

**Biological and Natural Community Analyses of Riparian
Communities Within the Coastal Zone of Kent County, Delaware
(Task No. 94-9)**

FINAL REPORT

Submitted to:

DELAWARE COASTAL MANAGEMENT PROGRAM

February 1995

by

**Delaware Natural Heritage Program
Division of Fish and Wildlife
Department of Natural Resources and Environmental Control
4876 Haypoint Landing Rd, Smyrna, DE 19977, (302) 653-2880**

Principle Investigators:

**Keith Clancy.....Community Ecologist
Christopher M. Heckscher.....Zoologist
William McAvoy.....Botanist
Avery Dalton.....Data Manager**

Attachment 94-9

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QL676.56 D3 1995

ACKNOWLEDGEMENTS

We would like to thank several individuals who have contributed to the collection of zoological, botanical and natural community information. Special thanks to Joseph McLaughlin for zoological inventory along the Choptank River, and to Harold B. White for assistance in identifying many Odonata species. Additional thanks go to Janet Ebert and Jack Holt for their rare plant surveys and natural community data collection. Thanks also go to R. Watson and Logan Miller, of the Delaware Solid Waste Authority for allowing access to their site along the Cow Marsh Branch, and to Dennis Ho, of Delaware's Department of Transportation for permission to survey Del DOT property along the Choptank River. A final thanks go to L. Miller for providing the color photograph reproduced as Fig. 11. Funding for this project was provided to the Delaware Natural Heritage Program by a grant from the National Oceanographic and Atmospheric Administration through the Delaware Coastal Management Program.

BIOLOGICAL AND NATURAL COMMUNITY ANALYSES OF RIPARIAN COMMUNITIES WITHIN THE COASTAL ZONE OF KENT COUNTY, DELAWARE

INTRODUCTION

The primary objective of this project was to undertake a biological and natural community assessment of the riparian habitats along selected streams in Kent County, Delaware. The full array of natural communities were assessed and described, and their quality noted. In addition, surveys were undertaken to locate rare species of plants and select groups of animals, and to identify any significant avian habitats. The results of this project provides up-to-date information on the presence of State rare species and Federally listed threatened and endangered species in riparian habitats, and provides locations and descriptions of the natural communities surveyed. These data can be used in protection and conservation activities at the state and county level within Kent County; in order to facilitate conservation activities, the data collected will be incorporated into the Natural Heritage Program's database and will be entered into the Department of Natural Resource's GIS System.

This report presents data from the second year of a two year study assessing the quality of habitats found in Kent County (see Heckscher et al. 1994). The first year's (1992-93) study, initially restricted to the coastal plain pond habitat (i.e. Delmarva Bays), was expanded to include all habitat types, when it was discovered that many of the ponds in Kent County were degraded.

METHODS

Preliminary work involved a review of the DNHP database for previously conducted field work in Kent County, including data from the 1992-93 study. These data were then used as an aid in selecting survey sites for the 1994 field season. In addition, potential inventory sites were also identified by reviewing United States Geological Survey (USGS) topographic maps for Kent County and by reviewing recent color infrared (CIR) aerial photography. These data and information helped direct the DNHP staff into selecting study sites that were expected to yield high quality habitats. Three river systems were chosen: (1) Choptank River; (2) St. Jones River; and (3) Murderkill River.

Data for each site were recorded onto field forms; these data included habitat descriptions (including notes on relative quality), natural community assessments, and presence of rare and common species.

Natural Community/Botanical Inventories

Natural community assessments and descriptions were made by recording species compositions in each habitat type, and determining the dominant species present in each stratum (tree, shrub, herb). In those habitats that were deemed to be of sufficient quality, one or more plots (of varying sizes) were established and each species' percent cover value was estimated. Names applied to the

natural communities described in this report, utilize the scientific names of one or more of the dominant, or characteristic species in the community; in some cases, only general terminology is used. After each "technical" name is a more general name. A brief description follows each community name.

The natural communities herein described are primarily characterized by their vegetation, rather than by edaphic or other physical or biological parameters. The botanical inventories, which included searches for rare species, are linked to the natural community assessments. Therefore, both the natural community and botanical survey components of this project are treated together.

Zoological Inventory

Zoological inventories were undertaken in similar fashion for all three study areas, focusing on animal species which the DNHP currently tracks, excluding fish and mammals. Birds were inventoried by sight and song while walking or boating through study areas. Select groups of invertebrates (e.g. Lepidoptera, Anisoptera, and Zygoptera) were collected and identified with the aid of a sweep net. Reptiles and amphibians were surveyed by visually inspecting different sites within the river corridors (modification of the VES method, Crump and Scott, 1994). Survey areas within the watersheds were visited at least once during the study period.

Species were assigned a B, M, or W depending on their breeding, migratory or wintering status, respectively. Rare species (S1 to S3) were considered element occurrences of conservation concern if they were utilizing the river system for reproduction (i.e. breeding); these species are highlighted (see appendices). Rare migratory and wintering species are normally not considered element occurrences of conservation concern by the DNHP. A comprehensive species list with respective state ranks is found in Appendix I.

Site specific information for rare species found during this project are available upon request (the use of this information may be restricted).

RESULTS AND DISCUSSION

Natural Heritage biologists undertook biotic surveys in a variety of riparian habitats along the Choptank, St. Jones and Murderkill Rivers in Kent County (see Kent County map insert); these sites are described, in detail, below. Surveys were undertaken in Palustrine and Estuarine wetland habitats which included hardwood swamps, scrub-shrub wetlands, tidal and non-tidal freshwater marshes, brackish and salt marshes, and (occasionally) terrestrial forests. Natural communities are classified (i.e. named and described) based on their dominant vegetation. Botanical and zoological inventories focused on State rare and Federal listed species. Rare species, and their ranks, are listed for each site where discovered. See Appendix 5 for definitions of state ranks. Property ownership and protection status are listed for each site surveyed, as well as additional survey needs. Apparent threats which might degrade the ecological quality of each site are discussed where appropriate.

