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**A PRELIMINARY SURVEY OF NATURAL HERITAGE RESOURCE
SITES IN NORTHAMPTON AND ACCOMACK COUNTIES, VIRGINIA**

FINAL REPORT: TASK 3



**NEOTROPICAL MIGRATORY SONGBIRD REGIONAL
COASTAL CORRIDOR STUDY**

Prepared by:

Virginia Department of Conservation and Recreation
Division of Natural Heritage

June 1992

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**A PRELIMINARY SURVEY OF NATURAL HERITAGE RESOURCE SITES IN
NORTHAMPTON AND ACCOMACK COUNTIES, VIRGINIA**

FINAL REPORT: TASK 3

**A REGIONAL STUDY OF THE COASTAL ZONE HABITAT OF CRITICAL
IMPORTANCE AS CONCENTRATION AREAS FOR NEOTROPICAL AVIAN MIGRANTS**

Submitted to:

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INTRODUCTION

This report describes the findings of the 1991 natural heritage inventory of Northampton and Accomack Counties, Virginia. The inventory was conducted to accomplish Task 3 of a larger study entitled, A Regional Study of the Coastal Zone Habitat of Critical Importance as Concentration Areas for Neotropical Avian Migrants (NOAA GRANT # NA90AA-H-CZ839). Task 3 stipulated that the best remaining upland (non-saltmarsh) natural communities be identified and described, and that the sites containing them be mapped using Natural Heritage Program methodology.

Past natural heritage inventories in Northampton and Accomack Counties focused on the off-shore barrier beach islands which are now largely protected by The Nature Conservancy and government agencies. The off-shore islands were therefore excluded from the present inventory to allow a more thorough examination of the largely neglected mainland portion of the region.

Community inventory represents a "coarse filter" approach to biological conservation. This approach protects a vast number of cryptic or poorly known species, and at the same time brings needed attention to the aesthetic, scientific, and ecosystem function values of natural communities. A classification is necessary when conducting an inventory, and for this study we selected the classification developed by Rawinski (1992) which is currently used state-wide by the Virginia Division of Natural Heritage (Appendix 1).

This report should be viewed as preliminary. Only those sites actually visited during the 1991 field season and found to contain exemplary communities are described. Additional field work sustained over a several year period is certainly needed here.

Virginia's Division of Natural Heritage

The Virginia Natural Area Preserves Act of 1989 (§10.1-209 et seq. of the Code of Virginia) directs the Department of Conservation and Recreation to "preserve the natural diversity of biological resources of the Commonwealth." The Act further establishes the Virginia Natural Heritage Program (now called the Division of Natural Heritage) and requires the Department to develop a natural heritage plan, produce an inventory of the Commonwealth's natural heritage resources, maintain a natural heritage data bank of inventory data, and provide for the protection and stewardship of natural areas. The Division of Natural Heritage fulfills this mandate as the Commonwealth's principal collector and manager of data on natural heritage resources: "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest" (§10.1-209 of the Code of Virginia). The Division of Natural Heritage is part of a network of 84 natural heritage data centers established throughout much of the Western Hemisphere.

Natural Heritage Resources

Each natural heritage resource is assigned a rank indicating rarity and status (Table 1). The primary criterion for ranking natural heritage

resources is the number of extant occurrences, i.e. the number of known distinct localities or populations. Other important ranking criteria are the number of individuals at each locality, the total number of individuals state-wide, the condition of the occurrences, the number of protected occurrences, and threats to the occurrences. These "S-ranks" apply to Virginia; global ranks, or "G-ranks", reflect species status on a global, or range-wide scale.

Subspecies and varieties are assigned "T-ranks", in addition to their G-rank. Taken together, these ranks give an instant picture of the rarity of the natural heritage resource. Ranks for communities are lacking or provisional because the community classification is not yet developed for the individual plant communities. Rarity ranks used by the Division of Natural Heritage are not legal designations, and they are continuously updated to reflect new information.

The landscape unit that supports a particular natural heritage resource is called an element occurrence. The Division of Natural Heritage has mapped over 5500 element occurrences in the Commonwealth. Information on the location and quality of these element occurrences is computerized within the Division's Biological and Conservation Databases (BCD), and additional information is recorded on maps and in manual files. Each element occurrence is ranked to differentiate large, outstanding occurrences from small, vulnerable ones. Species occurrences are ranked in terms of quality, condition, viability, and defensibility. Community occurrences are ranked by their overall natural condition and size.

Element ranks and element occurrence ranks form the basis for ranking the significance of entire sites. Site biodiversity ranks (B-ranks) are used to prioritize protection efforts among the sites; each B-rank is defined below:

- B1 Outstanding Significance: only site known for an element, an excellent occurrence of a G1 species, or the world's best example of a community type.
- B2 Very High Significance: one of the best examples of a community type, good occurrence of a G1 species, or excellent occurrence of a G2 or G3 species.
- B3 High Significance: excellent example of any community type, good occurrence of a G3 species.
- B4 Moderate Significance: good example of a community type, excellent or good occurrence of state-rare species.
- B5 General Biodiversity Significance: good or marginal occurrence of a community type, or state-rare species.

Note: Sites supporting rare subspecies or varieties are considered slightly less significant than sites supporting similarly ranked species.

Table 1. Definition of Natural Heritage state rarity ranks (S-ranks). Global ranks (G-ranks) are similar, but are based on range-wide status. Ranks for most community types have not been generated due to on-going community classification efforts. The S and G ranks should not be interpreted as legal designations.

- S1 Extremely rare; usually 5 or fewer occurrences in the state; or may have few remaining individuals; often especially vulnerable to extirpation.
- S2 Very rare; usually between 5 and 20 occurrences; or with many individuals in fewer occurrences; often susceptible to becoming endangered.
- S3 Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- S4 Common; usually >100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- S5 Very common; demonstrably secure under present conditions.
- SA Accidental in the state.
- SH Historically known from the state, but not verified for an extended period, usually >15 years; this rank is used primarily when inventory has been attempted recently.
- SN Regularly occurring migrants or transients species which are non-breeding, seasonal residents. (Note that congregation and staging areas are monitored separately).
- SU Status uncertain, often because of low search effort or cryptic nature of the element.
- SX Apparently extirpated from the state.

NOTE: Sometimes ranks are combined (e.g. S1S2) to indicate intermediate or somewhat unclear status. Elements with uncertain taxonomic validity are denoted by the letter, Q, after the global rank.

STUDY AREA

The Eastern Shore of Virginia, encompassing Northampton and Accomack Counties, is located on the Mid-Atlantic coastal plain at the southern end of the Delmarva Peninsula. To the west lies Chesapeake Bay and to the east lies an interrupted chain of barrier islands and the Atlantic Ocean. Approximately 70 miles long, the Eastern Shore is about 12 miles wide at its widest point near the Maryland border.

Topography is generally flat to undulating, except in the area of Holocene dune ridges and along streams where the underlying marine sediments have been eroded to form small, steep-sided valleys. Both coasts are deeply embayed by tidal creeks with associated peninsulas and necks. "Delmarva bays", shallow elliptical depressions of uncertain geological origin, are rather frequent on the Eastern Shore, though most have been drained for agriculture.

Soils are primarily well-drained to poorly-drained sandy loams and loams. The Bojac-Munden-Molena Series occurs mainly on flatland on the necks along Chesapeake Bay. Sandy loams in this series are characterized by rapid drainage and a seasonally high water table. The Nimmo-Munden-Drageston Series occurs along the eastern region on flats and in depressions. The loams in this series are moderately- to poorly-drained, particularly in depressions, and have a seasonally high water table.

The climate on the Eastern Shore is characterized by mild winters and hot humid summers. The average winter temperature in Painter, Accomack County, is 39.1 F, while the average summer temperature is 75 F. Temperatures in Northampton County average about one degree warmer in winter and summer. The average total annual precipitation 42.7 inches in Accomack County and 40.8 inches in Northampton County. Humidity averages about 60% throughout the region.

Vegetation patterns on the Eastern Shore are complex, varying in response to soil conditions, exposure to salt spray, past disturbances, biogeographic phenomena, and subtle differences in climatic conditions existing from south to north along the peninsula. In both Accomack and Northampton Counties, the Loblolly Pine-Shortleaf Pine forest type encompasses more than 40% of the forest acreage (Thompson 1991). The most common hardwoods include Southern Red oak, White Oak, Water Oak, Sassafras, Sweet Gum, Black Gum, Red Maple, Beech, and various hickories. Forests in Northampton County usually contain Red Bay and Yaupon, but these predominantly southern species become infrequent farther north in Accomack County. Tulip Poplar is rather frequent in Accomack County, but is virtually absent in Northampton County.

(Note: Source for much of the above information is from "Soil Survey of Northampton County, Virginia", USDA Soil Conservation Service, 1989.)

METHODS

To gain an overview of land use patterns within the two county area Division of Natural Heritage staff first evaluated the extent of the remaining forest land using Forest Survey data generated by the U.S. Forest Service. The natural area inventory then proceeded through the following five stages:

- 1) Review of aerial photographs and maps. Aerial photographs of the entire survey area were reviewed in detail to identify potential natural areas (PNAs) to be studied in the following stages. Where possible, both the oldest available photographs and the most recent ones were studied. Comparing these two sets of photographs provided insights into land use trends and past conditions. Topographic maps, wetlands maps, and soils maps were examined during this stage.
- 2) Gathering existing information. Museum collections were visited by Natural Heritage staff and specimen label information recorded for rare species. Publications and field notes were assembled and carefully read. Maps of public lands (federal, state and local) within the survey area were gathered, and the distribution of natural heritage resources examined. Local naturalists, soil conservationists, foresters, and college faculty were consulted for additional information. During this stage, some PNAs were eliminated from further consideration while others were added.
- 3) Initial ground survey. Field work during this stage verified ownership information, documented conspicuous element occurrences, and detected recent land use activities. As necessary, follow-up thorough inventories were planned.
- 4) Thorough inventory of the PNA. During this stage, detailed information was collected on the rare species or exemplary natural communities present at the site. Portions of a site not visited on foot were evaluated on the basis of aerial photographs and other information. The amount of land needed to protect the special biological features was determined. Threats and disturbances factors were noted. Element occurrence data were transcribed onto Division maps and entered into the BCD databases.
- 5) Compilation of results and preparation of final report. Division biologists reviewed the information gathered and prioritized the sites on the basis of biological significance, threats, and defensibility. Maps were drawn showing conservation planning boundaries. Protection and management recommendations were written, and all information combined into a final report.

RESULTS

Virginia's Eastern Shore is an area rich in natural heritage resources and an area providing critical stop-over habitat for a large number of neotropical migrant bird species. Many of these species utilize natural vegetation. Thus, the amount of forested land relative to non-forested (primarily agricultural) land in the area was examined first.

As of 1991, forest land in Northampton County covered an estimated 30,967 acres, or 21% of all land in the county, while in Accomack County forest land covered 96,630 acres, or 32% of that county's land area (Thompson 1991). Relative to the 1985 forest land statistics (Brown and Craver 1985), these values represent an apparent net gain of 1,035 acres in Northampton County and a net loss of 8,085 acres in Accomack County. However, because the sampling procedure used by the Forest Survey was intended primarily to furnish data for the entire Coastal Plain of Virginia, individual county estimates have limited and variable accuracy (Thompson 1991). Nevertheless, these data suggest that forest land may have declined as much as 2.4% in Accomack County during the six-year period between 1985 and 1991. Such a decline was not evident in Northampton County where a slight increase (0.7%) may have occurred. Throughout the 34-county region encompassing Virginia's Coastal Plain, timberland declined 2% from 1985 to 1991 (Thompson 1991).

The amount of forested land in Northampton and Accomack Counties indicates, in a general sense, the relative health and integrity of the natural terrestrial ecosystems present. These forests provide sustainable yields of wood products while maintaining biological diversity and providing ecosystem functions beneficial to human society. Unfortunately, the percentage of timberland in these two counties is far below 58%, the region-wide average for the Virginia Coastal Plain (Thompson 1991).

Figure 1 shows the location of the 11 natural heritage sites identified through the inventory. Each is individually described in site reports using the following standard reporting format:

SITE NAME: Most site names reflect a geographical locality or the prevalent type of vegetation.

SIZE: The approximate acreage included within the conservation planning boundary for the natural area.

BIODIVERSITY RANK: The overall significance of the natural area in terms of the rarity of the natural heritage resources and the quality of their occurrences. As discussed earlier, these ranks range from B1 (outstanding significance) to B5 (general biodiversity significance).

LOCALITY: The county.

QUADRANGLE AND QUADRANGLE CODE: The name of the USGS 7.5' quadrangle(s) on which the natural area occurs. The quadrangle code contains information on latitude and longitude, and identifies the location of the quadrangle.

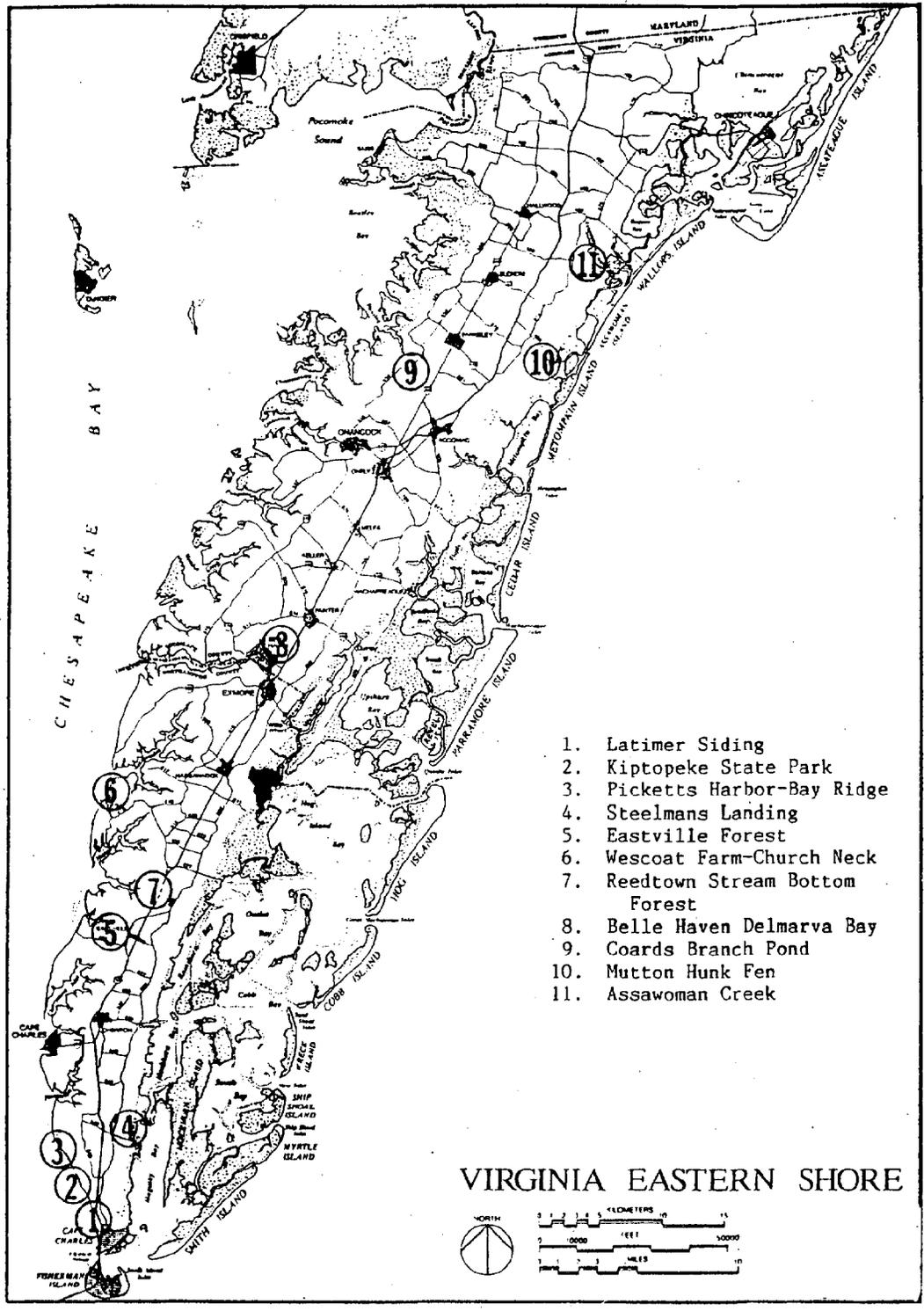


Figure 1. Map of Northampton and Accomack Counties showing the location of 11 natural heritage sites documented during the 1991 inventory.

