card 2, spaces 30 and 31.
Indicate the current major use of the site.

Current Use

01. Recreation
02. Vehicular Traffic (i.e. motor bikes) \
03. Trails
04. Hunting
05. Wildlife Management
06. Timber Management
07. Single Home
08. Several Homes
09. Swimming
10. Fishing
11. Boating
12. Pasture
13. Agriculture
14. Woodlots
15. Dumping
16. Other
17. None

SECURITY

Card 2, space 32.
Indicate the probable time frame within which significant physical alterations by man's activities may occur. Assess all facets of an area which may contribute toward the encroachment or destruction of the site.

Security

1. Threatened with destruction within five years.
   a. areas currently being disturbed by man (i.e. channelization, siltation, logging, construction)
   b. areas currently under plan to be altered (i.e. sewer lines, homes)
   c. areas contiguous with new development, highway interchanges
   d. areas zoned commercial, residential, industrial
2. Areas safe for five years.
   a. areas not currently threatened with destruction, but not currently protected
3. Areas safe indefinitely.
   a. areas owned by conservation organizations, designated as wildlife management areas or parks
4. Unknown

ACCESS

Card 2, space 33.
Indicate the ease of approach to the site.

Access

1. Easy - Major highway or road to site
2. Moderate - Trail to site
3. Difficult - Isolated area, no road or trail to the site

SITE TYPE

Card 2, space 34.
The Site Type refers to the general or dominant characteristic of the site. It attempts to answer the question "Why was this site designated as a Bay Access Park?" Where more than one type occurs within an area, list that type which is of greater significance to the site or is of greater regional significance.

"Cultural site" should be used to indicate a site of historical or archeological importance.

"Champion Tree" should be used to indicate sites with a designated or potential "National" or "State Champion Tree."

Site Type

1. Water Body Access
2. Upland Deciduous Forest
3. Lowland Deciduous Forest
4. Upland Evergreen Forest
5. Lowland Evergreen Forest
6. Upland Mixed Forest
7. Lowland Mixed Forest
8. Cultural Site
9. Champion Tree

INTEGRITY

Card 2, space 35.

Indicate the present "Natural Integrity" of the area on the basis of natural regeneration, age and the absence of disturbance.

Integrity

1. Self-Sustaining - Vegetation or physical feature is relatively stable as revealed by the pattern of regeneration or the absence of physical deterioration. Disturbance is insignificant although some natural disturbance may be in evidence. Vegetation is mature or relatively stable because of its ability to resist succession.
2. Transitory - Vegetation or physical feature is changing due to plant succession either as a consequence of man-made or natural disturbance such as fire, erosion or flooding. Vegetation is relatively young and dynamic.
3. In Need of Management - Area will require management to maintain present character.
4. Uncertain - Possible source of change is not evident.

OCCURRENCE

Card 2, space 36.

Indicate the relative frequency of the site in the context of its occurrence on the site. Where an unusual feature occurs within the area or where the site provides the habitat for a particular plant or animal which is in some way rare, unique, or unusual, then "Occurrence" shall be defined in terms of this feature, plant, or animal.

Occurrence

1. Common - Physical features or organism frequently encountered in the region.
2. Infrequent - Physical features or organism not commonly found are present; however, none are rare, endangered or unique.
3. Rare - Natural area containing an unusual physical feature or organism which is rare, endangered or at the geographic limit of its distribution.
4. Singularly Unique - Natural area containing a physical feature, organism or special habitat for an organism for which the area is the only known location in which it occurs.

SIZE

Card 2, spaces 37-40.

Record the size of the site in acres. Include all areas designated as subsections so that the total acreage of the subsections equals that recorded for the site. Right justify the area, leaving blanks before the numbers.

Use the dot grid to determine the number of acres on the aerial photographs. A dot grid (provided in the notebook) is a transparent overlay with dots systematically arranged on a grid pattern. In use, the grid is aligned with a straight line feature to avoid positioning bias and then dots or squares are tallied for the area. Follow the instructions on the transparent overlay.

Photo Scale

1:20,000	1 inch = 1,667 feet (uplands photos) 1 dot = 0.996 acres
	no. dots counted x 0.996 acres/dot = no. acres
1:12,000	1 dot = .336 acres (wetlands photos) 1 inch = 556 feet (wetlands photos)
1:31,680 (Cecil County)	1 inch = 2,640 feet 1 dot = 2.5 acres
	no. dots counted x 2.5 acres/dot = no. acres

AVERAGE WIDTH

Card 2, space 41.

Indicate the "Average Width" of the site measured on the aerial photographs.

Average Width

1. Disjunct - Area is broken into segments
2. Less than 200 feet
3. 200-400 feet
4. 400-600 feet
5. 600-800 feet
6. 800-1000 feet
7. 1000-1200 feet
8. Greater than 1200 feet

Photo Scale

1:20,000	1 inch = 1,667 feet (uplands photos) 0.12 inches = 200 feet
1:12,000	1 inch = 556 feet (wetlands photos)
1:31,680 (Cecil County)	1 inch = 2,640 feet 0.07 inches = 200 feet
1:15,840 (Xerox photos Cecil County)	1 inch = 1,320 feet 0.15 inches = 200 feet

Card 2, space 42.

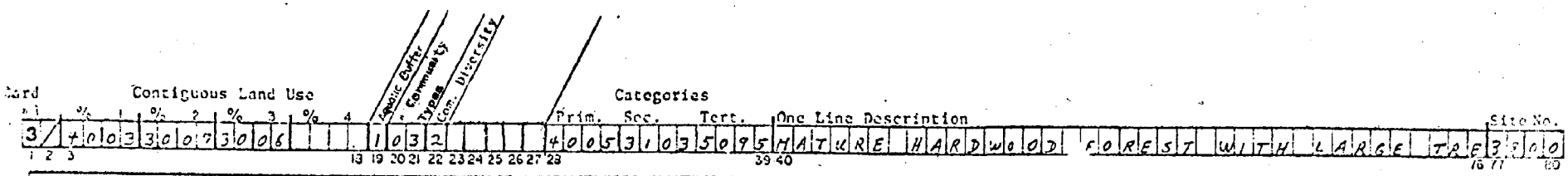
Using the aerial photographs as a source, indicate the relative length of forest/opening edge which occurs along the forested portions of the site.

Forest Edge

1. Minimal - Forested portions of the site occurring essentially as a single block with a minimum of forest/opening edge.
2. Moderate - Forested portions of the site somewhat dissected or occurring as a single block with internal openings resulting in a moderate amount of forest/opening edge.
3. High - Forested portions of the site highly dissected, occurring in narrow strips and/or including numerous enclosed openings resulting in a substantial amount of forest/opening edge.
4. Not applicable - No forested subsections.

The interface between forest and opening contributes to the value of an area as wildlife habitat as well as enhances its scenic qualities. For the purpose of this parameter, "opening" is defined as an open water or vegetated area with less than ten percent cover of canopy or understory trees contiguous with or enclosed by forest. "Forest" pertains to the portions of the site described as subsections with vegetation types numbered 1 through 104.

CARD 3



CONTIGUOUS LAND USE

% of border by use for 4 principle Contiguous Land Uses

01. Natural Area
02. Wetland
03. Water Body
04. Park
05. Old Field
06. Managed Forest
07. Agriculture
08. Wildlife Management
09. Road
10. Highway
11. Railroad
12. Residential
13. Commercial
14. Industrial
15. Recreational
16. Town
17. Channelized Stream
18. RIGHT OF WAY
19. DREDGESPOIL DISPOSAL
20. STRIP MINING
21. RESTRICTED GOVT. AREA

COMMUNITY DIVERSITY

1. High - Contains numerous different vegetation communities, animal habitats or physical features such as streams, bogs, scarps.
2. Medium - Contains a few different vegetation types and habitats or features.
3. Low - Contains predominantly one vegetation community or natural feature.

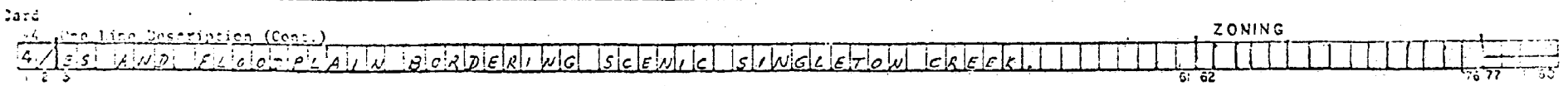
41

ONE LINE DESCRIPTION

- continue as one line on Card #4.

AQUATIC BUFFER ZONE

1. Adequate - The Natural Area provides a band of natural or successional vegetation greater than 300 feet in width along more than 66% of the border of included or contiguous aquatic systems (wetlands, watercourses, or waterbodies and adjacent D or D' soils).
2. Questionable - The Natural Area provides a band of natural or successional vegetation greater than 50 feet in width along more than 66% of the border of included or contiguous aquatic systems.
3. Inadequate - The Natural Area provides a band of natural or successional vegetation less than 50 feet in width along more than 66% of the border of included or contiguous aquatic systems.
4. Not Applicable



Card 3, spaces 3-18.

Four sets of four spaces are provided for indicating the 4 major Contiguous Land Uses and the percent of the site's border on which each use occurs. In the first two spaces of each set indicate the percent of border and in the second pair of spaces encode the land use. The total of the four percentages need not equal one hundred percent. Where land use 01, "Natural Area" is encoded, this adjacent area must be described as a separate site.

Contiguous Land Use

01. Natural Area
02. Wetland
03. Water Body
04. Park
05. Old Field
06. Managed Forest
07. Agriculture
08. Wildlife Management
09. Road
10. Highway
11. Railroad
12. Residential
13. Commercial
14. Industrial
15. Recreational
16. Town
17. Channelized Stream
18. Right of Way
19. Dredge Spoil Disposal
20. Strip Mining
21. Restricted Government Area

AQUATIC BUFFER ZONE

Card 3, space 19.

Aquatic buffer zones are important in protecting aquatic systems from erosion and from contamination by non-point source pollutants such as sediment, fertilizer and pesticides. A detailed description of the various aspects of the aquatic buffer zone concept is included in the field notebook.

For the purposes of this study, a buffer zone is a band of vegetation contiguous with an aquatic system. An aquatic system is defined as a wetland, watercourse, or water body, and adjacent soils with D or D^+ runoff potential. D and D^+ soils are included in aquatic systems because they contribute significant overland runoff to storm flow. A list of D and D^+ soils by county is included in the field notebook.

The value a site has as an aquatic buffer depends on the width and length of vegetation that it provides along its border with aquatic systems. These aquatic systems may be included or contiguous: part of, enclosed by, or adjacent to the site.

Indicate the width of vegetation within the site which occurs along more than 66% of the vegetation/aquatic system edge. Encode the lowest numbered category which fits the site.

Aquatic Buffer Zone

1. Adequate - the site provides a band of natural or successional vegetation greater than 300 feet in width along more than 66% of the border of included or contiguous aquatic systems (wetlands, watercourses, or waterbodies and adjacent D or D^+ soils).
2. Questionable - the site provides a band of natural or successional vegetation greater than 50 feet in width along more than 66% of the border of included or contiguous aquatic systems.
3. Inadequate- the site provides a band of natural or successional vegetation less than 50 feet in width along more than 66% of the border of included or contiguous aquatic systems.
4. Not Applicable

Photo Scale

1:20,000	1 inch = 1,667 feet (UNAS Photos) 0.18 inches = 300 feet
1:12,000	1 inch = 555 feet (Wetlands Photos)
1:31,680 (Cecil County)	1 inch = 2,640 feet 0.11 inches = 300 feet
1:15,840 (Xerox Photos, Cecil Co.)	1 inch = 1,320 feet 0.22 inches = 300 feet

NUMBER OF COMMUNITY TYPES

Card 3, spaces 20 and 21.

A diversity of community types contributes to a site's scenic, recreational and wildlife habitat values. Indicate the number of community types present on the site. Distinct vegetation communities should each be counted as 1 community type. These are normally equivalent to areas designated as subsections or sets of similar subsections. Where water bodies or tidal wetlands are contiguous with or enclosed by the site, but are not included as subsections, each water body type or wetland type should be counted as one community type.

COMMUNITY DIVERSITY

Card 3 space 22.

Indicate the relative number of different vegetation communities and other natural features which the site contains.

Community Diversity

1. High - contains numerous different vegetation communities, animal habitats or physical features such as streams, bogs, scarps.
2. Medium - contains a few different vegetation types and habitats or features.
3. Low - contains predominantly one vegetation community or natural feature.

CATEGORIES

Card 3, spaces 28-39.

Indicate the three categories which punctuate the most interesting, unusual or most descriptive characteristic of the site. The priority for choosing a category should follow the general rule of....rare, endangered, unusual, interesting descriptive. All three categories need not be filled out; however, the Primary and Secondary Categories should be filled out whenever possible. Record the number listed on the Category Code Sheets which are included in the field notebook under the tab labeled "Categories." Use the first four spaces labeled "Primary" for the most important characteristics, "Secondary" for the second most important, etc.

ONE-LINE DESCRIPTION

Card 3, spaces 40-76. Card 4, spaces 3-61.

Write a brief sentence or phrase describing the salient characteristic of the site. You are limited to 98 spaces. Continue this description on Card 4, treating Cards 3 and 4 as one line.

For Example:

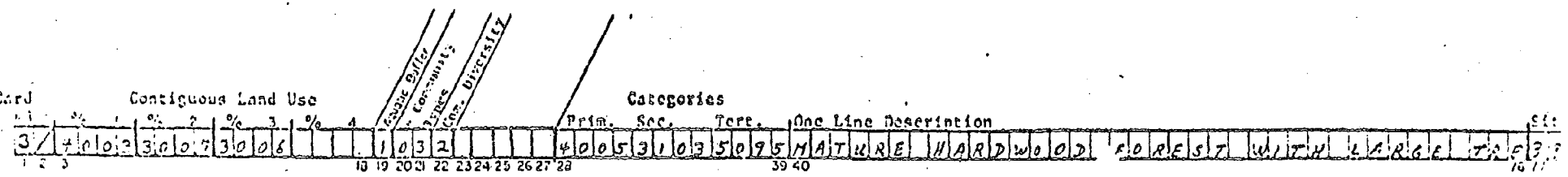
1. Large and active natural spring
2. Small bog with nearby hiking trails
3. Natural pond, excellent wildlife area
4. Large stand of mixed hardwoods with beech predominating
5. Large bog and pond, unusual vegetation on both
6. Very remote white cedar swamp with rhododendron

SITE NUMBER

Card 3, spaces 77-80.

Record the site number in the last four spaces on Card 3. This number will automatically be keypunched in the same spaces on Card 4.

CARD 4



CONTIGUOUS LAND USE

% of border by use for 4 principle Contiguous Land Uses

01. Natural Area	09. Road	18. RIGHT OF WAY
02. Wetland	10. Highway	19. DREDGESPOIL DISPOSAL
03. Water Body	11. Railroad	20. STRIP MINING
04. Park	12. Residential	21. RESTRICTED GOVT. AREA
05. Old Field	13. Commercial	
06. Managed Forest	14. Industrial	
07. Agriculture	15. Recreational	
08. Wildlife Management	16. Town	
	17. Channelized Stream	

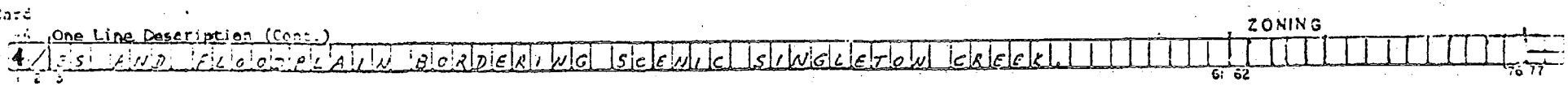
COMMUNITY DIVERSITY

1. High - Contains numerous different vegetation communities, animal habitats or physical features such as streams, bogs, scarps.
2. Medium - Contains a few different vegetation types and habitats or features.
3. Low - Contains predominantly one vegetation community or natural feature.

ONE LINE DESCRIPTION - continue as one line on Card #4.

AQUATIC BUFFER ZONE

1. Adequate - The Natural Area provides a band of natural or successional vegetation greater than 300 feet in width along more than 66% of the border of included or contiguous aquatic systems (wetlands, watercourses, or waterbodies and adjacent D or D^4 soils).
2. Questionable - The Natural Area provides a band of natural or successional vegetation greater than 50 feet in width along more than 66% of the borderof included or contiguous aquatic systems.
3. Inadequate - The Natural Area provides a band of natural or successional vegetation less than 50 feet in width along more than 66% of the border of included or contiguous aquatic systems.
4. Not Applicable



Card 4, spaces 62-76.

Record the zoning codes found on the county zoning maps.

CARD 5

TEXT P.1

5A THIS SITE INCLUDES 40 ACRES OF HARDWOOD FOREST AND 20 ACRES OF FLOODPLAIN
5B BORDERING SINGLETON CREEK WEST OF SINGLETON. WHITE OAK PREDOMINATES IN THE
5C UPLAND SECTION WITH S. RED OAK, VIRGINIA PINE, CHESTNUT OAK, HICKORY, AND
5D WALNUT OCCURRING AS ASSOCIATES. DBH'S IN THIS PORTION OF THE NATURAL AREA
5E RANGE UP TO 36 INCHES WITH MANY WHITE OAKS OF IMPRESSIVE SIZE PRESENT.
5F SIMILAR SPECIES ARE FOUND IN THE UNDERSTORY. THE SHRUB AND HERB LAYERS
5G ARE SPARSELY VEGETATED ALLOWING EASY PASSAGE AND PROVIDING A "PARK-LIKE"
5H APPEARANCE. NO EVIDENCE OF MANMADE DISTURBANCE IS PRESENT HERE ALTHOUGH
5I SELECTIVE CUTTING MAY HAVE BEEN DONE IN THE DISTANT PAST. THE FLOODPLAIN
5J FOREST LIES BETWEEN THE UPLAND PORTION OF THE SITE AND SINGLETON CREEK.
5K SYCAMORE IS THE PREDOMINANT SPECIES HERE WITH TULIP POPLAR, RED MAPLE,
5L BLACK GUM, AND RIVER BIRCH ALSO PRESENT. DBH'S OF THE CANOPY TREES RANGE
5M FROM 10 TO 28 INCHES. THE DENSE SHRUB LAYER AND SCATTERED WET AREAS MAKE
5N PASSAGE DIFFICULT. THIS FLOODPLAIN HAS AN UNDISTURBED APPEARANCE SAVE FOR
5O THAT CAUSED BY FLOODING FROM SINGLETON CREEK. ON THE WHOLE, THIS SITE

5P MARCS ARE IN THE REGION. THIS SCENIC AREA REFLECTS SINGLETON CREEK'S AD-

5Q JACENT AGRICULTURAL LAND AND PROVIDES VALUABLE HABITAT FOR ESTUARINE AND

5R WETLAND WILDLIFE.

5S

5T

5U

5V

5W

5X

5Y

5Z

51

52

53

54

Immediately upon completion of the survey, develop a paragraph from notes and Data Forms which includes the following considerations:

a. Unique, distinctive, or characteristic features of the site.

b. Description of the dominant vegetation or, if a mosaic, the types and the percentage of the site by each type. Limit discussion to generalized terms.

c. General description of characteristic DBH, any lack of reproduction, obvious trends in vegetation dynamics.

d. Disturbances and historical notes.

e. Unusual animals, importance of site for wildlife, geologic features and unusual plant species.

f. Role of site as a buffer for aquatic systems.

g. If available, present land use and future plans for the site should be noted.

h. Accessibility to site, to site interior and to water bodies.

CARD 6

NAME(S)

61 MR. CHUCK WHIPPLEBERRY BOX 34 SINGLETON RD. SINGLETON, MD. PART-OWNER

62 MR. SILAS CROCKETT BOX 36 SINGLETON RD. SINGLETON, MD. PART-OWNER

63

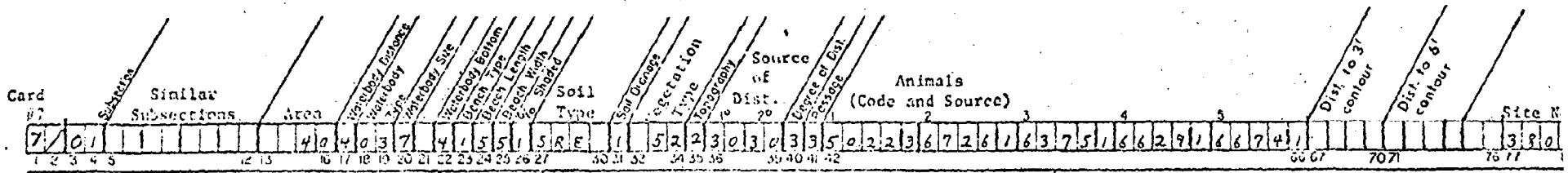
64

Record the names of any people either listed in the folders or to whom you have spoken with who have information on the site or who are very knowledgeable about it. See the Data Form entitled "NAMES."

Each line on the Data Form should be used for one name only.

The County and Field Site Numbers should be entered in the appropriate spaces in the upper right corner of the Data Form. Whenever possible, include the name(s) of the owner(s) of the site.

CARD 7



AREA OF SUBSECTION(S) acres, including similar subsections

WATERBODY DISTANCE

1. Same as this subsection
2. Included or contiguous (1-10 feet)
3. 10-99 feet
4. 50-100 feet
5. 100-200 feet
6. 200-300 feet
7. 300-500 feet
8. Greater than 500 feet

WATERBODY TYPE

01. Primary Stream, <5 feet wide
02. Secondary Stream, 5-30 feet wide
03. Tertiary Stream, > 30 feet wide
04. Tidal Stream
05. Sub-estuary
06. Potomac River
07. Chesapeake Bay
08. Pond
09. Bog
10. Freshwater Marsh
11. Shrub Swamp
12. Wooded Swamp
13. Tidal Wetlands
14. Same as Subsection 01
15 Susquehanna River

WATERBODY SIZE

1. Less than 1 acre
2. 1-5 acres
3. 5-10 acres
4. 10-20 acres
5. 20-30 acres
6. Greater than 30 acres
7. Not applicable

WATERBODY BOTTOM MATERIAL

1. Peat - fibrous organic material with recognizable plant parts.
2. Muck - black ooze composed of silt and decomposed organic matter.
3. Silt - fine sediment with little organic material.
4. Marl - granular sediment.
5. Gravel - granular sediment with particles larger than Sum (approximately 1/8 in.).
6. Cobble - round or sub-round, water-worn rock 2 1/2-10 inches in diameter.
7. Rock - solid aggregate of minerals larger than a cobble.

BEACH TYPE

1. Bluff - steep slope or abrupt embankment along waterbody edge or sandy beach
2. Bank - surrounding area gently sloping to waterbody edge
3. Sandy Beach - low, sloping sandy beach without dunes
4. Dunes - low, sloping sandy beach with dunes
5. Not applicable
6. Gravel beach
7. Shore erosion control (bulkheading,etc)

BEACH LENGTH

1. Less than 500 feet
2. 500-1000 feet
3. 1 ...1500 feet
4. Greater than 1500 feet
5. Not Applicable

BEACH WIDTH

1. Less than 1 foot
2. 1-10 feet
3. 10-20 feet
4. Greater than 20 feet
5. Not Applicable

% OF STREAM SHADED

0. Less than 10%
1. 10-25%
2. 25-50%
3. 50-75%
4. 75-100%
5. Not applicable

SOIL DRAINAGE

1. Yes, well drained soils occur in the subsection
2. No, well drained soils do not occur in the subsection

TOPOGRAPHY

1. Flat - little topographic relief over most of subsection
2. Rolling - hills with slopes < 15% over most of subsection
3. Steep - slopes > 15% over most of subsection
4. Mixed - flat or rolling topography with significant areas (>33%) with steep slopes, gorges, or bluffs

SOURCE OF DISTURBANCE

1. Channelization
2. Dredging
3. Sewer Outlet
4. Culverts
5. Bulkheading
6. Dikes
7. Dams
8. Change in Watertable
9. Logs and Debris
10. Beaver Dams
11. Algal Blooms
12. Fedid Odor
13. Siltation
14. Erosion
15. Noise
16. Air Pollution
17. Selective Cutting
18. Clear Cutting
19. Fire
20. Windthrow
21. Disease
23. Dumping
24. Littering, paper
25. Vandalism
26. Trampling
27. Motor Vehicles
28. Postagricultural
29. Other
30. None
31. Flooding
32. Grazing
33. EXOTIC PLANT INVASION
34. STRIP MINING
35. AGRICULTURAL, ACTIVE

DEGREE OF DISTURBANCE

1. Severe - man's impact resulting in severe alteration of vegetation or natural feature
2. Moderate - man's impact resulting in moderate alteration of vegetation or natural feature
3. Low - man's impact evident but not significant
4. None - evidence of man-made disturbance not present over most of the subsection

EASE OF PASSAGE

1. Difficult - Thick understory or wet mucky soil
2. Moderate - Interspersed understory or wet soils
3. Easy - Open understory, dry soils

ANIMALS

Record 4 letter code and source for each animal.

Source 1. Observed or Heard
2. Reported
3. Den, Nest or Spoor

SUBSECTION NUMBER

Card 7, spaces 3 and 4

Record the number assigned to the subsection (e.g. 01, 02, 03 . . .)

SIMILAR SUBSECTION

Card 7, spaces 5-12.

Indicate the subsections which are considered to be "similar subsections." Similar subsections are areas with minor differences in vegetation and comparable water bodies, disturbances and soils. Do not complete an additional Card 7 for the similar subsections. Do complete a vegetation sampling form for each subsection. Where fewer than four similar subsections are designated, leave the unused spaces blank.

AREA OF SUBSECTION

Card 7, spaces 13-16.

Record the area in acres for the subsection or the set of similar subsections. Right justify the acreage, leaving blanks before the numbers.

Card 7, space 17.

Indicate the straight line distance from the subsection to the nearest waterbody. Where the subsection is a waterbody, encode 1 (same as this subsection) as the distance.

Water Body Distance

1. Same as this subsection
2. Included or contiguous (1-10 feet)
3. 10-50 feet
4. 50-100 feet
5. 100-200 feet
6. 200-300 feet
7. 300-500 feet
8. Greater than 500 feet

Card 7, spaces 18 and 19.

Indicate the Water Body Type to which the distance has been recorded. Where one water body is the closest water body for more than one subsection, designate one of these subsections as subsection 01. Complete the remaining water body, beach and stream parameters for this subsection. Encode 14 (Same as subsection 01) as the Water Body Type for the other subsections for which that water body is closest. When "Same as subsection 01" is recorded as the Water Body Type, do not complete the remaining water body, beach and stream parameters (leave spaces 20 through 26 blank). If more than one Water Body Type is included or contiguous with the site, indicate different Water Body Types for different subsections so that all included or adjacent types are described.

Water Body Type

01. Primary Stream, < 5 feet wide
Non-tidal stream with an average width of less than 5 feet.
02. Secondary Stream, 5-30 feet wide
Non-tidal stream with an average width of between 5 and 30 feet.
03. Tertiary Stream, > 30 feet wide
Non-tidal stream with an average width greater than 30 feet.
04. Tidal Stream
Streams with tidal influence which appear as a single blue line on the County Topographic Maps.
05. Sub-Estuary
Tidal areas other than the Chesapeake Bay or Potomac River which appear as a light blue signature (indicating width) on the County Topographic Maps.
06. Potomac River
The Potomac River proper.
07. Chesapeake Bay
The Chesapeake Bay proper.
08. Pond
Small enclosed body of freshwater, often artificially formed.
09. Bog
Waterlogged spongy accumulation of sphagnum moss which may support herbs such as sedges, rushes or scattered shrubs that cover less than 50 percent of the area.

Water Body Type (Continued)

10. Freshwater Marsh
    Soils normally covered with between 6 inches and 3 feet of water. Vegetation is usually dominated by robust or marsh emergents.
11. Shrub Swamp
    Soils are usually waterlogged during the growing season and often covered by standing water. Vegetation is dominated by shrubs including alders, willows, red maple, buttonbush and dogwood.
12. Wooded Swamp
    Soils are usually waterlogged during the growing season and seasonally covered with up to one foot of standing water. Trees include willow oak, green ash, red maple, bald cypress, black gum, etc.
13. Tidal Wetlands
    Marshes and swamps which are influenced by the tide.
14. Same as subsection 01
    Closest water body to the subsection is the same water body as that described with subsection 01.

15. Susquehanna River

Photo Scale

1:20,000	1 inch = 1,667 feet (UNAS Photos) 0.5 mm = 30 feet
1:31,680 (Cecil County)	1 inch = 2,640 feet 0.3 mm = 30 feet
1:15,840 (Xerox photos Cecil County)	1 inch = 1,320 feet 0.6 mm = 30 feet
1:12,000	1 inch = 555 feet (Wetlands Photos)

WATERBODY SIZE

Card 7, space 20.