Due to the extreme mobility of animals and the fact that they may have large territories and utilize several habitat types, the zoological results will be presented in three separate sections at the end of the results section for the St. Jones, Murderkill, and Choptank Rivers. Where appropriate habitat usage by animals will be discussed. An animal list is provided for each watershed.

Survey Sites

I. St. Jones River

Surveys were undertaken in areas along the St. Jones River, from the mouth of the Delaware Bay upstream to the city of Dover, and in habitats along a number of tributaries of the St. Jones River [e.g. Beaver Gut Ditch, Cypress Branch, Tidbury Creek (see Figs. 1-3)]. Good to excellent quality tidal marshes were sampled from the mouth of the Delaware Bay upstream to Dover, while swamp forests ranging from poor to excellent quality were surveyed along the minor tributaries. In addition, several good quality, but small, terrestrial forests were surveyed.

I.1. Beaver Gut Ditch (Fig. 1):

SITE LOCATION/DESCRIPTION: This narrow tributary is located just north of Magnolia and extends in a northeast direction for almost two miles (from west of HWY 113A until it empties into the St. Jones River just past RD 364). It consists of salt to brackish marshes, scrub-shrub wetlands, palustrine forests, and narrow terrestrial hardwood forests (see below).

Natural Communities/Botanical Inventories:

- *Spartina alterniflora* Salt Marsh [Smooth cordgrass salt marsh] - moderate quality.

A narrow tidal marsh dominated by *Spartina alterniflora*, with scattered colonies of *S. patens*, and *Phragmites australis*. This marsh extends, in a narrow band on either side of Beaver Gut, for a distance of approximately 1.0 km. *Iva frutescens* thickets and small clumps of *Distichlis spicata* are also present. Occasional individuals of *Atriplex patula* and *Amaranthus cannabinus* may be found. *Phragmites* is more abundant in the upper reaches of this community, which grades into a more diverse, but narrow brackish marsh (*Peltandra* colonies are more common here).

- *Fagus grandifolia-Quercus alba-Liquidambar styraciflua* Forest Association [beech-white oak-sweet gum forest] - poor quality.

An extremely small upland hardwood forest adjacent to Beaver Gut is dominated by *Fagus*, with lesser quantities of *Quercus alba* and *Liquidambar*. Additional species, in lesser numbers, include *Liriodendron*, *Nyssa*, *Juniperus virginiana*, *Carya* sp., *Ilex opaca*, *Quercus rubra*, *Prunus serotina*, *Gaylussacia frondosa*, *Rhododendron* sp., and *Smilax rotundifolia*. The herbaceous stratum was extremely sparse and included *Epifagus virginiana*. Most of this woodland tract experienced damage from the 1994 ice storm (many of the large beech trees had limbs and tree

tops broken-off). Primarily because of the small size of this upland forest, it is designated as poor quality.

- *Acer rubrum* Streamside Forest Association [red maple swamp] - poor to moderate quality.

The upper end of Beaver Gut grades into a palustrine hardwood swamp forest dominated by *Acer rubrum* (ca. 60-70% cover). Less abundant trees and shrubs include *Nyssa sylvatica*, *Magnolia virginiana*, *Fraxinus pennsylvanica*, *Clethra alnifolia*, *Lindera benzoin*, *Viburnum dentata* var. *lucida*, *Itea virginica*, *Ilex opaca*, *I. verticillata*, and *Vaccinium corymbosum*. Herbs include *Impatiens capensis*, *Dioscorea villosa*, *Woodwardia areolata* (frequent), *Boehmeria cylindrica*, *Sambucus canadensis*, *Decodon verticillatus*, *Symplocarpus foetidus*, *Cuscuta* sp., and *Mitchella repens*. Woody vines include *Smilax rotundifolia*, *Toxicodendron radicans*, *Parthenocissus*, *Rubus* sp., and *Vitis rotundifolia*. Several weedy taxa are also present: e.g. *Rosa multiflora*, *Lonicera japonica* (dense in some areas), *Polygonum pennsylvanicum*, and *Ailanthus altissima* (near road).

Overall, this swamp forest is rather disturbed (as evidenced by the weedy species). The upland buffer on the north side is practically absent and it is very limited on the south side.

Rare Plants discovered along Beaver Gut Ditch:

No plants of **Special Concern** were observed along Beaver Gut Ditch.

OWNERSHIP/PROTECTION STATUS: Private/current protection is limited to regulations related to tidal wetlands.

THREATS: Eutrophication from surrounding agricultural run-off; urban development.

ADDITIONAL SURVEY NEEDS: North side of the stream near mouth of stream.

I.2. Cypress Branch (Fig. 1):

SITE LOCATION/DESCRIPTION: This stream is located immediately north of Beaver Gut, and also flows in a northeast direction to the St. Jones River. Surveys were undertaken primarily in the palustrine forests located between RD 363 and Hwy 113A. The habitats associated with this stream corridor are very similar to those found along the Beaver Gut Ditch. The headwaters of Cypress Branch consists of narrow palustrine forests with virtually no vegetated buffers to the wetlands. West of Hwy 113A, a substantial housing development is located on either side of the stream with houses built right to the border of the wetland. The Cypress Branch is included within the core boundaries of the St. Jones River National Estuarine Research Reserve System.

Natural Communities/Botanical Inventories:

- *Acer rubrum* Swamp Forest Association [red maple swamp] - moderately good quality.