LOCATION: Specific information on site location and directions to the site.

NATURAL HERITAGE RESOURCE SUMMARY TABLE: A synopsis of the rare species and significant natural communities that occur on the site.

SITE DESCRIPTION: A brief narrative describing the site, its significant elements, vegetation, habitat, and current land use.

BOUNDARY JUSTIFICATION: The preliminary conservation planning boundary delineated in this report includes all known occurrences of natural heritage resources and the adjacent lands required for their immediate protection. This information field explains the basis for particular boundaries.

THREATS: Potential and actual threats to the site and its elements.

MANAGEMENT RECOMMENDATIONS: A summary of the major issues and factors that should be considered in management of the site for its natural heritage values.

CURRENT STATUS: A summary of ownership and the degree of protection currently afforded the site.

PROTECTION RECOMMENDATIONS: The desired level of protection actions needed.

SITE MAP: The site map shows the conservation planning boundary which contains all known element occurrences and the land determined to be important for the long-term maintenance of these elements. The following factors are considered when drawing these boundaries:

- the extent of current and potential habitat for rare species and exemplary natural communities,
- species movement and migration corridors,
- maintenance of surface water quality within the site and the surrounding watershed,
- maintenance of the hydrologic integrity of the groundwater, e.g. by protecting recharge zones,
- land intended to mitigate off-site impacts,
- land or activities necessary to preclude or minimize invasive exotic species, and
- land necessary for management activities, such as prescribed burning.

The boundaries are intended for conservation planning purposes, and at the very least should prevent the inadvertent destruction of the natural areas. Many rare species are sensitive to disturbance, or may be sought out by collectors. Precise element locations within site boundaries are therefore not given in this report. Virginia law includes Natural Heritage Resources under a limited exemption to the requirements of the Freedom of Information Act.

Due to the limitations imposed by a one-year inventory, not all of the potential natural areas in the region were field checked. Future discoveries of significant natural areas in the study region are to be expected.

SITE REPORTS

LATIMER SIDING

SIZE: ca. 115 Acres BIODIVERSITY RANK: B5

LOCALITY: Northampton County

QUADRANGLE: Townsend QUADRANGLE CODE: 3707528

LOCATION: The site is located northwest of the intersection marked, "Latimer Siding", and south of Kiptopeke State Park.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>GLOBAL STATE</u>		<u>VA</u>	<u>ELEMENT</u>
		<u>RARITY RANK</u>	<u>RARITY RANK</u>	<u>LEGAL STATUS</u>	<u>OCCURRENCE RANK</u>
communities: Oligotrophic Forest		-	-	-	BC

SITE DESCRIPTION: This site is significant because it contains an exemplary Loblolly pine - White Oak forest. The pines are nearly 100 feet tall, rising above the lower canopy of hardwood species. American Holly is common in the understory, and one large individual was 35 cm diameter-at-breast-height. The evergreen shrub, Yaupon, is present, which floristically unites this stand with the mixed hardwood forests farther south. The herbaceous layer is quite sparse and consists primarily of Partridge-berry, Strawberry-bush, Greenbrier, and Poison Ivy.

BOUNDARY JUSTIFICATION: The boundary encloses the oldest stand of trees plus the adjacent stand of younger trees. The young forest serves as a buffer, protecting the old stand from excessive wind-throw, invasion by exotics, and other edge effects.

THREATS: The primary threat to this community is logging. Old stumps are present in the forest, so the stand was logged in the past. Development is also a threat.

MANAGEMENT RECOMMENDATIONS: No active management of the site is needed, although forests such as this probably burned periodically during precolonial times. Prescribed burning might therefore be practiced to simulate the original fire regime and create additional habitat for herbaceous species.

CURRENT STATUS: The site is in private ownership and unprotected.

PROTECTION RECOMMENDATIONS: Exemplary forests such as this are rapidly being cut or developed on the Eastern Shore. Therefore it is important to pursue protection action in the very near future.

KIPTOPEKE STATE PARK

SIZE: ca. 10 Acres BIODIVERSITY RANK: B3

LOCALITY: Northampton County

QUADRANGLE: Townsend QUADRANGLE CODE: 3707528

LOCATION: The site is that portion of Kiptopeke State Park located south of the ferry terminal building and fishing pier, approximately 2 miles north-northwest of Kiptopeke.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>GLOBAL STATE RANK</u>	<u>RARITY RANK</u>	<u>USFWS STATUS</u>	<u>VA LEGAL STATUS</u>	<u>ELEMENT OCCURRENCE RANK</u>
communities:						
Oligotrophic Scrub		-	-	-	-	B
Oligotrophic Herbaceous Vegetation		-	-	-	-	B
animals:						
Cicindela dorsalis						
dorsalis	Northeastern Beach Tiger Beetle	G4T2	S2	LT	-	B

SITE DESCRIPTION: In addition to being Virginia's newest state park, this site is noteworthy for its exemplary dune scrub and dune grassland vegetation. These two communities interdigitate, forming a vegetation mosaic which shifts continuously in response to sand movement and dune formation. The dune vegetation covers approximately 5 to 10% of the park property. Common woody species include Bayberry, Black Cherry, and Sassafras. The dune grassland supports Beach-grass, Seaside Goldenrod, Broomsedge, and Panic-grass.

Globally rare Northeastern Beach Tiger Beetles inhabit the beach area adjacent to the dune field.

BOUNDARY JUSTIFICATION: The boundary encompasses that section of Kiptopeke State Park known to support the two exemplary communities.

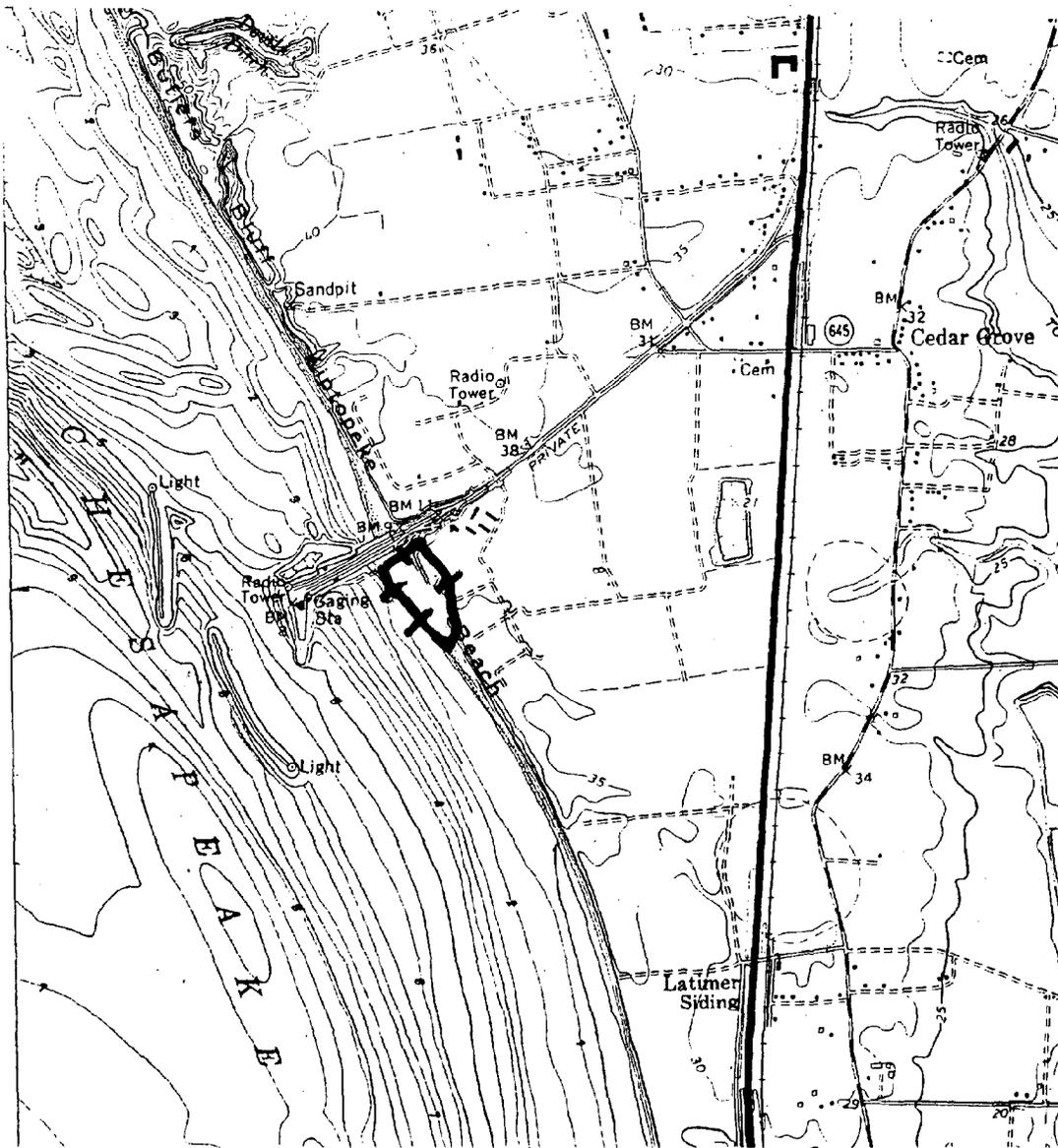
THREATS: Threats at this time appear to be minimal. Two proposed boardwalks and an interpretive trail will have little impact on this natural system.

MANAGEMENT RECOMMENDATIONS: The primary management prescription for this area is to minimize recreational impacts, thereby maintaining the natural condition of the vegetation. The Kiptopeke State Park Resource Committee has developed special management plans for this sensitive area. Potentially invasive exotic plants will be monitored and, if necessary, controlled.

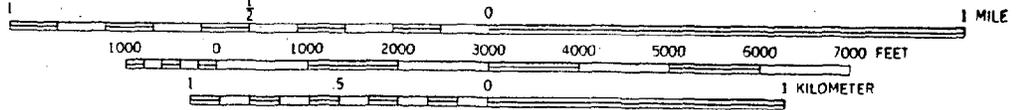
CURRENT STATUS: Protected within Kiptopeke State Park.

PROTECTION RECOMMENDATIONS: The site has been protected. Monitoring and management activities are planned.

KIPTOPEKE STATE PARK



SCALE 1:24000



CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

PICKETTS HARBOR - BAY RIDGE

SIZE: ca. 140 Acres BIODIVERSITY RANK: B2
 LOCALITY: Northampton County
 QUADRANGLE: Townsend QUADRANGLE CODE: 3707528
 Elliots Creek 3707621

LOCATION: The site includes a 2 mile long stretch of bayside shoreline and adjacent uplands extending from Picketts Harbor to Elliots Creek.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>GLOBAL RANK</u>	<u>STATE RANK</u>	<u>USFWS STATUS</u>	<u>VA LEGAL STATUS</u>	<u>ELEMENT OCCURRENCE RANK</u>
communities:						
Oligotrophic Scrub		-	-	-	-	A
Oligotrophic Herbaceous Vegetation		-	-	-	-	AB
Oligotrophic Forest		-	-	-	-	AB
plants:						
Galium hispidulum		G5	S2	-	-	AB
animals:						
Cicindela dorsalis						
dorsalis	Northeastern Beach Tiger Beetle	G4T2	S2	LT	-	A

SITE DESCRIPTION: This site contains outstanding coastal dune vegetation. In addition, a Holocene dune ridge is significant as a rare geologic feature. One of the largest known populations of the Federally threatened Northeastern Beach Tiger Beetle occurs here:

The dune grassland contains Beach-grass, Panic-grass, and a rare northern colony of Sea-oats. Plants of the dune scrub include Loblolly Pine, Sassafras, Persimmon, Black Cherry, Shining Sumac, Beach Heather, and Greenbrier. The maritime forest occurs along the crest of a high dune ridge behind the dune scrub. Common trees here include Loblolly Pine, Southern Red Oak, White Oak, Black Cherry, Black Gum, and American Holly.

BOUNDARY JUSTIFICATION: The boundary encloses the three exemplary natural communities. A small amount of upland buffer land is included to mitigate future impacts from adjacent development.

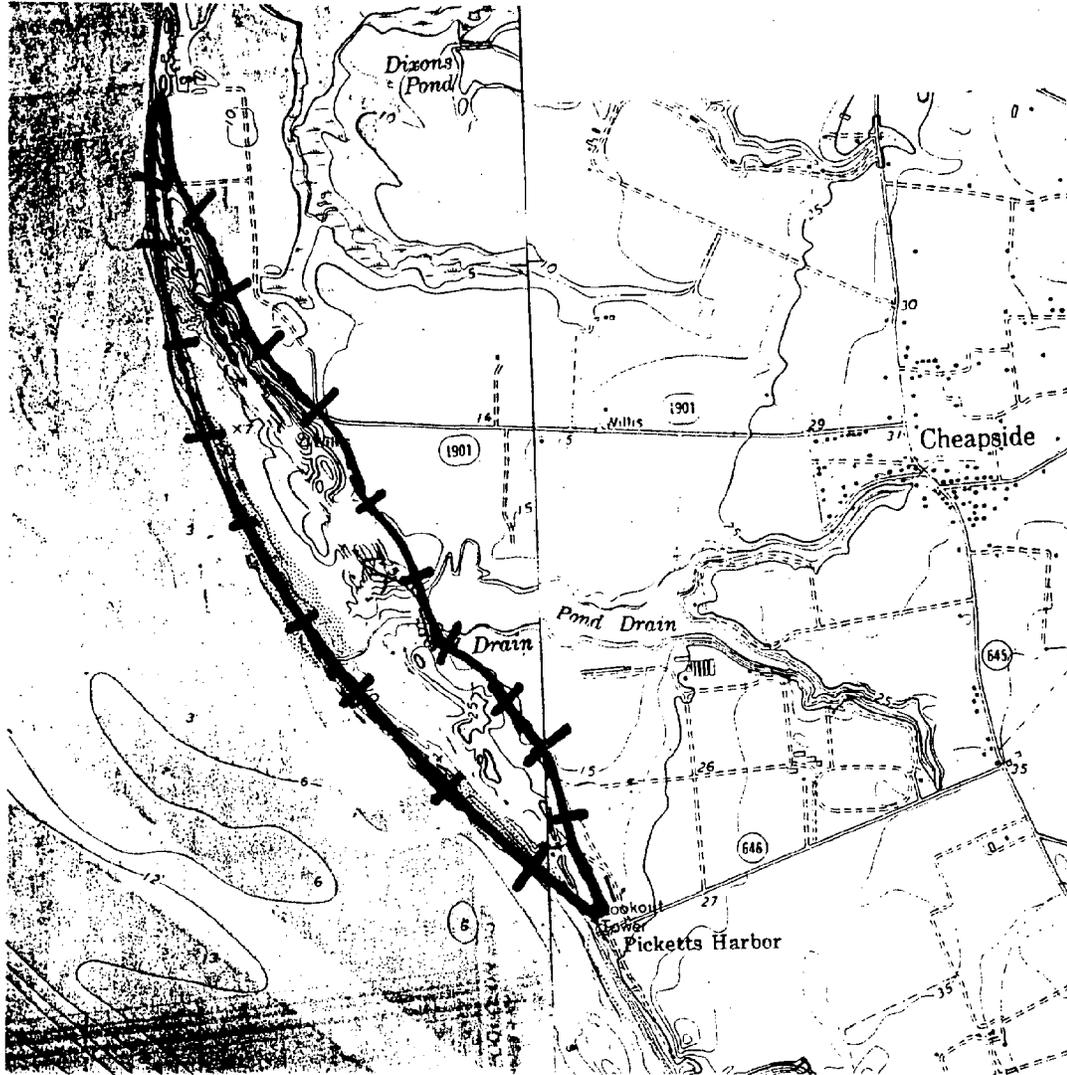
THREATS: The primary threat to this beach-front property is intensive development and coincident alteration of the natural vegetation.

MANAGEMENT RECOMMENDATIONS: No active management of the site is needed, although in the future recreational impacts may need to be minimized by using additional board walks across the sensitive dune vegetation.

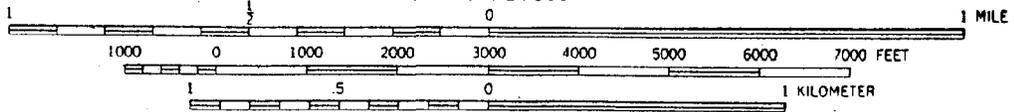
CURRENT STATUS: The site is in private ownership. Sara and Cooke Goffigon reside at the site.