Indicate the size of the water body cited under Water Body Distance. For Water Body Types 01 through 07, encode 7 (Not applicable) under Water Body Size. Where 14 (Same as subsection 01) is encoded for the Water Body Type, leave this space blank.

Water Body Size

1. Less than 1 acre
2. 1-5 acres
3. 5-10 acres
4. 10-20 acres
5. 20-30 acres
6. Greater than 30 acres
7. Not applicable

WATERBODY DEPTH

Card 7, space 21.

Indicate whether the water body previously described is greater or less than 1 foot in depth on the average. Where 14 (Same as subsection 01) is encoded for Water Body Type, leave this space blank.

*Water Body Depth

1. Less than 1 foot
2. Greater than 1 foot

* NOT USED FOR BAPS

Card 7, space 22.

Indicate the predominant bottom type found in the water body previously described. Where 14 (same as subsection 01) is encoded for Water Body Type, leave this space blank.

Water Body Bottom Material

1. Peat - fibrous organic material with recognizable plant parts.
2. Muck - black ooze composed of silt and decomposed organic matter.
3. Silt - fine sediment with little organic material.
4. Sand - granular sediment.
5. Gravel - granular sediment with particles larger than 2mm (approximately 1/8 in.).
6. Cobble - round or sub-round, water-worn rock 2½ - 10 inches in diameter.
7. Rock - solid aggregate of minerals larger than a cobble.

BEACH TYPE

Card 7, space 23.

Indicate the beach type which occurs along the water body previously described. Where one of 09 through 13 are encoded for Water Body Type record 6 (Not applicable) for Beach Type. Where 14 (Same as subsection 01) is recorded for the Water Body Type, leave this space blank.

Beach Type

1. Bluff - steep slope or abrupt embankment along waterbody edge or sandy beach
2. Bank - surrounding area gently sloping to waterbody edge
3. Sandy Beach - low, sloping sandy beach without dunes
4. Dunes - low, sloping sandy beach with dunes
5. Gravel Beach - low, sloping, beach composed of rocks or gravel
6. Not applicable
7. Shore erosion control (Bulkheading, etc).

BEACH LENGTH

Card 7, space 24.

Indicate the length of sandy beach which occurs along the water body previously described. Where 14 (Same as subsection 01) is encoded for Water Body Type, leave this space blank. Where no sandy beach occurs on the water body or the Water Body Distance is greater than 10 feet encode 5 (Not applicable) as the Beach Length.

Beach Length

1. Less than 500 feet
2. 500-1000 feet
3. 1000-1500 feet
4. Greater than 1500 feet
5. Not applicable

BEACH WIDTH

Card 7, space 25.

Indicate the width of sandy beach which was described under Beach Length. Where Beach Length was left blank leave this space blank. Where Beach Length was encoded as 5 (Not applicable) record the Beach Width as 5 (Not applicable).

Beach Width

1. Less than 1 foot
2. 1-10 feet
3. 10-20 feet
4. Greater than 20 feet
5. Not applicable

% OF STREAM SHADED

Card 7, space 26.

Where one of 01 through 04 is encoded for Water Body Type, indicate the percent of the subject stream which is shaded by tree or shrub cover with the sun directly overhead. Where the Water Body Type is not a stream, encode 5 (Not applicable) for % of stream shaded. Where 14 (Same as subsection 01) is encoded for Water Body Type, leave this space blank.

% of Stream Shaded

0. less than 10%
1. 10-25%
2. 25-50%
3. 50-75%
4. 75-100%
5. Not applicable

SOIL TYPE

Card 7, spaces 27-30.

Record the symbols for the dominant soil type which occurs within the subsection as indicated on the maps in the county soil survey. Left register all soil type symbols, leaving blanks after the code. Where a subsection such as a pond has no soil type recorded on the soil survey, encode "W" in the left most box under "Soil Type."

SOIL DRAINAGE

Card 7, space 31.

Indicate whether well drained soils occur in the subsection. Well drained soil types are listed by symbols under the tab entitled Well Drained Soils in the field notebook.

Soil Drainage

1. Yes, well drained soils occur in the subsection.
2. No, well drained soils do not occur in the subsection.

Card 7, spaces 32-34. **VEGETATION TYPE**

Indicate the vegetation type which characterizes the subsection. Forest vegetation types are described in the booklet Forest Cover Types of North America, Society of American Foresters, 1975. Record the vegetation type which best describes the subsection.

VEGETATION TYPES

14	Northern Pin Oak
16	Aspen
17	Pin Cherry
19	Gray Birch - Red Maple
20	White Pine - N. Red Oak - White Oak
21	White Pine
22	White Pine - Hemlock
23	Hemlock
24	Hemlock - Yellow Birch
26	Sugar Maple - Basswood
27	Sugar Maple
28	Black Cherry - Sugar Maple
29	Black Cherry
38	Tamarack
39	Black Ash - American Elm - Red Maple
40	Post Oak - Black Oak
41	Scarlet Oak
43	Bear Oak
44	Chestnut Oak
45	Pitch Pine
46	Eastern Red Cedar
47	Eastern Red Cedar - Pine
48	Eastern Red Cedar - Hardwoods
49	Eastern Red Cedar - Pine - Hardwoods
50	Black Locust
51	White Pine - Chestnut Oak
52	White Oak - Red Oak - Hickory
53	White Oak
54	Northern Red Oak - Basswood - White Ash
55	Northern Red Oak
56	Northern Red Oak - Mockernut Hickory - Sweetgum
57	Yellow Poplar (Tulip-Tree)
58	Yellow Poplar (Tulip-Tree) - Hemlock
59	Yellow Poplar (Tulip-Tree) - White Oak - Northern Red Oak
60	Beech - Sugar Maple
61	River Birch - Sycamore
62	Silver Maple - American Elm
63	Cottonwood
64	Sassafras - Persimmon
65	Pin Oak - Sweetgum
75	Shortleaf Pine
76	Shortleaf Pine - Oak
77	Shortleaf Pine - Virginia Pine
78	Virginia Pine - Southern Red Oak
79	Virginia Pine
80	Loblolly Pine - Shortleaf Pine
81	Loblolly Pine
82	Loblolly Pine - Hardwood
87	Sweetgum - Yellow Poplar (Tulip-Tree)
88	Laurel Oak - Willow Oak
91	Swamp Chestnut Oak - Cherrybark Oak

92 Sweetgum - Nuttal Oak - Willow Oak
93 Sugarberry - American Elm - Green Ash
94 Sycamore - Pecan - American Elm
95 Black Willow
96 Overcup Oak - Water Hickory
97 Atlantic White Cedar
98 Pond Pine
101 Bald Cypress
102 Bald Cypress - Water Tupelo
103 Water Tupelo
104 Sweetbay - Swamp Tupelo - Red Maple
107 Robust Emergents (Typha sp., etc.)
108 Shrub Swamp
109 Grasses, Sedges, Rushes
110 Floating Leaved and Submerged Vegetation
111 Shrub or Old Field Vegetation
112 Broad-Leaved Crops
113 Grain Crops

TOPOGRAPHY

Card 7, space 35.

Indicate the type of topography which typifies the subsection.

Topography

1. Flat - little topographic relief over most of subsection
2. Rolling - hills with slopes<15% over most of subsection
3. Steep - slopes>15% over most of subsection
4. Mixed - flat or rolling topography with significant areas (>33%) with steep slopes, gorges, or bluffs

Card 7, sapces 36-39.

Indicate the primary and secondary sources of physical alteration which are evident in the subsection. The first two spaces should be used for encoding the dominant type of disturbance. The co-dominant or less devastating type should be recorded in the second pair of spaces.

Source of Disturbance

1. Channelization
2. Dredging
3. Sewer Outlet
4. Culverts
5. Bulkheading
6. Dikes
7. Dams
8. Change in Watertable
9. Logs and Debris
10. Beaver Dams
11. Algal Blooms
12. Fetid Odor
13. Siltation
14. Erosion
15. Noise
16. Air Pollution
17. Selective Cutting
18. Clear Cutting
19. Fire
20. Windthrow
21. Disease
22. Litter Accumulation, leaf
23. Dumping
24. Littering, paper
25. Vandalism
26. Trampling
27. Motor Vehicles
28. Postagricultural
29. Other
30. None
31. Flooding
32. Grazing
33. Exotic plant invasion
34. Strip Mining
35. Agricultural, active

DEGREE OF DISTURBANCE

Card 7, space 40.

Indicate the relative amount of disturbance which is evident in the subsection as a result of man's actions.

Degree of Disturbance

1. Severe - man's impact resulting in severe alteration of vegetation or natural feature
2. Moderate - man's impact resulting in moderate alteration of vegetation or natural feature
3. Low - man's impact evident but not significant
4. None - evidence of man-made disturbance not present over most of the subsection

PASSAGE

Card 7, space 41.

Indicate the degree of difficulty a hiker would encounter when walking through the subsection.

Ease of Passage

1. Difficult - thick understory or wet mucky soils
2. Moderate - interspersed understory or wet soils
3. Easy - open understory, dry soils

Card 7, spaces 42-66.

Record the code and source for any birds, mammals and herptiles which are known to occur in the subsection. Six sets of five spaces are provided for citing six species. In the first four spaces of each set, record the four number code for the species. In the fifth space of each set encode whether the animal was observed or heard, reported, or a sign of the species was seen. Where more than 6 species are eligible for citation, encode the more unusual or rare species. If necessary, additional species important to the site may be encoded in other subsection.

Animals

Record 4 number code and source for each animal.

Source

1. Observed or Heard
2. Reported
3. Den, Nest, Spoor or Scats

Where known, the residency and frequency of occurrence of each animal in Maryland will be automatically printed for each species on the site's computer printout. These are encoded for your reference with each list of species according to the following scheme.

Residency

1. Breeding
2. Migratory
3. Winter
4. Year Round

Frequency

1. Abundant, common
2. Uncommon
3. Rare
4. Endangered

WATERBODY CONTOURS

Waterbody Contour Distance

Card 7, spaces 67-70
Distance to 3' contour in feet.

Card 7, spaces 71-74
Distance to 6' contour in feet.

SITE NUMBER

Card 7, spaces 77-80.

Record the County Site Number and Field Site Number in the last four spaces of Card 7.

CARD 8

VEGETATION SAMPLING FORM

Site No.	Sub-Sect	No. samples	Total Tally	Canopy	Understory	Shrub	Herb
831	00	19	97	86	33		

	Species	Layer	Import.	% Cover	DBH	Species	Tally 1 2 3 4 5 6 7 8 9 0	% Cov.	DBH	% Cov.	DBH	% Cov.	DBH	% Cov.	DBH	% Cov.	DBH	% Cov.	DBH	% Cov.	DBH	% Cov.	DBH	% Cov.	DBH
17	4921	1		4	7	White Oak		4	7					3	7					4	8				
25	4955	1		2	7	S. Red Oak		2	7					2	7					1					
33	4411	1		1	6	Va. Pine		1	5					0						1	7				
41	1241	1		0	5	Pignut Hickory		0	5					0	5					—					
49	3131	1		0	6	Black Walnut								0	6					—					
57	5071	1		0	5	Chestnut Oak														0	5				
65	1461	1		0	4	Hackberry		0	4					—						—					
73	3332	2		3		Red Maple		4		—				3						2					
82	(9-16 Blank)																								
17	4922	2		2		White Oak		2						3						2					
25	1872	2		0		Fl. Dogwood		1						0						0					
33	1322	2		0		Am. Chestnut								0						—					
41	4952	2		0		S. Red Oak		0						—						0					
49	5081	1		0		N. Red Oak														0	5				
57	2423	3		0		Strawberry Bush		0						0						—					
65	6623	3		1		H.B. Blueberry		2						1						1					
73	2673	3		1		Dangleberry		0						1						1					
83	(9-16 Blank)																								
17	6713	1		1		Maple Lvd. Viburnum		0						1						1					
25	2763	2		0		Witch-Hazel								0						1					
33	2937	4		0		Solomons Seal								1						0					
41	2775	4		0		Pygmy Pipes		0						0						—					
49	2925	4		1		May Apple		1						0						1					
57	3844	4		0		Partridge Berry		0						0						0					
65	2269	4		0		Moccasin Flower		0						—						—					
73	2134	4		1		Lady Fern		1						1						1					

LAYER
1. canopy
2. understory
3. shrub
4. herb

IMPORT
1. unique or rare
2. endangered

AVERAGE % COVER	AVERAGE DBH
0-<5	1=1-3"
1-10	2=4-6"
2-20	3=6-9"
3-30	4=9-12"
4-40	5=12-18"
5-50	6=18-24"
6-60	7=24-30"
7-70	8=30-36"
8-80	9= >36"
9-90	

ANIMALS:
Gray Squirrel-nest
Br. Creeper
Gr. Horned Owl
Solitary Vireo
Oven Bird
Scarlet Tanager
Downy Woodpecker

NOTES: Large Trees, Easy Passage

Locate sampling stations in areas of each subsection which fairly represent the character of the community as a whole. These sampling stations should be chosen to meet the following criteria:

a. The vegetation shall be located on a uniform topographic site, i.e. on the exposure, slope position and geological substrate.

b. The sample area shall generally reflect the character of the mapping unit within which it is located.

At each sampling point, first measure basal area by tallying trees with a BAF-10 wedge prism. A properly ground and calibrated prism is merely a tapered wedge of glass that bends or deflects light rays at a specific offset angle. When a tree stem is viewed through such a wedge, the bole appears to be displaced, as if seen through a camera range finder. The prism is rotated above a sampling point for a 360 degree circle. Use of the prism requires that it be held precisely over the sampling point at all times, for this point and not the observer's eye is the pivot from which the stand is swept. All tree stems not completely offset at 4.5 feet above the ground when viewed through the wedge are counted; others are not tallied. Trees that appear to be borderline should be measured and checked with the appropriate plot radius factor before arbitrarily deciding to tally every other borderline stem. A tree which forks below 4.5 feet is tallied as two trees; a tree which forks above 4.5 feet is counted as one.

The prism may be held at any convenient distance from the eye, provided it is always positioned directly over the sampling point. Proper orientation also requires that the prism be held in a vertical position and at right angles to the line of sight; otherwise, large errors in the tree tally may result. A complete explanation of point sampling and instructions for using the wedge prism are included in the reprint following the sampling instructions.

Record the number of trees counted at each sample point on the "Vegetation Sampling Form" in the box marked "Tally" above the proper sample number. At the completion of the survey, record the total number of trees counted in each subsection and the number of basal area samples taken in the proper boxes at the top of the "Vegetation Sampling Form."

A Basal Area Factor-10 prism has an offset angle of 104.18 min. With this viewing angle, all trees no farther than 33 times their diameter from the sample point are tallied. As a result of this relationship, each tree counted represents 10 square feet of basal area/acre at 4.5 feet above the ground. (Basal area is the cross sectional area of a tree stem.) For each subsection, the computer will divide the total number of trees tallied by the number of sample points and multiply this quotient by 10 to get the basal area/acre of the subsection in square feet. This will give an idea of the relative density of trees in different subsections.

The number of trees counted in each subsection using the prism is dependent on both the diameter of the trees in the stand and their spatial distribution. The accuracy of the resulting basal area measurement is

dependent on the variability of these two factors. For this reason, diverse stands require a higher sampling intensity than even-aged stands of low diversity. As a rule of thumb, a minimum of 4 samples is required for a monotypic, single-aged stand such as a pine plantation; up to 10 samples are required for mixed-aged stands with a diversity of species such as mixed hardwood forest.

As a representation of the species composition of each subsection, the vegetation should be described for each physiognomic strata. The canopy is the highest forest layer. The understory is composed of trees of intermediate height. The shrub layer lies below the understory and is generally composed of species with multiple stems less than 20 feet tall. The herb layer is within a few feet of the ground but may contain woody species such as partridgeberry, poison ivy, etc. Where vines extend into the canopy and understory, record them with the herb layer and note them in the text. Estimate and record percent cover by species for each layer under the appropriate sample point number on the "Vegetation Sampling Form". Record average DBH (Diameter Breast Height or diameter at 4.5 feet above the ground for the canopy species. Record this information at a sufficient number of sampling points to adequately reflect the composition of the community. Generally, fewer of these samples will be required than basal area samples, but a basal area sample should be taken at each of these vegetation sample points.

At the completion of the survey, average the DBH and percent cover estimates for each species and record these in the proper spaces at the left of the "Vegetation Sampling Form". Average the percent cover for each layer and note these at the top. Encode the layer for each species and note impact where applicable. Finally, encode the number for each species as found on the lists which follow in the notebook.

If conditions do not permit doing Basal area samples and no prism samples are taken, leave "No. Samples" and "Total Tally" blank. Do not put "0" in these spaces. An "0" should only be used in "No. Samples" if 10 samples are taken.

Reprinted from:

Avery, Eugene T. Ph.D. 1967. Forest Measurements. McGraw-Hill Book Company, New York.

POINT-SAMPLE TIMBER CRUISING

A NEW ANGLE TO CRUISING

10-1 The concept of point sampling. In its most elementary form, point sampling is merely a method of selecting trees to be tallied on the basis of their *sizes* rather than by their frequency of occurrence. Sample "points," somewhat analogous to plot centers, are randomly or systematically located within a forested tract, and a simple prism or angle gauge that subtends a fixed angle of view is used to "sight in" each tree dbh. Tree boles close enough to the observation point to completely fill the fixed sighting angle are tallied; stems too small or too far away are ignored. Thus the probability of tallying any given tree is proportional to its BA, and consequently more time is spent on larger, high-value trees than is the case with conventional strip or line-plot cruising.

The concept of point sampling was developed and first reported in

948 by Walter Bitterlich, a forest engineer of Salzburg, Austria. The introduction and adoption of the method in North America were largely due to the efforts of Lewis R. Grosenbaugh, a biometrician with the U.S. Forest Service. Grosenbaugh recognized the potentialities of the angle-gauge idea and expanded it into a complete inventory system that has largely supplanted strip and line-plot cruising in many regions. In the United States, the technique is usually referred to as the *Bitterlich system* or simply as *point sampling*. These two terms are generally favored over *variable-plot sampling* or *plotless cruising*.

10-2 The basal area approach. Point sampling does not require measurements of either plot areas or tree diameters. If a predetermined basal area factor (BAF) of 10 sq ft per acre is assumed and a total of 75 trees is tallied on 15 sample points, the average of five trees per point multiplied by 10 provides a BA estimate of 50 sq ft per acre. The well-established relationship between tree BA and volumes also makes it feasible to use point sampling for obtaining conventional timber inventory data when "counted" trees are recorded by merchantable or total height classes.

10-3 Selecting a sighting angle. BA conversion factors are dependent on the sighting angle (or "critical angle") arbitrarily selected. The sighting angle chosen, in turn, is largely based on the average size and distribution of trees to be sampled. Furthermore, from the standpoint of subsequent volume computations, it is desirable to select a sighting angle having a BAF that can be expressed as a whole number rather than as a fractional number.

In Eastern United States, a predetermined sighting angle of 104.18 min (BAF of 10 sq ft per acre) is commonly used in second-growth sawtimber or dense pole-timber stands. Critical angles of 73.66 min (BAF 5) and 147.34 min (BAF 20) are often employed for light-density pole stands and for large, old-growth sawtimber, respectively. With small, scattered stems, the sighting angle is narrowed so that it will extend farther out for trees of minimum diameter; conversely, where large tree diameters are common, the angle is enlarged to reduce excessively heavy field tallies.

TABLE 10-1 Common Basal Area Factors and Angle Sizes Used in Point Sampling

Basal area (sq ft per acre)	Angle size, min	Angle size, diopters	Ratio (tree diameter to plot radius)	Plot radius factor
1	32.94	0.96	1/104.4	8.696
2	46.59	1.36	1/73.8	6.149
3	57.06	1.66	1/60.2	5.021
4	65.89	1.92	1/52.2	4.348
5	73.66	2.14	1/46.7	3.889
10	104.18	3.03	1/33.0	2.750
15	127.59	3.71	1/26.9	2.245
20	147.34	4.29	1/23.3	1.944
25	164.73	4.79	1/20.9	1.739
40	180.46	5.25	1/19.0	1.588
45	194.92	5.67	1/17.6	1.470
70	208.38	6.07	1/16.5	1.375
80	232.99	6.79	1/14.8	1.230
90	255.25	7.44	1/13.5	1.123

Source: Hovind and Rieck, 1961

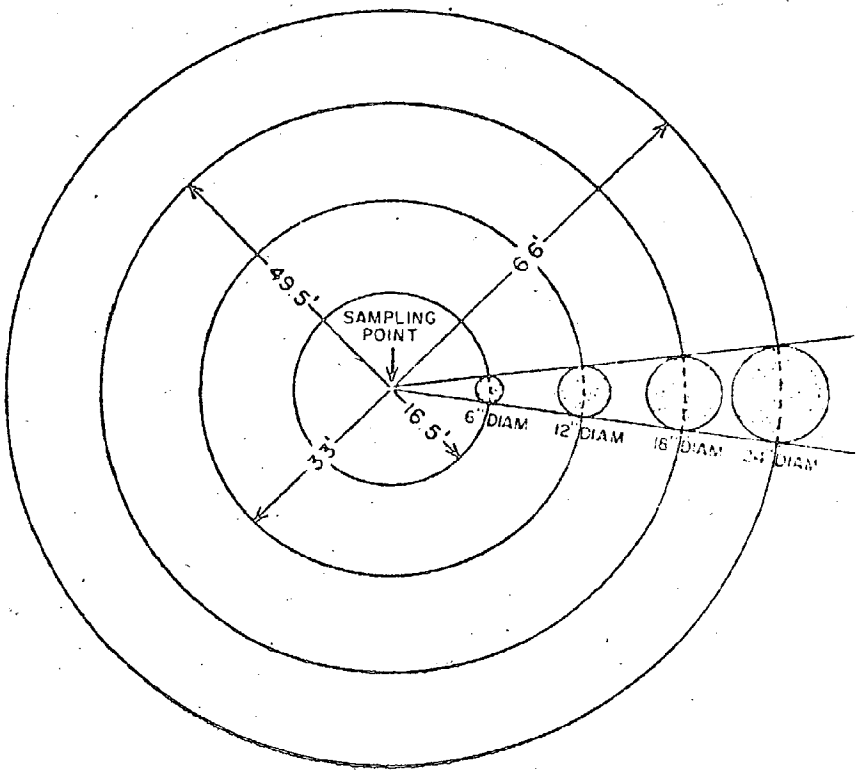


FIG. 10-1 Ratio of tree diameter to plot radius for BAF 10. *Adapted from Hovind and Rieck, 1961.*

Depending on the region, average tree size, and amount of underbrush restricting line-of-sight visibility, the BAF is usually chosen to provide an average tally of 5 to 12 trees per sample point. In Western United States where larger timber predominates, a BAF of 20 to 60 is in common use. For "West Side" Douglas fir, a BAF of 40 might be regarded as typical, but an instrument with a BAF of 20 would be more frequently encountered in sampling stands of "East Side" ponderosa pine.

10-4 Plot radius factor. To illustrate the meaning of BA conversions listed in Table 10-1, a sighting angle of 104.18 min (BAF 10) may be presumed. As this angle can also be defined by placing a 1-in. horizontal intercept on a sighting base of 33 in. (column 4 of Table 10-1), it follows that all trees located no farther than 33 times their diameter from the sample point will be tallied. Accordingly, a 1-in. dbh tree must be within 33 in. of the point, a 12-in.-dbh tree will be tallied up to 396 in. (33.0 ft) away, and a 24-in. or 2-ft-dbh tree will be recorded up to a distance of 66 ft (Fig. 10-1). This 1:33 ratio of tree diameter to plot radius, a constant for the specified angle of 104.18 min, has a value of 2.75 ft $(33 \div 12)$ when expressed as a "plot radius factor." Thus for each full inch added to stem diameter, a tree can be 2.75 ft farther from the sample point and still be tallied.

HOW POINT SAMPLING WORKS

10-5 Imaginary tree zones. As the plot radius factor for BAF 10 has been developed in the preceding section, all subsequent explanations of point-sampling theory and tree volume conversions in this chapter will presume a sighting angle of 104.18 min and a BAF of 10 sq ft per acre. Nevertheless, the underlying principles discussed may be applied to any other angle or BAF.

Because each tree "sighted in" must be within 33 times its diameter of the sample point to be tallied, it is convenient to presume that all trees are encircled with imaginary zones whose radii are exactly 33 times the diameter of each tree stem. All these imaginary circles that encompass a given sampling point on the ground represent trees to be tallied (Fig. 10-2). Thus the probability of tallying any given tree is proportional to its stem BA. A 12-in. dbh has four times the probability of being counted as a 6-in.-dbh stem. Stated in another way, the chances of tallying one 12-in.-dbh tree are the same as that of encountering four 6-in.-dbh trees.

10-6 Equality of trees on a per acre basis. For the sighting angle of 104.18 min, each tallied tree (regardless of its size or relative position to the sampling point) represents 10 sq ft of BA on a *per acre basis.*

a definite part of an acre and a specific number of trees per acre, depending on its size. The derivation of values for 6-in.- and 12-in.-dbh trees in Table 10-2 provides an explanation or "proof" of this theory.

Considering the 6-in. dbh first, its imaginary "plot" radius is read from Table 10-2 as 16.50 ft. This hypothetical zone represents an imaginary plot of 0.0196 acre around each 6-in.-dbh stem (column 3 of

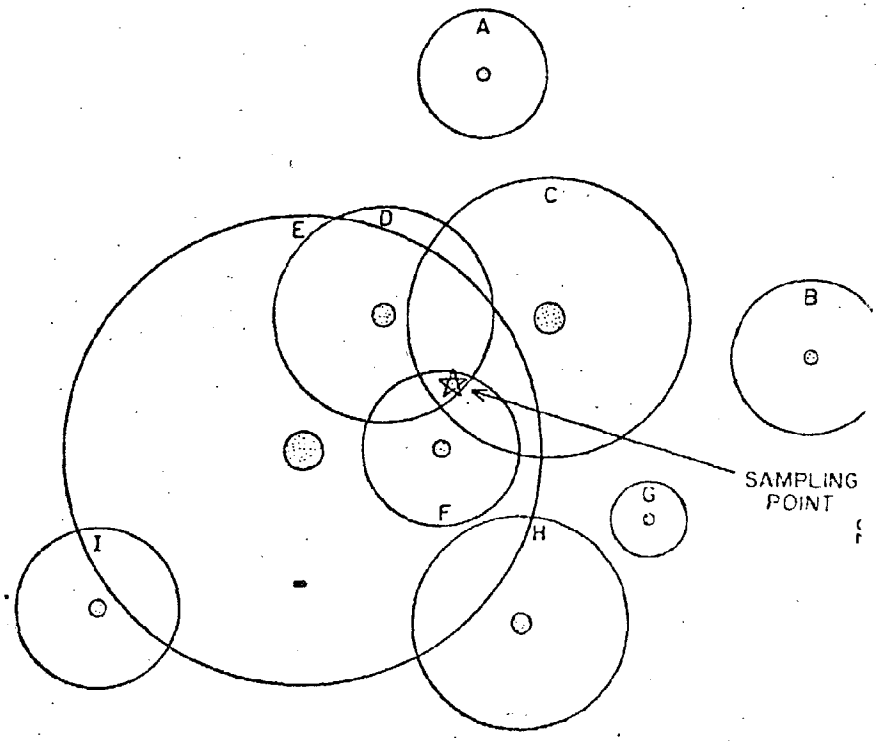


FIG. 10-2 Imaginary zones proportional to stem diameter and encircling each tree determine which trees will be tallied at a given point. *Adapted from Haviad and Rieck, 1961.*

Table 10-2). By dividing 0.0196 into 1.00 acre, it can be seen from column 4 that there can be 51.02 such areas fitted into a single acre. Thus when one 6-in.-dbh tree is tallied, it is tacitly assumed that there are 51.02 such stems *per acre.* Accordingly, the BA of a 6-in.-dbh tree (0.196 sq ft from column 5), multiplied by 51.02 trees per acre, yields the "constant" BAF of 10 sq ft *per acre* (column 6).