A red maple-dominated swamp forest is located in the headwaters of the Cypress Branch (above Cypress Pond). Other woody species include *Fraxinus pennsylvanica*, *Chamaecyparis thyoides*, *Nyssa sylvatica*, *Liquidambar*, *Ilex opaca*, *Clethra*, *Itea virginica*, *Diospyros virginiana*, *Leucothoe racemosa*, *Ilex verticillata*, *Magnolia virginiana*, *Rhododendron viscosum*, *Toxicodendron radicans*, and *Lonicera japonica*. The herbaceous stratum is relatively diverse and includes such species as *Arisaema triphyllum*, *Symplocarpus foetidus*, *Mitchella repens*, *Impatiens capensis*, *Lilium superbum*, *Helonias bullata*, *Boehmeria cylindrica*, *Iris versicolor*, *Lycopus* sp., *Viola cucullata*, *Decodon verticillatus*, *Peltandra virginica*, and *Carex* spp.

Downstream from this community, in the salt marsh on both the east and west sides of RD 363, are found numerous standing dead Atlantic white cedar trees. Previously, this area of the Cypress Branch consisted of extensive white cedar swamp, but now consists of salt marsh. The increased salinity levels are possibly a result of several factors (e.g. sea-level rise, stream deepening/channelization, and major storm events). A major hurricane struck Delaware's coastline in 1878 and may be the cause of Atlantic white cedar loss here.

* Green cypress is another common name for *Chamaecyparis thyoides* (Atlantic white cedar)

■ ***Acer rubrum*-*Clethra alnifolia*-*Rosa palustris* Scrub-Shrub Wetland [mixed scrub-shrub marsh]** - good quality.

This community is located in the transitional zone between hardwood swamp forest and open emergent tidal marsh and is floristically quite diverse. Shrubs present in this community include *Acer rubrum*, *Clethra alnifolia*, *Rhododendron viscosum*, *Vaccinium corymbosum*, *Rosa palustris*, *Magnolia virginiana*, *Myrica cerifera*, *Alnus serrulata*, and *Viburnum* sp. The herb layer is also diverse and consists of such species as *Aster* sp., *Iris versicolor*, *Decodon verticillatus*, *Boehmeria cylindrica*, *Sagittaria latifolia*, *Impatiens capensis*, *Sambucus canadensis*, *Peltandra virginica*, *Pontederia cordata*, *Nuphar lutea*, *Nymphaea odorata*, *Eleocharis* spp., *Hypericum virginicum*, *Osmunda cinnamomea*, *O. regalis*, and *Thalictrum pubescens*.

■ ***Spartina alterniflora* Salt Marsh [cordgrass salt marsh]** - good quality.

Downstream from the scrub-shrub swamp occurs a relatively good quality cordgrass marsh dominated by *S. alterniflora*, with small inclusion stands of *Phragmites australis* (not extensive here). Other species present, but in low numbers, include *S. patens*, *S. cynosuroides*, *Distichlis spicata*, *Schoenoplectus robustus*, *Atriplex patula*, *Rumex verticillatus*, *Iva frutescens*, and *Baccharis halamifolia*. As mentioned above snags of Atlantic white cedar are frequent in this marsh, testimony to this habitat's former forested status.

■ **Mixed *Quercus* spp.-*Pinus taeda* Forest Association [oak-pine forest]** - poor to moderate quality.

This terrestrial community occurs as a very narrow buffer along the wetlands associated with the

Cypress Branch and expands into a larger forest tract along the north side and upper end of the branch. It is characterized by a mixture of hardwoods and pines and ranges from immature, second growth to mature woodland. In addition to the oaks (*Q. alba*, *Q. falcata*, *Q. rubra*) and *P. taeda*, other species present include *Sassafras*, *Prunus serotina*, *Liquidambar*, *Nyssa*, *Pinus virginiana*, *Nyssa sylvatica*, *Acer rubrum*, *Ilex opaca*, *Vaccinium* spp., *Cypripedium acaule*, *Tipularia discolor*, *Chimaphila maculata*, and *Carex* sp.

Rare Plants discovered along Cypress Branch:

Several rare plants were discovered along the Cypress Branch:

<i>Chamaecyparis thyoides</i>	S3	Atlantic white cedar
<i>Helonias bullata</i>	S3, LT	swamp pink

OWNERSHIP/PROTECTION STATUS: Private/current protection is limited to regulations related to tidal wetlands.

THREATS: Agricultural run-off; urban sprawl.

ADDITIONAL SURVEY NEEDS: The oligohaline marshes of the upper end, as well as additional surveys are needed in the swamp and terrestrial forests.

I.3. Tidbury Creek (Fig. 2):

SITE LOCATION/DESCRIPTION: Surveys of this tributary were undertaken from just west of Hwy 113A downstream to the mouth of the St. Jones River. The oligohaline tidal marshes were of good quality and relatively diverse. Grasses, sedges, smartweeds, and jewelweeds (to name a few) were common on hummocks in the muck. Further shoreward the open, emergent marsh, becomes more of a scrub-shrub marsh, while downstream the oligohaline marsh grades into a brackish/salt marsh with an abundance of *Spartina alterniflora*.

Natural Communities/Botanical Inventories:

■ *Peltandra virginica-Pontederia cordata* Emergent Marsh [arrow arum-pickerel weed marsh] - good quality.

Peltandra virginica was dominant in the low-lying regularly tidal zones, with lesser amounts of *Pontederia cordata* and *Nuphar lutea*. This community association is of low floristic diversity.

■ *Impatiens capensis-Amaranthus cannabinus-Polygonum punctatum* Marsh Association [jewelweed-water hemp-smartweed marsh] - good quality.