PROTECTION RECOMMENDATIONS: This site represents one of the most significant natural areas on the Eastern Shore. It warrants strong protection.

PICKETTS HARBOR - BAY RIDGE



SCALE 1:24000



CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

STEELMAN'S LANDING

SIZE: ca. 134 Acres BIODIVERSITY RANK: B4

LOCALITY: Northampton County

QUADRANGLE: Townsend QUADRANGLE CODE: 3707528

LOCATION: The site lies east of Townsend, north of Route 646 and south of Walls Landing Creek.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	GLOBAL STATE		VA	ELEMENT
		<u>RANK</u>	<u>RANK</u>	<u>LEGAL STATUS</u>	<u>OCCURRENCE</u>

community: Oligotrophic Seasonally Flooded Forest					AB
--	--	--	--	--	----

SITE DESCRIPTION: A mature and fairly extensive swamp forest is the primary feature of this site. The swamp was, in fact, the best example of its type encountered on the Eastern Shore during the inventory. Black Gum trees up to 80 cm dbh and 30 meters high dominate. Understory trees include Sweetbay Magnolia and American Holly. The herbaceous layer is rather dense, and is dominated by Virginia Chain-fern, Nettle Chain-fern, Lizard-tail, and Cinnamon Fern. The trees in the swamp tend to grow from elevated hummocks, while most of the herbs occupy seasonally flooded mucky hollows.

BOUNDARY JUSTIFICATION: At present, the boundary includes the wetland and the surrounding upland forest vegetation. However, additional information is needed to describe the hydrologic regime of the wetland. Ideally, the entire drainage basin should be protected from ditching and agricultural impacts.

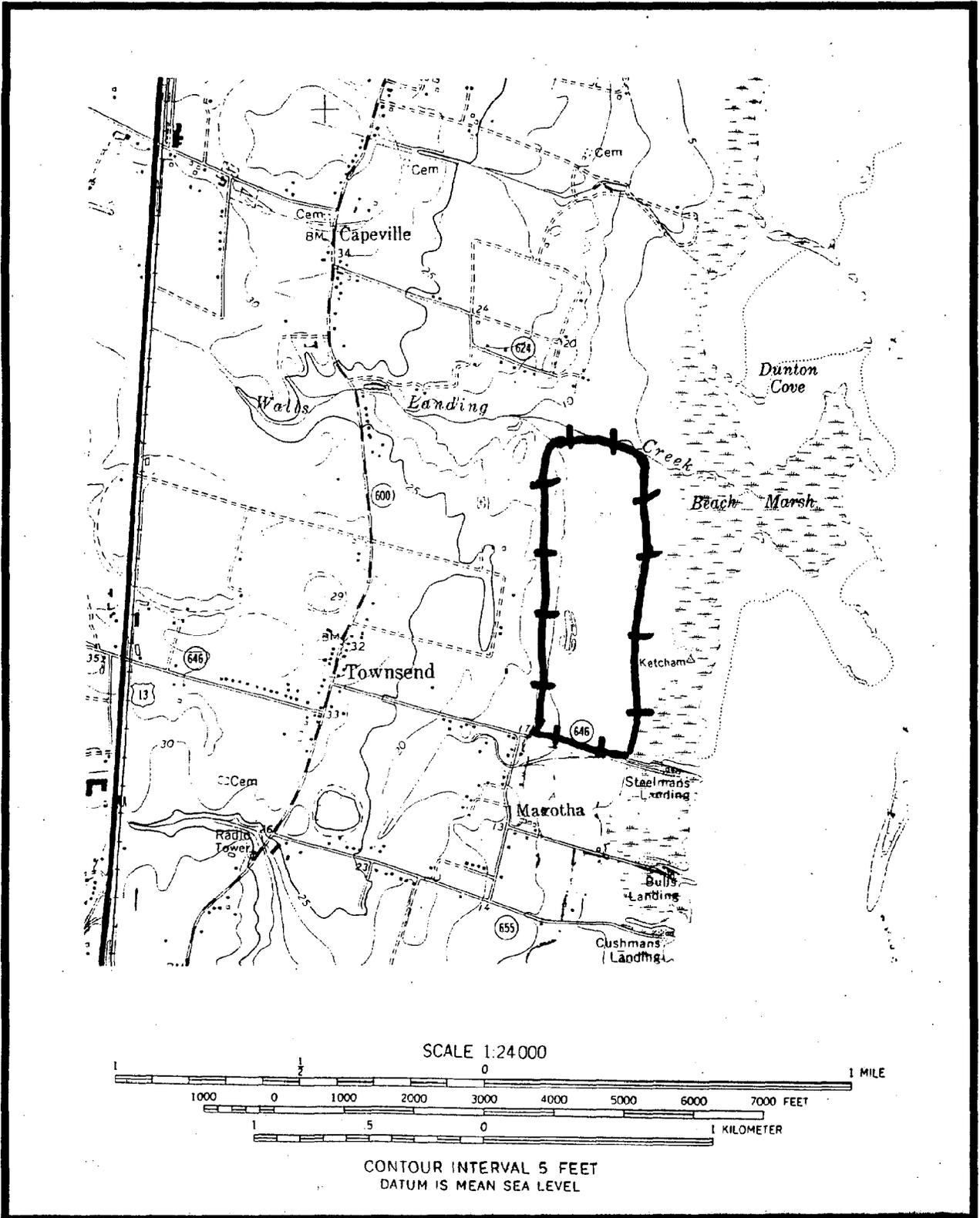
THREATS: Threats appear to be minimal because the area is managed as a natural area preserve. However, possible impacts from surrounding agricultural lands should be assessed.

MANAGEMENT RECOMMENDATIONS: No active management is needed. Fire is not necessary or even possible in wetlands such as this.

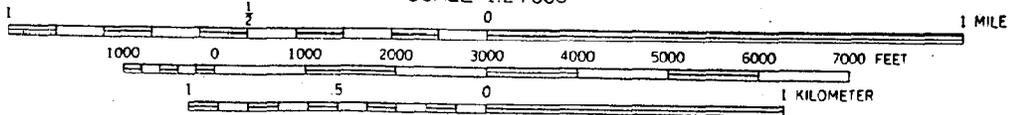
CURRENT STATUS: Protected and owned by The Nature Conservancy.

PROTECTION RECOMMENDATIONS: Determine whether the entire drainage basin is currently contained within Nature Conservancy land. If not, then additional lands may need protection.

STEELMANS LANDING



SCALE 1:24 000



CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

EASTVILLE FOREST

SIZE: ca. 149 Acres BIODIVERSITY RANK: B5

LOCALITY: Northampton County

QUADRANGLE: Cheriton QUADRANGLE CODE: 3707538

LOCATION: The site is located north of Route 634, approximately 0.5 mile west of Business Route 13 and 1 mile southwest of Eastville.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>GLOBAL STATE</u>		<u>VA</u>	<u>ELEMENT</u>
		<u>RANK</u>	<u>RANK</u>	<u>LEGAL</u>	<u>OCCURRENCE</u>
community:					
Oligotrophic Forest		-	-	-	BC
plant:					
Tillandsia usneoides	Spanish Moss	G5	S3	-	D

SITE DESCRIPTION: Part of this forested tract was recently cut, but the remaining portion represents one of the better examples of a mature oak-pine forest on the Eastern Shore. Prevalent trees include Loblolly Pine, White Oak, Red Maple, Black Gum, and Sweet Gum. American Holly and Flowering Dogwood form a rather dense sub-canopy in the forest, while Sweet Pepperbush, Highbush Blueberry, and Greenbrier dominate the shrub layer. Herbaceous species are relatively scarce, due perhaps to the dense shade and thick mats of poorly decomposed organic matter on the soil surface.

A small population of Spanish Moss is of great interest at this site. This epiphytic plant, so typical of southern forests, occurs here very close to its natural northern range limit. As such, the few surviving plants afford a marvelous opportunity for research and monitoring. The plants did flower in 1991, but reproduction seems to be restricted to vegetative propagation. The Spanish Moss was first documented on this site in 1935.

BOUNDARY JUSTIFICATION: The boundary encompasses the uncut and recently cut forest tracts. The cut forest may, with time, provide additional habitat for the Spanish moss. According to Eastville resident Robert Spady, the Spanish Moss was formerly found in the eastern end of the site before the logging took place.

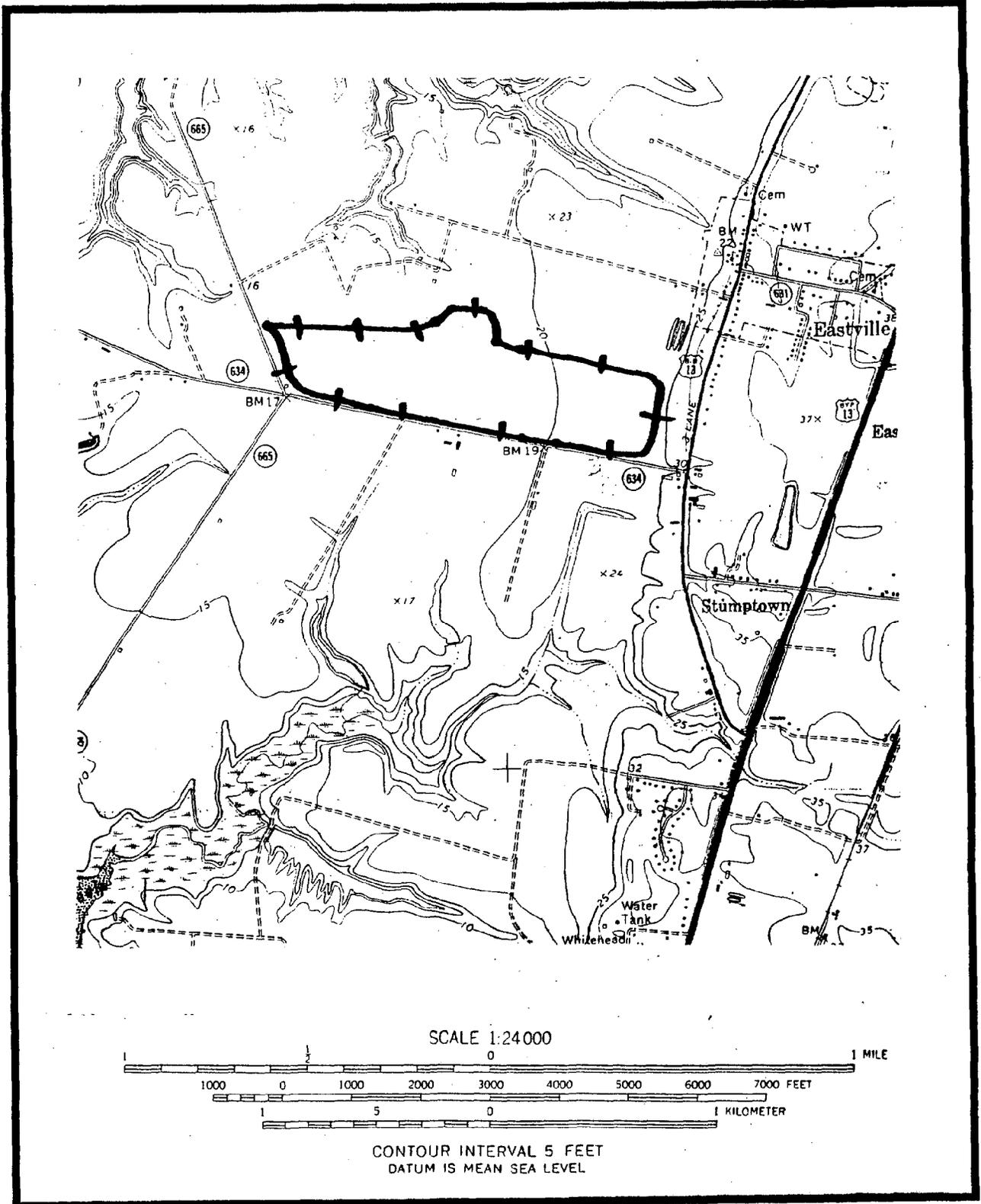
THREATS: Logging is the most immediate threat to the site. Land development may also pose a threat.

MANAGEMENT RECOMMENDATIONS: No active management of the site appears needed.

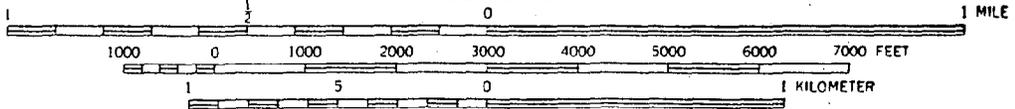
CURRENT STATUS: The site is privately owned. Contact Alice D.T. Rawles, Portsmouth, VA.

PROTECTION RECOMMENDATIONS: This site should be protected as an example of increasingly rare indigenous forest vegetation. Throughout the Eastern Shore, fine forests such as this are being clear-cut and converted to pine monocultures.

EASTVILLE FOREST



SCALE 1:24 000



CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

WESCOAT FARM - CHURCH NECK

SIZE: ca. 520 Acres BIODIVERSITY RANK: B2

LOCALITY: Northampton County

QUADRANGLE: Franktown QUADRANGLE CODE: 3707548

LOCATION: The Wescoat Farm on Church Neck is located south of Nassawadox Creek, and north of Westerhouse Creek.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>GLOBAL STATE</u>		<u>VA</u>	<u>ELEMENT</u>
		<u>RARITY RANK</u>	<u>RARITY RANK</u>	<u>LEGAL STATUS</u>	<u>OCCURRENCE RANK</u>
communities:					
Oligotrophic Herbaceous Vegetation		-	-	-	B
Oligotrophic Scrub		-	-	-	B
animals:					
Haliaeetus leucocephalus	Bald Eagle	G3	S2S3	LE	LE C
Cicindela dorsalis					
dorsalis	Northeastern Beach Tiger Beetle	G4T2	S2	LT	- A

SITE DESCRIPTION: The site contains a mile-long stretch of undeveloped bayside shoreline and two exemplary dune communities. The dune scrub is characterized by scattered shrubs and small trees, namely Eastern Red-cedar, Wax Myrtle, Shining Sumac, Loblolly Pine, Southern Red Oak, and Black Cherry. Herbaceous vegetation of the dune is composed of Beach-grass, Seaside Goldenrod, and Sand-spur.

A large population of the Federally threatened Northeastern Beach Tiger Beetle occurs along the beach. In 1991 a pair of Bald Eagles nested in a small forested tract near agricultural fields.

BOUNDARY JUSTIFICATION: The site boundary encompasses the undisturbed section of beach and dune, plus additional land intended to protect the Bald Eagle's nest site(s), roosting area, and, to a certain extent, feeding area.