For 12-in.-dbh stems, the imaginary plot radius is 33.00 ft, and the

TABLE 10-2 Derivation of the Basal Area Factor of 10 Sq Ft Per Acre for Point Sampling

Tree dbh, in. (1)	Imaginary plot radius, ft (2)	Imaginary plot size, acres (3)	Trees per acre,* no. of stems (4)	Basal area per tree, sq ft (5)	Basal area per acre, sq ft (6)
4	11.00	0.0087	114.94	0.087	10
6	16.50	0.0196	51.02	0.196	10
8	22.00	0.0349	28.65	0.349	10
10	27.50	0.0545	18.35	0.545	10
12	33.00	0.0785	12.74	0.785	10
14	38.50	0.1069	9.35	1.069	10
16	44.00	0.1396	7.16	1.396	10
18	49.50	0.1767	5.66	1.767	10
20	55.00	0.2182	4.58	2.182	10
22	60.50	0.2640	3.79	2.640	10
24	66.00	0.3142	3.18	3.142	10
26	71.50	0.3687	2.71	3.687	10
28	77.00	0.4276	2.34	4.276	10
30	82.50	0.4909	2.04	4.909	10
32	88.00	0.5585	1.79	5.585	10
34	93.50	0.6305	1.59	6.305	10
36	99.00	0.7069	1.41	7.069	10
Method of calculation	dbh × 2.75	$\frac{\pi r^2}{43{,}560}$	$\frac{1.00}{\text{plot size}}$	$0.005454D^2$	column 4 × 5

* Exact value for number of trees per acre may vary slightly, depending upon number of decimal places expressed for imaginary plot size.

implied plot size is 0.0785 acre. Only 12.74 trees per acre are assumed—approximately one-fourth the number of 6-in.-dbh trees expected. However, 12-in.-dbh trees have four times the BA of 6-in.-dbh stems, and this value (0.785 sq ft) from column 5, multiplied by 12.74 trees per acre, again produces a BA of 10 sq ft per acre. The same "proof" applies to all other tree sizes encountered when sampling with a BAF 10 angle gauge.

INSTRUMENTS FOR POINT SAMPLING

10-7 The stick-type angle gauge. This simple, horizontal angle gauge often consists of a wooden rod with a peep sight at one end and a

metal intercept at the other. To establish a sighting angle of 104.18 min (BAF 10), an intercept 1 in. wide on a 33-in. sighting base can be easily improvised. Gauges for other factors can be constructed according to ratios provided in Table 10-1. Regardless of the ratio desired, the sighting base should be at least 24 in. long; otherwise, it is difficult to keep both the intercept and the tree in focus simultaneously.

When the stick gauge is used, all tree diameters larger than the defined angle are counted; those smaller are ignored. Trees that appear to be exactly the same size as the intercept should be checked by measuring their exact dbh and distance from the sampling point. The product of dbh and the appropriate plot radius factor (2.75 for BAF 10) determines whether the tree is "in," "out," or a borderline case. Truly borderline trees are rare, but if they are encountered, they should be tallied as ½ tree.

With a stick gauge, the observer's eye represents the vertex of the sighting angle; hence the stick must be pivoted or revolved about this exact point for a correct tree tally. When properly calibrated for use by a particular individual, the stick gauge may be just as accurate as other more expensive point-sampling devices. In dense sapling or pole stands and where heavy underbrush is encountered, the stick gauge is often easier to use than more sophisticated relascopes or prisms.

10-8 The Spiegel relascope. This is a versatile, hand-held instrument developed for point sampling by Walter Bitterlich. It is a compact and rugged device that may be used for determining BA per acre, upper-stem diameters, tree heights, horizontal distances of 66 and 99 ft with correction for slope, and measurement of slope on per cent, degree, and topographic scales. Sighting angles are provided for factors of 5, 10, 20, or 40, and the instrument automatically corrects each angle for slope. The base has a tripod socket for use when especially precise measurements are desired.

Establishment of sighting angles with the Spiegel relascope is somewhat analogous to measuring distances with transit and stadia rod; the principal difference is that the relascope subtends a horizontal angle, and the transit and stadia system is based on a vertically projected angle. The Spiegel relascope is complex in design but relatively simple to use. Its principal disadvantages are that it is relatively expensive and lacks the optical qualities for good sighting visibility on dark and rainy days.

10-9 The wedge prism. A properly ground and calibrated prism is merely a tapered wedge of glass that bends or deflects light rays at a specific offset angle. When a tree stem is viewed through such a wedge,

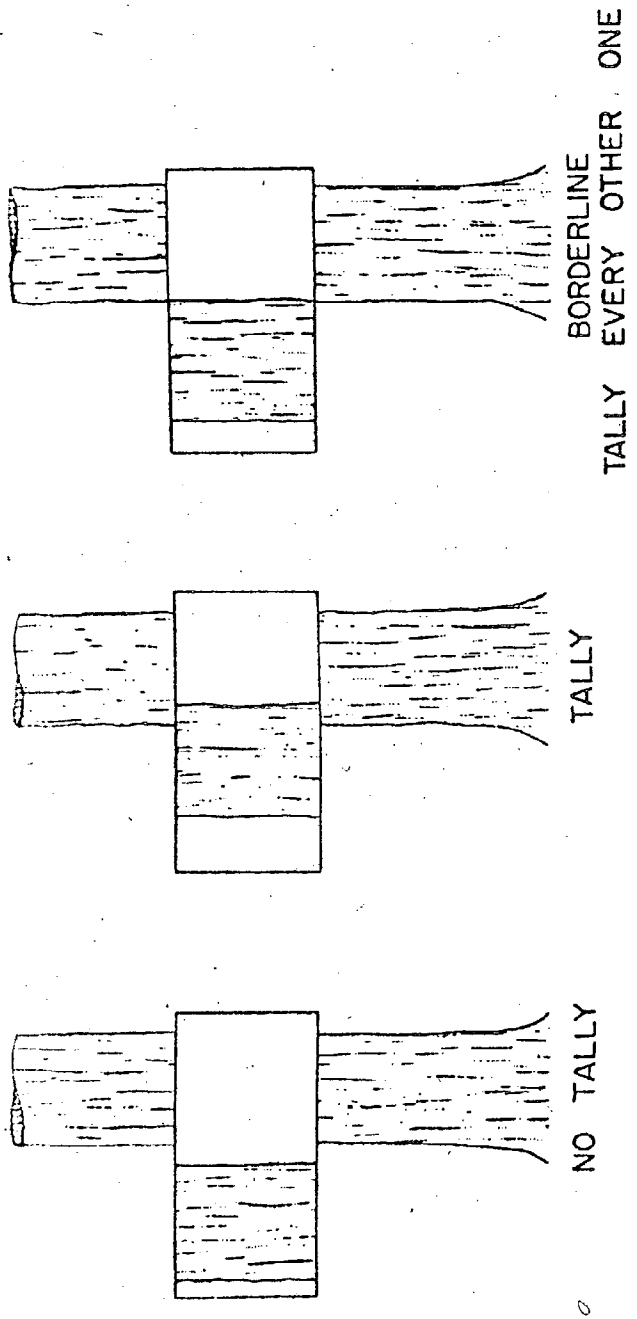


FIG. 10-3 Use of the wedge prism for point sampling. *Adapted from Bruce, 1955.*

the bole appears to be displaced, as if seen through a camera range finder. The amount of offset or displacement is controlled by the prism strength, measured in diopters. As one prism diopter is equal to a right angle displacement of one unit per 100 units of distance, a 3.03-diopter prism will produce a displacement of one unit per 33 units of distance, i.e., a critical angle of 104.18 min. Other prism-strength relationships are given in Table 10-1.

Field use of the prism requires that it be held precisely over the sampling point at all times, for this point and *not the observer's eye* is the pivot from which the stand is "swept" by a 360° circle. All tree stems not completely offset when viewed through the wedge are counted; others are not tallied (Fig. 10-3). Trees that appear to be borderline should be measured and checked with the appropriate plot radius factor *before* arbitrarily deciding to tally every other borderline stem.

The prism may be held at any convenient distance from the eye, provided it is always positioned directly over the sampling point. Proper orientation also requires that the prism be held in a vertical position and at right angles to the line of sight; otherwise, large errors in the tree tally may result (Fig. 10-4).

The wedge prism is simple, relatively inexpensive, portable, and as accurate as other angle gauges when properly calibrated and used. Some sighting difficulties are found in dense stands where displaced bole sections offset into one another, and special corrections must be applied when slopes of 15 per cent and greater are encountered. However, the latter disadvantage may be cited for all point-sampling devices except the Spiegel relaskope.

10-10 Calibration of prisms or angle gauges. Precision-tested prisms and angle gauges should be used whenever feasible, because a BAF of *exactly* 5, 10, or 40 is conducive to faster computations than such values as 4.9, 9.8, or 39.5 (Sec. 10-3). Prisms ground to within ±1 min of a specified angle are desired, for such deviation will usually result in a maximum error of about 2 per cent for a BAF 10 prism.

Where inexpensive prisms or angle gauges are employed and the exact BAF is unknown, such devices should be carefully calibrated. As individual eyesights may vary appreciably, it may even be desirable to calibrate *all instruments* (regardless of price or supposed precision) for each cruiser's own sighting habits or peculiarities.

To calibrate a prism or angle gauge, a target of known width (for example, 1.0 ft) is set up against a contrasting background. With the angle gauge or prism in proper orientation, the observer backs away from the target until the target exactly fills the sighting angle (or until the prism image is displaced as shown for the "borderline" tree in Fig.

)-3). The exact distance from target to instrument is then measured
d the BAF computed by this relationship:

$$\text{BAF} = 10{,}890\left(\frac{W}{D}\right)^2$$

here W is the target width in feet, and D is the distance to target
feet.

The foregoing formula is not exact when a flat target is used in calibra-
on but only when the target is a circular cross section with diameter W.

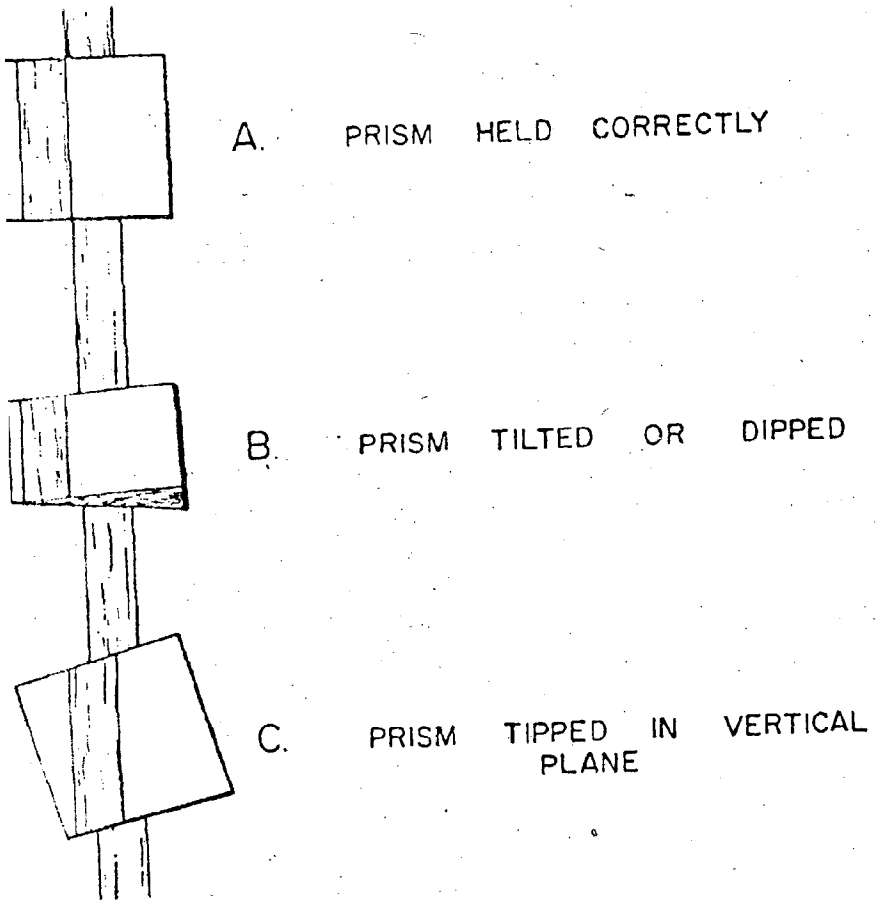


FIG. 10-4 Correct and incorrect methods of holding the wedge prism. *Adapted from Horiad and Bieck* (1961).

With small critical angles, however, this simple approximation is usually satisfactory, because of the near equality of sine and tangent functions for narrow angles. For reliable results, the instrument should be mounted on a plane table, tripod, or vise and several readings made of the horizontal distance to the target. When a fractional BAF is derived, conversions similar to those in Table 10-2 should be prepared to simplify subsequent inventory computations.

10-11 Corrections for slope. Unless the Spiegel relascope is used to establish sighting angles, corrections must be made in point sampling when slope is 15 per cent or greater, that is, a 15-ft rise or drop in elevation per 100 horizontal feet (Stage, 1959).

When the wedge prism is used, an approximate on-the-ground compensation for slope can be made by tilting the top edge of the prism through the estimated slope angle—at right angles to the line of slope.

TABLE 10-3 Slope Correction Table for Point Sampling*

Maximum per cent of slope at sampling point	Maximum degrees of slope at sampling point	Multiply tree count by—
15	6.75	1.01
20	9.00	1.02
25	11.25	1.03
30	13.50	1.04
35	15.75	1.06
40	18.00	1.08
45	20.25	1.10
50	22.50	1.12
55	24.75	1.14
60	27.00	1.17
65	29.25	1.19
70	31.50	1.22
75	33.75	1.25
80	36.00	1.28
85	38.25	1.31
90	40.50	1.34
95	42.75	1.38
100	45.00	1.41

* This correction for tree count, BA, and volume per acre is true only when it is assumed that in this sampling procedure a proportionate number of trees will be added when the slope distance is corrected to the true horizontal distance. For all practical purposes, however, tree count, BA, and volume can be corrected by using the above multipliers.

SOURCE: Hovind and Bieck, 1961.

With angle gauges such as the stick type, the unadjusted field tally can be corrected by (1) measuring the slope at right angles to the contour in per cent or degrees and (2) applying corresponding correction factors to BA or volume per acre estimates from Table 10-3. The amount of slope is usually measured with an Abney level.

10-12 Doubtful trees, limiting distances, and bias. Most cruisers possess some degree of observer bias when "sighting in" doubtful trees. In a strict sense, borderline trees occur only when the distance from the sampling point to the stem center is precisely equal to tree dbh times plot radius factor. Therefore, if doubtful trees are regularly checked by careful measurement, the borderline tree is rarely encountered.

To encourage regular field checks of doubtful trees and speed up the sampling process, it is helpful to compile tables of limiting distances in advance of fieldwork. These are easily prepared by multiplying various tree diameters by the appropriate plot radius factor (Table 10-4). For maximum utility, such tables should be expressed in feet and links.

When brush or other obstructions make it necessary to move from the sampling point to view certain stems, special care must be exercised to maintain the correct distances from obscured trees. Failure to maintain proper distance relationships can result in sizable errors in the tally, especially when using a large BAF.

TABLE 10-4 Horizontal Limiting Distances in Feet for BAF 10 Point-sampling Instruments

DBH, in.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	13.75	14.02	14.30	14.57	14.85	15.12	15.40	15.67	15.95	16.22
6	16.50	16.77	17.05	17.32	17.60	17.87	18.15	18.42	18.70	18.97
7	19.25	19.52	19.80	20.07	20.35	20.62	20.90	21.17	21.45	21.72
8	22.00	22.27	22.55	22.82	23.10	23.37	23.65	23.92	24.20	24.47
9	24.75	25.02	25.30	25.57	25.85	26.12	26.40	26.67	26.95	27.22
10	27.50	27.77	28.05	28.32	28.60	28.87	29.15	29.42	29.70	29.97
11	30.25	30.52	30.80	31.07	31.35	31.62	31.90	32.17	32.45	32.72
12	33.00	33.27	33.55	33.82	34.10	34.37	34.65	34.92	35.20	35.47
13	35.75	36.02	36.30	36.57	36.85	37.12	37.40	37.67	37.95	38.22
14	38.50	38.77	39.05	39.32	39.60	39.87	40.15	40.42	40.70	40.97
15	41.25	41.52	41.80	42.07	42.35	42.62	42.90	43.17	43.65	43.72
16	44.00	44.27	44.55	44.82	45.10	45.37	45.65	45.92	46.20	46.47
17	46.75	47.02	47.30	47.57	47.85	48.12	48.40	48.67	48.95	49.22
18	49.50	49.77	50.05	50.32	50.60	50.87	51.15	51.42	51.70	51.97
19	52.25	52.52	52.80	53.07	53.35	53.62	53.90	54.17	54.45	54.72
20	55.00	55.27	55.55	55.82	56.10	56.37	56.65	56.92	57.20	57.47
21	57.75	58.02	58.30	58.57	58.85	59.12	59.40	59.67	59.95	60.22
22	60.50	60.77	61.05	61.32	61.60	61.87	62.15	62.42	62.70	62.97
23	63.25	63.52	63.80	64.07	64.35	64.62	64.90	65.17	65.45	65.72
24	66.00	66.27	66.55	66.82	67.10	67.37	67.65	67.92	68.20	68.47
25	68.75	69.02	69.30	69.57	69.85	70.12	70.40	70.67	70.95	71.22
26	71.50	71.77	72.05	72.32	72.60	72.87	73.15	73.42	73.70	73.97
27	74.25	74.52	74.80	75.07	75.35	75.62	75.90	76.17	76.45	76.72
28	77.00	77.27	77.55	77.82	78.10	78.37	78.65	78.92	79.20	79.47
29	79.75	80.02	80.30	80.57	80.85	81.12	81.40	81.67	81.95	82.22
30	82.50	82.77	83.05	83.32	83.60	83.87	84.15	84.42	84.70	84.97

10-13 Choice of instruments. In summary, the selection of a point sampling sighting gauge is largely a matter of balancing such factors as costs, efficiency, and personal preferences. All the devices described here will provide a reliable tree tally if they are properly calibrated and carefully used. Accordingly, the following generalizations will be primarily useful to the newer advocates of point sampling:

1. When steep slopes are regularly encountered, the Spiegel relaskope is preferred.
2. For relatively flat topography, either the wedge prism or the stick gauge may be used. The prism is particularly desirable for persons who wear eyeglasses, because the vertex of the sighting angle occurs at the prism rather than at the observer's eye. However, the prism is difficult to use in dense stands due to displacement of stem sections into one another.
3. The simple stick gauge, though largely supplanted by the prism, is preferable in dense stands—especially if the cruiser does not wear spectacles. Cruisers who use point sampling only occasionally will find the stick gauge more reliable, because there are fewer ways for errors to result with this device than with the wedge prism.

VOLUME CONVERSIONS

10-14 Tree count and basal area. As previously described, each tree tallied in point sampling, *regardless of its diameter*, represents the same amount of BA on a per acre basis. BA per acre for any tract may thus be computed by this relationship:

$$\text{BA per acre} = \frac{\text{total trees tallied}}{\text{no. of points}} \times \text{BAF}$$

If the BAF is 10 and 160 trees are tallied at 20 sample points, the BA per acre would be $160/20 \times 10 = 80$ sq ft per acre. As with all cruising techniques, it is presumed that the counted trees are representative of the population sampled.

10-15 Derivation of tree volumes. Most cruisers are interested in volumes expressed in board feet, cubic feet, or cords rather than BA alone. When using point sampling, volume computations are handled differently

from conventional cruising, because all sizes of trees have the same BA per acre. The variable of dbh (a function of BA) can therefore be ignored when only total volumes are required, and the field tally can be reduced to a simple stem count by height classes. Average stand volume per acre is determined by using ratios of the volumes of each height class to their respective BA. These ratios or volume factors can be quickly determined by use of the "per acre conversion factors" in Table 10-2 and the volume of one tree of a specified size. Volume per acre can thus be derived by this relationship:

$$\text{Volume per acre} = \frac{(\text{volume per tree})(\text{no. trees per acre})}{\text{no. of sample points}}$$

To illustrate the computation of volume per acre conversions, it may be assumed that cordwood factors are desired for 1-bolt (8 ft of merchantable height) trees in the Lake states by five tree diameter classes. Essential steps in deriving these converting factors can be illustrated in tabular form:

Merchantable height, ft	Corresponding dbh class, in.	Volume per tree, cd	Trees per acre (Table 10-2), no. of stems	Volume per acre, (column 3 × 4)
8	6	0.017	51.02	0.87
8	8	0.031	28.65	0.89
8	10	0.049	18.35	0.90
8	12	0.070	12.74	0.89
8	14	0.095	9.35	0.89

For the single 8-ft-height class listed, it will be noted that volume per acre conversions show very little change from one dbh class to another. Hence, unless stand tables are required, it is superfluous to break down the tally by diameter classes. As shown here, a volume factor of 0.9 cd will suffice for all 8-ft heights, irrespective of diameter changes. For other height classes, volume per acre factors might be computed as follows:

Merchantable height, ft	Corresponding dbh class, in.	Volume per tree, cd	Trees per acre (Table 10-2), no. of stems	Volume per acre, (column 3 × 4)
8	8	0.031	28.65	0.89 = 0.9
16	10	0.083	18.35	1.52 = 1.5
24	12	0.155	12.74	1.97 = 2.0
32	14	0.269	9.35	2.52 = 2.5
40	18	0.531	5.66	3.01 = 3.0
48	22	0.918	3.79	3.48 = 3.5

To review the foregoing computations, the height classes desired for field tallying are listed first in column 1. The average dbh that corresponds to each height class must be obtained from existing records or special field samples (column 2). With these two values known, the volume per tree (column 3) is read from any desired tree volume table. Number of trees per acre (column 4), based on the appropriate dbh class, may be read directly from Table 10-2 for BAF 10 conversions—or computed as described in Sec. 10-6. Finally, the volume per acre conversion (column 5) is simply a product of volume per tree and number of trees per acre.

10-16 Field tally by height classes. The reason that point sampling appears to be such a simple method of deriving standing tree volumes is that most of the computational work is accomplished *in advance of the field tally*. When the volume per acre conversions are incorporated directly into the field tally form and trees are recorded by height classes only, a minimum of post-cruising calculations are necessary. Under these conditions, the field record essentially becomes a cumulative tally sheet and volumes can be speedily summarized (Table 10-5).

TABLE 10-5 Simplified Field Tally and Volume Summary for Point Sampling

Tract: La Crosse, Wisconsin — Timbered area: 40 acres
No. of points: 20 — BAF: 10

Height class, ft	Tree tally, no. of stems	Volume per acre, cd	Tally × volume, cd
8	20	0.9	18.0
16	30	1.5	45.0
24	40	2.0	80.0
32	20	2.5	50.0
40	10	3.0	30.0
48	5	3.5	17.5
Totals	125 Trees		240.5 cd

$$\text{BA per acre} = \frac{125 \text{ trees}}{20 \text{ points}} \times 10 = 62.5 \text{ sq ft per acre}$$

$$\text{Average volume per acre} = \frac{240.5 \text{ cd}}{20 \text{ points}} = 12.025 \text{ cd per acre}$$

When stand and stock tables are needed and trees must also be listed by diameter classes, special cumulative tally sheets have been published (Thornton and Hutchison, 1958).

10-17 Comparisons with conventional plots. There is no fixed plot size when using point sampling; hence it is difficult to compute cruise intensity on a conventional area-sample basis. Each tree has its own imaginary plot radius (depending on the BAF used), and the exact plot size cannot be easily determined, even after the tally has been made. However, approximations can be made on the basis of the *average* stem diameter encountered at a given point.

Assuming an even-aged plantation with a single dbh class of 6 in. and a critical angle of 104.18 min, the area sampled would have a radius of 6×2.75 or 16.5 ft—equivalent to about $\frac{1}{20}$ acre. If the dbh class were doubled to 12 in., the effective sample area would quadruple to about $\frac{1}{10}$ acre. To sample a full $\frac{1}{5}$ acre, average dbh would have to be about 19 in.

From the foregoing, it follows that use of BAF 10 sample points in lieu of the same number of $\frac{1}{5}$- or $\frac{1}{4}$-acre plots will usually result in a tally of fewer trees. From a statistical standpoint, however, the selection of trees according to size rather than frequency may more than offset this reduction of sample size—and with an additional saving in time. Conversely, it must be remembered that smaller samples of any kind require larger expansion or blow-up factors. Thus when point sampling is adopted, the so-called borderline trees must always be closely checked, for the erroneous addition or omission of a single stem reduces the accuracy of any volume estimate by the amount of the BAF.

10-18 Number of sampling points needed. The only accurate method of determining how many point samples should be measured is to determine the standard deviation (or coefficient of variation) of BA or volume per acre from a preliminary field sample. When this has been done, sampling intensity may be derived from Table 8-1 or by formulas described in Secs 8-15 and 8-16. If the statistical approach is not feasible, the following rules of thumb will often provide acceptable results:

1. If the BAF is selected according to tree size so that an average of 5 to 12 trees are counted at each point, use the same number of points as $\frac{1}{5}$-acre plots.
2. With a BAF 10 angle gauge and timber that averages 12 to 15 in. in diameter, use the same number of points as $\frac{1}{10}$-acre plots.
3. For reliable estimates, never use fewer than 20 points in natural timber stands or less than 10 points in even-aged plantations.

10-19 Point samples versus plots. Of the numerous field comparisons of point sampling and plot cruising, one of the more extensive evaluations was made by the U.S. Forest Survey in Southeast Texas (Grosenbaugh and Stover, 1957). In this test, BAF 10 point samples were measured from the centers of 655 circular $\frac{1}{4}$-acre plots that were distributed throughout 12 counties. Volume per acre comparisons were made for BA, cubic-foot volumes, and board-foot volumes.

Differences in mean volumes by the two sampling methods were not significant at the 5 per cent level. Coefficients of variation for point sampling were only 7 to 12 per cent larger than for the $\frac{1}{4}$-acre plots, and standard errors were within 0.5 per cent of each other. It was estimated that 20 per cent more point samples would be needed to provide the same accuracy in cubic volume as derived from the plots; however, even with these additional samples the points could be measured in considerably less field time.

10-20 Attributes and limitations. In summary, the principal advantages of point sampling over plot cruising are:

1. It is not necessary to establish a fixed plot boundary; thus greater cruising speed is possible.
2. Large, high-value trees are sampled in greater proportions than smaller stems.
3. BA and volume per acre may be derived without direct measurement of stem diameters.
4. When volume per acre conversions are developed in advance of fieldwork, efficient volume determinations can be made in a minimum of time. Thus the method is particularly suited to quick, reconnaissance-type cruises.

The main drawbacks to point sampling are:

1. Heavy underbrush reduces sighting visibility and cruising efficiency.
2. Because of the relatively small size of sampling units, carelessness and errors in the tally (when expanded to tract totals) are likely to be more serious than in plot cruising.
3. Slope compensation causes difficulties that may result in large errors unless special care is exercised. Similar difficulties are encountered in strip and line-plot cruising, of course.
4. Some problems arise in edge-effect bias when sampling very small tracts or long, narrow tracts.

CODE

20 Abies balsamea. Balsam Fir.
23 Aesculus spp. Aesculus.
24 Aesculus Hippocastanum. Horsechestnut.
25 Aesculus octandra. Sweet Buckeye.
28 Acer spp. Maple.
29 Acer negundo. Box Elder.
30 Acer nigrum. Black Maple.
31 Acer pensylvanicum. Striped Maple.
32 Acer platanoides. Norway Maple.
33 Acer rubrum. Red Maple.
34 Acer saccharinum. Silver Maple.
35 Acer saccharum. Sugar Maple.
36 Acer spicatum. Mountain Maple.
39 Ailanthus altissima. Ailanthus, Tree-of-heaven.
42 Akebia quinata. Akebia.
45 Albizzia julibrissin. Mimosa.
48 Alnus spp. Alder.
49 Alnus maritima. Seaside Alder.
50 Alnus rugosa. Speckled Alder.
51 Alnus serrulata. Smooth Alder
52 Althaea officinalis. Marshmallow.
54 Amelanchier spp. Service berry.
55 Amelanchier arborea. Common Service berry.
56 Amelanchier canadensis. Canadian Service berry.
57 Amelanchier humilis. Low Service berry.
58 Amelanchier intermedia spach. Intermediate Service berry.
59 Amelanchier laevis. Smooth Service berry.
60 Amelanchier obovalis. Obovate Service berry.
61 Amelanchier sanguinea. Roundleaf Service berry.
62 Amelanchier stolonifera. Stoloniferous Service berry.
65 Amorpha fruticosa. Falso Indigo.
68 Ampelopsis arborea. Pepper Vine.
69 Aralia sp. L. Aralia.
71 Aralia spinosa. Hercules-Club.
74 Aristolochia durior. Pipe-vine.
77 Arundinaria gigantea. Brake Cane.
80 Ascyrum spp. Ascyrum.
81 Ascyrum stans. St. Peters Wort.
82 Ascyrum hypericoides. St. Andrew's Cross.
85 Asimina tailoba. Pawpaw.
88 Baccharis halimifolia. High-tide Bush.
91 Berberis spp. Barberry.
92 Berberis canadensis. American Barberry.
93 Berberis thunbergii. Japanese Barberry.
94 Berberis vulgaris. Common Barberry.
95 Berchemia scandens. Rattan-vine.
97 Betula spp. Birch.
98 Betula alba. European White Birch.
99 Betula lenta. Black Birch.
100 Betula lutea. Yellow Birch.

Woody Plants - cont.