A diverse, herbaceous marsh dominated by the above three species but also including a wide array

of species including *Thalictrum pubescens*, *Boehmeria cylindrica*, *Pilea pumila*, *Agrostis perennans*, *Thelypteris palustris*, *Lobelia cardinalis*, *Bidens frondosa*, *Apios americana*, *Saururus cernuus*, *Hibiscus moscheutos*, *Scutellaria lateriflora*, *Osmunda regalis*, *Onoclea sensibilis*, *Cuscuta gronovii*, *Leersia oryzoides*, *Ptilimnium capilleceum*, *Sium suave*, *Elymus virginicus*, *Phalaris arundinacea*, *Asclepias incarnata*, and *Carex* spp. Further shore-ward more woody species are present, and this community intergrades into the following community.

■ ***Acer rubrum*-*Clethra alnifolia*-*Rosa palustris* Scrub-Shrub Wetland [mixed scrub-shrub marsh]** - good quality.

This scrubby habitat, located along the edge of the streamside forest, contains a diverse assemblage of woody species with *Acer rubrum*, *Magnolia virginiana*, and *Rosa palustris* especially common. Other woody species include *Clethra alnifolia*, *Toxicodendron radicans*, *Ilex* spp., *Nyssa sylvatica*, and *Viburnum dentata* var. *lucida*. The herb stratum is also diverse and includes the same species as noted in the previous community. This community type is also very similar to the community found along Cypress Branch (see above).

■ ***Spartina alterniflora* Salt Marsh [cordgrass salt marsh]** - good quality.

This low diversity marsh occurs near the mouth of Tidbury Creek and extends a short distance upstream where it intergrades into a freshwater marsh. The salt marsh is primarily comprised of cord grass, with lesser amounts of *Spartina patens*, *Atriplex patula*, *Phragmites australis*, *Distichlis spicata*, *Baccharis halimifolia*, and *Iva frutescens*. West of RD 356A, where the marsh is less brackish, additional species such as *Kosteletzkya virginica*, *Hibiscus moscheutos*, *Amaranthus cannabinus*, *Thelypteris palustris*, *Schoenoplectus robustus*, *Ptilimnium capillaceum*, *Asclepias incarnata*, and *Typha angustifolia* are present.

Rare Plants discovered along Tidbury Creek:

No plants of Special Concern were observed in areas surveyed along Tidbury Creek.

OWNERSHIP/PROTECTION STATUS: County and private/current protection is limited to regulations related to tidal wetlands. Part of Tidbury Creek is found within the boundaries of Tidbury Creek County Park.

THREATS: Pollution from runoff; further logging of uplands; urban sprawl.

ADDITIONAL SURVEY NEEDS: More surveys could be undertaken in the marshes in the upper reaches of Tidbury Creek.

I.4. Lower St. Jones River (Fig. 3):

SITE LOCATION/DESCRIPTION: Surveys were undertaken from near the river's mouth,

upstream to Barker's Landing. This area encompasses a vast contiguous, low diversity, *Spartina alterniflora* salt marsh community. The marsh in the lower portion of this River (within 1.5 miles of the Bay) has undergone channelization and extensive grid-ditching for purposes of mosquito control. Both the tall and short forms of *S. alterniflora* are present, with the latter dominant throughout the marsh. Near the Delaware Bay the marsh has undergone some open marsh water management (OMWAM) activities, and several dikes have been established. Throughout the Lower St. Jones River Estuary, little or no buffers are present; in some areas farming extends to the marsh's edge, as does a golf course located on Dover Air Force Base property. Occasional, narrow terrestrial mixed, or hardwood forest communities occur adjacent to the St. Jones estuary; these are typically of poor quality and were not surveyed in any detail.

Natural Communities/Botanical Inventories:

- *Spartina alterniflora* Salt Marsh [cordgrass saltmarsh] - fair to good quality.

A salt marsh dominated by the short form of the smooth cordgrass, *S. alterniflora*; the tall form is usually present along the lower slopes of tidal guts and along the grid ditches. Other less abundant species in this community include *Iva frutescens*, *Baccharis halimifolia*, *Spartina patens*, *Distichlis spicata*, *Spartina cynosuroides*, *Atriplex patula*, *Schoenoplectus robustus*, *Phragmites australis*, and *Salicornia* sp. *Phragmites* occurs in small, scattered colonies and does not appear to be too much of a nuisance; it usually appears in areas that have been disturbed (e.g. along roads and adjacent to bridges).

Rare Plants discovered in the Lower St. Jones River:

No plants of Special Concern were observed during surveys of the Lower St. Jones River.

OWNERSHIP/PROTECTION STATUS: County, State and private/protection is afforded a portion of the NERRs site along this stretch of the River and the Little Creek Wildlife Area near the Delaware Bay; in addition, all of this area is tidal and thus afforded protection through tidal wetlands regulations (though these regulations do not protect wetlands from impacts from non-point source pollutants).

THREATS: Pollution from runoff (in many areas agricultural fields end at the edge of the marsh); further logging of uplands; urban sprawl.

ADDITIONAL SURVEY NEEDS: More surveys are needed in the marshes of the St. Jones

Zoological Inventories:

The St. Jones watershed provides crucial feeding areas for many resident and migratory wetland-associated birds including the Great egret (S1), Snowy egret (S1) Glossy ibis (S1B) Great blue heron (S2), and Northern harrier (S1B, S3N). The ecological integrity of the salt, brackish and

freshwater marshes are crucial to maintain in order to provide long-term protection to these species during migration and the nesting season. The upper portions of the watershed include freshwater tidal marshes surrounded by palustrine and upland hardwood forests. However, buffers here are minimal and their loss likely has proved detrimental to the native fauna diversity in these regions. Nevertheless, they remain crucial to the natural functioning of the upper St. Jones River. Surrounding palustrine and upland forest should be protected and restored. Further degradation of these forests and buffers will decrease the natural ecological functioning of the St. Jones Estuary.