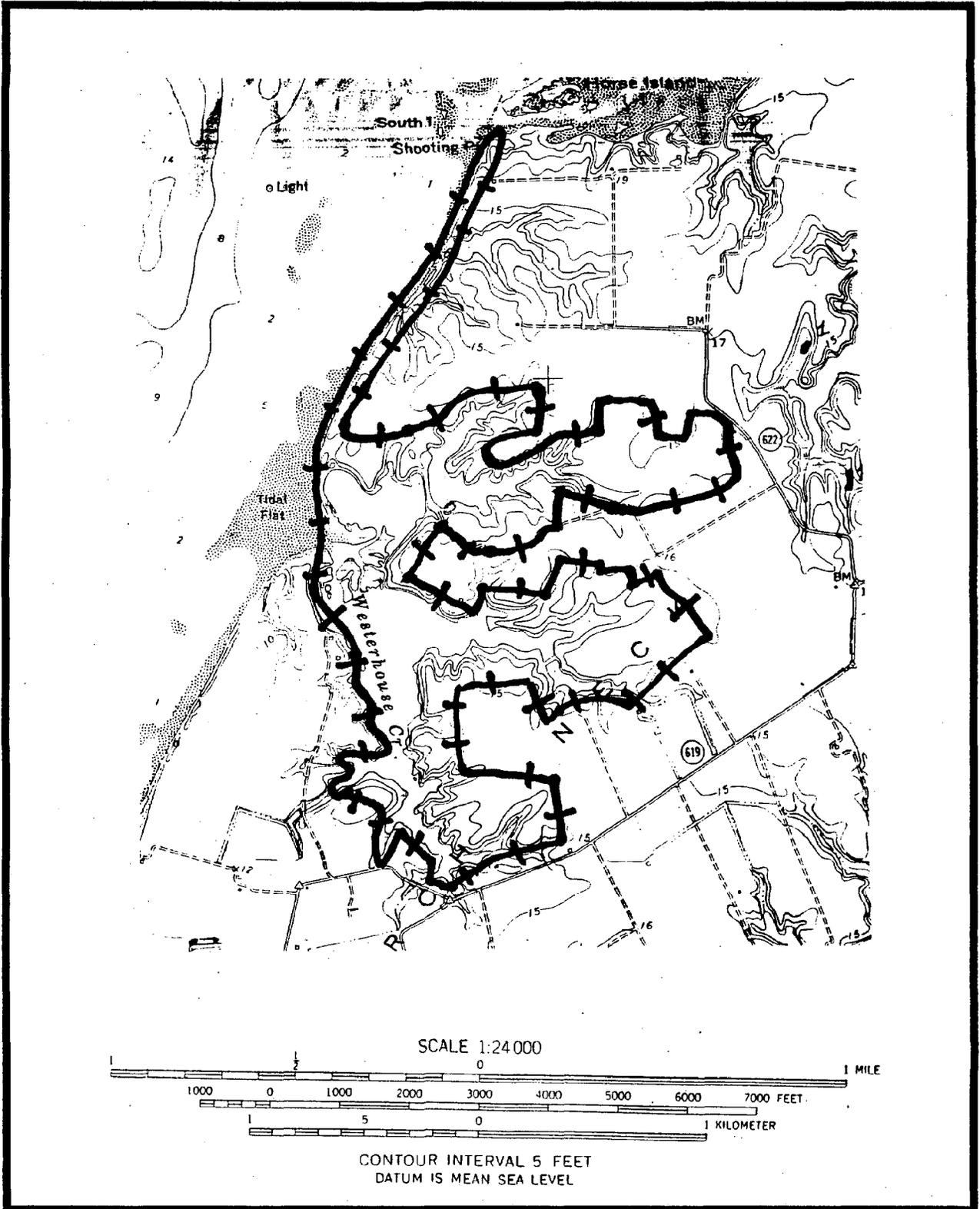
THREATS: Threats are intensive shoreline development and accompanying disruption to the natural dune vegetation. Also, the Bald Eagles are threatened by frequent human contact or outright destruction of the forest habitat.

MANAGEMENT RECOMMENDATIONS: The beach and dune communities require little or no active management. The Bald Eagles should be managed by minimizing human contact during the eagles' critical nesting period.

CURRENT STATUS: The site is privately owned. Contact John and Suzanne Wescoat, Eastville, VA.

PROTECTION RECOMMENDATIONS: This site is most worthy of protection.

WESCOAT FARM - CHURCH NECK



REEDTOWN STREAM BOTTOM FOREST

SIZE: ca. 48 Acres BIODIVERSITY RANK: B5

LOCALITY: Northampton County

QUADRANGLE: Franktown QUADRANGLE CODE: 3707548

LOCATION: The site is located west of Route 13 approximately 2 miles north of Eastville. The access point is the roadside park along Route 13.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	GLOBAL STATE		VA	ELEMENT
		<u>RANK</u>	<u>RANK</u>	LEGAL	OCCURRENCE
community: Oligotrophic Saturated Woodland		-	-	-	BC

SITE DESCRIPTION: This site encompasses an unnamed stream and a stream-side wetland situated in a steep, narrow valley. The wetland is maintained by continuous seepage of groundwater which profoundly influences the nature of the vegetation. Sweet-bay Magnolia is especially characteristic of the groundwater-saturated soils. Other species include Netted Chain-fern, Virginia Chain-fern, Sweet Pepperbush, Alder, Golden Saxifrage, and various sedges.

Wetlands such as this are fairly common alongside stream headwaters on the Eastern Shore, but this example is large and undisturbed.

BOUNDARY JUSTIFICATION: Upslope land provides the groundwater which seeps out into the wetland. Therefore, the site boundary encompasses upland as well as wetland environments.

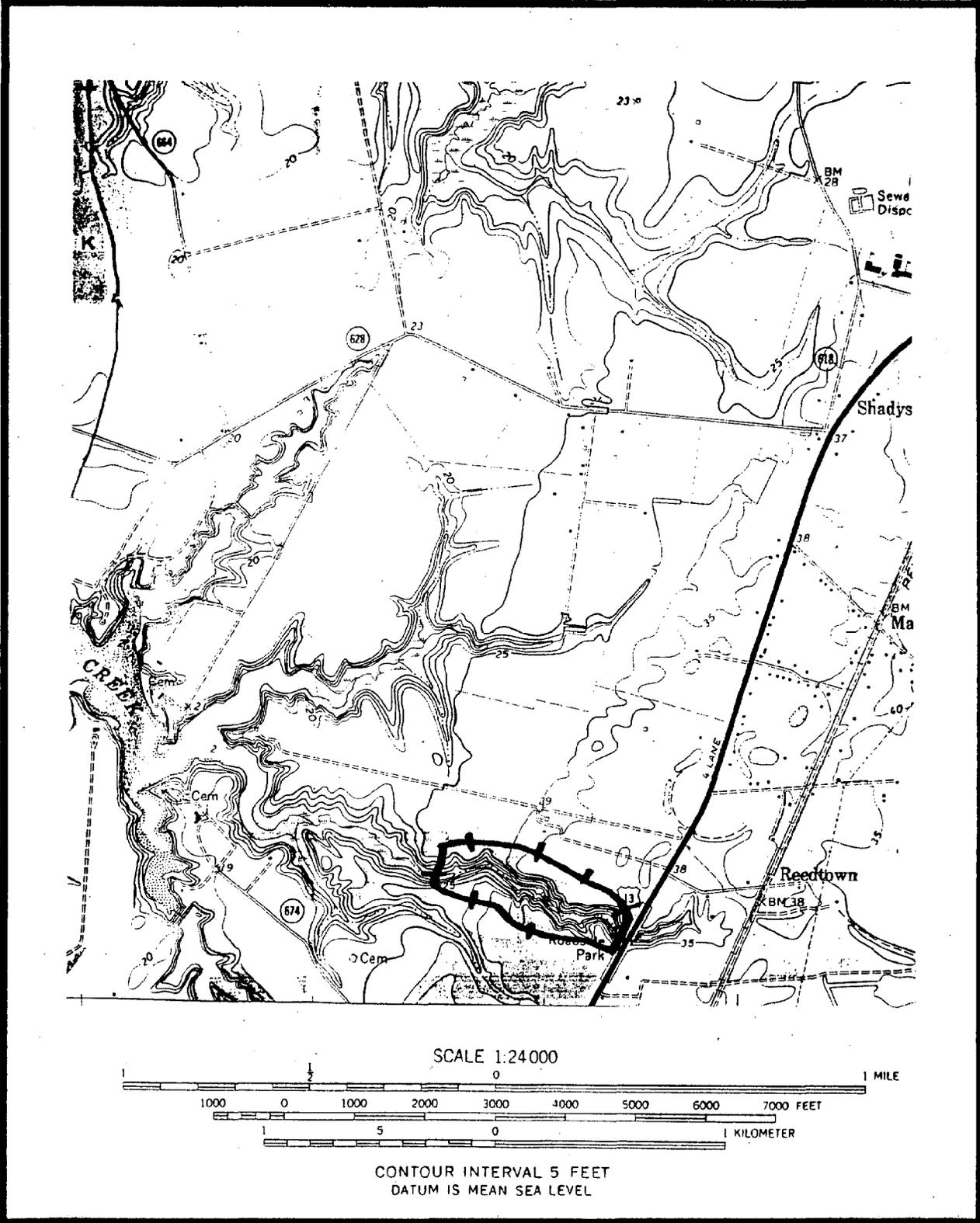
THREATS: Threats include ditching, impounding, and intensive upslope development. Logging of this fragile wetland habitat would also constitute a major ecological perturbation, as would nutrient enrichment or siltation resulting from adjacent agricultural activity.

MANAGEMENT RECOMMENDATIONS: The site and its exemplary wetland community require no active management.

CURRENT STATUS: The site is privately owned.

PROTECTION RECOMMENDATIONS: The site may warrant protection as one of the Eastern Shore's exemplary natural communities.

REEDTOWN STREAM BOTTOM FOREST



BELLE HAVEN DELMARVA BAY

SIZE: ca. 280 Acres BIODIVERSITY RANK: B5
 LOCALITY: Accomack County
 QUADRANGLE: Exmore QUADRANGLE CODE: 3707557
 LOCATION: The site is located immediately west of Route 13, northeast of the village of Belle Haven.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>GLOBAL STATE RANK</u>	<u>RARITY RANK</u>	<u>USFWS STATUS</u>	<u>VA LEGAL STATUS</u>	<u>ELEMENT OCCURRENCE RANK</u>
community: Oligotrophic Seasonally Flooded Forest		-	-	-	-	C

SITE DESCRIPTION: The site supports a remnant portion of a Delmarva bay swamp. Due to drainage, bay swamps have become extremely rare on the Eastern Shore. This wetland once extended east of Route 13, but that area was drained many years ago.

The remaining wetland supports both mature pine forest and post-logging coppice. Loblolly Pine and Red Maple dominate the canopy while lower trees include Black Gum, Water Oak, Sourwood, and Sweetbay Magnolia. Sweet Pepper-bush and Green-brier dominate the shrub layer while Virginia Chain-fern is common in the herb layer. The recently logged coppice is richer in herbaceous species, undoubtedly because of the increased amount of light.

Soils in the wetland have a very thick layer of organic duff (ca. 6 ") which has accumulated over the years in the absence of fire. Despite seasonal wetness, this vegetation is fire prone and past fires undoubtedly had an influence on the structure and composition of the vegetation.

BOUNDARY JUSTIFICATION: The boundary includes the remaining wetland and a small amount of upland buffer land intended to mitigate off-site impacts to the wetland vegetation.

THREATS: Much of the wetland supports mature Loblolly Pine forest, and consequently, logging is an imminent threat. According to regional extension forester David Halley, wetlands such as this have been drained primarily to facilitate logging operations, rather than to improve the growth characteristics of the pine. Drainage activity should be discouraged here.

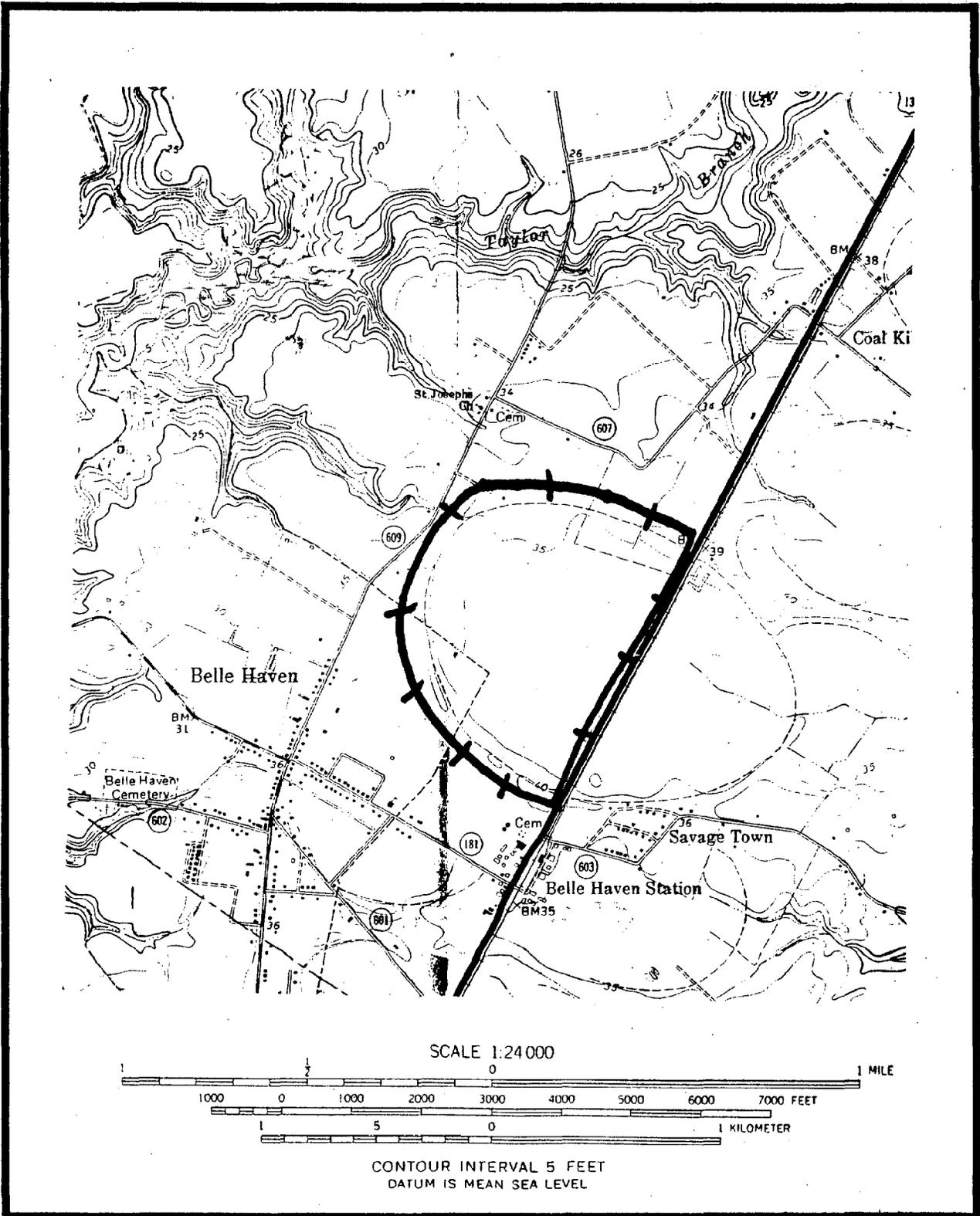
MANAGEMENT RECOMMENDATIONS: Fires once played a major role in shaping the structure and composition of Delmarva bay swamps, and consequently prescribed

burning would likely have a beneficial effect on this community. In particular, fire could create habitat for herbaceous species which presently are scarce and shade-stressed. A possible limitation to prescribed burning management here is the close proximity of Route 13, the major highway along the Eastern Shore.

CURRENT STATUS: The site is privately owned and unprotected.

PROTECTION RECOMMENDATIONS: Discourage ditching and promote prescribed burning management.

BELLE HAVEN DELMARVA BAY



COARDS BRANCH POND

SIZE: ca. 92 Acres BIODIVERSITY RANK: B3
 LOCALITY: Accomack County
 QUADRANGLE: Parksley QUADRANGLE CODE: 3707576
 LOCATION: Coards Branch Pond is located 2.1 air miles southwest of Parksley.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	GLOBAL STATE		USFWS	VA	ELEMENT OCCURRENCE
		<u>RANK</u>	<u>RANK</u>		LEGAL	
communities:						
Oligotrophic Saturated Scrub		-	-	-	-	BC
Oligotrophic Saturated Herbaceous Vegetation		-	-	-	-	BC
plants:						
Eleocharis equisetoides	Horse-tail Spikerush	G4	S1	-	-	B
Rhynchospora alba	White Beakrush	G5	S1	-	-	A
Nymphoides aquatica	Big Floating-heart	G5	S1	-	-	CD
Utricularia cornuta	Horned Bladderwort	G5	S1	-	-	-
Wolffia columbiana	Columbia water-meal	G5	S1	-	-	-
Eriocaulon aquaticum	White Buttons	G5	S1	-	-	B

SITE DESCRIPTION: Coards Branch Pond supports a bog-like wetland and one of the greatest concentrations of rare plants on the Eastern Shore. This pond is unlike all other mill-ponds on the Eastern Shore because it is profoundly influenced by groundwater seepage, as well as stream flow. Rare and unusual wildflowers abound at the site, perhaps none more striking than the Rose Pogonia Orchid which grows abundantly along the sphagnous pond margin. The Horse-tail Spikerush is known from no other site in Virginia.

The pond was created when the stream was dammed, originally in the 17th century. Presently, the rare plants and noteworthy communities are dependent upon the continued maintenance of the dam.

Much of the upland surrounding the pond has been modified by residential and agricultural activities, but the wetland vegetation remains relatively intact. Regular mowing and limited dredging activities currently affect part of the pond shore. To benefit the rare plants present, these activities should be halted, or conducted only on a very limited or very infrequent basis.

BOUNDARY JUSTIFICATION: The boundary includes the entire pond plus the upstream and upslope lands necessary to maintain surface water quality and sufficient groundwater seepage.