101 Betula nigra. River Birch.
104 Bignonia capreolata. Cross Vine.
107 Broussonetia papyrifera. Paper Mulberry.
110 Callicarpa americana. Beautyberry.
113 Calycanthus floridus. Carolina Allspice.
116 Campsis radicans. Trumpet Creeper.
119 Carpinus caroliniana. American Hornbeam.
122 Carya spp. Hickory.
123 Carya cordiformis. Swamp Hickory, Bitternut.
124 Carya glabra. Pignut.
125 Carya ovalis. Sweet Pignut.
126 Carya ovata. Shagbark Hickory.
127 Carya pallida. Pale Hickory.
128 Carya tomentosa. Mockernut.
131 Castanea spp. Castanea.
132 Castanea dentata. American Chestnut.
133 Castanea pumila. Chinquapin.
136 Catalpa spp. Catalpa.
137 Catalpa bignonioides. Southern Catalpa.
138 Catalpa ovata. Chinese Catalpa.
139 Catalpa speciosa. Northern Catalpa.
142 Ceanothus americanus. New Jersey Tea.
145 Celtis spp. Celtis.
146 Celtis occidentalis. Hackberry.
147 Celtis tenuifolia. Dwarf Hackberry.
150 Cephalanthus occidentalis. Buttonbush.
153 Celastrus scandens. Bittersweet.
156 Cercis canadensis. Redbud.
159 Chamaecyparis thyoides. Southern White Cedar.
160 Chamaedaphne calyculata. Leatherleaf.
162 Chimaphila spp. Chimaphila.
163 Chimaphila maculata. Spotted Wintergreen.
164 Chimaphila umbellata. Pipsissewa.
167 Chionanthus virginicus. Fringe-tree.
170 Clematis spp. Clematis.
171 Clematis dioscoreifolia. Clematis.
172 Clematis verticillaris. Mountain Clematis.
173 Clematis Viorna. Leather Flower.
174 Clematis virginiana. Virgin's Bower.
177 Clethra alnifolia. Sweet Pepperbush.
180 Comptonie peregrina. Sweet Fern.
183 Cornus alternifolia. Alternate-leaved Dogwood.
184 Cornus spp. Dogwood.
185 Cornus Amomum. Silky Dogwood.
186 Cornus canadensis. Bunchberry.
187 Cornus florida. Flowering Dogwood.
188 Cornus obliqua. Narrowleaf Dogwood.
189 Cornus racemosa. Gray-stem Dogwood.
190 Cornus stolonifera. Red Osier Dogwood.
191 Cornus rugosa. Roundleaf Dogwood.
193 Corylus spp. Hazelnut.
194 Corylus americana. American Hazelnut.
195 Corylus cornuta. Beaked Hazelnut.
198 Crataegus spp. Hawthorn.

Woody Plants - cont.

199 Crataegus basilica. Hawthorn #1.
200 Crataegus biltmoreana. Biltmore Hawthorn.
201 Crataegus Calpodendron. Pear Hawthorn.
202 Crataegus Canbyi. Canby's Hawthorn.
203 Crataegus crus-galli. Cockspur Hawthorn.
204 Crataegus Dodgei. Dodge Hawthorn.
205 Crataegus intricata. Hawthorn #2.
206 Crataegus macrosperma. Variable Hawthorn.
207 Crataegus Margaretta. Margaret Hawthorn.
208 Crataegus mercerensis. Hawthorn #3.
209 Crataegus pedicellata. Scarlet Hawthorn.
210 Crataegus pensylvanica. Hawthorn #4.
211 Crataegus Phaenopyrum. Washington Hawthorn.
212 Crataegus populnea. Hawthorn #5.
213 Crataegus pruinosa. Wax-fruit Hawthorn.
214 Crataegus punctata. Dotted Hawthorn.
215 Crataegus rugosa. Hawthorn #6.
216 Crataegus sicca. Hawthorn #7.
217 Crataegus stolonifera. Hawthorn #8.
218 Crataegus uniflora. Dwarf Hawthorn.
219 Crataegus viridis. Southern Hawthorn.
222 Cytisus scoparius. Scotch Broom.
224 Decodon verticillatus. Swamp Loosestrife.
225 Diervilla Lonicera. Bush Honeysuckle.
228 Diospyros virginiana. Common Persimmon.
231 Dirca Palustris. Leatherwood.
234 Elaeagnus angustifolia. Russian Olive.
237 Epigaea repens. Ground Laurel.
240 Euonymus spp. Euonymus.
241 Euonymus alatus. Winged Euonymus.
242 Euonymus americanus. Strawberry Bush.
243 Euonymus atropurpureus. Burning Bush.
246 Fagus grandifolia. American Beech.
247 Fagus sylvatica. European Beech.
249 Forsythia spp. Forsythia.
250 Forsythia suspensa. Forsythia.
251 Forsythia viridissima. Forsythia.
254 Fraxinus spp. Ash.
255 Fraxinus americana. White Ash.
256 Fraxinus pennsylvanica. Green Ash.
257 Fraxinus nigra. Black Ash.
260 Gaultheria procumbens. Wintergreen.
263 Gaylussacia spp. Huckleberry.
264 Gaylussacia baccata. Black Huckleberry.
265 Gaylussacia brachycera. Box Huckleberry.
266 Gaylussacia dumosa. Dwarf Huckleberry.
267 Gaylussacia frondosa. Dangleberry.
270 Gleditsia triacanthos. Honey Locust.
273 Gymnocladus dioica. Kentucky Coffeetree.
276 Hamamelis virginiana. Witch-hazel.
279 Hedera Helix. English Ivy.

Woody Plants - cont.

281 Hibiscus spp. Mallow.
282 Hibiscus syriacus. Rose-of-Sharon.
283 Hibiscus Moschculas. Swamp Rosemallow.
285 Hudsonia tomentosa. Beach Heath.
288 Hydrangea arborescens. Wild Hydrangea.
291 Hypericum spp. St. John's-wort.
292 Hypericum densifolorum. Dense St. John's wort.
293 Hypericum spathulatum. Shrubby St. John's wort.
295 Ilex coreacea. Large Gallberry.
296 Ilex spp. Holly.
297 Ilex decidua. Possum Haw.
298 Ilex glabra. Inkberry.
299 Ilex laevigata. Winterberry.
300 Ilex montana. Mountain Holly.
301 Ilex opaca. American Holly.
302 Ilex verticillata. Black Alder.
305 Itea virginica. Tassel-white.
308 Iva frutescens. Low-tide Bush.
311 Juglans spp. Juglans.
312 Juglans cinerea. Butternut.
313 Juglans nigra. Black Walnut.
316 Juniperus communis. Common-Juniper.
317 Juniperus virginiana. Red Cedar.
320 Kalmia spp. Laurel.
321 Kalmia angustifolia. Sheep Laurel.
322 Kalmia latifolia. Mountain Laurel.
325 Koelreuteria paniculata. Goldenrain-tree.
326 Kosteletzkya virginica. Seashore-mallow.
328 Larix laricina. American Larch.
331 Leucothoe racemosa. Fetterbush.
334 Ligustrum spp. Privet.
335 Ligustrum obtusifolium. Privet.
336 Ligustrum ovalifolium. California Privet.
337 Ligustrum vulgare. Common Privet.
340 Lindera Benzoin. Blume Spicebush.
343 Linnaea borealis. Twinflower.
346 Liquidambar styraciflua. Sweet Gum.
349 Liriodendron tulipifera. Tulip Tree.
352 Lonicera spp. Honeysuckle.
353 Lonicera canadensis. Canada Honeysuckle.
354 Lonicera dioica. Mountain Honeysuckle.
355 Lonicera japonica. Japanese Honeysuckle.
356 Lonicera Morrowi. Morrow Honeysuckle.
357 Lonicera sempervirens. Trumpet Honeysuckle.
358 Lonicera tatarica. Tartarian Honeysuckle
361 Lycium halimifolium. Matrimony-vine, European.
364 Lyonia spp. Lyonia.
365 Lyonia ligustrina. Male berry.
366 Lyonia mariana. Stagger Bush.
369 Maclura pomifera. Osage Orange.
372 Magnolia spp. Magnolia.

Woody Plants - cont.

373 Magnolia acuminata. Cucumber Tree.
374 Magnolia tripetala. Umbrella Magnolia.
375 Magnolia virginiana. Sweet Bay.
378 Menisperum canadense. Canada Moonseed.
381 Menziesia pilosa. Minnie bush.
384 Mitchella repens. Partridgeberry.
387 Morus spp. Mulberry.
388 Morus alba. White Mulberry.
389 Morus rubra. Red Mulberry.
392 Myrica spp. Myrica.
393 Myrica cerifera. Wax myrtle.
394 Myrica Pensylvanica. Bayberry.
397 Nemopanthus mucronata. Catberry, Mountain Holly.
400 Nyssa sylvatica. Black Gum.
401 Opuntia humifusa. Prickly Pear.
403 Ostrya virginiana. Hop Hornbeam.
406 Oxydendrum arboreum. Sorrel Tree.
409 Parthenocissus quinquefolia. Virginia Creeper.
412 Paulownia tomentosa. Empress Tree.
415 Persea Borbonia. Red Bay.
418 Philadelphus spp. Mock-orange.
419 Philadelphus coronarius. Garden Mock-orange.
420 Philadelphus hirsutus. Hairy Mock-orange.
421 Philadelphus inodorus. Common Mock-orange.
422 Philadelphus pubescens. Gray Mock-orange.
425 Phoradendron flavescens. Mistletoe.
428 Physocarpus opulifolius. Ninebark.
431 Picea spp. Spruce.
432 Picea Abies. Norway Spruce.
433 Picea glauca. White Spruce.
434 Picea pungens. Blue Spruce.
435 Picea rubens. Red Spruce.
438 Pinus pungens. Mountain Pine.
439 Pinus echinata. Yellow Pine.
440 Pinus resinosa. Red Pine.
441 Pinus rigida. Pitch Pine.
442 Pinus serotina. Marsh Pine, Pond Pine.
443 Pinus strobus. White Pine.
444 Pinus sylvestris. Scotch Pine.
445 Pinus taeda. Loblolly Pine.
446 Pinus virginiana. Virginia Pine.
447 Pinus nigra. Austrian Pine.
449 Platanus occidentalis. Sycamore.
452 Populus spp. Poplar.
453 Populus alba. White Poplar.
454 Populus canescens. Gray Poplar.
455 Populus deltoides. Eastern Cottonwood.
456 Populus gileadensis. Balm-of-Gilead.
457 Populus grandidentata. Large-toothed Aspen.
458 Populus heterophylla. Downy Poplar.
459 Populus nigra. Black Poplar.
460 Populus tremuloides. Quaking Aspen.
461 Potentilla spp. Cinquefoil.

463 Prunus spp. Wild Plum, Cherry.
464 Prunus alleghaniensis. Alleghany Plum.
465 Prunus americana. American Wild Plum.
466 Prunus angustifolia. Chickasaw Plum.
467 Prunus avium. Bird Cherry, Sweet Cherry.
468 Prunus Cerasus. Sour Cherry.
469 Prunus Mahaleb. Mahaleb Cherry.
470 Prunus maritima. Beach Plum.
471 Prunus pensylvanica. Pin Cherry.
472 Prunus Persica. Peach.
473 Prunus serotina. Black Cherry.
474 Prunus virginiana. Choke Cherry.
477 Ptelea trifoliata. Hoptree.
480 Pyrus spp. Pyrus.
481 Pyrus americana. American Mountain-ash.
482 Pyrus angustifolia Ait. Narrowleaf Crabapple.
483 Pyrus arbutifolia. Red Chokeberry.
484 Pyrus communis. Common Pear.
485 Pyrus coronaria. American Crabapple.
486 Pyrus floribunda. Purple Chokeberry.
487 Pyrus Malus. Apple.
488 Pyrus melanocarpa. Black Chokeberry.
491 Quercus spp. Oak.
492 Quercus alba. White Oak.
493 Quercus bicolar. Swamp White Oak.
494 Quercus coccinea. Scarlet Oak.
495 Quercus falcata. Southern Red Oak.
496 Quercus ilicifolia. Scrub Oak.
497 Quercus imbricaria. Shingle Oak.
498 Quercus lyrata. Swamp Post Oak.
499 Quercus macrocarpa. Bur Oak.
500 Quercus marilandica. Black Jack Oak.
501 Quercus Michauxii. Basket Oak, Swamp Chestnut Oak.
502 Quercus Muehlenbergii. Yellow Oak.
503 Quercus nigra. Water Oak.
504 Quercus palustris. Pin Oak.
505 Quercus Phellos. Willow Oak.
506 Quercus prinoides. Chinquapin Oak.
507 Quercus Prinus. Chestnut Oak, Rock Oak.
508 Quercus rubra. Red Oak.
509 Quercus Shumardii. Shumard's Oak.
510 Quercus stellata. Post Oak.
511 Quercus velutina. Black Oak.
512 Quercus laurifolia. Laurel-leaved Oak.
514 Rhamnus spp. Buckthorn.
515 Rhamnus cathartica. Common Buckthorn.
516 Rhamnus frangula. European Buckthorn.
519 Rhododendron spp. Rhodendron.

Woody Plants - cont.

520 Rhododendron arborescens. Smooth Azalea.
521 Rhododendron atlanticum. Dwarf Azalea.
522 Rhododendron calendulaceum. Flame Azalea.
523 Rhododendron canescens. Sweet Azalea.
524 Rhododendron maximum. Great Rhododendron.
525 Rhododendron nudiflorum. Pink Azalea.
526 Rhododendron roseum. Mountain Azalea.
527 Rhododendron viscosum. Swamp Azalea.
529 Rhus spp. Rhus.
530 Rhus aromatica. Fragrant Sumac.
531 Rhus copallina. Shining Sumac.
532 Rhus glabra. Smooth Sumac.
533 Rhus radicans. Poison Ivy.
534 Rhus toxicodendron. Poison Oak.
535 Rhus typhina. Staghorn Sumac.
536 Rhus vernix. Poison Sumac.
539 Ribes spp. Ribes.
540 Ribes americanum. Black Currant.
541 Ribes cynosbati. Dogberry.
542 Ribes glandulosum. Skunk Currant.
543 Ribes rotundifolium. Eastern Wild Gooseberry.
546 Robinia spp. Locust.
547 Robinia hispida. Bristly Locust.
548 Robinia pseudo-acacia. Black Locust.
551 Rosa spp. Rose.
552 Rosa canina. Dog Rose.
553 Rosa carolina. Low Pasture Rose.
554 Rosa eglanteria. Sweet Brier.
555 Rosa multiflora. Multiflora Rose.
556 Rosa palustirs. Swamp Rose.
557 Rosa virginiana. Pasture Rose.
560 Rubus spp. Raspberry. Blackberry.
561 Rubus argutus. Tall Balckberry.
562 Rubus allegheniensis. Allegheny Blackberry.
563 Rubus cuneifolius. Sand Blackberry.
564 Rubus eusleuii. Southern Dewberry.
565 Rubus flagellaris. Northern Dewberry.
566 Rubus hispidus. Swamp Dewberry.
567 Rubus occidentalis. Wild Black Raspberry.
568 Rubus odoratus. Purple-flowering Raspberry.
569 Rubus ostryifolius. Dewberry.
570 Rubus pensilvanicus. Blackberry #1.
571 Rubus phoenicolasius. Wineberry.
572 Rubus ideas strigosus. Maximum Red Raspberry.
575 Salix spp. Willow.
576 Salix alba. White Willow.
577 Salix babylonica. Weeping Willow.
578 Salix bebbiana. Bebb's Willow.
579 Salix capra. Goat Willow.
580 Salix caroliniana. Ward's Willow.
581 Salix discolor. Pussy Willow.
582 Salix fragilis. Crack Willow
583 Salix hispida. Bristly Crier.
584 Salix humilis. Upland Willow.

Woody Plants - cont.

585 Salix interior. Sandbar Willow.
586 Salix lucida. Shining Willow.
587 Salix nigra. Black Willow.
588 Salix pentandra. Bay-leaf Willow.
589 Salix purpurea. Purple Willow.
590 Salix rigida. Heart-leaf Willow.
591 Salix sericea. Silky Willow.
594 Sambucus spp. Elderberry.
595 Sambucus canadensis. Common Elderberry.
596 Sambucus pubens. Red-berry Elder.
599 Sassafras albidum. Sassafras.
602 Smilax spp. Smilax.
603 Smilax Bone-nox. Bullbrier.
604 Smilax glauca. Glaucus Greenbrier.
605 Smilax laurifolia. Laurel-leaf brier.
606 Smilax rotundifolia. Common Greenbrier.
607 Smilax walterei. Redberried Greenbrier.
608 Solanum spp. Nightshade.
609 Solanum Dulcamara. Bittersweet.
612 Spiraea spp. Spiraea.
613 Spiraea alba. Narrow-leaved Meadowsweet.
614 Spiraea corymbosa. Dwarf Spirea.
615 Spiraea japonica. Japanese Spirea.
616 Spiraea latifolia. American Meadowsweet.
617 Spiraea tomentosa. Steeplebush Spirea.
620 Staphylea trifolia. American Bladdernut.
621 Styrax grandifolia. Bigleaf Snowball.
623 Symphoricarpos spp. Symphoricarpos.
624 Symphoricarpos albus. Snowberry.
625 Symphoricarpos orbiculatus. Coralberry.
628 Symplocos tinctoria. Sweetleaf.
631 Syringa spp. Lilac.
632 Syringa Persica. Persian lilac.
633 Syringa vulgaris. Common Lilac.
636 Taxodium distichum. Blad Cypress.
639 Thuja occidentalis. Northern White Cedar.
642 Tilia spp. Basswood.
643 Tilia americana. Basswood.
644 Tilia heterophylla. White Basswood.
647 Tsuga canadensis. Hemlock.
650 Ulmus spp. Elm.
651 Ulmus americana. American Elm.
652 Ulmus parvifolia. Chinese Elm.
653 Ulmus procera. English Elm.
654 Ulmus pumila. Siberian Elm.
655 Ulmus rubra. Red Elm, Slippery Elm.
658 Vaccinium spp. Vaccinium.
659 Vaccinium angustifolium. Late Low Blueberry.
660 Vaccinium atrococcum. Black Highbush Blueberry.
661 Vaccinium caesariense. Coastal Highbush Blueberry.
662 Vaccinium corymbosum. Highbush Blueberry.
663 Vaccinium macrocarpon. Large Cranberry.

664 Vaccinium myrtilloides. Velvetleaf Blueberry.
665 Vaccinium Oxycoccos. Small Cranberry.
666 Vaccinium stamineum. Tall Deerberry.
667 Vacccinium vacillans. Early Low Blueberry.
670 Viburnum spp. Viburnum.
671 Viburnum acerifolium. Maple-leaved Viburnum.
672 Viburnum alnifolium. Hobblebush.
673 Viburnum cassinoides. Northern Wild-Raisin.
674 Viburnum dentatum. Southern Arrowwood.
675 Viburnum Lentago. Nannyberry.
676 Viburnum nudum. Possum-haw, Southern Wild-Raisin.
677 Viburnum prunifolium. Smooth Black-haw.
678 Viburnum Rafinesquianum. Downy Arrowwood.
679 Viburnum recognitum. Smooth Arrowwood.
680 Viburnum rufidulum. Rusty Blackhaw.
681 Viburnum molle. Soft-leaved Arrowwood.
682 Vitex Agnus-castus. Chaste Tree.
685 Vitis spp. Grape.
686 Vitis aestivalis. Summer Grape.
687 Vitis Labrusca. Fox Grape.
688 Vitis riparia. Riverbank Grape.
689 Vitis rotundifolia. Muscadine Grape.
690 Vitis rupestris. Sand Grape.
691 Vitis vulpina. Frost Grape.
694 Wisteria spp. Wisteria.
695 Wisteria floribunda. Japanese Wisteria.
696 Wisteria frutescens. American Wisteria.
697 Wisteria sinensis. Chinese Wisteria.
699 Woody Seedlings.

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2000 Acalypha virginica. Three-seeded Mercury.
2003 Achillea millefolium. Common Yarrow.
2006 Acnida cannabina. Water-Kemp.
2009 Acorus calamus. Sweet Flag.
2012 Actinomeris alternifolia. Wingstem.
2013 Adiantum pedatum. Maidenhair Fern.
2015 Aeschynomene spp. Sensitive Joint Vetch.
2018 Agastache nepetoides. Purple Giant Hyssop.
2021 Agrimonia spp. Cocklebur.
2024 Agropyron spp. Agropyron.
2027 Agropyron repens. Couch-grass.
2030 Agrostis spp. Agrostis.
2033 Agrostis hyemalis. Rough Hair-grass.
2035 Agrostis perennans Upland Bent-grass.
2036 Alisma spp. Water-plantain.
2039 Alisma Plantago-aquatica. Old World Water-plantain.
2040 Alliaria officinalis. Garlic Mustard.
2042 Allium sp. Garlic.
2045 Amaranthus spp. Amaranth.
2048 Ambrosia spp. Ragweed.
2051 Amianthium muscaetoxicum. Fly-poison.
2054 Ammophila arenaria. Sand-reed.
2057 Amphicarpa bracteata. Hog-peanut.
2060 Anagallis arvensis. Scarlet Pimpernel.
2063 Andropogon spp. Beard-grass.
2066 Andropogon furcatus. Forked Beard-grass.
2069 Andropogon scoparius. Little Blue-stem Grass.
2072 Andropogon ternarius. Silvery Beard-grass.
2075 Andropogon virginicus. Broom-sedge (Va. Beard-grass).
2078 Anemone spp. Anemone.
2081 Anemonella thalictroides. Rue-anemone.
2084 Antennaria spp. Everlasting.
2087 Anthemis spp. Chamomile.
2090 Anthoxanthum spp. Vernal-grass.
2093 Anthoxanthum odoratum. Sweet Vernal-grass.
2096 Apios americana. Ground-nut.
2099 Aplectrum hyemale. Putty-root.
2102 Apocynum spp. Dogbane.
2105 Aquilegia spp. Columbine.
2108 Arabidopsis thabana. Mouse-ear-cress.
2111 Arabis spp. Rock-cress.
2112 Arabis lyrata. Lyre-leaved Rock-cress.
2113 Arctium spp. Burdock.
2115 Arisaema spp. Jack-in-the-pulpit.
2116 Arisaema Dracontium. Green Dragon.
2117 Arisaema triphyllum. Jack-in-the-pulpit.
2119 Aristida spp. Triple-awned Grass.
2121 Aristida dichtoma. Poverty-grass.
2123 Asclepias spp. Milkweed.
2124 Asclepias verticillata. Whorled Milkweed.
2125 Asparagus officinalis. Asparagus.
2127 Asplenium platyneuron. Ebony Spleenwort.
2129 Aster spp. Wild Aster.

2131 Athyrium felix-femina. Lady Fern.
2133 Athyrium thelypteroides. Crested Fern.
2134 Atriplex spp. Orache.
2137 Baptisia spp. Wild Indigo.
2140 Barbaria spp. Winter Cress.
2143 Bidens spp. Beggar Ticks.
2146 Boehmeria cylindrica. False Nettle.
2149 Botrychium dissectum. Cut-leaved Grape Fern.
2152 Botrychium virginianum. Virginia Grape Fern.
2155 Brasenia Schreberi. Water-shield.
2158 Bromus spp. Brome-grass.
2161 Bulbostylis Capillaris. Bulbostylis.
2164 Cakile edentula. Sea-rocket.
2167 Callitriche spp. Water Starwort.
2170 Calopogon pulchellus. Grass-pink.
2173 Capsella bursa-pastoris. Shepherd's Purse.
2176 Cardamine spp. Bitter Cress.
2179 Carex spp. Sedge.
2180 Carex Grayi. Gray's Sedge.
2182 Cassia sp. Senna.
2183 Cassia fasciculata. Partridge Pea.
2185 Cenhrus tribuloides. Bur-grass.
2188 Centaurea spp. Starthistle.
2191 Cerastium spp. Mouse-ear Chickweed.
2192 Cerastium arvensi. Field Chickweed.
2194 Ceratophyllum spp. Hornwort.
2197 Chamaelirium spp. Blazing Star.
2200 Chamaelirium leteum. Blazing Star.
2203 Chelone spp. Turtlehead.
2204 Chelone Lyoni. Lyon's Turtlehead.
2206 Chenopodium spp. Goosefoot.
2209 Chimaphila maculata. Spotted Wintergreen.
2211 Chrysanthemum leucanthemum. Ox-eye Daisy.
2212 Chrysopisis spp. Golden Aster.
2215 Cichorium Inthybus. Chicory.
2216 Cicuta maculata. Water Hemlock.
2218 Cinna spp. Wood Reed-grass.
2221 Circara quadrisulcata. Enchanter's Nightshade.
2224 Cirsium spp. Thistle.
2227 Cladium mariscoides. Twig Rush.
2230 Claytonia spp. Spring Beauty.
2233 Collinsonia canadensis. Horse Balm.
2236 Comandra umbellata. Bastard Toadflax.
2239 Commelina spp. Day Flower.
2242 Convolvulus spp. Bindweed.
2245 Corallorrhiza spp. Coral-root.
2248 Coreopsis spp. Tickseed.
2251 Croton spp. Croton.
2254 Cryptotaenia canadensis. Honewort.
2257 Cuscuta spp. Dodder.
2260 Cynoglossum spp. Wild Comfrey.
2263 Cyperus spp. Cyperus.
2266 Cypripedium spp. Ladies Slipper.
2269 Cypripedium acaule. Moccasin Flower.
2272 Danthonia spp. Wild Oat-grass.
2275 Daucus Carota. Wild Carrot; Queen Anne's Lace.

2278 Datura spp. Jimson Weed.
2280 Dennstaedtia punctilobula. Hay-scented Fern.
2281 Dentaria spp. Toothwort.
2284 Deschampsia spp. Hair Grass.
2287 Desmodium spp. Tick-trefoil.
2290 Dianthus spp. Pink.
2293 Digitaria spp. Finger Grass.
2296 Digitaria Ischaemum. Small Crab Grass.
2299 Digitaria sanguinalis. Large Crab Grass.
2302 Diodia teres. Rough Buttonweed.
2305 Dioscorea spp. Wild Yam.
2309 Distichlis spicata. Marsh Spike Grass.
2411 Draba spp. Whitlow Grass.
2414 Drosera spp. Sundew.
2417 Dryopteris spp. Wood Fern.
2420 Dryopteris cristata. Crested Wood Fern.
2423 Dryopteris heyagonoptera. Broad Beech Fern.
2426 Dryopteris marginalis. Marginal Wood Fern.
2429 Dryopteris noveboracensis. New York Fern.
2432 Dryopteris Phegoptaris. Long Beech Fern.
2435 Dryopteris spinulosa. Spinulose Wood Fern.
2438 Dryopteris Thelypteris. Marsh Fern.
2440 Duchesnea indica. Indian Strawberry.
2441 Dulichium arundinaceum. Dulichium.
2444 Echinochloa spp. Echinochloa.
2447 Eleocharis spp. Spike Rush.
2450 Elephantopus spp. Elephant's Foot.
2453 Elodea spp. Waterweed.
2456 Elodea canadensis. Waterweed.
2459 Elymus spp. Wild Rye.
2462 Epifagus virginiana. Beechdrops.
2465 Epilobium spp. Willow Herb.
2468 Equisetum spp. Horsetail.
2471 Equisetum arvense. Field Horsetail.
2474 Equisetum hyemale. Scouring-rush.
2477 Eragrostis spp. Love Grass.
2480 Erechtites spp. Fireweed.
2483 Erianthus spp. Plume Grass.
2486 Erianthus giganteus. Giant Plume Grass.
2489 Erigeron spp. Fleabane.
2492 Eriocaulon spp. Pipewort.
2495 Eriocaulon septangulare. Seven-angled Pipewort.
2498 Eriophorum spp. Cotton-grass.
2501 Eriophorum virginicum. Virginia Cotton-grass.
2504 Erythronium spp. Adder's Tongue.
2507 Eupatorium spp. Thoroughwort.
2508 Eupatorium perfoliatum. Boneset.
2510 Euphorbia spp. Spurge.
2513 Festuca spp. Fescue.
2516 Fimbristylis spp. Fimbristylis.
2519 Fragaria spp. Strawberry.
2522 Froelichia spp. Froelichia.
2525 Fuirena spp. Umbrella Grass.
2526 Galinsoga ciliata. Quickweed.
2528 Galium spp. Bedstraw.
2531 Gentiana spp. Gentian.
2534 Geranium spp. Cranesbill.