The brackish marshes within the watershed support cover, feeding areas and breeding sites for many vertebrate and invertebrate species. Additionally, these marshes are crucial to migratory species of butterflies which depend on these wetlands (Appendix 2).

The saltmarshes and mud flats associated with the St. Jones River (as well as the Murderkill River, see below) provide foraging areas for numerous bird species including crucial migratory bird foraging areas. Some species are strictly associated with the open sandy beaches along the mouth of the river. Indeed this is a **globally significant** foraging site for migratory shorebirds (e.g. red knots, sanderlings, dunlins, ruddy turnstones, semipalmated sandpipers). Protecting this site from surrounding land development as well as recreationists, should be addressed immediately. Additional rare species found at the mouth of the St. Jones, include the Black Skimmer (S1B). This species was found in large numbers during portions of the nesting season, and likely nested here.

In addition to the sandy beaches along the river, there were other significant discoveries. A pair of Bald eagles (S1B, LT) attempted to nest, in the vicinity of Lebanon. It is unknown whether these birds ever produced eggs. However, it is known that they eventually abandoned the nest, yet the pair continued to roost and feed along the St. Jones. It was noted that the open marshes provided crucial nesting habitat for the Coastal plain swamp sparrow (S3B), a taxon endemic to the mid-Atlantic tidal marshes. While these open marshes regularly provided nesting territories of Northern Harriers (S1B), none were observed during the 1994 nesting season. The reason for the sudden disappearance of this species is unknown, however, the potential exists for the harrier to return as an important predator and a regular nesting species. See Appendix 2 for a complete list of animal species observed in the St. Jones River watershed.

II. Murderkill River

Biotic inventories of the Murderkill River Estuary were undertaken in habitats from the mouth of the Murderkill at Delaware Bay upstream to west of Hwy 13, along second and third order tributaries (e.g. along Ash Gut, Browns Branch, Black Swamp Creek, Spring Branch, Beaver Ditch and in the Big Cripple Swamp). Much of the habitat surveyed proved to be very difficult to traverse as numerous limbs and "snapped" tree tops were scattered throughout, and the substrate consisted of soft deep muck interspersed by hummocks often too far apart to allow for easy movement. The palustrine forests were comprised primarily of red maple-green ash canopies with diverse understories, and are of relatively good quality.

II.1. Ash Gut (Fig. 4):

SITE LOCATION/DESCRIPTION: Ash Gut was surveyed from RD 35 to the mouth of the Murderkill River. Habitats along this tributary include hardwood swamp forests, extremely narrow upland hardwood forests, scrub-shrub wetlands and emergent marshes near the tributary's mouth. Much of the forest was damaged from the recent ice storm.

Natural Communities/Botanical Inventories:

- ***Acer rubrum* Swamp Forest [red maple swamp] - fair quality.**

An *Acer rubrum*-dominated swamp with scattered individuals of *Fraxinus pennsylvanica*, and *Liquidambar styraciflua*. *Liriodendron* and *Prunus serotina* occurs along the wetland's edge. Other woody and herbaceous species encountered include *Clethra* (abundant), *Lindera benzoin*, *Smilax rotundifolia*, *Rhododendron viscosum*, *Sambucus*, *Symplocarpus foetidus* (extremely abundant; +80% cover in areas), *Woodwardia areolata*, *Osmunda cinnamomea*, *O. regalis*, *Peltandra virginica*, *Fragaria* sp., *Viola* sp., *Impatiens capensis*, *Boehmeria*, *Arisaema triphyllum*, *Athyrium filix-femina*, *Glechoma hederacea*, and *Carex* spp. Throughout most of this forest there is only ca. 40% total cover value due to the abundant downed trees and broken tree limbs. The extremely abundant *Symplocarpus* may have developed in response to an opening-up of the canopy.

- ***Acer rubrum*/*Cornus amomum*-*Alnus serrulata* Streamside Scrub Wetland [red maple-ash/dogwood-alder scrub wetland] - excellent quality.**

An extensive, narrow, streamside scrub wetland occurs along either side of Ash Gut as one approaches its mouth (also see community description below). This natural community occurs as a narrow band along the water's edge and is dominated by *Acer rubrum* and *Fraxinus pennsylvanica* in the low canopy (15-20' in height), although the *Fraxinus* occurs less frequently here than further downstream. This tidally influenced community is extremely diverse and is comprised of *Magnolia virginiana*, *Clethra alnifolia*, *Itea virginica*, *Rosa palustris*, *Viburnum nudum*, *V. pruniifolium*, *Ilex verticillata*, *Rhododendron viscosum*, *Vaccinium corymbosum*, *Asclepias incarnata* var. *pulchra*, *Apios americana*, *Osmunda regalis*, *Thelypteris palustris*, *Thalictrum pubescens*, *Hibiscus moscheutos*, *Aster* spp., *Carex comosa*, *C. lacustris*, *Lobelia cardinalis*, *Iris versicolor*, *Bidens laevis*, *Schoenoplectus* spp., and *Hypericum virginicum*, to name a few. Virtually identical to community type found along Browns Branch and elsewhere along the Murderkill River.

- ***Peltandra virginica*-*Nuphar lutea* Emergent Marsh [arrow arum-spatterdock marsh] - good quality.**

An emergent non-persistent plant association found in the upper portions of Ash Gut. This community is generally of very low diversity and is found in the lower portions of the tidal marsh (in freshwater).