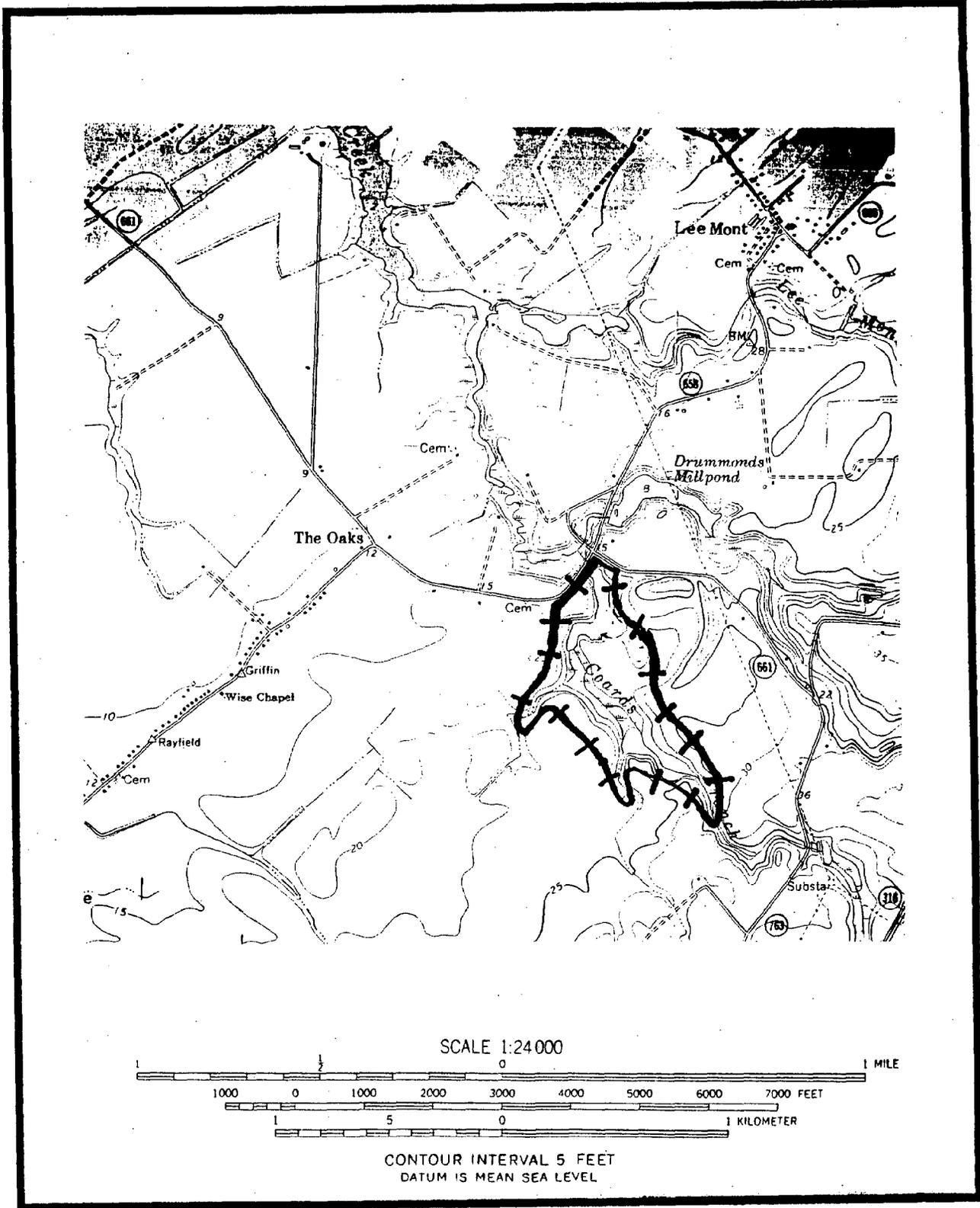
THREATS: Land bordering the west side of the pond is currently for sale, and residential development seems imminent. Such development would likely be accompanied by pond shore perturbations such as boat dock construction, dredging, or clearing of the native vegetation. These activities would have a negative impact on the many rare plant species present at the site. The peat mat is quite fragile and foot travel through the wetland can leave a lasting trail of altered soil and vegetation. At present this appears to have little or no effect on the rare plant populations, but frequent visits by large groups of botanists and wildflower enthusiasts should be discouraged.

MANAGEMENT RECOMMENDATIONS: The dam should be monitored and, if necessary, repaired to ensure the continued existence of the pond and the rare species.

CURRENT STATUS: The site is privately owned. Henry Fuller resides at the site.

PROTECTION RECOMMENDATIONS: Protection is urgently needed.

COARDS BRANCH POND



MUTTON HUNK FEN

SIZE: ca. 121 Acres

BIODIVERSITY RANK: B2

LOCALITY: Accomack County

QUADRANGLE: Bloxom

QUADRANGLE CODE: 3707575

LOCATION: The site lies approximately 1 mile east-northeast of Metomkin along Mutton Hunk Branch.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	GLOBAL STATE		USFWS	VA	ELEMENT
		<u>RARITY RANK</u>	<u>RARITY RANK</u>			
communities:						
Oligotrophic Saturated Scrub		G2?	S1	-	-	AB
Oligotrophic Saturated Herbaceous Vegetation		G2?	S1	-	-	CD
plants:						
Erigeron vernus	White-top Fleabane	G5	S2	-	-	B
Eriocaulon decangulare	Ten-angle Pipewort	G5	S2	-	-	B
Eleocharis rostellata	Beaked Spikerush	G5	S2	-	-	B
Eleocharis halophila	Salt-marsh Spikerush	G4	S1	-	-	A
Rhynchospora alba	White Beakrush	G5	S1	-	-	BC
Utricularia juncea	Southern Bladderwort	G5	S2	-	-	C
Juncus pelocarpus	Brown-fruited Rush	G5	S1	-	-	C

SITE DESCRIPTION: This site contains the greatest concentration of rare plants found the Eastern Shore. All of the rarities occur in a linear strip of bog-like vegetation situated between salt marsh and upland forest. The wetland receives a constant supply of cold groundwater seepage, and muck soils predominate. Such wetlands are referred to as "sea-level fens". They are extremely rare.

Mutton Hunk Fen is significant not only for the number of rare species present but because of the site's biogeographic importance. Prior to 1991 and this inventory, Brown-fruited Rush was not known to occur south of Maryland. Mutton Hunk now represents the new southern range limit for the species. Similarly, Titi is a southern shrub never before documented north of southeastern Virginia. Mutton Hunk Fen marks the new northern range limit for this species; it occurs nowhere else on the Delmarva.

BOUNDARY JUSTIFICATION: The boundary includes the small significant wetland plus up-slope and upstream lands necessary to protect the supply and quality of groundwater seepage. The adjacent salt marsh and tidal creek are also included.

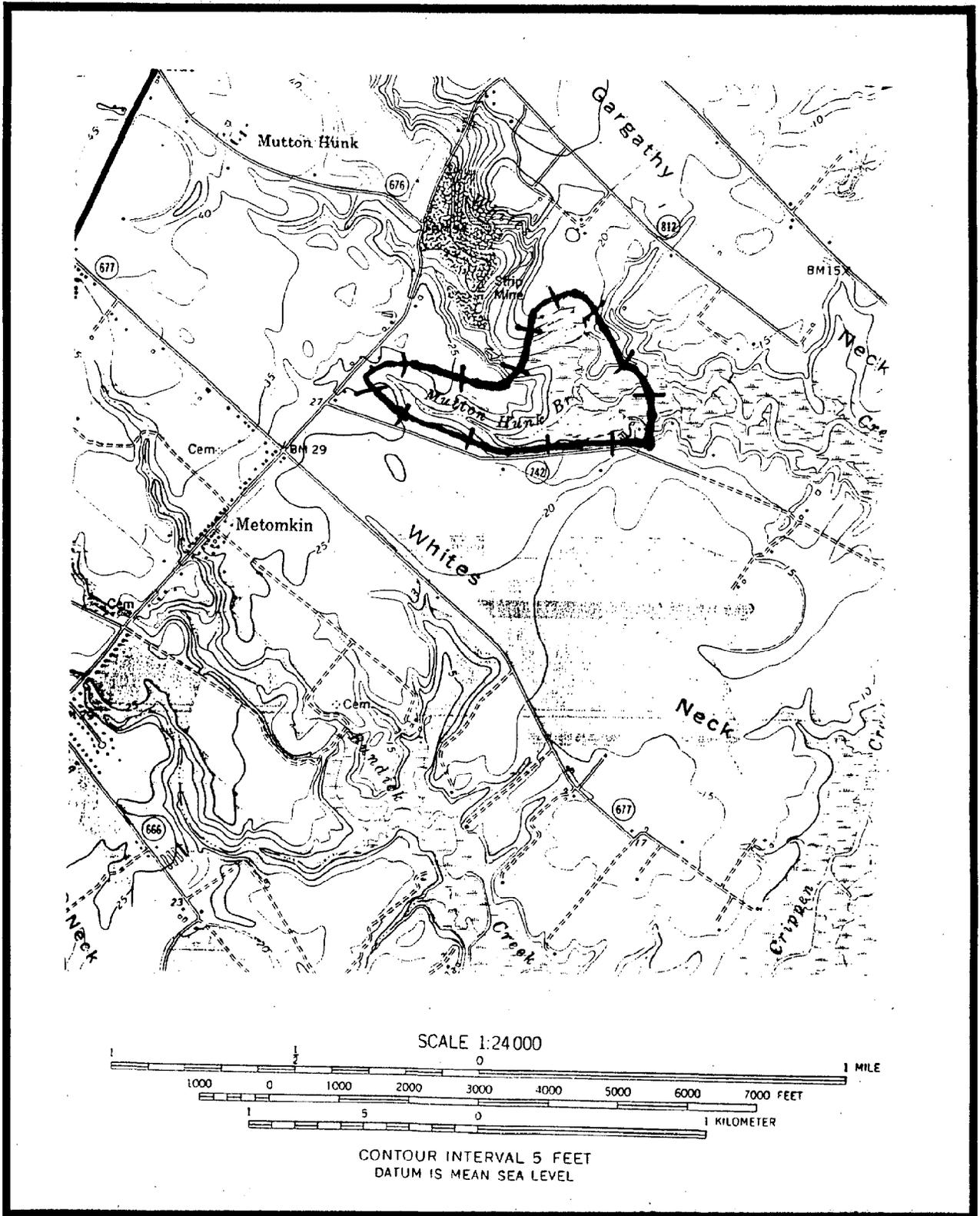
THREATS: Development of upslope land could alter the quality or quantity of the groundwater seepage. Also, over-collection of the rare and interesting plants is a real concern. Botanists should refrain from specimen collection here because several of the species occur as very small populations.

MANAGEMENT RECOMMENDATIONS: The wetland and the rare plant populations appear to require no active management. However, storm tides during the growing season might inundate this area with salt water, the effect of which is not known and should be determined.

CURRENT STATUS: The site is privately owned and unprotected.

PROTECTION RECOMMENDATIONS: Protection is urgently needed for this highly significant site.

MUTTON HUNK FEN



ASSAWOMAN CREEK

SIZE: ca. 68 Acres BIODIVERSITY RANK: B2

LOCALITY: Accomack County

QUADRANGLE: Bloxom QUADRANGLE CODE: 3707575

LOCATION: The site is located along the west side of Assawoman Creek, south of Petit Branch.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	GLOBAL STATE		USFWS	VA	ELEMENT
		RARITY RANK	RARITY RANK		LEGAL STATUS	
community:						
Oligotrophic Saturated Scrub		G2?	S1	-	-	B
plants:						
Sclerolepis uniflora	One-flower Sclerolepis	G4	S1	-	-	B
Eleocharis rostellata	Beaked Spikerush	G5	S2	-	-	D
Eriocaulon decangulare	Ten-angle Pipewort	G5	S2	-	-	B
Erigeron vernus	White-top Fleabane	G5	S2	-	-	B

SITE DESCRIPTION: This site supports an extremely rare type of wetland vegetation referred to as a "sea-level fen". The wetland is situated between salt marsh vegetation and upland forest. Groundwater seepage emerges from the base of the upland and flows through the wetland, forming an ecologically stressful, bog-like environment. Rare plants thrive in this wetland, perhaps because they face little competition from larger, more common plants which are poorly adapted to the harsh soil conditions. Trees such as Loblolly Pine and Red Maple, which achieve great stature in other wetlands, are here present as stunted and somewhat chlorotic individuals which fail to form a closed forest canopy.

Like the nearby Mutton Hunk Fen site, this site is extremely important from a biological diversity perspective. One-flowered Sclerolepis was not known to occur in Virginia until it was discovered here during the 1991 inventory. Also, this site established a new northern range limit for the southern plant, White-top Fleabane.

BOUNDARY JUSTIFICATION: The site encompasses the significant wetland, surrounding salt marsh, and the upslope lands necessary to protect the quality and quantity of groundwater seepage entering the wetland.

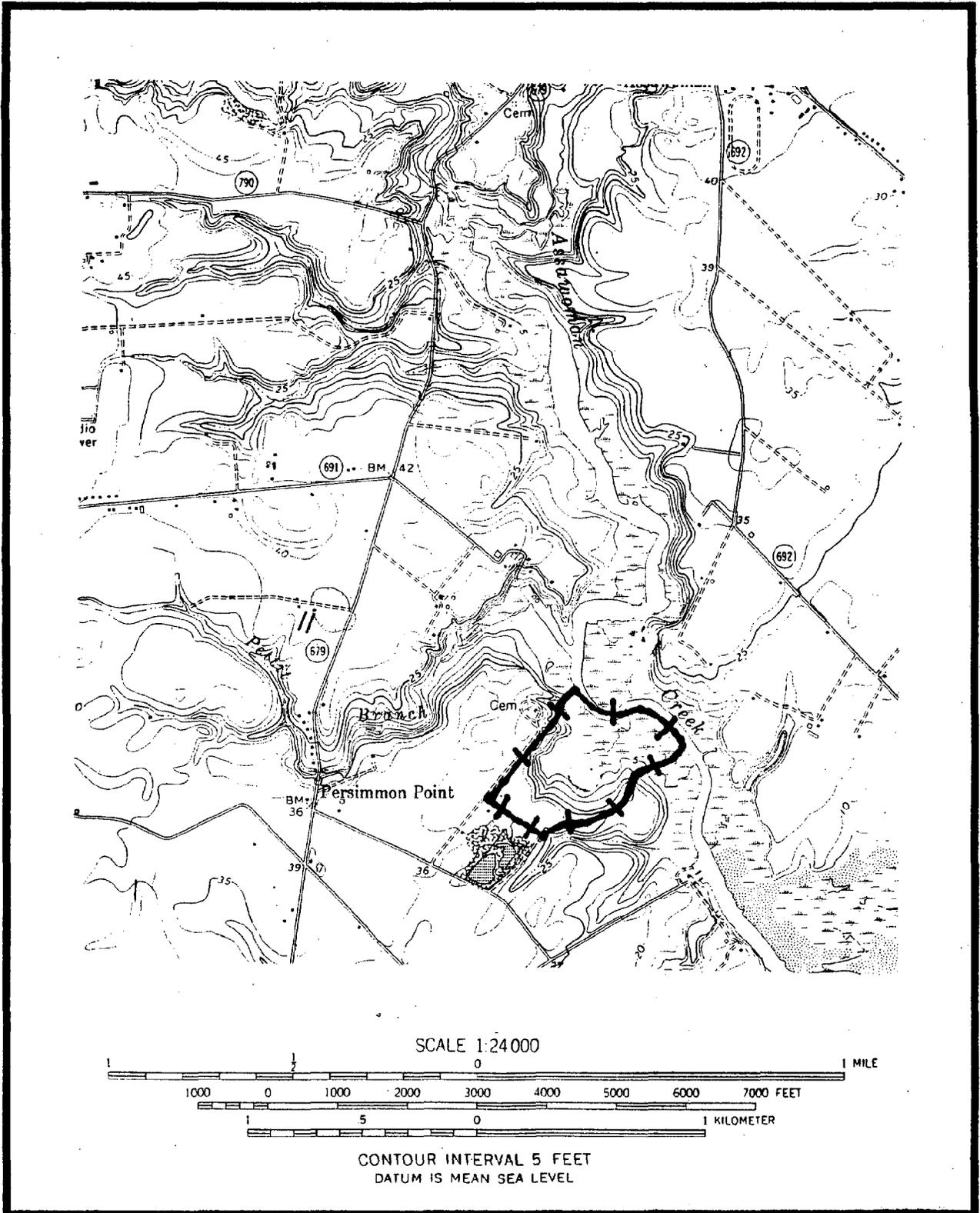
THREATS: Upslope development is the primary threat to the site.