2537 Gerardia spp. Gerardia.
2540 Geum spp. Avens.
2541 Glechoma hederacea. Ground Ivy.
2543 Glyceria spp. Manna Grass.
2546 Gnaphalium spp. Cudweed, Everlasting.
2549 Gonolobus spp. Angle-pod.
2552 Goodyera pubescens. Rattlesnake Plantain.
2555 Gratiola spp. Hedge-Hyssop.
2558 Habenaria spp. Orchids.
2561 Hackelia virginiana. Virginia Stickseed.
2564 Helianthemum spp. Frostweed.
2567 Helianthus spp. Sunflower.
2570 Hemerocallis fulva. Day Lily.
2573 Hepatica spp. Hepatica.
2576 Heteranthera spp. Mud Plantain.
2579 Heteranthera dubia. Water Star-grass.
2582 Hexalectris spicata. Crested Coral-root.
2585 Hieracium spp. Hawkweed.
2586 Hieracium venosum. Rattlesnake-weed.
2588 Hordeum spp. Barley.
2591 Houstonia spp. Bluets.
2594 Hydrocotyle spp. Marsh-Pennywort.
2596 Hydrophyllum canadense. Broad-leaved Waterleaf.
2597 Hypericum spp. St. John's-wort.
2599 Hypericum virginicum. Marsh St. John's-wort.
2600 Hypoxis hirsuta. Yellow Star-grass.
2603 Hystrix patula. Bottle-brush Grass.
2606 Impatiens spp. Jewel-weed; Touch-me-not.
2609 Ipomoea spp. Morning Glory.
2612 Iris spp. Iris.
2615 Iris versicolor. Large Blue-Flag.
2618 Isoetes saccharata. Sugary Quillwort.
2621 Isotria verticillata. Whorled Pogonia.
2624 Juncus sp. Rush.
2625 Juncus Roemerianus. Black Needle Rush.
2626 Jussiaea repens. Primrose-willow.
2627 Lactuca spp. Wild Lettuce.
2630 Lamium spp. Dead-nettle.
2633 Laportea canadensis. Wood nettle.
2636 Lechea spp. Pinweed.
2637 Leersia oryzoides. Rice Cutgrass.
2642 Lemna minor. Lesser Duckweed.
2643 Leontodon autumnalis. Fall Dandelion.
2645 Lepidium spp. Pepper Cress.
2648 Lespedeza spp. Bush Clover.
2651 Liatris spp. Button-snakeroot.
2652 Liatris scariosa. Large Button-snakeroot.
2654 Lilaeopsis chinensis. Lilaeopsis.
2657 Lilium spp. Lily.
2660 Lilium canadense. Wild Yellow Lily.
2663 Limonium spp. Sea Lavender.
2665 Linaria canadensis. Blue Toad-flax.
2666 Lindernia spp. False Pimpernel.
2669 Linum spp. Flax.
2672 Liparis lilifolia. Large Twayblade.
2675 Lobelia cardinalis. Cardinal Flower.
2676 Lobelia inflata. Indian Tobacco.
2678 Lolium spp. Lolium.
2681 Ludwigia spp. False Loosestrife.

2684 Ludwigia palustris. Marsh Purslane.
2687 Luzula spp. Woodrush.
2690 Lychnis spp. Campion.
2693 Lycopodium spp. Club-moss.
2696 Lycopodium complanatum. Running-pine.
2699 Lycopodium inundatum. Bog Club-moss.
2702 Lycopodium lucidulum. Shining Club-moss.
2705 Lycopodium obscurum. Tree Club-moss.
2708 Lycopodium tristachyum. Running-cedar.
2711 Lycopus spp. Water Horehound.
2714 Lygodium palmatum. Climbing Fern.
2717 Lysimachia spp. Loosestrife.
2720 Lythrum spp. Loosestrife.
2723 Malaxis unifolia. Green Adder's-mouth.
2736 Malva spp. Mallow.
2739 Medeola virginiana. Indian Cucumber-root.
2742 Melampyrum lineare. Narrow-leaved Cow-Wheat.
2745 Melanthium spp. Bunch Flower.
2748 Melanthium hybridum. Crisped Bunch Flower.
2751 Melanthium virginicum. Bunch Flower.
2754 Melilotus spp. Sweet Clover.
2757 Mentha sp. Mint.
2760 Mikania scandens. Climbing Hempweed.
2763 Mimulus spp. Monkey Flower.
2764 Mimulus ringens. Square-stemmed Monkey Flower.
2766 Mollugo verticillata. Carpetweed.
2769 Monarda spp. Balm; Bergamot.
2772 Monotropa spp. Pinesap.
2775 Monotropsis odorata. Sweet Pinesap.
2778 Muhlenbergia spp. Dropseed Grass.
2781 Myosotis spp. Forget-me-not.
2784 Myriophyllum spp. Water Milfoil.
2787 Myriophyllum spicatum. Spiked Water Milfoil.
2790 Naias spp. Naias.
2793 Naias Flexilis. Slender Naias.
2796 Naias gracillima. Thread-like Naias.
2799 Narcissus spp. Daffodil.
2802 Nasturtium officinale. Water Cress.
2805 Nuphar spp. Water Lily.
2806 Nuphar advena. Large Yellow Pond Lily.
2808 Nymphaea spp. Water Lily.
2811 Obolaria virginica. Pennywort.
2814 Oenothera spp. Evening-Primrose.
2817 Onoclea sensibilis. Sensitive Fern.
2820 Ophioglossum spp. Adder's Tongue Fern.
2823 Ophioglossum vulgatum. Adder's Tongue Fern.
2826 Opuntia humifusa. Prickly Pear.
2829 Orchis spectabilis. Showy Orchis.
2832 Orontium aquaticum. Golden Club.
2835 Osmorhiza spp. Sweet Cicely.
2838 Osmunda cinnamomea. Cinnamon Fern.
2841 Osmunda Claytoniana. Interrupted Fern.
2844 Osmunda regalis. Royal Fern.
2847 Oxalis spp. Wood Sorrel.

2850 Panicum spp. Panic Grass.
2853 Panicum agrostuides. Red-top Panic Grass.
2856 Panicum capillare. Witch Grass.
2859 Panicum dichotomum. Forked Panic Grass.
2862 Panicum microcarpon. Barbed Panic Grass.
2863 Panicum virgatum. Switch Grass.
2865 Paspalum spp. Paspalum.
2868 Paspalum Floridanum. Florida Paspalum.
2871 Paspalum Laeve. Field Paspalum.
2874 Passiflora spp. Passion-Flower.
2877 Pellaea spp. Cliff-brake.
2880 Peltandra virginica. Arrow-arum.
2883 Penthorum sediodes. Ditch Stonecrop.
2886 Phalaris spp. Canary Grass.
2889 Phalaris arundinacea. Reed Canary Grass.
2892 Phalaris canariensis. Canary Grass.
2895 Phaseolus Polystachyus. Wild Bean.
2898 Phleum pratense. Timothy.
2899 Phlox maculata. Sweet William.
2901 Phragmites communis. Reed Grass.
2904 Phyrma Leptostachya. Lopseed.
2907 Physalis spp. Ground-Cherry.
2910 Phytclacca americana. Pokeweed.
2913 Pilea spp. Richweed.
2916 Plantago spp. Plantain.
2919 Pluchea spp. Marsh Fleabane.
2922 Poa spp. Meadow or Spear Grass.
2925 Podophyllum peltatum. May Apple.
2928 Podostemum ceratophyllum. Threadfoot.
2931 Pogonia spp. Pogonia.
2932 Pogonia ophioglossoides. Rose Pogonia.
2933 Polemonium Van Bruntiae. Jacob's Ladder.
2934 Polygala spp. Milkwort.
2937 Polygonatum biflorum. Hairy Solomon's Seal.
2940 Polygonum spp. Knotweed.
2943 Polygonum arifolium. Halberd-leaved Tearthumb.
2944 Polygonum perfoliatum. Witchweed.
2945 Polygonum Sagittatum. Arrow-leaved Tearthumb.
2946 Polygonum scandens. Climbing False Buckwheat.
2949 Polymnia Uvedalia. Large-flowered Leaf-Cup.
2952 Polypogon Monspeliensis. Annual Beard Grass.
2955 Polystichum acrostichoides. Christmas Fern.
2958 Pontederia cordata. Pickeral-weed.
2961 Potamogeton spp. Pondweed.
2964 Potamogeton crispus. Curly Pondweed.
2967 Potamogeton diversifolius. Rafinesque's Pondweed.
2970 Potamogeton nodosus. Nodular Pondweed.
2973 Potamogeton mysticus. Mystic Pondweed.
2976 Potamogeton Natans. Floating Pondweed.
2979 Potamogeton epihydrus. Nuttall's Pondweed.
2982 Potamogeton pectinatus. Fennel-leaved Pondweed.
2985 Potamogeton perfoliatus. Clasping-leaved Pondweed.
2988 Potamogeton pulcher. Spotted Pondweed.
2989 Potentilla spp. Cinquefoil.
2991 Proserpinaca spp. Mermaidweed.
2994 Prunella vulgaris. Heal-all.

2997 Pteridium aquilinum. Bracken Fern.
3000 Ptilimnium spp. Mock Bishop-weed.
3003 Pycnanthemum spp. Mountain Mint.
3006 Ranunculus spp. Buttercup.
3009 Rhexia spp. Meadow Beauty.
3012 Rhynchospora spp. Beaked-rush.
3015 Rhynchospora alba. White Beaked-rush.
3018 Rhynchospora corniculata. Horned Rush.
3021 Roripa spp. Yellow Cress.
3024 Roripa islandica. Island Yellow Cress.
3027 Rudbeckia spp. Coneflower.
3030 Rumex spp. Dock, Sorrel.
3033 Ruppia maritima. Tassel Pondweed.
3036 Sabbatia spp. Sabbatia.
3037 Sabbatia angularis. Rose-pink.
3039 Sagittaria spp. Arrow-head.
3042 Sagittaria Engelmanniana. Engelmann's Arrow-head.
3045 Sagittaria graminea. Grass-leaved Sagittaria.
3048 Sagittaria falcata. Scythe-fruited Sagittaria.
3051 Sagittaria latifolia. Broad-leaved Arrow-head.
3054 Sagittaria subulata. Subulate Sagittaria.
3057 Salicornia spp. Glasswort.
3060 Salsola Kali. Saltwort.
3063 Salvia spp. Sage.
3066 Samolus parviflorus. Water Pimpernel.
3069 Sanguinaria canadensis. Bloodroot.
3072 Sanguisorba spp. Burnet.
3073 Sanguisorba canadensis. Canada Burnet.
3075 Sanicula spp. Snakeroot.
3078 Sarracenia spp. Pitcher Plant.
3091 Satureia spp. Savory.
3094 Saururus cernuus. Lizard's-tail.
3097 Saxifraga spp. Saxifrage.
3100 Scirpus spp. Club Rush.
3101 Scirpus americanus. Three-square.
3103 Scleria spp. Nut Rush.
3106 Sedum spp. Stonecrop.
3109 Selaginella apoda. Creeping Selaginella.
3112 Senecio spp. Groundsel, Squaw-weed.
3113 Senecio Smallii. Small's Squaw-weed.
3115 Seriocarpus asteroides. Toothed White-topped Aster.
3118 Setaria spp. Foxtail Grass.
3121 Sicyos angulatus. One-seeded Burr-cucumber.
3124 Silene spp. Campion, Catchfly.
3127 Sisyrinchium spp. Blue-eyed Grass.
3130 Sisyrinchium angustifolium. Pointed Blue-eyed Grass.
3133 Sium suave. Water Parsnip.
3136 Smilacina racemosa. False Spikenard.
3137 Smilax Pseudo-China. Long-stalked Greenbrier.
3139 Solidago spp. Goldenrod.
3140 Solidago nemoralis. Gray Goldenrod.
3142 Sorgum halepense. Johnson-grass.
3145 Sparangium spp. Bur-reed.
3147 Spartina alterniflora. Salt Marsh Grass.

3148 Spartina patens. Salt Meadow Grass.
3149 Spartina cynosuroides. Salt Reed Grass.
3151 Sphagnum spp. Sphagnum.
3154 Sphenopholis spp. Eaton's Grass.
3157 Spiranthes spp. Ladies-tresses.
3158 Spiranthes gracilis. Slender Ladies'-tresses.
3160 Spirodela polyrhiza. Greater Duckweed.
3163 Sporabolus spp. Rush-grass.
3166 Stellaria spp. Chickweed.
3167 Streptopus spp. Twisted-stalk.
3168 Streptopus amplexifolius. Clasping-leaved Twisted-stalk.
3169 Strophostyles spp. Wild Bean.
3172 Stylosanthes spp. Pencil Flower.
3175 Symplocarpus foetidus. Skunk Cabbage.
3176 Tanacetum vulgare. Tansy.
3178 Taraxacum spp. Dandelion.
3181 Teucrium canadense. Wood Sage.
3184 Thalictrum spp. Meadow Rue.
3186 Tiarella cordifolia. Foam Flower.
3187 Tipularia discolor. Crane-fly Orchis.
3188 Tissa marina. Salt Marsh Sand Spurry.
3190 Tovara virginiana. Virginia Knotweed.
3193 Tradescantia virginiana. Spiderwort.
3194 Trapa spp. Water-nut.
3196 Trifolium spp. Clover.
3199 Trillium spp. Wake-robin.
3200 Trillium erectum. Purple Wake-robin.
3202 Triosteum spp. Horse Gentian.
3205 Triplasis purpurea. Sand Grass.
3208 Tripsacum dactyloides. Gama Grass.
3210 Typha sp. Cattail.
3211 Typha angustifolia. Narrow-leaved Cattail.
3214 Typha domingensis. Southern Cattail.
3217 Typha latifolia. Broad-leaved Cattail.
3220 Urtica spp. Nettle.
3222 Uniola paniculata. Beach Grass.
3223 Uniola sp. Uniola.
3226 Uniola latifolia. Broad-leaved Spike Grass.
3229 Uniola laxa. Slender Spike Grass.
3230 Urtica dioica. Stinging Nettle.
3232 Utricularia spp. Bladderwort.
3235 Uvularia spp. Bellwort.
3238 Valerianella spp. Corn Salad.
3241 Vallisneria americana. Tape Grass.
3244 Veratrum viride. American White Hellebore.
3247 Verbascum spp. Mullein.
3250 Verbena spp. Vervain.
3253 Verbesina spp. Crown-beard.
3256 Veronia spp. Ironweed.
3259 Veronica spp. Speedwell.
3262 Wolffia spp. Water Meal.
3265 Woodwardia areolata. Net-veined Chain Fern.
3268 Woodwardia virginica. Virginia Chain Fern.
3269 Xanthium spp. Cocklebur.

3280 Xyris spp. Yellow-eyed Grass.
3283 Yucca Filamentosa. Adam's Needle.
3286 Zannichellia palustris. Horned Pondweed.
3289 Zizania aquatica. Wild Rice.
3292 Zizaniopsis miliacea. Water Millet.
3295 Zizia Aptera. Zizia.
3298 Zostera marina. Eel Grass.
3301 Lichens.
3304 Unknown Fern.
3307 Unknown Herb.
3310 Unknown Grass.
3313 Unknown Sedge.
3316 Unknown Moss.
3317 Agricultural Crops.
3318 Justica americana. Water-willow.

* See end of list for additional species not listed in alphabetical order.

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NUMBER	SPECIES	*Resid., *Freq.
6002	Red-necked Grebe	3,3
6003	Horned Grebe	3,2
6006	Pied-billed Grebe	4,2
6007	Common Loon	3,2
6011	Red-throated Loon	3,2
6042	Glaucous Gull	3,2
6043	Iceland Gull	3,2
6047	Great Black-backed Gull	4,1
6051	Herring Gull	4,1
6054	Ring-billed Gull	4,1
6058	Laughing Gull	1,2
6060	Bonaparte's Gull	2,2
6063	Gull-billed Tern	1,2
6064	Caspian Tern	2,2
6065	Royal Tern	1,2
6069	Forster's Tern	1,2
6070	Common Tern	1,1
6074	Least Tern	1,2
6077	Black Tern	2,2
6080	Black Skimmer	1,2
6117	Gannet	3,3
6120	Double-cr. Cormorant	2,2
6129	Common Merganser	3,2
6130	Red-br. Merganser	3,2
6131	Hooded Merganser	4,3
6132	Mallard	4,2
6133	Black Duck	4,2
6135	Gadwall	2,2
6136	European Widgeon	3,3
6137	American Widgeon	3,2
6139	Green-winged Teal	3,2
6140	Blue-winged Teal	4,2
6142	Shoveler	3,3
6143	Pintail	3,2
6144	Wood Duck	1,2
6146	Redhead	3,2
6147	Canvasback	3,2
6148	Greater Scaup	3,2
6149	Lesser Scaup	3,2
6150	Ring-necked Duck	3,2
6151	Common Goldeneye	3,2
6153	Bufflehead	3,2
6154	Oldsquaw	3,2
6163	Black Scoter	3,2
6165	White-winged Scoter	3,2
6166	Surf Scoter	3,2
6167	Ruddy Duck	3,2
6169	Snow Goose	3,2
6172	Canada Goose	3,2
6178	Mute Swan	4,3
6180	Whistling Swan	3,2

*Residency
1. Breeding
2. Migratory
3. Winter
4. Year Round

*Frequency
1. Common
2. Uncommon
3. Rare
4. Endangered

		Resid. Freq.
6186	Glossy Ibis	1,2
6190	American Bittern	1,2
6191	Least Bittern	1,2
6194	Great Blue Heron	4,2
6196	Great Egret	1,2
6197	Snowy Egret	1,2
6198	Cattle Egret	1,2
6199	Louisiana Heron	1,2
6200	Little Blue Heron	1,2
6201	Green Heron	1,1
6202	Black-cr. Night Heron	4,2
6203	Yellow-cr. Night Heron	1,3
6208	King Rail	4,2
6211	Clapper Rail	4,2
6212	Virginia Rail	4,2
6214	Sora	1,3
6216	Black Rail	1,3
6218	Purple Gallinule	1.3
6219	Common Gallinule	1,2
6221	American Coot	3,2
6223	Northern Phalarope	2,2
6225	American Avocet	2,3
6228	American Woodcock	4,2
6230	Common Snipe	3,2
6231	Short-billed Dowitcher	2,2
6233	Stilt Sandpiper	2,2
6234	Knot	2,3
6239	Pectoral Sandpiper	2,2
6240	White-rumped Sandpiper	2,2
6241	Baird's Sandpiper	2,3
6242	Least Sandpiper	3,2
6243	Dunlin	3,2
6246	Semipalmated Sandpiper	2,2
6247	Western Sandpiper	2,2
6248	Sanderling	4,2
6249	Marbled Godwit	2,3
6254	Greater Yellowlegs	2,2
6255	Lesser Yellowlegs	2,2
6256	Solitary Sandpiper	2,2
6258	Willet	1,2
6261	Upland Sandpiper	2,3
6262	Buff-breasted Sandpiper	2,3
6263	Spotted Sandpiper	1,2
6265	Whimbrel	2,2
6270	Black-bellied Plover	3,2
6273	Killdeer	4,2
6274	Semipalmated Plover	1,2
6277	Piping Plover	1,2
6283	Ruddy Turnstone	2,3
6289	Bobwhite	4,1
6300	Ruffed Grouse	4,2
6309	Ring-necked Pheasant	4,2
6310	Wild Turkey	4,3
6316	Mourning Dove	4,1
6325	Turkey Vulture	4,1
6326	Black Vulture	4,1
6331	Marsh Hawk	2,2

		ba, pis
6332	Sharp-shinned Hawk	4,2
6333	Cooper's Hawk	4,3
6337	Red-tailed Hawk	4,2
6339	Red-shouldered Hawk	4,2
6343	Broad-winged Hawk	1,2
6347	Rough-legged Hawk	3,2
6349	Golden Eagle	3,3
6352	Bald Eagle	4,4
6356	Peregrine Falcon	3,4
6357	Merlin	3,3
6360	American Kestrel	4,2
6364	Osprey	1,1
6365	Barn Owl	4,2
6366	Long-eared Owl	4,3
6367	Short-eared Owl	3,2
6368	Barred Owl	4,1
6372	Saw-whet Owl	4,3
6373	Screech Owl	4,1
6375	Great Horned Owl	4,1
6387	Yellow-billed Cuckoo	1,1
6388	Black-billed Cuckoo	1,2
6390	Belted Kingfisher	4,2
6393	Hairy Woodpecker	4,2
6394	Downy Woodpecker	4,1
6402	Yellow-bellied Sapsucker	4,2
6405	Pileated Woodpecker	4,2
6406	Red-headed Woodpecker	4,2
6409	Red-bellied Woodpecker	4,1
6412	Common Flicker	4,2
6416	Chuck-will's-widow	1,3
6417	Whip-poor-will	1,1
6420	Common Nighthawk	1,2
6423	Chimney Swift	1,1
6428	Ruby-throated Hummingbird	1,2
6444	Eastern Kingbird	1,2
6452	Great Crested Flycatcher	1,1
6456	Eastern Phoebe	1,2
6459	Olive-sided Flycatcher	2,2
6461	Eastern Wood Pewee	1,2
6463	Yellow-bellied Flycatcher	2,2
6465	Acadian Flycatcher	1,1
6466	Traill's Flycatcher	1,3
6467	Least Flycatcher	1,2
6474	Horned Lark	4,2
6477	Blue Jay	4,2
6488	Common Crow	4,2
6490	Fish Crow	4,2
6494	Bobolink	1,2
6495	Brown-headed Cowbird	4,2
6498	Red-winged Blackbird	4,1
6501	Eastern Meadowlark	4,1
6506	Orchard Oriole	1,1
6507	Northern Oriole	1,2
6509	Rusty Blackbird	3,2
6511	Common Grackle	4,1

		Resid Freq.
6513	Boat-tailed Grackle	4,2
6514	Evening Grosbeak	3,2
6517	Purple Finch	4,2
6519	House Finch	4,2
6512	Red Crossbill	3,3
6529	American Goldfinch	4,2
6533	Pine Siskin	3,3
6534	Snow Bunting	3,2
6536	Lapland Longspur	3,3
6540	Vesper Sparrow	4,2
6542	Savannah Sparrow	4,2
6546	Grasshopper Sparrow	1,1
6547	Henslow's Sparrow	1,2
6549	Sharp-tailed Sparrow	4,2
6550	Seaside Sparrow	4,2
6553	Field Sparrow	4,1
6554	White-crowned Sparrow	3,2
6558	White-throated Sparrow	3,1
6559	Tree Sparrow	3,1
6560	Chipping Sparrow	4,2
6567	Dark-eyed Junco	4,2
6575	Bachman's Sparrow	1,3
6581	Song Sparrow	4,1
6583	Lincoln's Sparrow	2,2
6584	Swamp Sparrow	4,1
6585	Fox Sparrow	3,2
6587	Rufous-sided Towhee	4,2
6593	Cardinal	4,1
6595	Rose-breasted Grosbeak	1,2
6597	Blue Grosbeak	1,2
6598	Indigo Bunting	1,1
6604	Dickcissel	1,3
6608	Scarlet Tanager	1,1
6610	Summer Tanager	1,2
6611	Purple Martin	1,1
6612	Cliff Swallow	1,2
6613	Barn Swallow	1,1
6614	Tree Swallow	1,2
6616	Bank Swallow	1,2
6617	Rough-winged Swallow	1,2
6619	Cedar Waxwing	4,2
6622	Loggerhead Shrike	4,3
6624	Red-eyed Vireo	1,1
6626	Philadelphia Vireo	2,3
6627	Warbling Vireo	1,2
6628	Yellow-throated Vireo	1,2
6629	Solitary Vireo	1,2
6631	White-eyed Vireo	1,2
6636	Black and White Warbler	1,2
6637	Prothonotary Warbler	1,1
6639	Worm-eating Warbler	1,2
6641	Blue-winged Warbler	1,2
6642	Golden-winged Warbler	1,2
6645	Nashville Warbler	2,2
6647	Tennessee Warbler	2,2
6648	Parula Warbler	1,2

		Resid Freq.
6650	Cape May Warbler	2,2
6652	Yellow Warbler	1,2
6654	Black-throated Blue Warbler	1,2
6655	Myrtle Warbler	3,1
6657	Magnolia Warbler	1,2
6658	Cerulean Warbler	1,2
6659	Chestnut-sided Warbler	1,1
6660	Bay-breasted Warbler	2,2
6661	Blackpoll Warbler	2,2
6662	Blackburnian Warbler	1,2
6663	Yellow-throated Warbler	1,1
6667	Black-throated Green Warbler	1,2
6671	Pine Warbler	4,2
6672	Palm Warbler	3,3
6673	Prairie Warbler	1,1
6674	Oven-bird	1,1
6675	Northern Waterthrush	1,2
6676	Louisianna Waterthrush	1,2
6677	Kentucky Warbler	1,1
6678	Connecticut Warbler	2,3
6679	Mourning Warbler	2,3
6681	Yellowthroat	4,1
6683	Yellow-breasted Chat	1,1
6684	Hooded Warbler	1,1
6685	Wilson's Warbler	2,3
6686	Canada Warbler	1,1
6687	American Redstart	1,1
6688	House Sparrow	4,1
6693	Starling	4,1
6697	Water Pipit	3,2
6703	Mockingbird	4,1
6704	Catbird	4,2
6705	Brown Thrasher	4,2
6718	Carolina Wren	4,1
6721	House Wren	1,1
6722	Winter Wren	3,2
6724	Sedge Wren	1,2
6725	Marsh Wren	4,2
6726	Brown Creeper	4,2
6727	White-breasted Nuthatch	4,2
6728	Red-breasted Nuthatch	3,2
6729	Brown-headed Nuthatch	4,1
6731	Tufted Titmouse	4,1
6735	Black-capped Chickadee	4,2
6736	Carolina Chickadee	4,1
6748	Golden-crowned Kinglet	4,2
6749	Ruby-crowned Kinglet	3,2
6751	Blue-gray Gnatcatcher	1,1
6755	Wood Thrush	1,1
6756	Veery	1,1
6757	Grey-cheeked Thrush	2,2
6758	Swainson's Thrush	2,2
6759	Hermit Thrush	3,1
6761	Robin	4,1
6766	Eastern Bluebird	4,2

		*Resid. *Freq.
6007	Common Loon	3,2
6011	Red-throated Loon	3,2
6002	Red-necked Grebe	3,3
6003	Horned Grebe	3,2
6006	Pied-billed Grebe	4,2
6117	Gannet	3,3
6120	Double-cr. Cormorant	2,2
6194	Great Blue Heron	4,2
6201	Green Heron	1,1
6200	Little Blue Heron	1,2
6198	Cattle Egret	1,2
6196	Great Egret	1,2
6197	Snowy Egret	1,2
6199	Louisiana Heron	1,2
6202	Black-cr. Night Heron	4,2
6203	Yellow-cr. Night Heron	1,3
6191	Least Bittern	1,2
6190	American Bittern	1,2
6186	Glossy Ibis	1,2
6178	Mute Swan	4,3
6180	Whistling Swan	3,2
6172	Canada Goose	3,2
6169	Snow Goose	3,2
6132	Mallard	4,2
6133	Black Duck	4,2
6135	Gadwall	2,2
6143	Pintail	3,2
6139	Green-winged Teal	3,2
6140	Blue-winged Teal	4,2
6136	European Widgeon	3,3
6137	American Widgeon	3,2
6142	Shoveler	3,3
6144	Wood Duck	1,2
6146	Redhead	3,2
6150	Ring-necked Duck	3,2
6147	Canvasback	3,2
6148	Greater Scaup	3,2
6149	Lesser Scaup	3,2
6151	Common Goldeneye	3,2
6153	Bufflehead	3,2
6154	Oldsquaw	3,2
6165	White-winged Scoter	3,2
6166	Surf Scoter	3,2
6163	Black Scoter	3,2
6167	Ruddy Duck	3,2
6131	Hooded Merganser	4,3
6129	Common Merganser	3,2
6130	Red-br. Merganser	3,2
6325	Turkey Vulture	4,1
6326	Black Vulture	4,1
6332	Sharp-shinned Hawk	4,2
6333	Cooper's Hawk	4,3
6337	Red-tailed Hawk	4,2
6339	Red-shouldered Hawk	4,2
6343	Broad-winged Hawk	1,2
6347	Rough-legged Hawk	3,2