Rare Plants discovered along Ash Gut:

No plants of **Special Concern** were observed during surveys of the Ash Gut.

OWNERSHIP/PROTECTION STATUS: Private/current protection is limited to regulations related to tidal wetlands.

THREATS: Pollution from runoff; further logging of uplands; urban sprawl.

ADDITIONAL SURVEY NEEDS: Upstream along Ash Gut and an unnamed tributary west of RD 35.

II.2. Browns Branch/Big Cripple Swamp (Fig. 5):

SITE LOCATION/DESCRIPTION: Browns Branch was surveyed from the mouth of the Murderkill River upstream to below McCauley Pond, and also above McCauley Pond (Fig. 5a). The habitats surveyed consisted of medium-high quality hardwood swamp forests, scrub-shrub wetlands, and emergent marshes. The swamp forest experienced extensive damage caused by the 1994 winter ice storm; numerous broken tree limbs and snapped tree tops were strewn throughout the swamp.

Natural Communities/Botanical Inventories:

■ *Acer rubrum*-*Fraxinus pennsylvanica* Swamp Forest [red maple-green ash swamp] - excellent quality.

A diverse floodplain fresh tidal swamp forest dominated by maple and ash, with scattered *Nyssa sylvatica*, and *Magnolia virginiana*. The woody understory is comprised of *Clethra alnifolia*, *Rosa palustris*, *Cornus amomum*, *Alnus serrulata*, *Itea virginica*, *Toxicodendron radicans*, *Lindera benzoin*, *Vaccinium corymbosum*, *Leucothoe racemosa*, *Viburnum dentata* var. *lucida*, *Magnolia virginiana*, and *Ilex opaca*. The herb stratum is also diverse and consists of *Imatiens capensis*, *Boehmeria cylindrica*, *Leersia virginica*, *Iris versicolor*, *Cicuta maculata*, *Lilium superbum*, *Carex seorsa*, *Sium suave*, *Polygonum arifolium*, *Osmunda regalis*, *Thalictrum pubescens*, *Peltandra virginica*, *Carex gynandra*, *C. comosa*, *C. lupulina*, *C. straminea*, *C. folliculata*, *Arisaema triphyllum*, *Platanthera clavellata*, *Viola* cf. *cucullata*. The vegetation occurs primarily on hummocks surrounded by tidal muck.

■ *Acer rubrum*-*Liquidambar styraciflua* Swamp Forest [red maple-sweet gum swamp] - good to excellent quality.

This community is nearly identical to the previous type, and consists of a similar species composition, but with a preponderance of *Liquidambar* rather than *Fraxinus* in the canopy.

Further upstream (above McCauley Pond) there appears to be a greater floristic diversity with the following woody species typically found: *Acer*, *Liquidambar*, *Liriodendron*, *Fraxinus americana*, *Carpinus caroliniana*, *Nyssa sylvatica*, *Ilex opaca*, *Prunus serotina*, *Cornus florida*, *Betula nigra*, *Quercus michauxii*, *Q. phellos*, *Clethra*, *Lindera benzoin*, *Viburnum dentata* var. *lucidum*, *Rosa multiflora*, *Smilax* spp., *Toxicodendron radicans*, *Itea virginica*, *Magnolia virginiana*, *Aralia spinosa*, *Ilex verticillata*, *Lonicera japonica*, *Aronia arbutifolia*, and *Cornus amomum*, among others. The herbaceous layer is diverse, comprised of dozens of species, including typical wetland species such as *Arisaema triphyllum*, *Impatiens capensis*, *Boehmeria cylindrica*, *Botrychium dissectum*, *Typha latifolia*, *Ranunculus recurvatus*, *Smilax herbacea*, *Cyperus strigosus*, *Alisma cordatum*, *Carex* spp., *Mikania scandens*, *Onoclea sensibilis*, *Woodwardia areolata*, *Osmunda cinnamomea*, *O. regalis*, *Mitchella repens*, and *Saururus cernuus*. Much damage from 1994 winter ice storm was observed.

■ ***Fraxinus pennsylvanica*/*Cornus amomum*-*Alnus serrulata* Streamside Scrub Wetland [ash-dogwood-alder scrub wetland]** - excellent quality.

An extensive, narrow, streamside scrub wetland occurs on either side of the Browns Branch from below McCauley Pond to the mouth of the Murderkill River (this community also occurs along the Murderkill east and west of Browns Branch). This natural community occurs as a narrow band along the water's edge and is dominated by *Fraxinus pennsylvanica* and *Acer rubrum* in the low canopy (15-20' in height); *Fraxinus* may be the sole representative in the canopy along some stretches. This tidally influenced community is extremely diverse and is comprised of additional species such as *Quercus bicolor*, *Alnus maritima*, *Lyonia ligustrina*, *Magnolia virginiana*, *Clethra alnifolia*, *Rosa palustris*, *Viburnum nudum*, *V. pruniifolium*, *Ilex verticillata*, *Asclepias incarnata* var. *pulchra*, *Acorus calamus*, *Amaranthus cannabinus*, *Zizania aquatica*, *Hibiscus moscheutos*, *Kosteletzyka virginica*, *Aster* spp., *Carex comosa*, *C. lacustris*, *Lobelia cardinalis*, *Bidens laevis*, *Schoenoplectus* spp., and *Triadenum walteri*.

■ ***Taxodium distichum*/*Acer rubrum* Floodplain Swamp Forest [bald cypress swamp]** - good quality.