MANAGEMENT RECOMMENDATIONS: No active management of this site is needed. However, storm tides during the growing season might inundate this area with salt water, the effects of which are not known and should be determined.

CURRENT STATUS: The site is privately owned and is unprotected.

PROTECTION RECOMMENDATIONS: This highly significant site should receive strong protection.

ASSAWOMAN CREEK



RECOMMENDATIONS

1. Participate fully in the development of local protection tools. Most of the 11 natural areas described in this report are unprotected. The Division of Natural Heritage and the Council on the Environment will continue to seek the advice and utilize the expertise of local officials in evaluating practical and effective protection options. Also, continued field work is necessary to refine site conservation planning boundaries and to identify new sites.
2. Include the Division of Natural Heritage in the review of projects in or near natural areas. The site boundaries contained in this report are provided for planning purposes only, and are not regulatory in nature. As proposed development projects come before the localities, project maps should be compared with the site maps in this report. The Natural Heritage staff offers its knowledge and expertise in reviewing project proposals that may affect a natural area. Since the early stages of the planning process typically offer the greatest flexibility, it is important to contact the Natural Heritage staff as soon as possible.
3. Expand public awareness of the need for protecting natural areas. Intensified land use activities throughout the Eastern Shore have placed natural lands in jeopardy. Natural areas not only provide biological diversity values, but they also provide recreational opportunities for the public and add to the quality of life in the region. The Nature Conservancy's Virginia Coast Reserve and the recently established Kiptopeke State Park are bringing needed attention to natural area values. A recent public opinion survey of 300 adult citizens in Virginia indicated that 82% were in favor of land conservation. Unprotected natural areas throughout the Eastern Shore can only benefit from the increased awareness of natural area values - citizens are realizing that inappropriate land use activities are steadily destroying their natural heritage.
4. Increase cooperation among pertinent organizations. Among the many groups and individuals that should be involved are those that own, manage, or have the authority to acquire natural areas. One goal should be to develop stronger ties among federal, state, local and private interests involved in the protection or management of natural lands.
5. Properly manage natural areas. The first step is to develop management programs for public and private conservation lands. The Department of Conservation and Recreation can assist local agencies in developing management plans. The Department's Division of Natural Heritage is interested in working with other agencies and organizations to conduct research and develop techniques for maintaining or restoring natural areas.

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APPENDIX 1

A CLASSIFICATION OF VIRGINIA'S INDIGENOUS BIOTIC COMMUNITIES:
VEGETATED TERRESTRIAL, PALUSTRINE, AND ESTUARINE COMMUNITY CLASSES

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INTRODUCTION:

The goal of this work is to create a framework for understanding and classifying Virginia's indigenous biotic communities. Achieving this goal has direct bearing on the success of the Division of Natural Heritage whose mission is to document the status, distribution, and ecology of native species and their habitats in the Commonwealth, protect these living resources by way of a system of natural area preserves, and provide information and technical advice to individuals, organizations, and agencies. Community classification and inventory represents a "coarse-filter" approach to biological conservation which secures the protection of a vast number of cryptic or poorly known species. Also, it brings needed attention to the aesthetic, scientific, and ecosystem function values of natural communities. The present draft of the classification deals with communities supporting vascular plant species within the Terrestrial, Palustrine and Estuarine Systems. It supplants appropriate sections of an earlier Division of Natural Heritage classification (Rawinski, 1990).

CLASSIFICATION PRINCIPLES AND METHODS:

A classification system is an organized form of cataloging based on fixed principles. Community classifications vary widely, largely because principles vary in accord with classification purposes. The ultimate purpose of this effort is to name, describe, and differentiate Associations - the basic systematic units. Unfortunately, these units have not yet been identified because of insufficient information. However, the upper levels of a hierarchy, described here, will help partition the great diversity of the natural world into logical units; this in turn will help us identify and understand relationships among the Associations. The hierarchical levels within the final draft of the Virginia classification will likely be:

SYSTEM

 CLASS

 ALLIANCE

 ASSOCIATION

 SUBASSOCIATION.

Communities of life are inextricably associated with the physical environment, and ignoring edaphic-ecological factors when constructing a "community" classification is difficult. When classifications use biotic and abiotic factors to differentiate the basic systematic units (e.g. Reschke, 1990; Schafale and Weakley, 1990), these units are best characterized as "ecosystems", or "ecosystem units". In the Virginia classification, the basic systematic units - the Associations - will be differentiated entirely on the basis of their biological characteristics, with edaphic-ecological factors used in a complementary manner. Consequently, this draft of the Virginia community classification does not require any prior formal or ad hoc classification of physiographic region, landform, or habitat. It also avoids the use of terms such as bog, marsh, and fen in community names because such terms tend to vary in meaning, or reflect an ecosystem or landform approach to classification. Judging by my use of edaphic-ecological terms in Class names, one might assume

that an ecosystem or landform approach was used; this is not the case. Each Class was defined on the basis of a specified floristic composition. Ideally, the Classes should have been named using a few diagnostic plant taxa, but because each Class encompassed many different kinds of vegetation, this was not possible.

Unavoidably, this classification focuses on vegetation, but it should not be viewed as simply a plant community classification. Among all forms of life, vascular plants are the easiest to work with because they are large and conspicuous, immotile, and superbly reflect subtle environmental conditions and site history. Classifying plant communities is therefore the key to describing and delimiting a full range of habitats utilized by animal and microbial life, at least within the vegetated Terrestrial, Palustrine, and Estuarine Systems. Principles of vegetation classification, namely those articulated by Westhoff and van der Maarel (1973) in their discussion of the Braun-Blanquet approach to community classification, are followed in the Virginia classification:

- "Plant communities are conceived as types of vegetation, recognized by their floristic composition. The full species compositions of communities better express their relationships to one another and environment than any other characteristic.
- Amongst the species that make up the floristic composition of a community, some are more sensitive expressions of a given relationship than others. For practical classification (and indication of environment) the approach seeks to use those species whose ecological relationships make them most effective indicators; these are diagnostic species (character-species, differential-species, and constant companions).
- Diagnostic species are used to organize communities into a hierarchical classification of which the association is the basic unit. The vast information with which phytosociologists deal must, of necessity, be thus organized; and the hierarchy is not merely necessary but invaluable for the understanding and communication of community relationships that it makes possible."

Character-species are more or less restricted to the stands of a given abstract community type, and therefore characterize it and indicate its environment (Westhoff and van der Maarel, 1973). These species may be used to identify syntaxa (named communities) within several levels of a classification hierarchy, from Subassociation to Class. Use of character-species is an extremely powerful tool in community classification, but very few plant species show strong fidelity to a given syntaxon, and this fact has seemed to hinder efforts to apply the Braun-Blanquet classification approach in eastern United States where the influential work of Whittaker (1953, 1962) and others emphasized continuous change in community composition along environmental gradients, resulting from the individualistic nature of species populations.

Continuous compositional change along environmental gradients does not, however, preclude the use of the Braun-Blanquet classification approach, and in fact continuous and predictable compositional change can be used to great

advantage. As long as species response along environmental and community gradients is reasonably well understood, character-species and certain differential-species may be used to classify communities. Differential-species are usually used to define only lower syntaxa (Westhoff and van der Maarel, 1973), but I have broadened their use and meaning to define Class-level syntaxa. To reflect the broadened application of the differential-species concept, I refer to these species as "conditional character-species". These plants closely resemble true character-species in their ability to identify various syntaxa, but their diagnostic ability is conditional on the absence of certain other species. Referring to these plants as "conditional character-species" and arranging them in a sequence reflecting a community gradient bring a more intuitive level of understanding to the classification approach, and facilitate the production of dichotomous keys.

The Terrestrial System:

To generate Classes within the Terrestrial System, trophic (nutrient) regime was identified as a major environmental gradient affecting floristic composition and community gradients. Five trophic regime descriptors were selected:

- 1) eutrophic
- 2) permesotrophic
- 3) mesotrophic
- 4) submesotrophic, and
- 5) oligotrophic.

Using floras, published and unpublished community literature, specimen label data, plot data, personal knowledge of plant habitat preference, and interviews with a number of botanists, I first generated a list of those plants restricted to the richest soil environments. These are true character-species and they are, almost without exception, instantly diagnostic of eutrophic communities. This method of selecting diagnostic species was very similar to that used by Reed (1988) who reviewed many floras and consulted with experts to generate lists of plant species diagnostic of wetland conditions. When the eutrophic indicators are not present in a given stand, other plants, the "conditional character-species", may become diagnostic of permesotrophic communities. These species have diagnostic qualities only when the eutrophic indicators are absent. Note that permesotrophic indicators may occur within eutrophic communities, but eutrophic indicators cannot occur in permesotrophic communities; the response of species populations along this community gradient is therefore unidirectional.

In the absence of both eutrophic and permesotrophic indicators, other plants become diagnostic of mesotrophic communities. Similarly, in the absence of eutrophic, permesotrophic, and mesotrophic indicators, certain plants become diagnostic of submesotrophic communities. Stands lacking the eutrophic, permesotrophic, mesotrophic, and submesotrophic indicators are classified as oligotrophic if any of the oligotrophic indicators are present. Finally, anomalous stands lacking the oligotrophic indicators may be assigned to a given class using other factors, e.g. soils, or simply called "unclassified".

Superimposed on the above trophic regime gradient is a light regime gradient. For this reason the mesotrophic, submesotrophic, and oligotrophic indicators were arranged by their relative shade tolerance. Stands containing only shade tolerant species will likely be forests, while stands supporting moderately shade tolerant or shade intolerant species will likely be woodland, scrub, or herbaceous-dominated types. The exception to this rule is applied to a short-term successional stage of vegetation resulting from infrequent or unusual episodes of disturbance. For example, a blown-down forest now dominated by blackberry should still be classified as forest despite the absence of trees. While this may seem awkward, it is a pragmatic solution to a difficult classification problem. Open-canopy vegetation maintained over the long-term through frequent disturbance (e.g. frequent fire, seasonal flood scour, repeated exposure to severe winds) should be regarded as distinct structural-floristic Classes. Implicit in the distinction between infrequent and frequent disturbance is the notion that the history of frequent disturbance has allowed light-demanding plants to persist at the site over a long period of time. There will certainly be instances in which disturbance factors cannot readily be characterized as infrequent or frequent, and in these cases I recommend the recognition of distinct structural-floristic Classes; this is a conservative measure that ensures that poorly known or problematic communities are not dismissed as seral stages. Users of this classification should be aware that the shade tolerant plants identified in the lists can occur in semi-forested and non-forested communities, but the shade intolerant plants will rarely, if ever, be found in forests. This implies another unidirectional gradient.

Eutrophic and permesotrophic woodland, scrub, and herbaceous vegetation will most often be the result of infrequent disturbance, such as blow-down. No light-demanding plants faithful to these nutrient regimes could be identified. Open canopy eutrophic and permesotrophic communities are therefore not recognized as distinct Classes at the present time, but rather as seral stages of the forests. If future field work documents naturally occurring open canopy eutrophic and permesotrophic communities in Virginia, the classification can be adjusted accordingly.

Lists of character-species and conditional character-species were derived from the Atlas of the Virginia Flora (Harvill *et al.*, 1986), but nomenclature followed Kartesz and Kartesz (1980). A species was selected for a list only if its habitat preference was reasonably well known, and if it had distinct diagnostic value for the purpose of the classification. Approximately 900 diagnostic species were selected. Species of wide ecological tolerance, such as those growing in both upland and wetland soils, were generally excluded from consideration; they did not meet fidelity criteria at the System level. Some of the excluded species will, however, have diagnostic value in differentiating the lower syntaxa when these are classified in the future.

The Estuarine System:

Halophytes were used to define vegetated classes within the Estuarine System. A very few of the species also occur in inland saline wetlands; such wetlands should be classified within the Palustrine System for the time being and regarded as a rare, or anomalous condition.

The Palustrine System:

Classes within the Palustrine System were identified through the character-species/conditional character-species approach. I have not supplied detailed instructions for separating the Palustrine System from the Terrestrial because in most cases this difference will be readily apparent. However, when dealing with problematic transitional zones, I refer the user to Reed's (1988) list of plant species that occur in Northeastern wetlands. Only those plants with indicator status of Obligate or Facultative Wetland should be regarded as diagnostic of the Palustrine System, for the purpose of the Virginia classification. If necessary, other factors such as soils or flooding regime may also be used to assign stands to the Palustrine System. The Palustrine System of the Virginia classification has a broader definition than that used in Cowardin *et al.* (1979). The Virginia definition includes all freshwater (to oligohaline) wetland and aquatic environments supporting non-halophytic vascular plant life, thereby encompassing parts of Cowardin's Lacustrine, Riverine, and Estuarine Systems. Note that the Cowardin definition of the Estuarine System relies upon an average salinity measure (0.5 ppt.), and not halophytic plants, to define the upstream or landward limit of the System. Determining this salinity measure in the field is difficult, and as a consequence, some wetlands classified within Cowardin's Estuarine System support non-halophytic vegetation.

Hydrologic regime was identified as a major factor influencing floristic composition at the Class level. Four hydrologic regime descriptors were subsequently identified:

- 1) saturated,
- 2) seasonally flooded,
- 3) semipermanently flooded (including permanently flooded environments supporting emergents), and
- 4) permanently flooded (lacking emergents).

These descriptors were derived from Cowardin *et al.* (1979), but I've given numbers 2 and 3 broader meaning. Number 2 encompasses Cowardin's temporarily flooded category, while number 3 includes the intermittently exposed category and any permanently flooded environments supporting emergent vegetation. This was done out of practical necessity; too often the Cowardin hydrologic regime categories cannot be recognized in the field. Description number 4 also deviates from the Cowardin definition in the sense that it is exclusively reserved for those permanently flooded environments lacking emergents, i.e. communities composed entirely of submergents and/or floating-leaved species.

Plant species indicative of trophic regime were also used to generate Classes within the Palustrine System. Unlike the Terrestrial System, where five trophic regime levels were identified, only two trophic regime levels were selected for use in the Palustrine System. This difference in approach seemed unavoidable, given the fact that fewer plant species were strictly diagnostic of trophic regime within the Palustrine System. The two trophic regime descriptors were:

- 1) oligotrophic, and
- 2) eutrophic.

Note that the each of the above terms now connotes a relatively wide range of fertility conditions; use of these terms in the Terrestrial System is much more restrictive. While this might cause some confusion, it maintains a level of nomenclatural continuity between Systems.

Lists of character-species and conditional character-species serve to identify and differentiate Classes within the Palustrine System. As with the Terrestrial System, some of the lists are subdivided into shade tolerant, moderately shade tolerant, and shade intolerant species to aid in distinguishing the various structural types.

Keys to the Classes of the Terrestrial, Estuarine, and Palustrine Systems were developed. The character-species and conditional character-species that need to be examined when using the keys are given in appendices.

CONCLUDING REMARKS:

Character-species and conditional character-species play an important role in the classification of Virginia's indigenous vegetation. Relatively large lists of these species have been generated, and most stands of natural vegetation can be readily classified to the level of Class using this approach. The basic requirement is that a reasonably complete species list from a representative sample of the vegetation is collected and interpreted using the keys. Recommended plot size for forests and woodlands is 400 sq. m., and for scrub and herbaceous communities, 100 sq. m. As stand data sets accumulate and are analyzed, the Associations should become apparent.

The lists of character-species and conditional character-species serve another important purpose. They give an indication of the classification and inventory work which lies ahead. Each listed species needs to be observed in the field, and recorded as a component of a given community. This will ensure complete coverage of the final draft classification. Refinements and suggestions are definitely needed, and in fact, I eagerly await word of any unusual communities that aren't readily classified under the present system. Natural vegetation is exceedingly complex and trying to make sense of it using feeble human constructs will no doubt be a long, frustrating, and humbling endeavor.

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A KEY TO VEGETATED TERRESTRIAL COMMUNITY CLASSES

(Note: All Class names are understood to represent the Terrestrial System).

- a. Eutrophic character-species (Appendix T1) present. [EUTROPHIC FOREST]
- a. Eutrophic character-species absent.

- b. Permesotrophic conditional character-species (Appendix T2) present. [PERMESOTROPHIC FOREST]
- b. Permesotrophic conditional character-species absent.