In A.O.U. Checklist Order

*Residency
1. Breeding
2. Migratory
3. Winter
4. Year Round

*Frequency
1. Common
2. Uncommon
3. Rare
4. Endangered

		Resid. Freq.
6070	Common Tern	1,1
6074	Least Tern	1,2
6065	Royal Tern	1,2
6064	Caspian Tern	2,2
6077	Black Tern	2,2
6080	Black Skimmer	1,2
6316	Mourning Dove	4,1
6387	Yellow-billed Cuckoo	1,1
6388	Black-billed Cuckoo	1,2
6365	Barn Owl	4,2
6373	Screech Owl	4,1
6375	Great Horned Owl	4,1
6368	Barred Owl	4,1
6366	Long-eared Owl	4,3
6367	Short-eared Owl	3,2
6372	Saw-whet Owl	4,3
6416	Chuck-will's-widow	1,3
6417	Whip-poor-will	1,1
6420	Common Nighthawk	1,2
6423	Chimney Swift	1,1
6428	Ruby-thr. Hummingbird	1,2
6490	Belted Kingfisher	4,2
6412	Yellow-shafted Flicker	4,2
6405	Pileated Woodpecker	4,2
6409	Red-bellied Woodpecker	4,1
6406	Red-headed Woodpecker	4,2
6402	Yellow-bellied Sapsucker	4,2
6493	Hairy Woodpecker	4,2
6494	Downy Woodpecker	4,1
6444	Eastern Kingbird	1,2
6452	Great Crested Flycatcher	1,1
6456	Eastern Phoebe	1,2
6463	Yellow-bellied Flycatcher	2,2
6465	Acadian Flycatcher	1,1
6466	Traill's Flycatcher	1,3
6467	Least Flycatcher	1,2
6461	Eastern Wood Pewee	1,2
6459	Olive-sided Flycatcher	2,2
6474	Horned Lark	4,2
6614	Tree Swallow	1,2
6616	Bank Swallow	1,2
6617	Rough-winged Swallow	1,2
6613	Barn Swallow	1,1
6612	Cliff Swallow	1,2
6611	Purple Martin	1,1
6477	Blue Jay	4,2
6488	Common Crow	4,2
6490	Fish Crow	4,2
6735	Black-capped Chickadee	4,2
6736	Carolina Chickadee	4,1
6731	Tufted Titmouse	4,1
6727	White-br. Nuthatch	4,2
6728	Red-br. Nuthatch	3,2
6729	Brown-headed Nuthatch	4,1
6726	Brown Creeper	4,2

		Resid. Freq.
6349	Golden Eagle	3,3
6352	Bald Eagle	4,4
6331	Marsh Hawk	2,2
6364	Osprey	1,1
6356	Peregrine Falcon	3,4
6357	Merlin	3,3
6360	American Kestrel	4,2
6289	Bobwhite	4,1
6309	Ring-necked Pheasant	4,2
6300	Ruffed Grouse	4,2
6310	Wild Turkey	4,3
6208	King Rail	4,2
6211	Clapper Rail	4,2
6212	Virginia Rail	4,2
6214	Sora	1,3
6216	Black Rail	1,3
6218	Purple Gallinule	1,3
6219	Common Gallinule	1,2
6221	American Coot	3,2
6274	Semipalmated Plover	1,2
6277	Piping Plover	1,2
6273	Killdeer	4,2
6270	Black-bellied Plover	3,2
6283	Ruddy Turnstone	2,3
6228	American Woodcock	4,2
6230	Common Snipe	3,2
6265	Whimbrel	2,2
6261	Upland Sandpiper	2,3
6263	Spotted Sandpiper	1,2
6256	Solitary Sandpiper	2,2
6258	Willet	1,2
6254	Greater Yellowlegs	2,2
6255	Lesser Yellowlegs	2,2
6234	Knot	2,3
6239	Pectoral Sandpiper	2,2
6240	White-rumped Sandpiper	2,2
6241	Baird's Sandpiper	2,3
6242	Least Sandpiper	3,2
6243	Dunlin	3,2
6231	Short-billed Dowitcher	2,2
6233	Stilt Sandpiper	2,2
6246	Semipalmated Sandpiper	2,2
6247	Western Sandpiper	2,2
6262	Buff-br. Sandpiper	2,3
6249	Marbled Godwit	2,3
6248	Sanderling	4,2
6225	American Avocet	2,3
6223	Northern Phalarope	2,2
6042	Glaucous Gull	3,2
6043	Iceland Gull	3,2
6047	Great Black-backed Gull	4,1
6051	Herring Gull	4,1
6054	Ring-billed Gull	4,1
6058	Laughing Gull	2,2
6060	Bonaparte's Gull	2,2
6063	Gull-billed Tern	1,2
6069	Forster's Tern	1,2

		Resid. Freq.
6721	House Wren	1,1
6722	Winter Wren	3,2
6718	Carolina Wren	4,1
6725	Marsh Wren	4,2
6724	Sedge Wren	1,2
6703	Mockingbird	4,1
6704	Catbird	4,2
6705	Brown Thrasher	4,2
6761	Robin	4,1
6755	Wood Thrush	1,1
6759	Hermit Thrush	3,1
6758	Swainson's Thrush	2,2
6757	Grey-cheeked Thrush	2,2
6756	Veery	1,1
6766	Eastern Bluebird	4,2
6751	Blue-gray Gnatcatcher	1,1
6748	Golden-crowned Kinglet	4,2
6749	Ruby-crowned Kinglet	3,2
6697	Water Pipit	3,2
6619	Cedar Waxwing	4,2
6622	Loggerhead Shrike	4,3
6693	Starling	4,1
6631	White-eyed Vireo	1,2
6628	Yellow-throated Vireo	1,2
6629	Solitary Vireo	1,2
6624	Red-eyed Vireo	1,1
6626	Philadelphia Vireo	2,3
6627	Warbling Vireo	1,2
6636	Black and White Warbler	1,2
6637	Prothonotary Warbler	1,1
6639	Worm-eating Warbler	1,2
6642	Golden-winged Warbler	1,2
6641	Blue-winged Warbler	1,2
6647	Tennessee Warbler	2,2
6645	Nashville Warbler	2,2
6648	Parula Warbler	1,2
6652	Yellow Warbler	1,2
6657	Magnolia Warbler	1,2
6650	Cape May Warbler	2,2
6654	Black-thr. Blue Warbler	1,2
6655	Myrtle Warbler	3,1
6667	Black-thr. Green Warbler	1,2
6658	Cerulean Warbler	1,2
6662	Blackburnian Warbler	1,2
6663	Yellow-throated Warbler	1,1
6659	Chestnut-sided Warbler	1,1
6660	Bay-breasted Warbler	2,2
6661	Blackpoll Warbler	2,2
6671	Pine Warbler	4,2
6673	Prairie Warbler	1,1
6672	Palm Warbler	3,3
6674	Oven-bird	1,1
6675	Northern Waterthrush	1,2
6676	Louisianna Waterthrush	1,2
6677	Kentucky Warbler	1,1
6678	Connecticut Warbler	2,3
6679	Mourning Warbler	2,3

		Resid. Freq.
6681	Yellow throat	4,1
6683	Yellow-breasted Chat	1,1
6684	Hooded Warbler	1,1
6685	Wilson's Warbler	2,3
6686	Canada Warbler	1,1
6687	American Redstart	1,1
6688	House Sparrow	4,1
6494	Bobolink	1,2
6501	Eastern Meadowlark	4,1
6498	Red-winged Blackbird	4,1
6506	Orchard Oriole	1,1
6507	Northern Oriole	1,2
6509	Rusty Blackbird	3,2
6513	Boat-tailed Grackle	4,2
6511	Common Crackle	4,1
6495	Brown-headed Cowbird	4,2
6608	Scarlet Tanager	1,1
6610	Summer Tanager	1,2
6593	Cardinal	4,1
6595	Rose-breasted Grosbeak	1,2
6597	Blue Grosbeak	1,2
6598	Indigo Bunting	1,1
6604	Dickcissel	1,3
6514	Evening Grosbeak	3,2
6517	Purple Finch	4,2
6519	House Finch	4,2
6533	Pine Sisken	3,3
6529	American Goldfinch	4,2
6521	Red Crossbill	3,3
6587	Rufous-sided Towhee	4,2
6542	Savannah Sparrow	4,2
6546	Grasshopper Sparrow	1,1
6547	Henslow's Sparrow	1,2
6549	Sharp-tailed Sparrow	4,2
6550	Seaside Sparrow	4,2
6540	Vesper Sparrow	4,2
6575	Backman's Sparrow	1,3
6567	Dark-eyed Junco	4,2
6559	Tree Sparrow	3,1
6560	Chipping Sparrow	4,2
6553	Field Sparrow	4,1
6554	White-crowned Sparrow	3,2
6558	White-throated Sparrow	3,1
6585	Fox Sparrow	3,2
6583	Lincoln's Sparrow	2,2
6584	Swamp Sparrow	4,1
6581	Song Sparrow	4,1
6536	Lapland Longspur	3,3
6534	Snow Bunting	3,2

Source:

_____. 1974. List of Species Numbers and Recommended Band Size. American Ornithological Union.

VEGETATION TYPING SCHEME

MARYLAND COASTAL WETLANDS STUDY

(WETLANDS MAPPING UNITS)

NOTE: Codes are used only on wetland Air Photo overlays found in DNR, Water Resources Division. Photos are used for determination of wetland vegetation cover.

SHRUB SWAMP CATEGORY

11 Rosa palustris
12 Alnus serrulata/Salix nigra (Alder/Willow)
13 Acer rubrum/Fraxinus spp. (Maple/Ash)

WOODED SWAMP CATEGORY

21 Taxodium distichum (Cypress)
22 Acer rubrum/Fraxinum spp. (Maple/Ash)
23 Pinus spp.

FRESH MARSH CATEGORY

30 Polygonum spp./Leersia oryzoides
31 Nuphar advena
32 Pontederia cordata/Peltandra virginica
33 Acorus calamus
34 Typha spp
35 Hibiscus spp.
36 Zizania aqatica
37 Scirpus spp.
38 Spartina cynosuroides
39 Phragmites australis

BRACKISH HIGH MARSH CATEGORY

41 Spartina paten/Distichlis spicata
42 Iva frutescens/Baccharis halimifolia/Spartina patens (S.patens only as an understory with the shrubs being dominant. This type is in recognition of a common, or frequent, association recognized herein as a type).
43 Juncus roemerianus
44 Typha spp.
45 Hibiscus spp.
46 Panicum virgatum
47 Scripus spp.
48 Spartina cynosuroides
49 Phragmites australis

BRACKISH LOW MARSH CATEGORY

51 Spartina alterniflora (No growth forms differentiated)

SALINE HIGH MARSH CATEGORY

61 Spartina patens/Distichlis spicata
62 Iva frutescens/Baccharis halimifolia/Spartina patens
63 Juncus roemerianus

SALINE LOW MARSH CATEGORY

71 Spartina alterniflora
72 Spartina alterniflora (low growth form)/Salicornia/Limonium

MUD FLATS CATEGORY

80 Open Water-Natural Pond
81 Mud flats (may be seasonally vegetated by emergent broadleafs and/or submerged vegetation)

BEACHES - SAND BARS CATEGORY

91 Beaches/Sand bars

SUBMERGED AQUATIC VEGETATION CATEGORY

101 Submerged aquatic vegetation

MAMMALS

5034	Bat, Big Brown. Eptesicus fuscus.	4,1
5100	Bat, Big-eared. Plecotus townsendii virginianus.	2,3
5035	Bat, Eastern Pipistrelle. Pipistrellus subflavus.	4,2
5036	Bat, Evening. Nycticeius humeralis.	1,2
5037	Bat, Hoary. Lasiurus cinereus.	2,3
5101	Bat, Indiana Myotis. Myotis sodalis.	4,3
5038	Bat, Keen's Myotis. Myotis keenii.	4,1
5039	Bat, Little Brown. Myotis lucifugus.	4,1
5040	Bat, Red. Lasiurus borealis.	4,1
5041	Bat, Silver-haired. Lasionycteris noctivagans.	2,-
5102	Bat, Small-footed Myotis. Myotis subulatus.	4,3
5002	Beaver. Castor canadensis.	4,2
5104	Black Bear. Ursus americanus.	4,3
5103	Bobcat. Lynx rufus.	4,3
5026	Chipmunk, Eastern. Tamias striatus.	4,1
5025	Cottontail, Eastern. Sylvilagus floridanus.	4,1
5105	Cottontail, New England. Sylvilagus transitionalis.	4,3
5015	Deer, White-tailed. Odocoileus virginianus.	4,1
5106	Ermine. Mustela erminea.	4,3
5028	Fox, Gray. Urocyon cinereoargenteus.	4,1
5030	Fox, Red. Vulpes vulpes.	4,1
5110	Hare, Snowshoe. Lepus americanus.	
5042	Lemming, Southern Bog. Synaptomus cooperi.	4,1
5014	Mink. Mustela vison.	4,-
5021	Mole, Eastern. Scalopus aquaticus.	4,-
5107	Mole, Hairy-tailed. Parascalops breweri.	4,2
5004	Mole, Star-Nosed. Condylura cristata.	4,1
5043	Mouse, Deer. Peromyscus maniculatus.	4,2
5044	Mouse, Eastern Harvest. Reithrodontomys humulis.	4,3
5012	Mouse, House. Mus musculus.	4,1
5031	Mouse, Meadow Jumping. Zapus hudsonius.	4,1
5108	Mouse, Red-backed. Clethrionomys gapperi.	4,1
5018	Mouse, White-Footed. Peromyscus leucopus.	4,1
5109	Mouse, Woodland Jumping. Napaeozapus insignis.	4,2
5016	Muskrat. Ondatra zibethicus.	4,1
5006	Opossum. Didelphia marsupialis.	4,1
5008	Otter, River. Lutra canadensis.	4,1
5020	Raccoon, Procyon lotor.	4,3
5111	Rat, Eastern Wood. Neotoma floridana.	4,1
5017	Rat, Marsh Rice. Orzomys palustris.	4,1
5045	Rat, Norway. Rattus norvegicus.	4,1
5005	Shrew, Least. Cryptotis parva.	4,1
5112	Shrew, Long-tailed. Sorex dispar.	4,1
5024	Shrew, Masked. Sorex cinereus.	4,3
5046	Shrew, Pigmy. Microsorex hoyi.	4,1
5001	Shrew, Short-tailed. Blarina brevicauda.	4,3
5113	Shrew, Smokey. Sorex fumeus.	4,1
5047	Shrew, Southeastern. Sorex longirostris.	4,3
5114	Shrew, Water. Sorex palustris punctulatus.	4,3
5115	Skunk, Eastern Spotted. Spilogale putorius.	4,3
5010	Skunk, Striped. Mephitis mephitis.	4,-
5023	Squirrel, Eastern Fox. Sciurus niger vulpinus.	4,-
5022	Squirrel, Gray. Sciurus carolinensis.	4,3
5027	Squirrel, Red. Tamiasciurus hudsonicus.	4,1
5007	Squirrel, Southern Flying. Glaucomys volans.	4,2

MAMMALS (cont.)

5011	Vole, Meadow. Microtus pennsylvanicus.
5048	Vole, Pine. Pitymys pinetorum.
5013	Weasel, Long-tailed. Mustela frenata.
5032	Woodchuck. Marmota monax.

Source:

Paradisco, John L. 1969. Mammals of Maryland. North American Fauna, Number 66. Bureau of Sport Fisheries and Wildlife. U.S. Government Printing Office, Washington, D.C.

HERPTILES

Caudata

7019	Dusky Salamander, Northern. Desmognathus f. fuscus.	4,-
7006	Dusky Salamander, Northern. Desmognathus fuscus fuscus.	4,-
7009	Four-toed Salamander. Hemidactylium scutatum.	4,-
7100	Green Salamander. Aneides aeneus.	4,4
7001	Hellbender. Cryptobranchus alleganiensis alleganiensis.	4,4
7014	Jefferson Salamander. Ambystoma jeffersonianum.	4,4
7013	Long-tailed Salamander. Eurycea longicauda longicauda.	4,-
7004	Marbled Salamander. Ambystoma opacum.	4,-
7010	Mud Salamander, Eastern. Pseudotriton montanus montanus.	4,-
7015	Mudpuppy. Necturus m. maculosus.	4,-
7007	Red-backed Salamander. Plethodon cinereus cinereus.	4,-
7011	Red Salamander, Northern. Pseudotriton ruber ruber.	4,-
7002	Red-spotted Newt. Notophthalmus viridescens viridescens.	4,-
7016	Seal Salamander, Appalachian. Desmognathus m. monticola.	4,-
7008	Slimy Salamander. Plethodon glutinosus	4,-
7003	Spotted Salamander. Ambystoma maculatum.	4,-
7017	Spring Salamander, Northern. Cyrinophilus p. porphyriticus.	4,-
7005	Tiger Salamander, Eastern. Ambystoma tigrinum tigrinum.	4,4
7012	Two-lined Salamander, Northern. Eurycea bislineata bislineata.	4,-
7018	Valley and Ridge Salamander. Plethodon hoffmani.	4,-

Salientia

7021	American Toad. Bufo americanus americanus.	4,-
7028	Bullfrog. Rana catesbeiana.	4,-
7024	Chorus Frog. Mountain. Pseudacris brachyphona.	4,-
7023	Cricket Frog, Northern. Acris crepitans crepitans.	4,-
7022	Fowler's Toad. Bufo woodhousei fowleri.	4,-
7027	Gray Treefrog. Eastern. Hyla versicolor.	4,-
7034	Gray Treefrog. Southern. Hyla chrysoscelis.	4,-
7029	Green Frog. Rana clamitans melanota.	4,-
7025	Green Treefrog. Hyla cinerea.	4,-
7031	Leopard Frog, Northern. Rana pipiens.	4,-
7035	Leopard Frog, Southern. Rana utricularia.	4,-
7036	Narrow-mouthed Toad, Eastern. Castrophryne carolinensis.	4,4
7037	New Jersey Chorus Frog. Pseudacris triseriata kalmi.	4,-
7030	Pickerel Frog. Rana palustris.	4,-
7020	Spadefoot, Eastern. Scaphiopus holbrooki holbrooki.	4,-
7026	Spring Peeper, Northern. Hyla crucifer crucifer.	4,-
7038	Upland Chorus Frog. Pseudacris triseriata feriarum.	4,-
7032	Wood Frog. Rana sylvatica sylvatica.	4,-

Squamata (Sauria)

7073	Broad-headed Skink. Eumeces laticeps.	4,-
7075	Coal Skink, Northern. Eumeces a. anthracinus.	4,4
7070	Fence Lizard, Northern. Sceloporus undulatus hyacinthinus.	4,1
7072	Five-lined Skink. Eumeces fasciatus.	4,1
7074	Six-lined Racerunner. Cnemidophorus sexlineatus sexlineatus.	4,-
7071	Ground Skink. Leiolopisma laterale.	

Squamata (Serpentes)

7044	Black Racer, Northern. Coluber constrictor constrictor.	4,1
7046	Black Rat Snake. Elaphe obsoleta obsoleta.	4,1
7054	Brown Snake, Northern. Stoeria dekayi dekayi.	4,1
7059	Copperhead, Northern. Agkistrodon contortrix mokasen.	4,1
7045	Corn Snake. Elaphe guttata guttata.	4,3
7056	Earth Snake. Eastern. Virginia valeriae valeriae.	4,3
7064	Earth Snake, Mountain. Virginia valeriae pulchra.	4,4
7058	Garter Snake, Eastern. Thamnophis sirtalis sirtalis.	4,1
7042	Hognose Snake, Eastern. Heterodon plathyrhinos.	4,1
7047	Kingsnake, Eastern. Lampropeltis getulus getulus.	4,-
7049	Milk Snake, Coastal Plain. Lampropeltis triangulum temporalis.	4,3
7048	Milk Snake, Eastern. Lampropeltis triangulum triangulum.	4,-
7060	Mole Snake. Lampropeltis calligaster rhombomaculata.	4,2
7052	Queen Snake, Natrix septemvittata.	4,1
7061	Rainbow Snake. Farancia erytrogramma erytrogramma.	4,4
7055	Red-bellied Snake, Northern. Storeria o. occipitomaculata	4,2
7057	Ribbon Snake, Eastern. Thamnophis sauritus sauritus.	4,-
7041	Ringneck Snake, Northern. Diadophis punctatus edwardsi.	4,-
7043	Rough Green Snake. Opheodrys aestivus.	4,1
7050	Scarlet Snake, Northern. Cemophora coccinea copei.	4,3
7063	Smooth Green Snake. Opheodrys v. vernalis.	4,-
7062	Timber Rattlesnake. Crotalus horridus horridus.	4,2
7053	Water Snake, Northern. Natrix sipedon sipedon.	4,1
7040	Worm Snake, Eastern. Carphophis amoenus amoenus.	4,1

Chelonia

7084	Bog Turtle. Clemmys muhlenbergi.	4,4
7085	Box Turtle, Eastern. Terrapene carolina carolina.	4,1
7095	Cumberland Turtle. Feral. Chrysemys scripta troosti.	4,-
7086	Diamondback Terrapin, Northern. Malaclemys terrapin terrapin.	4,1
7087	Map Turtle. Graptemys geographica.	4,-
7081	Mud Turtle, Eastern. Kinosternon subrubrum subrubrum.	4,1
7088	Painted Turtle, Eastern. Chrysemys picta picta.	4,1
7090	Painted Turtle, Midland. Chrysemys picta marginata.	4,-
7089	Red-bellied Turtle. Chrysemys rubriventris.	4,1
7096	Red-eared Turtle, Feral. Chrysemys scripta elegans.	4,-
7082	Snapping Turtle, Common. Chelydra serpentina serpentina.	4,1
7098	Spiny Softshell, Eastern. Trionyx s. spiniferus.	4,-
7083	Spotted Turtle. Clemmys guttata.	4,1
7080	Stinkpot. Sternotherus odoratus.	4,1
7097	Wood Turtle. Clemmys insculpta.	4,1

Sources:

_____.1973. "Endangered Amphibians and Reptiles of Maryland: A Special Report." Bulletin of the Maryland Herpetological Society. The Natural History Society of Maryland, Inc. Vol. 9, No. 3.

Harris, Herbert S. 1975. "Distributional Survey (Amphibia/Reptilia): Maryland and D.C." Bulletin of the Maryland Herpetological Society. The Natural History Society of Maryland, Inc. Vol. 11, No. 3.

Alleghany County

Au, Av - alluvial land
Aw - Atkins
Co - Cavode
Hn, Hx - Huntington
Lm - Lickdale
Ln - Lindside
Ly - Laysville
Me - Melvin
No - Nolo
Op - Opequon
Rb - Robertsville
Ty - Tyler
We, Wl, Wn - Weikert

Baltimore County

Av - alluvial
Ba - Baile
Br - Barclay
Du - Dunning
Em, En, Eo - Elkton
Fa, Fs - Fallsington
Hb - Hatbaro
Ke, Ks, Ku - Kelly
Ll, Lm, Ln, Lo - Lenair
Mh, Mo - Melvin
Ot - Othello
Po - Pocomoke
Wa, Wc - Wachung

Carroll County

Ar - Abbottstown
Ba - Baile
Bs - Bowmansville
Ht - Hatboro
Mo - Melvin

Cecil County

Ba - Baile
El, Em - Elkton
Fa, Fm - Fallsington
Ha - Hatboro
Lo - Leonardtown
Mu - Mixed alluvial
Oh - Othello
Wa - Wachung

Harford County

Av - alluvial
Ba - Baile
En - Elkton
Fs - Fallsington
Hb - Hatboro
Ke, Kf - Kelly
Kr - Kinkara
Lr - Leonardtown
Ot - Othello
Wa, Wc - Wachung

Howard County

Ba - Baile
Em - Elkton
Fa - Fallsington
Ha - Hatboro
Kc, Ke - Kelly
Kn - Kinkora
Ll - Leonardtown
Mo - Mixed alluvial
Wa - Wachung

Frederick County

Aa - alluvial
Ad, Ae - Augusta
Bd - Bowmansville
Cd - Chalfont
Co - Colbert
Ct - Croton
Gg - Guthrie
La - Lantz
Mc - Melvin
Rc - Roanoke
Rd - Rohrersville
Wa - Westphalia

Garrett County

An - alluvial
Ar - Armagh
At - Atkins
Br - Brinkerton
Co - Cavode
Ek - Elkins
Lc - Lickdale
No - Nolo
Pe - Peat
Pu - Purdy

Montgomery County

Bo - Bowmansville
Ca - Calvert
Cx - Croton
Id, Ie - Iredell
Lg - Leonardtown
Mg - Melvin
Mh - Mixed alluvial
Rk - Roanoke
Wc - Wachung
Wh - Wehadkee
Wo - Worsham

Washington County

At - Atkins
Bt - Brinkertown
Cw - Carydon
Dz - Dunning/Melvin
Me - Melvin
Ro - Rohrersville
Ty - Tyler
Wh - Wehadkee

Alleghany County

Ah, Al, An - Allegheny
Be - Belmont
Bk - Brooke
Ca, Cl, Cn - Calvin
Cs - Chavies
De, Dk, Dl - Dekalb
Ed, Ee - Edom
El, Em - Elliber
Gl, Gn, Gs, Gu, Gw - Gilpin
He - Hagerstown
Hn, Hx - Huntington
La, Lb - Laidig
Lg - Leetonia
Lh, Ll - Lehew
Ls - Litz
Op, Ou - Opequon
Pn, Ps - Pope
Sh - Shelocta
We, Wk, Wl, Wn - Weikert
Ws - Westmorelane

Anne Arundel County

Ca, Cb - Chillum
Cc, Cd - Christiana
Cn, Co, Cp - Collington
Cr - Comus
Cs, Ct - Croom
Eo, Es, Eu, Er - Evesboro
Ga - Galestown
Hf, Hg, Hs, Ht, Hy, Hz - Howell
Mf - Marr
Mk, Mm, Matapeake
Mu, Mv, Mw, Mx - Monmouth
My, Mz - Muirkirk
Ru, Ry - Rumford
Sa, Sf, Sn - Sassafras
Wa - Westphalia

Baltimore County

Bm, Bn - Baltimore
Bw, By - Brandywine
CC, Cg - Chester
Ch, Ck, Cl - Chillum
Cm - Christiana
Cn, Co - Chrome Series
Cv - Comus
Cw - Conestoga
Ed, Eg - Edgemont
Eh, Ek, El - Elioak
Es - Elsinboro
Ft - Fort Mott
Ga - Galestown
Gc, Gg, Gl - Glenelg
Ha - Hagerstown
Ho, Hr, Hs - Hollinger
Jp, Ju - Joppa
Le, Lf, Lg, Lh - Legore
Mb, Mc, Md, Me, Mg, Mh - Manor
Mk - Matapeake
Ms - Montalto
Mt - Mt. Airy
Ne - Neshaminy
Re, Rs, Ry - Relay
Sh, Sl, Sn, Ss - Sassafras
Su - Sunnyside

Carroll County

Br - Birdsboro
Bu - Bucks
Ca - Cardiff
Ce - Chester
Co - Conestoga
El, Em - Elioak
En, Es - Elsinboro
Gc, Gl - Glenelg
Ha - Hagerstown
Lb - Lewisberry
Ln - Linganore
Mg, Ml, Mn - Manor
Mt - Mt. Airey
Pe, Ph, Pn, Po, Ps - Penn
St - Steinsburg

Calvert County

Ev - Evesboro
Ho, Hw, Hy - Howell
Ml - Marr
Mm, Mn - Matapeake
Oc - Ochlockonee
Rd, Re - Rumford
Sa, Sh, Sl, Sp, Sr - Sassafras
Wa - Westphalia

Cecil County

Au - Aura
Ce - Chester
Ch - Chillum
ClB2 - Christiana
Cm, Cn - Chrome
Cs, Ct - Collington
Cu - Comus
Eo - Elsinboro
Ev - Evesboro
Ge - Glenelg
Le, Lg - Legore
Ml, Mm - Manor
Mn, Mo - Matapeake
Mt, Mv, My - Montalto
Ne - Neshaminy
Ru - Rumford
Sa, Sg, Sf, Sr - Sassafras

Charles County

Au - Aura
ChB, ChC - Chillum
CrB, CrC - Croom
Ev - Evesboro
Ga - Galestown
GvE - Gravelly Land
Mg - Magnolia
Ml - Marr
Mm, Mn - Matapeake
Oc - Ocklockonee
Rd, Rg - Rumford
SaE - Sandy Land
Sh - Sassafras
Wa, We - Westphalia
Wk, Wm - Wickham

Frederick County

Ab, Ac - Athol
Bc - Birdsboro
Be, Bg, Bh - Braddock
Bn - Brandywine
Bo - Bucks
Cb - Cardiff
Cc - Catoctin
Ce, Cg, Ch - Chandler
Ck - Chester
Cn - Clymer
Cp - Conestoga
Da, Db - Dekalb
Dc, De, Dd - Duffield
Ea, Eb, Ec, Ed - Edgemont
Ee, Eg - Elioak
Eh, Ek - Elk
Fa, Fb, Fc, Fd, Fe, Fg - Fauquier
Ga, Gb, Gc - Glenelg
Ha, Hb, Hc, He - Hagerstown
Hg, Hh, Hk - Highfield
Lc, Ld, Le - Legore
Ln, Lo, Lp - Linganore
Ma, Mb - Manor
Md, Me - Montalto
Mg, Mh, Mk, Mm, Mn, Mo - Myersville
Na, Nb - Norton
Pa, Pb, Pc, Pd, Pe, Pg, Ph - Penn
Sa - Sequatchie
Ta, Tb, Td, Te - Thurmont
Wb - Waynesboro

Garrett County

Ah - Allegheny
Ca, Cl, Cn - Calvin
Cr - Clymer
Db, Dc, Dg, Dl - Dekalb
Gn - Gilpin
La - Laidig
Mc, Md - Meckesville
Ps - Pope
Uc, Un - Ungers