A small inclusion community (< 1 acre), but highly significant due to the fact that this site is one of the two most northern, naturally occurring populations of bald cypress in North America. *Taxodium* is the dominant canopy tree (60-70' in height), with *Acer rubrum* and *Nyssa sylvatica* in the sub-canopy. The understory consists of species found throughout the Murderkill swamp forests and include *Aronia arbutifolia*, *Viburnum dentata* var. *lucida*, *Vaccinium corymbosum*, *Clethra alnifolia*, *Leucothoe*, *Rhododendron viscosum*, *Rosa palustris*, *Itea virginica*, *Ilex* spp., *Cornus amomum*, *Smilax rotundifolia*, *Toxicodendron radicans*, *Arisaema triphyllum*, *Lilium superbum*, *Lobelia cardinalis*, *Impatiens capensis*, *Iris versicolor*, *Cicuta maculata*, *Boehmeria cylindrica*, *Lycopus* sp., *Osmunda* spp., *Sium suave*, *Thalictrum pubescens*, and *Thelypteris palustris*, to name a few.

Rare Plants discovered along Browns Branch/Big Cripple Swamp:

<i>Carex gynandra</i>	S2	a sedge
<i>Carex lacustris</i>	S1	lake sedge
<i>Dryopteris cristata</i>	S2	crested shield-fern
<i>Taxodium distichum</i>	S2	bald cypress

OWNERSHIP/PROTECTION STATUS: Private/currently not protected except for that portion under tidal regulations.

THREATS: Pollution from runoff; further logging of uplands; urban sprawl.

ADDITIONAL SURVEY NEEDS: There is a significant amount of high quality, tidal swamp forest (Big Cripple Swamp) that was incompletely surveyed and needs to be thoroughly surveyed in the near future; also much of the headwaters of Browns Branch need to be surveyed (though much of this area consists of very narrow stream corridors).

II.3. Black Swamp Creek (Fig. 6):

A small stretch of Black Swamp Creek was surveyed from Hwy 13 west to RD 284. Habitats consisted of mixed hardwood swamp forests and young second growth oak-pine uplands. Many of the trees along this creek had been damaged by the winter ice storm of 1994. An assemblage of rare species were discovered along this stretch (see below).

Natural Communities/Botanical Inventories:

■ *Quercus alba-Q. michauxii* Floodplain Forest Association [oak swamp forest] - excellent quality; little disturbed.

A rather uncommon natural community association with *Quercus alba* and *Q. michauxii* as co-dominant canopy species. Some rather impressive-sized oaks, several with dbhs > 36." The understory consists of *Acer*, *Liquidambar*, *Carpinus caroliniana*, *Clethra alnifolia*, *Lindera benzoin*, *Toxicodendron radicans*, *Ilex opaca*, *Cinna arundinacea*, *Osmunda regalis*, *O. cinnamomea*, *Mitchella repens*, *Lilium superbium*, *Pilea pumila*, *Peltandra virginica*, *Carex* spp., and *Amianthum muscatoxiceum*. This natural community is small in size and grades into the more common community described next.

■ *Acer rubrum-Liquidambar styraciflua-Fraxinus americana* Swamp Forest [maple-gum-ash swamp] - good quality.

In addition to the above three species, the tree stratum is comprised of *Liriodendron*, *Magnolia virginiana*, *Carpinus caroliniana*, *Quercus phellos*, *Q. palustris*, *Betula nigra*, *Diospyros virginiana*, *Ilex opaca*, *Prunus serotina*, and *Chionanthus virginicus*. The understory shrubs and

vines consist of *Clethra alnifolia*, *Alnus serrulata*, *Lindera benzoin*, *Leucothoe racemosa*, *Ilex verticillata*, *Vaccinium corymbosum*, *Viburnum nudum*, *V. dentata* var. *lucida*, *Aronia arbutifolia*, *Cornus amomum*, *Rhododendron viscosum*, *Rosa palustris*, *Corylus americana*, *Parthenocissus*, *Campsis radicans*, *Toxicodendron radicans*, *Lonicera japonica*, *Vitis* sp., *Smilax* spp., and *Dioscorea villosa*. The herbaceous layer is extremely diverse, consisting of too many species to list here, but those most frequently encountered include *Osmunda regalis*, *Saururus cernuus*, *Onoclea sensibilis*, *Osmunda cinnamomea*, *Athyrium filix-femina*, *Impatiens capensis*, *Arisaema triphyllum*, *Lilium superbum*, *Thalictrum pubescens*, *Thelypteris palustris*, *Symplocarpus foetidus*, *Mitchella repens*, *Carex* spp., *Oxypolis rigidior*, *Woodwardia areolata*, *Iris versicolor*, *Lobelia cardinalis*, and *Viola* spp.

This community type may also be found from east of Hwy 13 to Killens Pond State Park (see below).

Rare Plants discovered along Black Swamp Creek:

The following plants of **Special Concern** have been located in habitats associated with Black Swamp Creek:

Swamp Forest:

<i>Amianthium muscaetoxicum</i>	S2	fly-poison
<i>Quercus bicolor</i>	S2	swamp white oak
<i>Smilax pseudochina</i>	S2	long-stalked greenbrier
<i>Toxicodendron vernix</i>	S3	poison sumac

Terrestrial Oak-Pine Forests:

<i>Chimaphila umbellata</i>	S2	wintergreen
<i>Deschampsia flexuosa</i>	S2	crinkled hairgrass
<i>Lechea villosa</i>	S2	hairy pinweed
<i>Paronychia canadensis</i>	S3	forked chickweed

OWNERSHIP/PROTECTION STATUS: Private/not protected.

THREATS: Additional logging, agricultural run-off; urban sprawl.

ADDITIONAL SURVEY NEEDS: The entire length of Black Swamp Creek west of RD 284 should be surveyed.