- c. Mesotrophic conditional character-species (Appendix T3) present.
 - d. Moderately shade tolerant or shade intolerant species (Appendices T3, T4, & T5) present and conspicuous; woodland, scrub and herbaceous communities.
 - e. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [MESOTROPHIC WOODLAND]
 - e. Trees absent or cover less than 5% of the area.

 - f. Woody species between 1 and 6 m tall (scrub) cover more than 5% of the area. [MESOTROPHIC SCRUB]
 - f. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [MESOTROPHIC HERBACEOUS VEGETATION]
 - d. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [MESOTROPHIC FOREST]
- c. Mesotrophic conditional character-species absent.

- g. Submesotrophic conditional character-species (Appendix T4) present.
 - h. Moderately shade tolerant or shade intolerant species (Appendices T4 & T5) present and conspicuous; woodland, scrub and herbaceous communities.
 - i. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [SUBMESOTROPHIC WOODLAND]
 - i. Trees absent or cover less than 5% of the area.

 - j. Woody species between 1 and 6 m tall (scrub) cover more than 5% of the area. [SUBMESOTROPHIC SCRUB]
 - j. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [SUBMESOTROPHIC HERBACEOUS VEGETATION]
 - h. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [SUBMESOTROPHIC FOREST]
- g. Submesotrophic conditional character-species absent.

- k. Oligotrophic conditional character-species (Appendix T5) present.
 - l. Moderately shade tolerant or shade intolerant species present and conspicuous; woodland, scrub and herbaceous communities.
 - m. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [OLIGOTROPHIC WOODLAND]
 - m. Trees absent or cover less than 5% of the area.

 - n. Woody species between 1 and 6 m tall (scrub) cover more than 5% of the area. [OLIGOTROPHIC SCRUB]
 - n. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [OLIGOTROPHIC HERBACEOUS VEGETATION]
 - l. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [OLIGOTROPHIC FOREST]
- k. Oligotrophic indicators absent. Use other factors (e.g. soils) to assign the stand to one of the above classes. If this isn't possible, refer to the stand as: [UNCLASSIFIED TERRESTRIAL COMMUNITY]

A KEY TO VEGETATED ESTUARINE COMMUNITY CLASSES

- a. Estuarine character-species (Appendix E1) present.
 - b. Woody species between 1 and 6 m. tall (scrub) cover more than 5% of the area. [ESTUARINE SCRUB]
 - b. Scrub vegetation absent or cover less than 5% of the area.
 - c. Herbaceous species other than submergents present. [ESTUARINE HERBACEOUS VEGETATION]
 - c. The only vascular plants present are submergents such as Ruppia maritima and Zostera marina. [ESTUARINE SUBMERGENT VEGETATION]
- a. Estuarine character-species absent. Consider whether the stand could be classified using the Palustrine System key, or refer to the stand as: [UNCLASSIFIED ESTUARINE COMMUNITY]

KEYS TO THE VEGETATED PALUSTRINE COMMUNITY CLASSES

(Note: All Class names are understood to represent the Palustrine System. Also, use of the terms, eutrophic and oligotrophic, is in the broad sense, each term encompassing roughly half of the range of community trophic conditions).

Character-species indicating saturated, eutrophic conditions (Appendix P1) present.	EUTROPHIC SATURATED Key P1
Conditional character-species indicating saturated, oligotrophic conditions (Appendix P2) present.	OLIGOTROPHIC SATURATED Key P2
Conditional character-species indicating semipermanently flooded, eutrophic conditions (Appendix P3) present.	EUTROPHIC SEMIPERMANENTLY FLOODED Key P3
Conditional character-species indicating semipermanently flooded, oligotrophic conditions (Appendix P4) present.	OLIGOTROPHIC SEMIPERMANENTLY FLOODED Key P4
Conditional character-species indicating seasonally flooded, eutrophic conditions (Appendix P5) present.	EUTROPHIC SEASONALLY FLOODED Key P5
Conditional character-species indicating seasonally flooded, oligotrophic conditions (Appendix P6) present.	OLIGOTROPHIC SEASONALLY FLOODED Key P6
Conditional character-species indicating permanently flooded conditions (Appendix P7) present (submergent/floating-leaved vegetation).	[SUBMERGENT/FLOATING-LEAVED VEGETATION]
None of the above species present. Use other factors to assign the stand to a Class. If this isn't possible, refer to the stand as:	[UNCLASSIFIED PALUSTRINE COMMUNITY]

Key P1: Eutrophic Saturated

- a. Moderately shade tolerant or shade intolerant species (Appendices P1 & P2) present and conspicuous; woodland, scrub, and herbaceous communities.
- b. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [EUTROPHIC SATURATED WOODLAND]
- b. Trees absent or cover less than 5% of the area.
- c. Woody species between 1 and 6 m. tall (scrub) cover more than 5% of the area. [EUTROPHIC SATURATED SCRUB]
- c. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [EUTROPHIC SATURATED HERBACEOUS VEGETATION]
- a. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [EUTROPHIC SATURATED FOREST]

Key P2: Oligotrophic Saturated

- a. Moderately shade tolerant or shade intolerant species present and conspicuous; woodland, scrub, and herbaceous communities.
- b. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [OLIGOTROPHIC SATURATED WOODLAND]
- b. Trees absent or cover less than 5% of the area.
- c. Woody species between 1 and 6 m. tall (scrub) cover more than 5% of the area. [OLIGOTROPHIC SATURATED SCRUB]
- c. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [OLIGOTROPHIC SATURATED HERBACEOUS VEGETATION]
- a. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [OLIGOTROPHIC SATURATED FOREST]

Key P3: Eutrophic Semipermanently Flooded

- a. Moderately shade tolerant or shade intolerant species (Appendices P3 & P4) present and conspicuous; woodland, scrub, and herbaceous communities.
- b. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [EUTROPHIC SEMIPERMANENTLY FLOODED WOODLAND]
- b. Trees absent or cover less than 5% of the area.
- c. Woody species between 1 and 6 m. tall (scrub) cover more than 5% of the area. [EUTROPHIC SEMIPERMANENTLY FLOODED SCRUB]
- c. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [EUTROPHIC SEMIPERMANENTLY FLOODED HERBACEOUS VEGETATION]
- a. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [EUTROPHIC SEMIPERMANENTLY FLOODED FOREST]

Key P4: Oligotrophic Semipermanently Flooded

- a. Moderately shade tolerant or shade intolerant species present and conspicuous; woodland, scrub, and herbaceous communities.
- b. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [OLIGOTROPHIC SEMIPERMANENTLY FLOODED WOODLAND]
- b. Trees absent or cover less than 5% of the area.
- c. Woody species between 1 and 6 m. tall (scrub) cover more than 5% of the area. [OLIGOTROPHIC SEMIPERMANENTLY FLOODED SCRUB]
- c. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [OLIGOTROPHIC SEMIPERMANENTLY FLOODED HERBACEOUS VEGETATION]
- a. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [OLIGOTROPHIC SEMIPERMANENTLY FLOODED FOREST]

Key P5: Eutrophic Seasonally Flooded

- a. Moderately shade tolerant or shade intolerant species (Appendices P5 & P6) present and conspicuous; woodland, scrub, and herbaceous communities.
- b. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [EUTROPHIC SEASONALLY FLOODED WOODLAND]
- b. Trees absent or cover less than 5% of the area.
- c. Woody species between 1 and 6 m. tall (scrub) cover more than 5% of the area. [EUTROPHIC SEASONALLY FLOODED SCRUB]
- c. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [EUTROPHIC SEASONALLY FLOODED HERBACEOUS VEGETATION]
- a. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [EUTROPHIC SEASONALLY FLOODED FOREST]

Key P6: Oligotrophic Seasonally Flooded

- a. Moderately shade tolerant or shade intolerant species present and conspicuous; woodland, scrub, and herbaceous communities.
- b. Trees present (covering at least 5% of the area), but significant gaps exist among tree crowns. [OLIGOTROPHIC SEASONALLY FLOODED WOODLAND]
- b. Trees absent or cover less than 5% of the area.
- c. Woody species between 1 and 6 m. tall (scrub) cover more than 5% of the area. [OLIGOTROPHIC SEASONALLY FLOODED SCRUB]
- c. Scrub vegetation absent or covers less than 5% of the area; herbaceous species prevalent. [OLIGOTROPHIC SEASONALLY FLOODED HERBACEOUS VEGETATION]
- a. Moderately shade tolerant or shade intolerant species absent or inconspicuous; trees form a more or less continuous cover; forest. [OLIGOTROPHIC SEASONALLY FLOODED FOREST]

Appendix T1 Character-species of the eutrophic forest class

SHADE TOLERANT

Acer nigrum
Blephila ciliata
Carex albursina
Carex careyana
Carex hitchcockiana
Carex plantaginea
Diplazium pycnocarpon
Dryopteris goldiana
Erigenia bulbosa
Erythronium albidum
Floerkea proserpinacoides
Hydrophyllum macrophyllum
Jeffersonia diphylla
Matteuccia struthiopteris
Meehanian cordata
Mertensia virginica
Miliun effusum
Phacelia bipinnatifida
Smilacina stellata
Trillium cernuum
Trillium sessile
Uvularia grandiflora

Appendix T2 Conditional character-species of the permesotrophic forest class

SHADE TOLERANT

Allium tricoccum
Carex pedunculata
Carex sparganioides
Caulophyllum thalictroides
Chaerophyllum procumbens
Delphinium tricorne
Diarrhena americana
Dicentra canadensis
Dicentra cucullaria
Disporum maculatum
Gymnocladus dioica
Hepatica nobilis v. acuta
Hybanthus concolor
Hydrastis canadensis
Hydrophyllum canadense
Panax quinquefolius
Phlox divaricata
Phlox stolonifera
Polemonium reptans
Schizachne purpurascens
Trillium grandiflorum
Viola canadensis
Viola rostrata
Viola striata

Appendix T3 Conditional character-species of mesotrophic classes

SHADE TOLERANT

Acer floridanum
Aconitum reclinatum
Actaea pachypoda
Adiantum pedatum
Allium canadense
Aplectrum hyemale
Aralia racemosa
Aristolochia macrophylla
Asarum canadense
Asimina triloba
Astilbe biternata
Botrychium virginianum
Carex amphibola
Carex gracillima
Carex jamesii
Cimicifuga americana
Cimicifuga racemosa
Claytonia caroliniana
Claytonia virginica
Collinsonia canadensis
Cryptotaenia canadensis
Dentaria diphylla
Dentaria laciniata
Deparia acrostichoides
Desmodium cuspidatum
Desmodium glutinosum
Diphylleia cymosa
Dirca palustris
Dryopteris celsa
Festuca obtusa
Fraxinus quadrangulata
Galearia spectabilis
Geranium maculatum
Helianthus decapetalus
Hepatica nobilis v. obtusa
Hydrophyllum virginianum
Hystrix patula
Impatiens pallida
Laportea canadensis
Magnolia tripetala
Menispermum canadense
Mitella diphylla
Monarda clinopodia
Osmorhiza claytoni
Osmorhiza longistylis
Penstemon laevigatus
Polymnia canadensis
Polymnia uvedalia
Rubus odoratus
Rudbeckia laciniata
Sanguinaria canadensis
Sanicula canadensis
Sanicula gregaria
Sanicula marilandica
Solidago flexicaulis
Staphylea trifolia
Thalictrum coriaceum
Thalictrum dioicum
Thelypteris hexagonoptera
Tilia heterophylla
Trillium sulcatum
Triosteum angustifolium
Triosteum aurantiacum
Triosteum perfoliatum

MODERATELY SHADE TOLERANT

Adlumia fungosa
Astragalus canadensis
Baptisia australis
Blephilia hirsuta
Camassia scilloides
Campanula americana
Carex oligocarpa
Cassia marilandica
Clematis occidentalis
Eupatorium sessilifolium
Hackelia virginiana
Hexalectris spicata
Lathyrus venosus
Liatris spicata
Onosmodium hispidissimum
Oryzopsis racemosa
Pycnanthemum incanum
Salvia urticifolia
Silphium terebinthinaceum
Solidago rigida
Uniola latifolia
Zanthoxylum americanum

Appendix T4 Conditional character-species of submesotrophic classes

SHADE TOLERANT

Acer saccharum
 Ageratina altissima
 Anemone lancifolia
 Anemone virginiana
 Angelica triquinata
 Antennaria plantaginifolia
 Arabis canadensis
 Arabis laevigata
 Arisaema triphyllum
 Asclepias exaltata
 Asclepias quadrifolia
 Asplenium resiliens
 Aster macrophyllus
 Athyrium asplenoides
 Betula papyrifera
 Brachyeletrum erectum
 Callicarpa americana
 Calycanthus floridus
 Carex aestivalis
 Carex digitalis
 Carex laxiculmis
 Carex laxiflora
 Carex nigromarginata
 Carex platyphylla
 Carex virescens
 Carex willdenowii
 Carpinus caroliniana
 Carya cordiformis
 Chrysogonum virginianum
 Clintonia umbellulata
 Conopholis americana
 Coreopsis auriculata
 Cornus alternifolia
 Cunilla organoides
 Cynophyllus fraseri
 Cynoglossum virginianum
 Dentaria heterophylla
 Desmodium nudiflorum
 Desmodium pauciflorum
 Desmodium rotundifolium
 Dichantheium latifolium
 Dioscorea villosa
 Disporum lanuginosum
 Galium circaezens
 Galium concinnum
 Galium latifolium
 Hedyotis purpurea
 Heracleum lanatum
 Hieracium paniculatum
 Hydrangea arborescens
 Ligusticum canadense
 Liparis liliifolia
 Lonicera canadensis
 Luzula acuminata
 Magnolia acuminata
 Obolaria virginica
 Ostrya virginiana
 Oxalis violacea
 Phryma leptostachya
 Platanthera orbiculata
 Platanthera viridis v. bracteata
 Poa cuspidata
 Podophyllum peltatum
 Polygonatum biflorum
 Polygonatum pubescens
 Polystichum acrostichooides
 Prenanthes alba
 Pyricularia pubera
 Scirpus verecundus
 Sedum ternatum
 Senecio obovatus
 Silene stellata
 Smilacina racemosa
 Solidago arguta
 Solidago caesia
 Solidago curtisii
 Sphenopholis nitida
 Stellaria pubera
 Styrax americana
 Taenidia integerrima
 Taxus canadensis
 Thalictrum thalictroides
 Thaspium barbinode
 Thaspium trifoliatum
 Tiarella cordifolia
 Uvularia perfoliata
 Viburnum acerifolium
 Viola hastata
 Viola rotundifolia
 Viola triloba

MODERATELY SHADE TOLERANT

Agropyron trachycaulum
 Aquilegia canadensis
 Arabis patens
 Aster infirmus
 Aster oblongifolius
 Aureolaria flava
 Berberis canadensis
 Bouteloua curtipendula
 Bromus pubescens
 Carex cephalophora
 Carex eburnea
 Carex meadii
 Celastrus scandens
 Clematis viorna
 Cornus rugosa
 Cuscuta coryli
 Cystopteris fragilis
 Echinacea laevigata
 Fragaria vesca
 Helianthus divaricatus
 Helianthus strumosus
 Lithospermum canescens
 Lonicera dioica
 Muhlenbergia sobolifera
 Muhlenbergia tenuifolia
 Myosotis verna
 Parthenium auriculatum
 Passiflora lutea
 Pellaea atropurpurea
 Penstemon calycosus
 Penstemon hirsutus
 Phacelia dubia
 Polygala senega
 Ranunculus fascicularis
 Ranunculus micranthus
 Rhamnus caroliniana
 Rudbeckia triloba
 Silene virginica
 Silphium trifoliatum
 Solidago ulmifolia
 Tradescantia ohioensis
 Viburnum rafinesquianum
 Woodsia obtusa
 Zizia aptera

SHADE INTOLERANT

Aster grandiflorus
 Atriplex arenaria
 Buchnera americana
 Cakile edentula
 Castilleja coccinea
 Cirsium virginianum
 Coreopsis tripteris
 Eryngium yuccifolium
 Helianthus angustifolius
 Helianthus atrorubens
 Polygonum glaucum
 Psoralea psoralioides
 Salsola kali
 Sporobolus asper