Harford County

Br - Brandywine
Cc, Cg - Chester
Ch, Ck - Chillum
Cr - Chrome
Cv - Comus
Eh - Elioak
Es - Elsinboro
Ev - Evesboro
Gc, Gg - Glenelg
Jp - Joppa
Le, Lg, Lf - Legore
Mb, Mc, Md, Mg - Manor
Mk - Matapeake
Ms - Montalto
Ne, Ns - Neshaminy
Sh, Sl, Ss - Sassafras
Wh - Whiteford

Howard County

Ag - Aura
Br, Bw - Brandywine
Ch, Cg - Chester
Cm, Cl, Cn - Chillum
Cs, Cu - Comus
Ek, El - Elioak
En - Elsinboro
Ev - Evesboro
Gl - Glenelg
Le, Lg, - Legore
Ln, Lo - Longanore
Ml, Mg, Mn - Manor
Mp, Mr, Ms - Montalto
Mt - Mt. Ariey
Ne, Ns - Neshaminy
Re - Relay
Ru - Rumford
Sf, Sl, Ss - Sassafras
Su - Sunnyside

Montgomery County

As - Ashton
Be - Bermudian
Br - Brandywine
Bu - Bucks
Ch - Chester
Cl, Cm, Cn - Chillum
Co, Cp, Cr - Chrome
Ct - Congarie
Cw - Croom
Ed - Edgemont
Ee, Ek - Elioak
El, Em - Elk
Gc, Gg, Gh, Gl - Glenelg
Ho - Huntington
La - Lakeland
Le - Legore
Lh - Lewisberry
Lo, Lr - Linganore
Mc, Md, Me - Manor
Mm, Mn, Mo - Montalto
Ne, Ns - Neshaminy
Pe, Ps, Pv - Penn
Rs - Rumford
Sa, Sf, Ss - Sassafras
Wk - Wickham

Prince Georges County

Au, Av - Aura
Ca, Cb - Chillum
Cc, Cd, Ce, Cf - Christiana
Cm, Co - Collington
Cr - Comus
Cs, Ct, Cu - Croom
Em, En, Eu - Elsinboro
Ge, Re, We - Evesboro
Ga, Gd, Gm, Ge - Galestown
Gn, Go - Glenelg
Hc - Howell
Mf, Mg - Magnolia
Mh, Mk - Manor
Ml - Marr
Mn, Mm, Mp - Matapeake
Mx - Monmouth
Mz - Muirkirk
Oc, Oh, Ok - Ochlockonee
Rd, Re - Rumford
SaE - Sandy Land
Sf, Sg, Sl, Sh, Sk - Sassafras
St, Su, Sw - Sunnyside
Wa, Wb, We - Westphalia

Washington County

As - Ashton
Ba - Benerola
Bc, Be, Bk, Bo - Berks
Br - Braddock
Ca, Cc, Cm, Cn, Co - Calvin
Cr - Chandler
Cv - Congaree
De, Dk - Dekalb
Du, Dm, Dv - Duffield
Dy - Dunmore
Ed, Eg - Edgemont
Eh - Elliber
Et, Ew - Etowah
Fa, Fs, Ft, Fr - Fauquier
Fu, Fv - Frankstown
Fw - Frankstown/Duffield
Fy - Frederick
Ha, Hb, Hc, Hd, He, Hf, Hg, Hh, Hk, Hl, Hm - Hagerstown
Hn - Hazel
Ho, Hp - Highfield
Hr, Hs, Ht - Holston
Hu, Hv, Hw, Hx - Huntington
La, Lb - Laidig
Lo, Ls, Lt - Litz
Mm - Montevallo
Mo, Mr, Ms - Murrill
Mr, Mw, Mx, My - Myersville
Pn, Po, Pp, Ps, Pt - Pope
Ta - Talladega
Th - Thurmont
Wb, Wg - Waynesboro
Wm - Westmoreland

STATE OF MARYLAND

WATER RESOURCES ADMINISTRATION

Watershed Designations

Major Basin
Minor Basin
Sub-Basin
Segment

02-13-99 Chesapeake Bay (Proper)

-98 Lower Chesapeake Bay (below north side original Bay Bridge)
-99 Upper Chesapeake Bay (above north side original Bay Bridge)

02-12-02 Lower Susquehanna River Area - 3

-01 Susquehanna River (below Conowingo Dam)
-02 Deer Creek drainage
-03 Octoraro Creek drainage
-05 Susquehanna River (above Dam)
-06 Broad Creek drainage
-07 Castleton area drainage
-08 Oakwood area drainage
-09 Pennsylvania line area drainage
-10 Havre de Grace area drainage
-11 Bainbridge area drainage
-12 Camp Ramblewood area drainage
-15 Susquehanna River (Pennsylvania area) drainage

02-13-01 Coastal Area

-01 Atlantic Ocean
-02 Assawoman Bay drainage
-03 Isle of Wight Bay drainage
-04 Sinepuxent Bay drainage
-05 Newport Bay drainage
-06 Chincoteaque Bay drainage

02-13-02 Pocomoke River Area

-01 Pocomoke Sound
-02 Pocomoke River, mainstem
-03 Dividing Creek drainage
-04 Nassawango Creek drainage
-05 Pocomoke City-Snow Hill area drainage
-06 Tangier Sound
-07 Little Annemessex River area drainage
-08 Big Annemessex River drainage
-09 Manokin River drainage
-10 Pocomoke River East area drainage
-11 Pocomoke River West area drainage
-12 Corbin area drainage
-13 Other Pocomoke River drainage
-14 Deal Island area drainage
-15 North Pocomoke Sound drainage

02-13-03 Nanticoke River Area

-01 Wicomico River, mainstem
-02 Wicomico Creek drainage
-03 Ferry Point area drainage
-04 Nanticoke River, mainstem
-05 Marshyhope Creek drainage
-06 Nanticoke River West area drainage
-07 Fishing Bay drainage
-08 Transquaking River drainage
-09 Chicamacomico River drainage
-10 Blackwater River drainage
-11 Monie Bay drainage
-12 Wicomico River West area drainage
-13 Wicomico River headwaters area drainage
-15 Nanticoke River East area drainage
-16 Nanticoke River North area drainage

02-13-04 Choptank River Area

-01 Honga River drainage
-02 Little Choptank River drainage
-03 Choptank River, mainstem
-04 Harris Creek-Blackwater Cove drainage
-05 Broad Creek drainage
-06 Tred Avon River drainage
-07 Hunting Creek drainage
-08 Tuchahoe Creek drainage
-09 Trippe Bay area drainage
-10 Choptank River Northwest area drainage
-11 Cambridge area drainage
-12 Choptank River Northwest area drainage
-13 Choptank River East area drainage
-14 Choptank River headwaters area drainage

02-13-05 Chester River Area

-01 Eastern Bay
-02 Miles River drainage
-03 Wye River drainage
-04 Eastern Bay north area drainage
-05 Kent Island narrows
-06 Chester River, mainstem
-07 Langford Creek drainage
-08 Corsica River drainage
-09 Southeast Creek drainage
-10 Eastern Bay South area drainage
-11 Kent Island Bay area drainage
-15 Cloverfields area drainage
-16 Queenstown area drainage
-17 Eastern Neck (Chester River) area drainage
-18 Indiantown - Riverview area drainage
-19 Old Town area drainage
-20 Chester River headwaters area

02-13-06 Elk River Area - 9

-01 Sassafras River drainage
-02 Elk River, mainstem
-03 Bohemia River drainage
-04 Back Creek drainage
-06 Northeast River drainage
-07 Furnace Bay area drainage
-08 Stillpond - Fairlee area drainage
-09 Christina River drainage (Delaware)
-10 Crystal Beach area drainage
-11 Elk Neck (Elk River) area drainage
-12 Port Herman area drainage
-13 Elk River headwaters area drainage
-14 Elk Neck (Bay) area drainage

02-13-07 Bush River Area - 10

-01 Swan Creek drainage
-02 Bush River drainage
-03 Bynum Run drainage
-04 Winters Run drainage
-05 Aberdeen Proving Ground area drainage
-06 Susquehanna Flats area drainage

02-13-08 Gunpowder River Area - 11

-01 Gunpowder River drainage
-02 Gunpowder Falls drainage
-03 Little Gunpowder Falls drainage
-04 Bird River drainage
-05 Middle River drainage
-06 Browns Creek area drainage
-07 Seneca Creek drainage

02-13-09 Patapsco River Area - 12

-01 Back River drainage
-02 South Branch Patapsco River drainage
-03 North Branch Patapsco River drainage
-04 Patapsco River drainage (confluence North and South Branch to Hanover Street Bridge)
-05 Inner Baltimore Harbor (Patapsco River from Hanover Street to straight line between Hawkins Point and Sollers Point)
-06 North drainage to Inner Baltimore Harbor
-07 Outer Baltimore Harbor drainage (straight line between Rock Point and North Point from Sollers Point)
-08 South drainage to Inner Baltimore Harbor
-09 Bodkin area drainage
-10 Shallow Creek drainage

02-13-10 West Chesapeake Bay Area - 13

-01 Magothy River drainage
-02 Severn River drainage
-03 South River drainage
-04 West River drainage
-05 Other drainage of West Chesapeake Bay area
-06 Beverly Beach area drainage
-07 Bay Ridge area drainage
-08 Broadneck area drainage
-09 Pinehurst - Gibson area drainage

02-13-11 Patuxent River Area - 14

-01 Patuxent River, mainstem
-02 Western Run (Branch) drainage
-03 Little Patuxent River drainage
-04 Middle Patuxent River drainage
-05 Other drainage of Patuxent River area (directly into Chesapeake Bay)
-06 Patuxent River east area drainage
-07 Patuxent River southwest area drainage
-08 Patuxent River west area drainage
-09 Patuxent River headwaters area drainage

02-14-01 Lower Potomac River Area - 16

-02 Lower Potomac River, mainstem (from mouth of Marshall Hall)
-03 Saint Mary's River drainage
-04 Saint George Creek drainage
-05 Breton Bay drainage
-06 Saint Clement Bay drainage
-07 Wicomico River drainage
-08 Gilbert Swamp drainage
-09 Zekiah Swamp drainage
-10 Port Tobacco River drainage
-11 Nanjemoy Creek drainage
-12 Nattawoman Creek drainage
-13 Potomac River mouth area drainage
-14 Huggins Point Strait Point area drainage
-15 White Neck Point to Colton Point area drainage
-16 Morgantown area drainage
-17 Cedar Point area drainage
-18 Chicamuxen Creek to Riverside area drainage
-19 Potomac Heights area drainage
-20 Lower Potomac River area Virginia drainage

02-14-02 Washington Metropolitan Area - 17

-01 Potomac River, mainstem (from Marshall Hall to FR/MO County Line)
-02 Piscataway Creek drainage
-03 Anacostia River drainage
-04 Rock Creek drainage
-05 Bryan Point area drainage
-06 Seneca Creek drainage
-07 Washington, D.C. south area drainage
-08 Central Washington, D.C. area drainage
-09 Rockville-Bethesda area drainage
-10 Poolesville area drainage
-15 Washington-Metropolitan area Virginia drainage

02-14-03 Middle Potomac River Area

-01 Potomac River Frederick County area drainage
-02 Lower Monocacy River drainage (Mouth to Route 26)
-03 Upper Monocacy River drainage (Route 26 to Md./Pa. Line)
-04 Double Pipe Creek drainage
-05 Catoctin Creek drainage
-06 Middle Potomac area Virginia drainage

02-14-05 Upper Potomac River Area

-01 Potomac River Washington County area drainage (Shenandoah River to Little Tonoloway Creek)
-02 Antietam Creek drainage
-03 Marsh Run drainage
-04 Conococheague Creek drainage
-05 Little Conococheague Creek drainage
-06 Licking Creek drainage
-07 Tonoloway Creek drainage
-08 Potomac River Allegany County area drainage (Little Tonoloway Creek to confluence of North and South Branches)
-09 Little Tonoloway Creek drainage
-10 Sideling Hill Creek drainage
-11 Fifteen Mile Creek drainage
-12 Town Creek drainage
-13 Upper Potomac River area West Virginia drainage

02-14-10 North Branch Potomac River Area

-01 Lower North Branch Potomac River area drainage (below Westernport Bridge)
-02 Evitts Creek drainage
-03 Wills Creek drainage
-04 Georges Creek drainage
-05 Upper North Branch Potomac River area drainage (above Westernport Bridge)
-06 Savage River drainage
-07 North Branch Potomac River area West Virginia drainage

05-02-02 Youghiogheny River Area

-01 Youghiogheny River drainage
-02 Little Youghiogheny River drainage
-03 Deep Creek Lake drainage
-04 Casselman River drainage

GEOLOGIC (Landform)

1001 Gorges
1002 Distinctive mountain features
1003 Cliffs, Bluffs
1004 Natural rock outcrops of geologic significance
1005 Manmade rock outcrops of geologic significance (road cuts and quarries)
1006 Natural sand, beach, dune features
1007 Fossil evidence
1008 Scarp
1009 Other unusual geologic formations

SOILS

2101 Unusual soil groups; undisturbed by human activity

HYDROLOGIC

3091 Significant and unusual water-land interfaces (i.e. islands; scenic stretches of coast, rivers, streams, lakes or ponds)
3092 Whitewater stretches
3093 Waterfalls
3094 Natural Springs
3095 Marshes, bogs, swamps, flats (coastline)
3096 Marshes, bogs, swamps, flats (inland)
3097 Aquifer recharge areas
3098 Water areas supporting unusual or significant freshwater aquatic life
3099 Lakes, ponds of unusually low productivity
3100 Lakes, ponds of unusually high productivity
3101 Unusual natural river, lake, pond
3102 Stream and marginal wetland habitat
3103 Floodplain
3104 Lake or pond
3105 Other unusual hydrologic feature

BIOLOGICAL - FLORA

4001 Rare, remnant or unique species of plants
4002 Unique plant community
4003 Plant communities unique to a geographic area
4004 Individual plant specimen(s) of unusual significance (i.e. large trees)
4005 Plant communities of unusual age or maturity
4006 Plant communities of unusual diversity and productivity
4007 Areas exhibiting outstanding seasonal color

Category Code Sheet - cont.

4008 Forest
4009 Managed Forest
4010 Field or shrub vegetation

BIOLOGICAL - FAUNA (terrestrial animals)

5091 Habitat area of rare, endangered and unique species
5092 Habitat area of unusual significance to a fauna community (i.e. feeding, breeding, wintering, resting)
5093 Fauna communities unusual to a geographic area
5094 Habitat areas supporting fauna communities of unusual diversity and productivity
5095 Habitat areas exhibiting other interesting features

BIOLOGICAL FAUNA (birds)

6001 Habitat areas of rare, endangered and unique species
6002 Habitat area of unusual significance to a fauna community (i.e. feeding, breeding, wintering, resting)
6003 Fauna community unusual to a geographic area
6004 Habitat areas supporting fauna communities of unusual diversity and productivity

BIOLOGICAL FAUNA (aquatic life)

7091 Habitat areas of rare, endangered and unique species
7092 Habitat areas of unusual significance to a fauna community
7093 Fauna communities unusual to a geographic area
7094 Habitat areas supporting fauna communities of unusual diversity and productivity

CULTURAL - AESTHETIC - VISUAL

8001 Manmade features having unusual aesthetic features or aesthetic significance due to natural setting (i.e. old mill along creek)
8002 Scenic gravel or unimproved roads
8003 Vista points
8004 Trail systems
8005 Unusual juxtaposition of manmade and natural features
8006 Unusually scenic area

GLOSSARY

Aquatic Buffer Zone - a band of vegetation contiguous with wetlands and watercourses which protects an aquatic system from excess runoff, erosion and contamination from non-point sources of pollution such as fertilizers and pesticides. The width of vegetated land necessary to adequately buffer the aquatic system varies, depending on the soil's ability to store water and the type and extent of the vegetation in the buffer.

Aquatic System - a wetland, watercourse, or water body and contiguous areas with D or D+ soils.

Bacterial Danger Zone - soil between the highest water table level and one foot below the lowest water table level; where conditions are ideal for bacterial growth.

Basal Area - the area, usually measured in square feet, of the cross-section at breast height of a single tree or of all trees in a stand.

Baseflow - stream flow derived from deep percolation of infiltrated water that enters the permanently saturated ground water system and discharges into the stream channel.

Buffer - a limited use area between a developed area and a protected area.

Categories - a division within a parameter used for the purpose of scaling.

Class - a group of areas considered as a unit (e.g., wetlands, forest).

Community - any assemblage of populations living in a prescribed area or physical habitat.

Contamination - befoulment through contact with a pollutant (e.g., pesticide, herbicide, toxic chemical, oil residue, bacteria, sediment).

Contiguous Land Use - the type of use being made of land adjacent to and bordering a natural area.

Critical Area - areas where man's activities can have a relatively severe impact on natural systems. Critical areas may also be habitats which are infrequently found in a state or in the nation as a whole.

DBH - tree diameter at breast height (4.5 feet above the ground).

Detritus - particles of plant matter in varying stages of decomposition.

Disturbance - a disruption, or perturbation, of an ecosystem resulting from human activity.

Diversity - the number of different vegetation types, animal species or physical features (e.g., streams, scarps, bogs) which the natural area contains.

Drainageway - a pathway for watershed drainage, characterized by wet soil vegetation; often intermittent in flow.

Edaphic Climax - where topography, soil, water, fire and other disturbances are such that the climatic climax cannot develop.

Endemic - a species of limited geographic extent.

Erodibility Coefficient - (K factor) - the erosion rate per unit of erosion index for a specific soil in continuously cultivated fallow ground on a 9% slope, 72.6 feet long. This factor is used by the Soil Conservation Service to calculate the erosion from a particular soil.

Exotic species - any plant or animal species not naturally a member of the plant community in which it is found.

Fauna - a collective term for the animal species present in an ecosystem.

Floodplain - a flat, low-lying area bordering a river or stream which is flooded only at times of high water.

Flora - a collective term for the plant species present in an ecosystem.

Floristics - plant species composition of an area.

Ground flow - the movement of water within the ground.

Ground water - that part of the subsurface water which is in the zone of saturation.

Habitat - the area of residence for an animal species or a community of species.

Home range - the area to which individuals, pairs, or family groups of vertebrates and the higher invertebrates restrict their activity.

Infiltration - the flow or movement of water through the soil surface into the ground.

Mottling - colored spots in soil horizons which indicate the existence of fluctuations in the ground water level.

Natural area - areas where at present natural processes predominate and are not significantly influenced by either deliberate manipulation or accidental interference by man.

Natural integrity - the degree to which a natural area is characterized by the natural regeneration of vegetation, mature or stable vegetation and the absence of man-induced disturbances.

Natural soils group - a new classification system of the State of Maryland's Department of State Planning which groups soils into similar major properties and features. The soil typologies of each county are regrouped around six categories of interest: agriculture, productivity, erosion susceptability, permeability, depth of bedrock, depth of water table and stability. In general, the natural soil groups are arranged in order of increasing limitation for most uses.

Occurrence - the relative frequency of the vegetation type(s) or natural features in a natural area within the context of its frequency of occurrence on the Delmarva Peninsula.

Overland flow - water flowing over the ground surface.

Parameter - a topic whose information is amenable to collection and analysis.

Partial area - dynamic, saturated, often shallow, stony or compacted areas near streams which contribute large volumes of runoff during a storm.

Perked water table - water table above an impermeable bed underlain by unsaturated rocks of sufficient permeability to allow movement of ground water.

Percolation - movement under hydrostatic pressure of water through the interstices of the ground.

Primary productivity - the amount of organic matter produced by photosynthesis.

Quadrat - a sampling area, usually square, of relatively small but consistent size.

Return flow - subsurface flow which intersects the ground surface and emerges as a spring or seep.

Runoff - the discharge of water through surface streams, expressed usually in units of volume such as gallons, cubic feet or acre-feet.

Runoff potential - the potential of the soil to shed rainwater. The runoff potential rating is based on soil catenas. Soils are grouped into seven runoff potential rating categories according to internal drainage, depth and texture of the soil as well as subsurface soil conditions. The rating system enables hydrologists or land management personnel to classify the soils hydrologically. D and D+ soils have the highest runoff potential while A soils have the lowest. This system not only expands S.C.S. hydrologic soil groups but also includes relevant soils information to reclassify certain soils based on recent research.

Saturated overland flow - surface water flowing over saturated soils near streams and drainage ways.

Security - the probable period of time during which no significant man-induced, direct or indirect alteration of a natural area is foreseen.

Sedimentation - the process of gravitational deposition of soil and other particles transported by water.

Soil series - a group of soils developed by the same combination of genetic processes. Its horizons have similar differentiating characteristics and arrangement in the soil profile and soils have developed from the same kind of parent material. Except for the "A" horizon texture (which is used to classify soil series into types) all soils having similar physical, chemical and morphological characteristics such as structure, texture, pH, base saturation, organic matter content, topographic position, drainage, depth, color, parent material and horizon thickness, type and arrangement belong to the same series.

Soil series are named for the geographic location where they were first described. Hence names such as Pocomoke, Sassafras, etc.

Soil type - a subdivision of the soil series based on the texture of the "A" horizon. Soil individuals belonging to the same type have similar characteristics as required by the soil series as well as the same surface texture. Soil types derive their name by adding the surface texture to the series name.

Subsection - a division of a natural area which reflects a discrete vegetation type, site-type or natural feature.

Substrate - layer beneath the soil surface.

Subsurface flow - water flowing through substrate, often along impeding layers (fragipan) in the soil.

Succession - a systematic series of species replacement in a biological system.

Transpiration - giving off of moisture and gases through the surface of leaves and other parts of a plant.

Trophic level - a step in the food chain.

Type - a subdivision of a class, a group having distinguishing characteristics, (e.g., pond, marsh, swamp; oak-beech, mixed oak, oak-pine).

Uplands - sites where the soil is dry or moist most of the year including ridges, upperslopes, midslopes, lowerslopes and well drained stream terraces.

Vegetation - the mosaic of plant communities in the landscape.

Vegetation structure - the density and distribution of leaf surfaces vertically and horizontally. Canopy, understory, shrub and herb layers are common descriptions of vegetation structure.

Vegetation types - an assemblage of plants consisting of particular species composition. The vegetation type is named for the dominant or co-dominant species. Vegetation types such as "Oak-Hickory" or "Bald cypress", may include as many as 20 different species of trees, as well as numerous shrubs and herbs. In some cases the transition between adjacent types are gradual; therefore the description given the vegetation type is more typical of the center of the type than its edge.

Water table - the highest level at which the soil or underlying rock material is wholly saturated with water. In certain places a perked water table may be separated from a lower water table by a dry zone.

Well drained soil - soils nearly free of mottling and commonly of an intermediate texture.

Wetland - any area where the water table stands at or above the land surface for at least part of the year. Wetlands are described according to the degree of wetness and the type of vegetation which the site supports.

AQUATIC BUFFER ZONE

Aquatic Buffer Zone

Owing to its importance to the Coastal Zone Management Program, various aspects of the aquatic buffer zone are extensively detailed below.

In recent decades, the degradation and loss of aquatic systems has underscored the need for sound ecological management of streams, ponds and wetland. Increased public awareness of the relationship of land use, water quality and aquatic life led to the enactment of the Coastal Zone Management Act of 1972 as well as to passage of the 1972 amendments to the Federal Water Quality Act. Such legislation provides the potential for environmental protection through responsible State action.

As mandated in Section 205 of the Coastal Zone Management Act of 1972, states are required to delineate areas of particular concern and indicate permissible land uses. Sites with rare or otherwise important species and physical features are candidates for designation as areas of concern.

Within all sites containing water courses or water bodies, a critical zone of land exists between the water and the neighboring upland. This zone is of particular concern because it is both fragile and, under natural conditions, acts as a buffer to the aquatic system. Throughout the coastal zone, buffers play a variety of roles. They are of primary importance in protecting aquatic systems against impacts accompany agriculture and development, which include sediment, toxic chemicals such as herbicides and pesticides, fertilizers, nutrients, oils and bacteria. In addition, this zone detains runoff and controls erosion on streamside slopes. These vegetated buffers provide a visually diversified landscape and contribute to environmental quality by providing wildlife shelter, nesting sites and food.

The present land use pattern of the Eastern Shore contains many lush stream side forests of sufficient width to serve important protective functions with respects to aquatic biota. The natural vegetation in these buffer zones maintains the health of the aquatic system by (1) maintaining a balanced nutrient regime, (2) moderating water temperatures by shade, (3) providing aquatic organisms with food sources, (4) reducing the scouring of stream bottoms and (5) preventing sedimentation through control of runoff and erosion. Thus, when retained in a natural condition, buffer zones serve as maintenance-free "public works projects". Once destroyed, these amenities and their services are lost and are difficult, if not impossible, to replace at reasonable cost. Functionally equivalent benefits can only be attained by public expenditures for water filtration, dredging, recurrent stocking of streams with fish, flood control programs and the creation of artificial wildlife habitats. Natural amenities are irreplaceable.

The following discussion outlines the key features considered in the identification of aquatic buffers and in ascertaining adequate buffer widths under varying conditions. First is described the key physical processes which occur along water bodies and watercourses, these are then related to appropriate buffer widths. A discussion of possible compatible uses is included. This discussion is detailed to provide decision makers with a thorough understanding of the processes and considerations involved in determining adequate widths for aquatic buffer zones.

Runoff

When rain strikes the ground it can dislodge soil particles and transport this sediment, as well as any oil residues, pesticides, fertilizers, to watercourses. In general, it is the properties of the soil which determine whether the rain will infiltrate into the ground or move overland as runoff to the aquatic system. If the rate of rainfall is greater than the capacity of the soil to absorb it, or if the soil is already saturated, the unabsorbed excess becomes overland flow, and the water and its contents can reach the aquatic system.

If the precipitation is absorbed by the soil it may move toward the surface water system by a variety of pathways. If the soil is deep and of fairly uniform permeability, the subsurface water moves downward to the zone of saturation and then flows within the soil to the nearest watercourses. (Dunne, 1974).

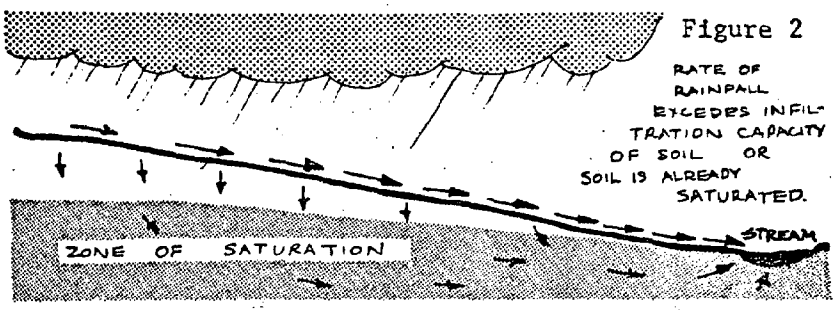


Figure 2

OVERLAND & GROUND FLOW IN HOMOGENOUS SOIL

RUNOFF TRANSPORTS SEDIMENT NUTRIENTS, AND TOXIC CHEMICALS TO AQUATIC SYSTEMS.

Soils or rocks with varying properties may complicate this simple pattern (Davis and Dewiest, 1966). Generally, ground water flows slowly, and the underground paths of flow are long. Therefore, most underground flow contributes only to the stream's baseflow, the basic stream flow to which storm water is an addition.

If percolating water encounters an impeding horizon (claypan or fragipan) in the subsoil, at some shallow depth part of the water will be diverted horizontally over the impeding layer and will reach the watercourses sooner by a shorter path. This diversion through the soil, often along the impeding surface, is called sub-surface flow, and is one form of the general ground flow. (Dunne, 1974).

Where water follows this shorter path or where steeper slope gradients occur, water may reach the stream channel more quickly than by typical groundwater flow and may contribute to the storm peak-flow of the stream (Weyman, 1970, Ragan, 1968). On some slopes, sub-surface flow may intersect the ground

surface and emerge as a spring or seep. The water then traverses the surface of a saturated area as return flow (Dunne, 1974).

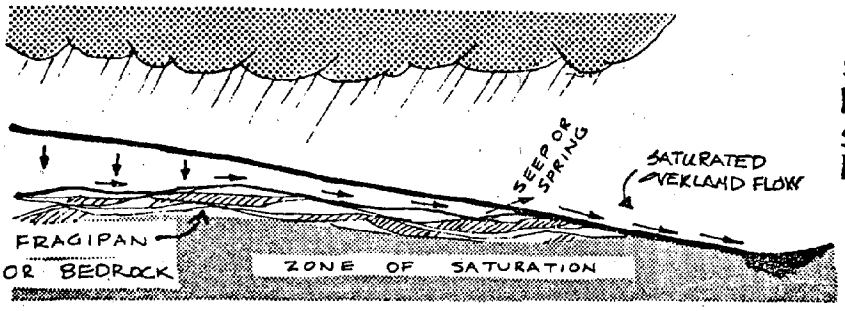


Figure 3
SUB-SURFACE, RETURN, AND SATURATED OVERLAND FLOWS

Rain falling directly onto saturated soils near streams cannot infiltrate into the wet soil, but runs over the surface to the stream channel. This is termed saturated overland flow. It is impossible to separate saturated overland flow from return flow and the two together are usually considered saturated overland flow (Dunne, 1974).