Appendix T5 Conditional character-species of oligotrophic classes

SHADE TOLERANT

Acer pensylvanicum
Amianthium muscaetoxicum
Antennaria virginica
Asimina parviflora
Aster acuminatus
Aster divaricatus
Betula lenta
Buckleya distichophylla
Carex brunnescens
Carex debilis
Carex pensylvanica
Carya glabra
Castanea dentata
Castanea pumila
Chamaelirium luteum
Chimaphila maculata
Chimaphila umbellata
Clethra acuminata
Clintonia borealis
Comandra umbellata
Convallaria montana
Corallorhiza odontorhiza
Coreopsis major
Cypripedium acaule
Deschampsia flexuosa
Draba ramosissima
Dryopteris campyloptera
Dryopteris marginalis
Epigaea repens
Galax urceolata
Gaultheria procumbens
Goodyera pubescens
Gymnocarpium dryopteris
Hamamelis virginiana
Hexastylis virginica
Ilex vomitoria
Isotria medeoloides
Isotria verticillata
Lycopodium annotinum
Lycopodium clavatum
Lycopodium digitatum
Lycopodium obscurum
Lycopodium obscurum v. dendroideum
Lycopodium tristachyum
Lysimachia quadrifolia
Malaxis unifolia
Medeola virginiana
Melampyrum lineare
Melanthium hybridum
Menziesia pilosa
Oxalis acetosella
Oxydendrum arboreum
Pieris floribunda
Polypodium virginianum
Prenanthes trifoliata
Pteridium aquilinum
Quercus coccinea
Quercus marilandica
Quercus montana
Quercus velutina
Rhododendron calendulaceum
Rhododendron periclymenoides
Rhododendron prinophyllum
Sassafras albidum
Symplocos tinctoria
Tipularia discolor
Trillium undulatum
Tsuga caroliniana
Uvularia pudica
Uvularia sessilifolia
Vaccinium arboreum
Vaccinium elliotii
Vaccinium erythrocarpum
Vaccinium stamineum
Vaccinium tenellum
Viburnum lantanoides

MODERATELY SHADE TOLERANT

Ageratina aromatica
Allium cernuum
Angelica venenosa
Arabis serotina
Aristida lanosa
Aster linariifolius
Aster undulatus
Aureolaria laevigata
Aureolaria pedicularia
Baptisia tinctoria
Calamagrostis porteri
Calystegia spithamea
Campanula divaricata
Carex emmonsii
Carex polymorpha
Carex umbellata
Carya pallida
Centrosema virginianum
Cheilanthes lanosa
Chrysopsis gossypina
Clematis albicoma
Clematis ochroleuca
Clematis viticaulis
Cnidocolus stimulosus
Comptonia peregrina
Coreopsis verticillata
Danthonia compressa
Desmodium paniculatum
Dicentra eximia
Diervilla lonicera
Eriogonum alleni
Euphorbia ipecacuanhae
Galactia regularis
Gaylussacia dumosa
Gymnopogon ambiguus
Helianthemum canadense
Heuchera americana
Iris verna
Kuhnia eupatorioides
Liatris graminifolia
Lilium philadelphicum
Lupinus perennis
Lycopodium prophyllum
Lycopodium selago
Ophioglossum engelmannii
Paronychia canadensis
Paxistima canbyi
Pinus echinata
Pinus palustris
Pinus pungens
Pinus virginiana
Pityopsis graminifolia
Polygonum cilinode
Prenanthes roanensis
Pseudotaenidia montana
Pyxidantha barbulate
Quercus ilicifolia
Quercus incana
Quercus laevis
Quercus margarettae
Quercus virginiana
Rhus aromatica
Saxifraga michauxii
Sedum telephoides
Selaginella rupestris
Senecio antennariifolius
Senecio pauperculus
Silene caroliniana
Smilax tamnoides
Solidago bicolor
Solidago odora
Solidago roanensis
Sorbus americana
Spiraea betulifolia ssp. corymbosa
Sporobolus clandestinus
Stipa avenacea
Stylosanthes biflora
Tephrosia virginiana
Tradescantia rosea v. graminea
Trifolium virginicum
Vaccinium angustifolium
Vaccinium cressifolium
Vaccinium myrtilloides
Viburnum rufidulum
Viola pedata
Woodstia ilvensis
Woodstia scopulina
Xerophyllum asphodeloides
Zigadenus glaucus
Zigadenus leimanthoides

SHADE INTOLERANT

Agrostis elliottiana
Ammophila breviligulata
Anaphalis margaritacea
Andropogon gerardii
Arabis lyrata
Aralia hispida
Arctostaphylos uva-ursi
Aristida curtissii
Aristida dichotoma
Aristida purpurascens
Aristida tuberculosa
Asclepias amplexicaulis
Asclepias verticillata
Asplenium montanum
Aster spectabilis
Bulbostylis capillaris
Bulbostylis ciliatifolia
Carex silicea
Carphephorus bellidifolius
Carphephorus tomentosus
Cenchrus tribuloides
Cirsium horridulum
Corydalis sempervirens
Cyperus granitophilus
Cyperus grayi
Danthonia sericea
Danthonia spicata
Desmodium sessilifolium
Desmodium strictum
Diamorpha smallii
Eragrostis hirsuta
Eragrostis refracta
Eragrostis spectabilis
Euphorbia ammannioides
Euphorbia polygonifolia
Festuca octoflora
Haplopappus divaricatus
Helianthemum bicknellii
Helianthus hirsutus
Hudsonia tomentosa
Isanthus brachiatus
Juncus secundus
Juniperus communis
Krigia biflora
Krigia montana
Krigia virginica
Lechea maritima
Lechea racemulosa
Lechea villosa
Leptoloma cognatum
Liatris aspera
Liatris turgida
Manfreda virginica
Minuartia glabra
Minuartia groenlandica
Minuartia michauxii
Minuartia patula
Muhlenbergia capillaris
Muhlenbergia cuspidata
Oenothera humifusa
Opuntia humifusa
Panicum amarulum
Panicum amarum
Panicum flexile
Paronychia argyrocoma
Paronychia fastigiata
Paronychia riparia
Polygala verticillata
Polygonella articulata
Polygonella polygama
Portulaca smallii
Potentilla tridentata
Ruellia humilis
Salix tristis
Schizachyrium scoparium
Scutellaria parvula
Silphium compositum
Sisyrinchium albidum
Solidago racemosa
Solidago spathulata ssp. rendii
Spiranthes tuberosa
Sporobolus vaginiflorus
Stipulicida setacea
Stylisma humistrata
Talinum teretifolium
Triplasis purpurea
Uniola paniculata
Zanthoxylum clava-herculis

Appendix E1 Character-species of vegetated classes within the estuarine system

Agalinis maritima
Aster tenuifolius
Borrchia frutescens
Distichlis spicata
Fimbristylis castanea
Iva frutescens
Juncus gerardii
Juncus roemerianus
Kosteletzkya virginica
Lythrum lineare
Puccinellia fasciculata
Ruppia maritima
Salicornia bigelovii
Salicornia europea
Salicornia virginica
Scirpus maritimus
Scirpus robustus
Sesuvium maritimum
Spartina alterniflora
Spartina cynosuroides
Spartina patens
Spergularia marina
Suaeda linearis
Suaeda maritima
Zostera marina

Appendix P1 Character-species of eutrophic saturated classes

SHADE TOLERANT

Carex scabrata
Hexastylis lewisii
Ranunculus septentrionalis

MODERATELY SHADE TOLERANT

Caltha palustris
Carex stipata
Carex trichocarpa
Iris versicolor
Lobelia siphilitica
Myosotis laxa
Veronica americana
Veronica anagallis-aquatica

SHADE INTOLERANT

Acorus calamus
Carex lacustris
Carex lanuginosa
Carex tetanica
Cyperus haspan
Eleocharis rostellata
Juncus balticus
Lathyrus palustris
Lysimachia quadriflora
Lythrum alatum
Mentha arvensis
Pedicularis lanceolata
Sabatia dodecandra

Appendix P2 Conditional character-species of oligotrophic saturated classes

SHADE TOLERANT

Cardamine bulbosa
Cardamine rotundifolia
Carex collinsii
Carex laevivaginata
Carex leptalea
Carex prasina
Carex styloflexa
Chamaecyparis thyoides
Chrysosplenium americanum
Cynilla racemiflora
Dalibarda repens
Fraxinus nigra
Hedyotis michauxii
Helonias bullata
Listera smallii
Lyonia lucida
Ophioglossum vulgatum
Parnassia asarifolia
Platanthera clavellata
Platanthera psycodes
Poa paludigena
Saxifraga micranthidifolia
Saxifraga pensylvanica
Solidago patula
Symplocarpus foetidus
Thalictrum clavatum
Thelypteris simulata
Toxicodendron vernix
Veratrum viride
Viburnum nudum
Viola walteri

MODERATELY SHADE TOLERANT

Alnus incana ssp. *rugosa*
Asclepias rubra
Aster radula
Campanula aparinooides
Carex atlantica
Carex bullata
Carex trisperma
Carex venusta
Chelone cuthbertii
Cirsium muticum
Conioselinum chinense
Cypripedium reginae
Drosera rotundifolia
Eleocharis tortilis
Equisetum sylvaticum
Parnassia grandifolia
Platanthera ciliaris
Poa palustris
Rhamnus alnifolia
Sanguisorba canadensis
Sarracenia purpurea
Selaginella apoda
Solidago uliginosa
Sphenopholis pensylvanica
Zenobia pulverulenta

SHADE INTOLERANT

Aletris aurea
Calamagrostis cinnoides
Calopogon tuberosus
Carex buxbaumii
Carex conoidea
Carex hystericina
Carex interior
Carex prairea
Centella asiatica
Cladium mariscoides
Cleistes divaricata
Dichromena colorata
Drosera brevifolia
Drosera capillaris
Epilobium leptophyllum
Equisetum fluviatile
Eriocaulon decangulare
Eriophorum virginicum
Eryngium aquaticum
Filipendula rubra
Fimbristylis puberula
Iris prismatica
Juncus abortivus
Juncus nodosus
Juncus pelocarpus
Lilium catesbaei
Lobelia georgiana
Lycopodium alopecuroides
Lycopodium appressum
Lycopodium inundatum
Menyanthes trifoliata
Muhlenbergia glomerata
Nasturtium officinale
Platanthera blephariglottis
Platanthera cristata
Pogonia ophioglossoides
Polygala cruciata
Rhynchospora alba
Rhynchospora capillacea
Sabatia calycina
Sarracenia flava
Scirpus expansus
Scleria reticularis
Scleria verticillata
Sclerolepis uniflora
Tofieldia glutinosa
Tofieldia racemosa
Utricularia cornuta
Utricularia juncea
Xyris ambigua
Xyris difformis
Xyris jupicai
Xyris torta
Zigadenus densus
Zigadenus glaberrimus

Appendix P3 Conditional character-species of eutrophic semipermanently flooded classes

SHADE TOLERANT

Cardamine longii
Fraxinus caroliniana
Nyssa aquatica
Peltandra virginica
Ranunculus flabellaris
Ranunculus laxicaulis
Rumex verticillatus
Triadenum walteri

MODERATELY SHADE TOLERANT

Azola caroliniana
Carex decomposita
Carex hyalinolepis
Echinodorus cordifolius
Heteranthera reniformis
Hydrocotyle ranunculoides
Limnobium spongia
Pontederia cordata
Ranunculus sceleratus
Sium suave

SHADE INTOLERANT

Aeschynomene virginica
Amaranthus cannabinus
Asclepias lanceolata
Aster subulatus
Bacopa inominata
Bidens coronata
Carex alata
Carex torta
Cladium jamaicense
Cyperus brevifolioides
Echinochloa walteri
Elatine minima
Elatine triandra
Eleocharis halophila
Eriocaulon parkeri
Isoetes riparia
Juncus acuminatus
Justicia americana
Lemna trisulca
Lilaeopsis carolinensis
Lilaeopsis chinensis
Lobelia elongata
Nelumbo lutea
Nuphar luteum ssp. sagittifolium
Physostegia purpurea
Sacciolepis striata
Sagittaria calycina v. spongiosa
Sagittaria rigida
Sagittaria subulata
Scirpus acutus
Sparganium eurycarpum
Spirodella polyrhiza
Wolffiella gladiata
Zizania aquatica

Appendix P4 Conditional character-species of oligotrophic semipermanently flooded classes

SHADE TOLERANT

Itea virginica
Taxodium distichum

MODERATELY SHADE TOLERANT

Carex comosa
Hottonia inflata
Hydrocotyle umbellata
Hydrocotyle verticillata
Orontium aquaticum

SHADE INTOLERANT

Bidens laevis
Brasenia schreberi
Carex canescens
Dulichium arundinaceum
Eleocharis equisetoides
Eleocharis quadrangulata
Eleocharis robbinsii
Eriocaulon septēngulare
Glyceria acutiflora
Glyceria septentrionalis
Isoetes engelmannii
Panicum hemitomon
Polygonum amphibium
Polygonum hydropiperoides
Sagittaria graminea
Scirpus ancistrochaetus
Scirpus subterminalis
Scirpus tabernaemontanii
Scirpus torreyi

Appendix P5 Conditional character-species of eutrophic seasonally flooded classes

SHADE TOLERANT

Arisaema dracontium
Carex crus-corvi
Carex frankii
Carex grayi
Carex oxylepis
Carex squarrosa
Carex typhina
Carya aquatica
Commelina virginica
Cornus foemina
Mimulus alatus
Populus heterophylla
Quercus bicolor
Quercus lyrata
Saururus cernuus
Scirpus divaricatus

MODERATELY SHADE TOLERANT

Carex gigantea
Hibiscus moscheutos
Justicia ovata v. *lanceolata*
Penthorum sedoides
Salix caroliniana
Salix nigra

SHADE INTOLERANT

Axonopus furcatus
Cyperus erythrorhizos
Cyperus filicinus
Cyperus strigosus
Eclipta alba
Eragrostis frankii
Eragrostis hypnoides
Glyceria grandis
Juncus torreyi
Lippia lanceolata
Phalaris arundinacea
Rorippa palustris
Scirpus atrovirens
Scirpus fluviatilis
Scirpus pendulus

Appendix P6 Conditional character-species of oligotrophic seasonally flooded classes

SHADE TOLERANT

Carex crinita
 Carex louisianica
 Carex lupulina
 Cinna arundinacea
 Cornus amomum
 Quercus palustris

MODERATELY SHADE TOLERANT

Carex glaucescens
 Carex jorii
 Carex walteriana
 Glyceria melicaria
 Iris virginica
 Juncus effusus
 Scirpus cyperinus

SHADE INTOLERANT

Boltonia asteroides
 Calamagrostis canadensis
 Carex albolutescens
 Carex barrattii
 Cyperus dentatus
 Drosera intermedia
 Eleocharis baldwinii
 Eleocharis flavescens
 Eleocharis melanocarpa
 Eleocharis tricostata
 Eleocharis tuberculosa
 Erigeron vernus
 Eupatorium leucolepis
 Eupatorium recurvans
 Fimbristylis annua
 Fimbristylis autumnalis
 Fuirena pumila
 Glyceria canadensis v. laxa
 Helenium virginicum
 Juncus brevicaudatus
 Juncus caesariensis
 Juncus canadensis
 Juncus repens
 Juncus scirpoides
 Lachnocaulon anceps
 Lindernia anagallidea
 Lipocarpha maculata
 Lobelia puberula
 Ludwigia brevipes
 Ludwigia sphaerocarpa
 Lysimachia hybrida
 Panicum rigidulum
 Proserpinaca palustris
 Proserpinaca pectinata
 Pycnanthemum flexuosum
 Rhynchospora caduca
 Rhynchospora cephalantha
 Rhynchospora corniculata
 Rhynchospora macrostachya
 Scirpus purshianus

Appendix P7 Conditional character-species of the submergent/floating-leaved class

Cabomba caroliniana
Callitriche heterophylla
Ceratophyllum demersum
Ceratophyllum muricatum
Elodea canadensis
Elodea nuttallii
Heteranthera dubia
Myriophyllum heterophyllum
Myriophyllum humile
Myriophyllum spicatum
Najas flexilis
Najas gracillima
Najas guadalupensis
Nymphoides aquatica
Podostemon ceratophyllum
Potamogeton crispus
Potamogeton diversifolius
Potamogeton epihydrus
Potamogeton foliosus
Potamogeton illinoensis
Potamogeton nodosus
Potamogeton oakesianus
Potamogeton pectinatus
Potamogeton perfoliatus
Potamogeton pulcher
Potamogeton pusillus
Potamogeton spirilus
Potamogeton tennesseensis
Potamogeton zosteriformis
Utricularia biflora
Utricularia fibrosa
Utricularia inflata
Utricularia purpurea
Utricularia radiata
Utricularia vulgaris
Vallisneria americana
Zannichellia palustris