Partial Areas

The occurrence of each water flow process is a function of geology, physiography, soil properties, vegetation and land use in a particular region. Recent studies of undeveloped watersheds in the eastern United States and in England have shown that a saturated area adjacent to streams contributes the greatest runoff volume during storms. A number of investigations (Table 3) support the idea that most overland flow occurs from areas that make up no more than 10%, and usually only 1-3% of a drainage basin (Dunne and Black, 1971). Betson (1964) first discussed these areas when he realized that only partial areas of entire basins in the Tennessee Valley could be contributing runoff to storm flow. Hence, he coined the term "partial area" for these saturated, often shallow, stony, or compacted areas. This modifies the classic theory of Horton (1933) which implies that most rainfall events exceed the infiltration capacity of the soil and that overland flow is commonly widespread in area.

Partial areas are dynamic, expanding and contracting seasonally and with variations in storm duration and intensity. When expanded during storms, the outer edge of these areas can be considered the outer edge of the functional aquatic system. Under dry conditions the areas contract. In general, partial areas parallel the water's edge, but their shape and size is dependent on local geology, soils, relief, vegetation and land use. At a minimum, partial areas are critical to the protection of aquatic systems. They are the natural zone of overland flow and are highly erodible.

Table 3. **PROPONENTS OF PARTIAL AREA THEORY**

S.E. Forest Exp. Station, 1962	S.E.F.E.S.	Postulate	West Virginia
Betson, 1964	Tennessee Valley Authority	Postulate	Tennessee
Ragan, 1968	U.S. Forest Service	Field Study	Vermont
Dunne and Black, 1971	McGill & Cornell Universities	Field Study	Vermont
Chiang, 1971	D.E.P. Penn.	Computer Model (Pers. comm.)	Pennsylvania
Hills, 1971	Bristol Univ.	Field Study	England
Freeze, 1972a,b	IBM, Thomas Watson Research Center	Computer Model (sub-surface runoff)	New York
Grubruck and Heald, 1974	U.S.D.A. Watershed Research Center	Field Study (Phosphate transport)	Pennsylvania

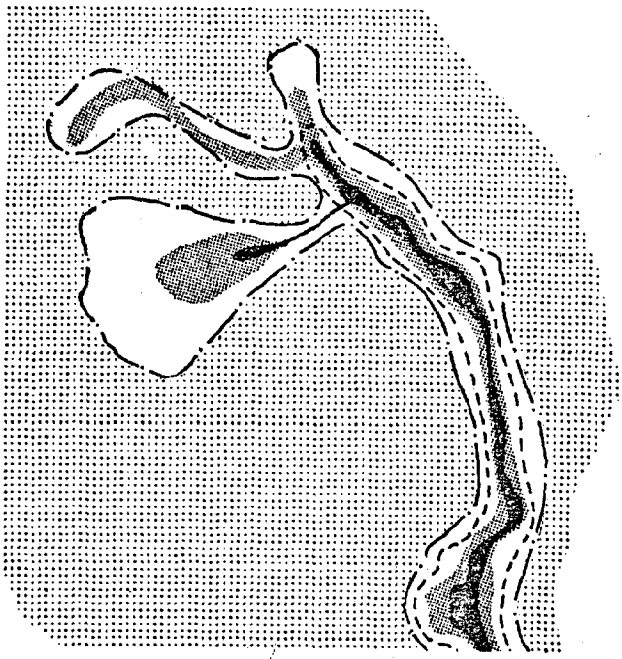


Figure 4

AREAS PRODUCING OVERLAND FLOW:
IN SUMMER STORMS
IN EXTREME AUTUMN STORMS
AREAS WITHIN DASHED LINES PRODUCED SUB-SURFACE FLOW:
IN SUMMER STORMS
IN EXTREME AUTUMN STORMS
0 80
SCALE IN FEET

(ADAPTED FROM THOMAS DUNNE, UNPUBLISHED PhD. THESIS, THE JOHNS HOPKINS UNIVERSITY, 1966: AREAS CONTRIBUTING RUNOFF UNDER VARIOUS STORM CONDITIONS HAPPY VALLEY BASIN NEAR DANVILLE, VT., IN: LEOPOLD, 1974, WATER, A PRIMER.)

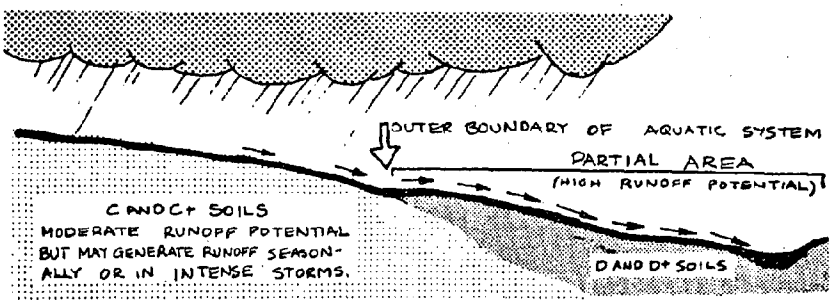
Soils are a good indicator of where partial areas are located. Chiang, (1971) has recognized that certain physical soil properties help identify the relative runoff potentials of different soils. Chiang's method of classification is an expansion of the Soil Conservation Service's Hydrologic Soils Groups, as well as a reclassification of certain soil series (Table 4).

Table 4. RUNOFF POTENTIAL RATING TABLE (Chiang, 1971)

	I	II	III	IV	V	VI	VII
	Well Drained			Moderately well drained	Somewhat poorly drained	Poorly drained	Very poorly drained
	shallow (18")	moderately deep (18"-36")	deep (36")				
1. Medium texture or mixture of coarse to fine texture	C or (+D)***	+C	B or (+B)**	+C	C	+D	D
2. Coarse texture	+C or (+D)***	B	+B or (A)** (B)*	B	+C	+D	D
3. Fine texture	C or (D)***	C	+C or (B)**	C	C	D	D
4. Medium textured soil on vertically fractured rock	+C	B	+B	+C	C	+D	D
5. Coarse textured soil on vertically fractured rock	B	+B	A	B	+C	+D	D

Revised rating for well-drained soils:
* if fragipans or clay pans exist in deep soils
** if the soil is deeper than 10 ft. and excessively well drained
*** if the soil is less than 9" deep

This system recognizes that shallow soils over impermeable bedrock, as well as deep soils with shallow fragipans or clay lenses, may quickly become saturated, generating runoff. This is supported by other recent studies (Hewlett and Hibbert, 1967; Hewlett and Nutter, 1970; Whipkey, 1965). Soils classified by Chiang as D and D^+ have high runoff potentials and are roughly equivalent to partial areas (Chiang, 1974, pers. comm.). Where these soils exist in juxtaposition to aquatic systems, they should be considered the outer boundaries of the aquatic system. In addition, C and C^+ soils may become saturated seasonally or during storms, and generate runoff. Although these soils generate runoff less frequently, they may be included as part of the buffer zone.



OVERLAND FLOW ON D AND D+ SOILS

Figure 5

Several processes combine to reduce the infiltration capacity of the soil during a storm. When soils are cleared of vegetation, the filling of fine pores with water reduces capillary forces drawing water into the soil and the storage potential of the soil is more quickly reached. If clay is present in the soil, the clay particles swell as they become wet, reducing soil pore size. The impact of the raindrops, the major cause of erosion, (Young and Weirsma, 1973) breaks up soil aggregates, splashing fine particles over the surface and washing them into pores where they impede infiltration. At the beginning of a storm, percolation generally exceeds rainfall intensity and there is little accumulation of water on the soil surface. As either the intensity increases or the infiltration rate is decreased by saturation, rainfall exceeds infiltration capacity. At first, this excess rainfall fills surface depressions. When the depressions become filled the excess becomes overland flow traversing the land in a system of rills (Emmett, 1970).

Slope

Another consideration in the protection of aquatic systems from excess runoff and siltation is the slope of the adjacent land. On slopes greater than 10 percent the slope of surface depressions is too steep to permit a significant retention of water and silt (Leopold, 1968). In fact, depending on the pattern of land management or the type of soil, surface depressions may be absent. Where denuded slopes of greater than 10 percent occur next to aquatic systems, particularly with soils having high erosion potentials, they pose a significant hazard to the aquatic system. In developing watersheds, where the soils are denuded of vegetation, the sediment yields in streams can be increased to 100 times their natural rates (Wolman, 1964).

Slopes greater than 10 percent must be carefully managed, particularly along streams, and should be kept covered with vegetation. They should be considered as part of the buffer zone depending on their proximity to the aquatic system.

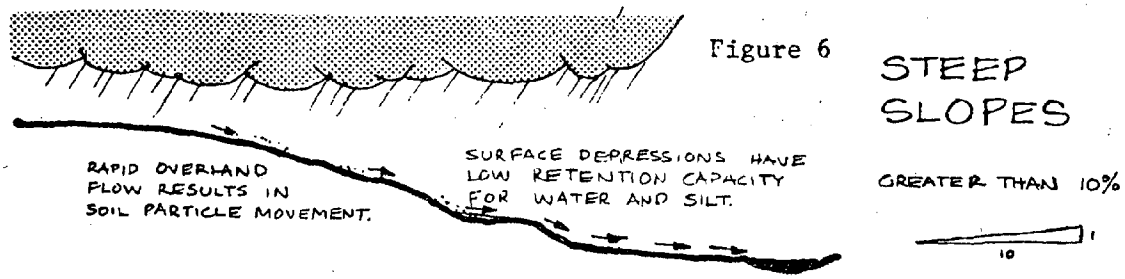


Figure 6

Urbanization

In an urbanizing watershed, the path of surface water flow is largely determined by sewers, roads, rooftops and other impervious surfaces and by land uses. The two factors governing the stream flow regime are the percentage of the watershed area made impervious and the rate at which the water is transmitted to stream channels. The former is governed by the type of land use, the latter by the density, size and characteristics of tributary channels and storm sewers (Leopold, 1968). Impervious surfaces in uplands which are connected to aquatic systems by sewers are, in effect, man-made partial areas. Alternative methods for infiltrating water on site, such as pervious pavement and rooftop or other types of detention ponds, should be given serious consideration over shunting water directly to aquatic systems via sewers.

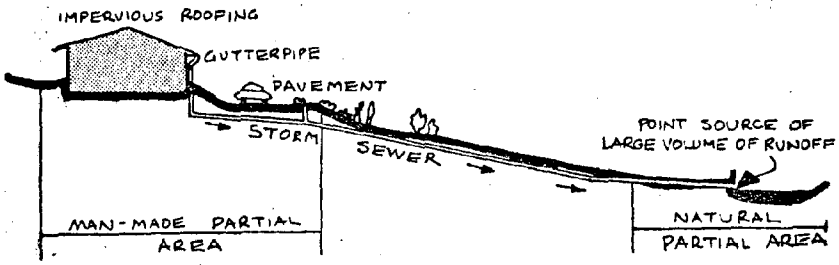


Figure 7

Surfaces such as lawns, pastures and trails are usually compacted and may act as impervious surface. In intense storms surfaces such as lawns become matted and runoff occurs in sheets and rills. When next to aquatic systems, they do not provide the impediment to runoff necessary for the system's protection. Vegetation undergoing natural succession is much more effective in detaining and retaining runoff.

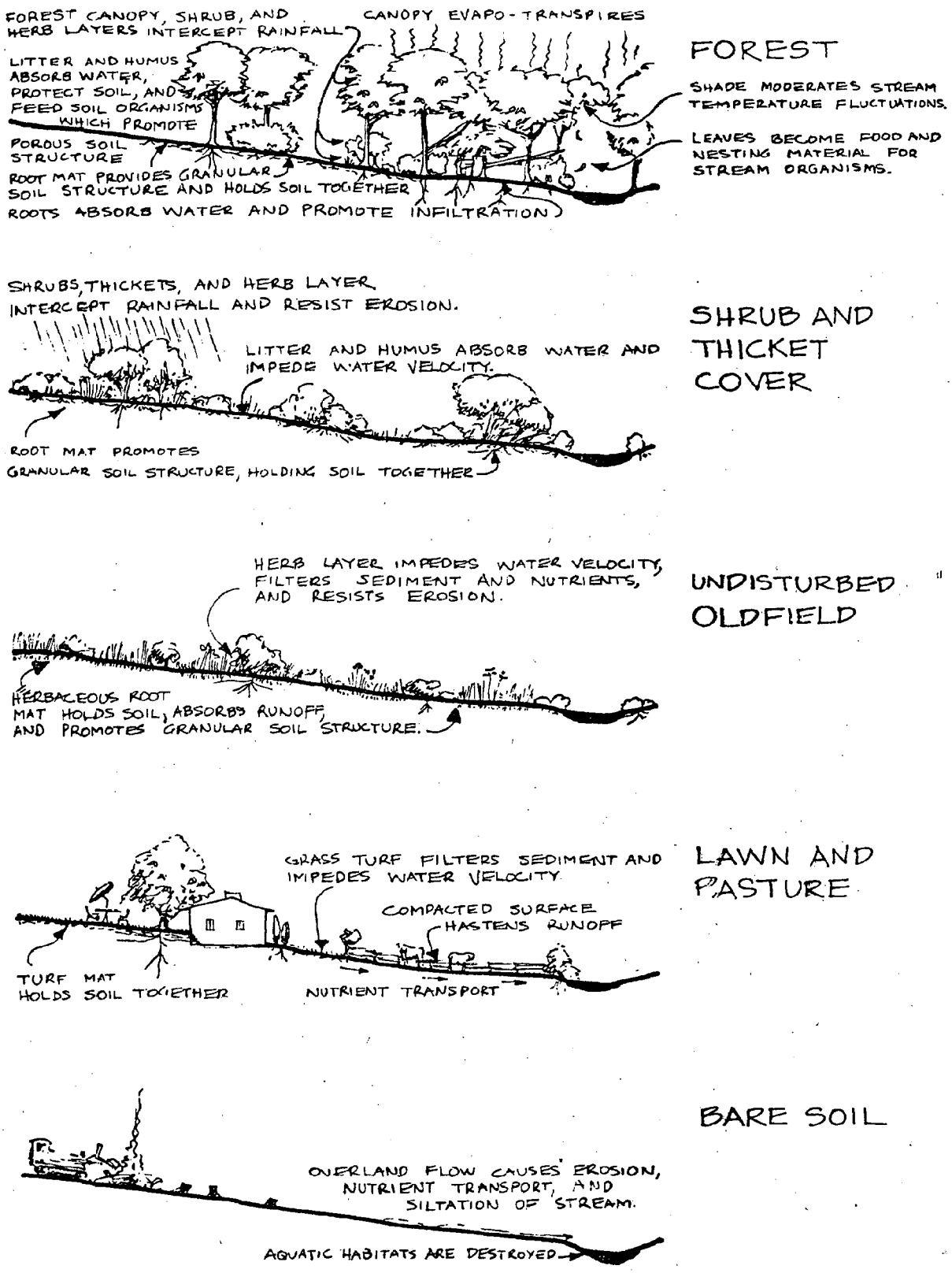
Vegetation

Vegetation protects the soil from raindrop impact, traps sediment, and impedes overland flow. At the same time, root systems, particularly in partial areas, absorb significant volumes of soil water during the growing season, thereby potentially increasing the infiltration capacity of streamside soils.

The foliage and roots of streamside trees such as blackgum, willow, red maple and beech are substantially more efficient than other plants at removing water from the soil (Fowells, 1965; Lee, 1942). Trees also provide litter and humus which absorb and store water. Roots which penetrate deep into the ground aerate the soil, maintaining its porosity and granular structure (Buckman and Brady, 1974). Shade from a floodplain or streamside forest moderates temperatures in the stream, thus buffering aquatic organisms

AQUATIC BUFFERS

Figure 8



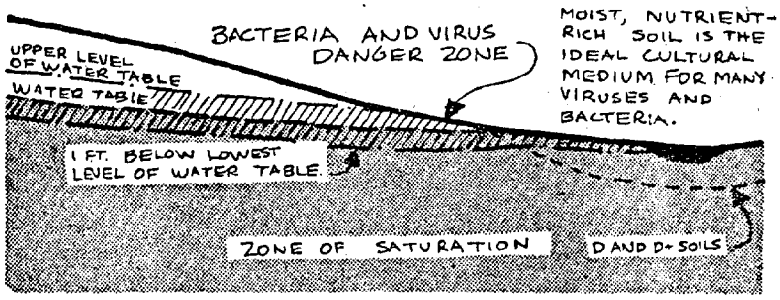
from temperature extremes. Leaf material also serves as a significant source of food and nutrient for aquatic flora and fauna (Vannote, 1975). If vegetation is removed and more sunlight allowed to penetrate the water surface, diurnal temperature fluctuations may exceed the tolerance of aquatic fauna during one or all of the life phases (Auberton and Patrick, 1965), meanwhile, the food necessary for certain organisms may be eliminated by tree removal (Vannote, 1975).

Biological Contamination

The soil is a rich medium for culturing both pathenogenic and non-pathenogenic bacteria. The nutrient rich, moist soils of partial areas are especially important in this respect.

Bacteria and viruses move through the soil with ground water flow. The movement of the pollution in the soil is connected with and dependent upon the rise and fall of the ground water table and the alternation of wet and dry weather conditions (Stiles and Crohurst, 1923).

The soil between the highest water table level and one foot below the lowest water table level is called the bacterial danger zone (Stiles and Crohurst, 1923). Here the conditions are ideal for bacterial growth. Partial areas often have a seasonal high water table at or near the surface, therefore, the bacterial danger zone is at or near the surface in these areas.



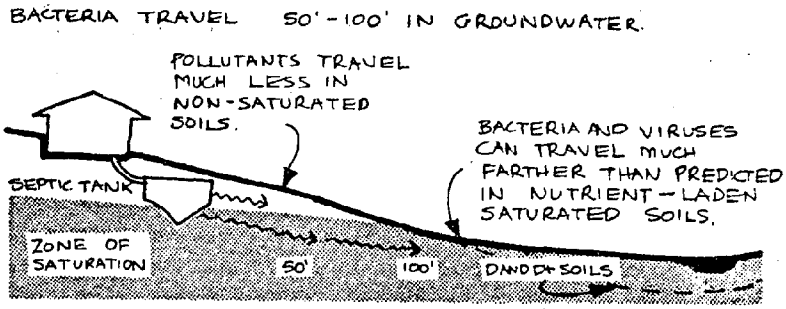
SOIL AS MICROBIAL SUBSTRATE

Figure 9

The properties of the soil in contact with bacterial or virulent sources play a dominant role in the subsequent life and movement of the contaminant (Caldwell, 1937, 1938). Soils which are very fine to fine grained sands with a high clay content are best suited to remove biological contamination (Romero, 1972). Bacteria in wet, nutrient rich soils have beem known to survive up to five years, however, 60-100 days is probably a more common life span in temperate climates (Romero, 1972).

Many scientific studies report various sicknesses and epidemics caused by viruses traveling more than 50 feet in soil. Most controlled experiments indicate that viruses have a tendency to deteriorate within 10 feet of their source (Romero, 1972). Significant concentrations of anaerobic bacteria probably travel 50 feet according to Caldwell (1938, 1937); and Romero (1972) concludes that under ideal conditions the maximum travel distance of biological contaminants within ground water ranges from 50 to 100 feet. However, contaminant movement in non-saturated soils is considerably less than in saturated soils, with maximum lengths of travel appearing to be in the vicinity of 10 feet. Bacteria or viruses might travel considerably farther

than predicted if contaminated water is intercepted by a stream during the course of travel (Romero, 1972). If impregnated with bacteria and viruses by septic tanks or leaky sewers, partial areas, which shed surface waters to streams, may become contaminated, creating a health hazard.

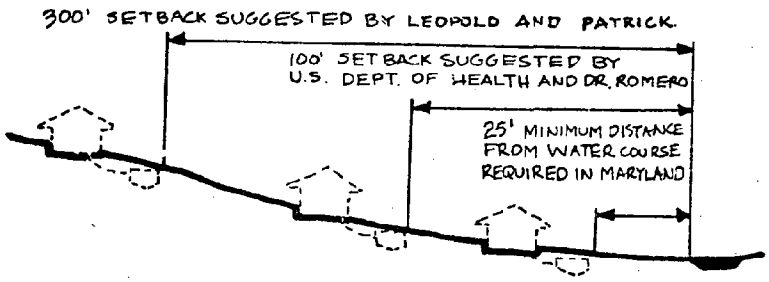


VIRUS AND BACTERIA TRAVEL

Figure 10

Setbacks

The United States Public Health standards suggest a minimum setback of 100 feet between wells or watercourses and septic tanks (Romero, 1972). The Maryland Health Department requires a minimum setback of 25 feet from wells and watercourses. Romero (1972) recommends a 100 foot setback from all wells and water bodies unless it can be shown that a shorter distance will not increase the probability of contamination. Aquatic biologists and hydrologists realize that circumstances dictate different setbacks, and that a setback of 300 feet should be recognized as a standard if all bacteria and nutrients are to be filtered out by the soils, (Leopold, 1968; Patrick, pers. comm.)



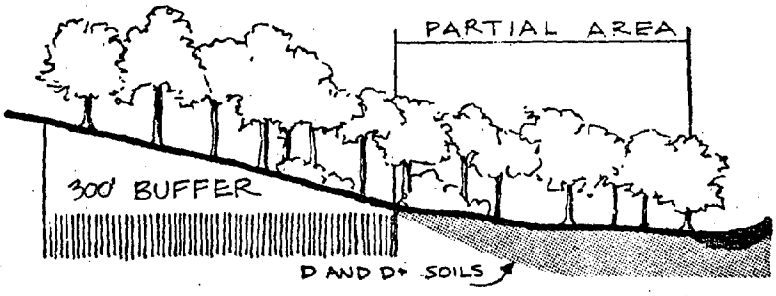
VARIOUS RECOMMENDED SETBACKS

Figure 11

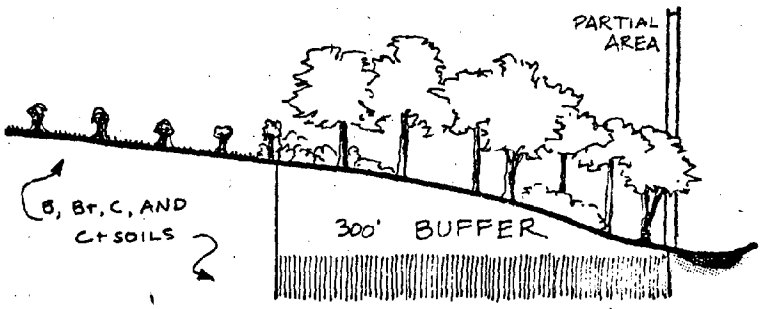
Using partial areas increases the accuracy of determining the length of setbacks from water bodies and aquatic systems. The setback should be delineated from the landward edge of the partial areas (D and D+ soils). Thus, while the setback is standard, the distance from the water body is variable depending on the width of the partial area. As noted above setbacks less than 50 feet will probably not filter out the biological and nutrient contaminants. Setbacks over 300 feet increase the adequacy.

The following illustrations show the considerations of soil character and vegetation used to evaluate the adequacy of aquatic buffer zones during the field survey of sites for this study.

ADEQUATE

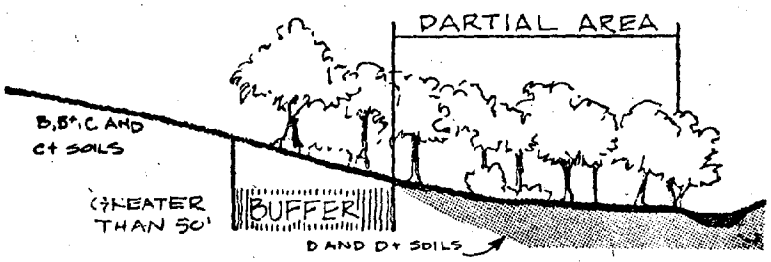


WIDE
STREAM-SIDE
PARTIAL AREA

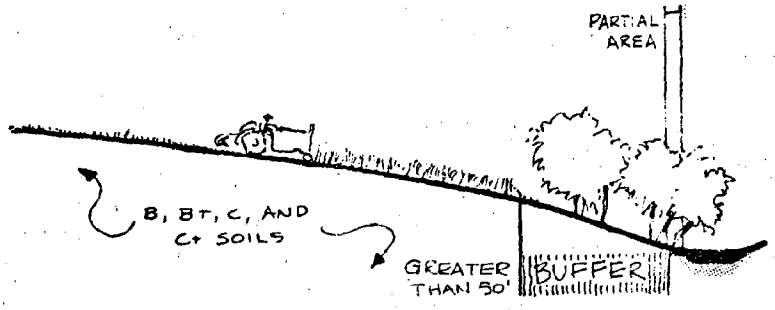


NARROW
STREAM-SIDE
PARTIAL AREA

QUESTIONABLE



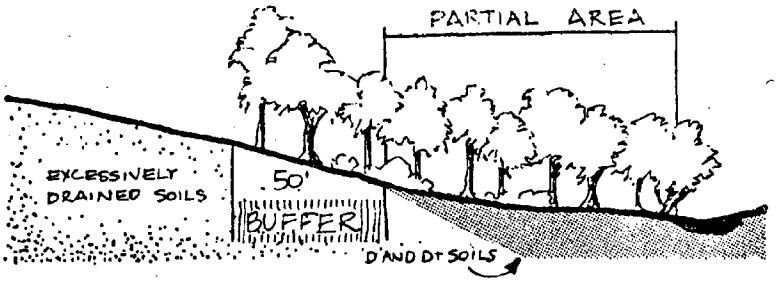
WIDE
STREAM-SIDE
PARTIAL AREA



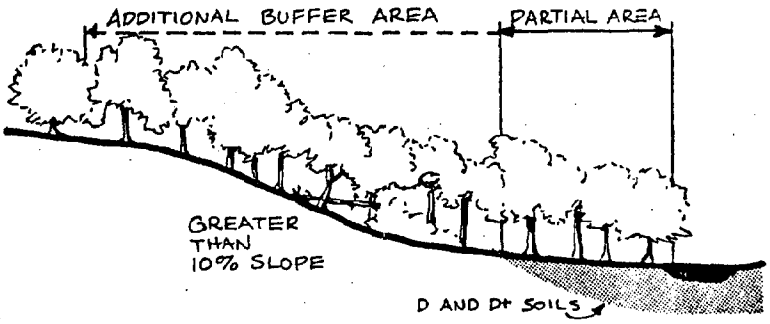
NARROW
STREAM-SIDE
PARTIAL AREA

Figure 12.

QUESTIONABLE (POSSIBLY INADEQUATE)



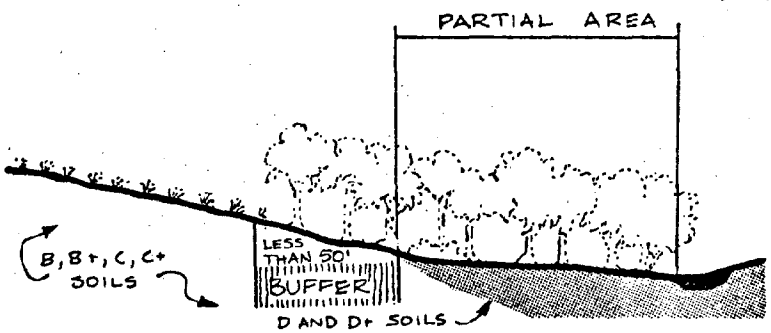
MINIMAL SET-BACK NEAR EXCESSIVELY DRAINED SOILS



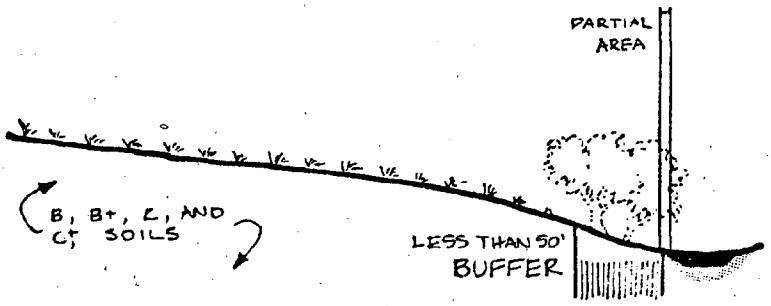
STEEP SLOPES

WHEN SLOPES GREATER THAN 10% OCCUR NEAR OR ADJACENT TO PARTIAL AREAS, THEY MIGHT BE INCLUDED IN THE BUFFER ZONE. EROSION AND HIGH RUNOFF MAKE THESE AREAS SOURCES OF POLLUTION.

INADEQUATE



WIDE STREAM-SIDE PARTIAL AREA



NARROW STREAM-SIDE PARTIAL AREA

Figure 13