II.4. Murderkill River/Killens Pond State Park (Fig. 7):

This site extends from Hwy 13 east to Coursey Pond and includes exceptionally good quality hardwood swamp forests along the Murderkill and good to poor quality terrestrial forest communities.

Natural Communities/Botanical Inventories:

- ***Acer rubrum-Liquidambar styraciflua* Swamp Forest Association** - excellent quality.

An association very similar, if not identical, to the community that occurs west of Hwy 13 (along Black Swamp Creek); see above. However, in this stretch of the Murderkill (west of Killens Pond and east of Hwy 13), *Fraxinus americana* is less common and *Carpinus caroliniana* is an abundant element of the understory. See above for species composition (similar). Additional species found here but not along Black Swamp Creek include the **Federally Threatened** swamp pink, *Helonias bullata* (S3), the rare sedge, *Carex collinsii*, and several individuals of bald cypress, *Taxodium distichum* (S2); the latter species appears to have been planted.

- ***Quercus alba-Liquidambar styraciflua-Liriodendron tulipifera* Forest Association [white oak-sweet gum-poplar forest]** - good quality.

A terrestrial forest surveyed on the south side of the Murderkill which occurs above the floodplain forest. Other woody species here include *Quercus falcata*, *Q. coccinea*, *Q. marilandica*, *Cornus florida*, *Pinus taeda*, *P. virginiana*, *Carya tomentosa*, *Sassafras albidum*, *Magnolia virginiana*, *Acer rubrum*, *Ilex opaca*, *Vaccinium stamineum*, *V. cf. vacillans*, *Viburnum dentata* var. *lucida*, *Amelanchier cf. arborea*, *Prunus serotina*, *Vitis rotundifolia*, *Aralia spinosa*, *Kalmia angustifolia*, and *Smilax rotundifolia*. The herbaceous layer is quite sparse, but includes *Cypripedium acaule*, *Tipularia discolor*, and *Mitchella repens*.

- ***Acer rubrum-Fraxinus pennsylvanica* Swamp Forest [maple-ash swamp]** - fair quality.

This community occurs between Killens and Coursey Ponds and is characterized by the presence of *Acer* and *Fraxinus* as co-dominants, with scattered *Liquidambar styraciflua* (50-60% canopy cover). Much winter storm damage was evident by the numerous downed trees and broken limbs. The understory consists of *Clethra*, *Lindera* and *Vaccinium corymbosum* as nearly codominant shrubs. Other common woody species and herbs include *Viburnum* spp., *Ilex opaca*, *I. verticillata*, *Carpinus*, *Saururus* (abundant), *Boehmeria*, *Arisaema*, *Cicuta maculata*, *Impatiens*, *Sphagnum* sp., *Peltandra*, *Ludwigia palustris*, *Carex* spp., *Gaultheria procumbens*, *Symplocarpus foetidus*, *Woodwardia areolata*, *W. virginica*, and *Viola* sp.

- **Mixed Herbaceous Freshwater Marsh** - good quality.

A diverse, freshwater marsh occurs on either side of the Murderkill River, just west of Coursey Pond. This marsh contains the following species: *Alnus serrulata*, *Rosa palustris*, *Salix* sp., *Clethra*, *Acer rubrum*, *Quercus palustris*, *Cephalanthus*, *Cornus amomum*, *Carex stricta*

(abundant), *Betula* sp., *Sagittaria latifolia*, *Peltandra*, *Leersia oryzoides*, *Boehmeria cylindrica*, *Decodon*, *Saururus*, *Juncus effusus*, *Galium* sp., *Onoclea sensibilis*, *Iris versicolor*, *Hydrocotyle*, *Cuscuta* sp., *Polygonum* sp., and *Osmunda regalis*.

■ *Fagus grandifolia*-*Liriodendron tulipifera* Terrestrial Forest [beech-tulip poplar woods] - good quality.

On the south side of the Murderkill and west of Coursey Pond occurs a relatively good quality mature beech-poplar woods; some portions of this woods were previously logged (in the last 20 years). Additional species here include *Quercus falcata*, *Q. alba*, *Q. cf. prinus*, *Pinus taeda*, *P. virginiana*, *Carya tomentosa*, *Ilex opaca*, *Euonymus americanus*, *Magnolia virginiana*, *Epigaea repens*, *Chimaphila maculata*, *Tipularia discolor*, *Lycopodium* sp., and *Cypripedium acaule*.

Rare Plants discovered along Murderkill River/Killens Pond State Park:

Swamp Forest:

<i>Carex collinsii</i>	S3	Collin's sedge
<i>Helonias bullata</i>	S3, LT	swamp pink

Terrestrial Habitats:

<i>Helianthemum propinquum</i>	S2	low frostweed
<i>Kalmia angustifolia</i>	S2	sheep laurel
<i>Lupinus perennis</i>	S1	blue lupine

OWNERSHIP/PROTECTION STATUS: Private and State/State Park portion relatively well protected, while private holdings are not protected.

THREATS: Logging of terrestrial and palustrine forests on private lands, agricultural run-off.

ADDITIONAL SURVEY NEEDS: Floodplain forests need additional surveys.

II.5. Spring Branch (Fig. 7):

A narrow palustrine forest, along Spring Branch between RDs 385 and 386, was surveyed. Habitats consist of red maple and bald cypress communities. Spring Branch flows into the Murderkill east of Killens Pond State Park.

Natural Communities/Botanical Inventories:

■ *Acer rubrum* Floodplain Swamp Forest [red maple swamp] - fair quality.

Typical red maple-sweet gum swamp with fairly good species diversity. Contains species typical of the floodplain forests along the Murderkill River.

- *Taxodium distichum/Acer rubrum* Floodplain Swamp Forest [bald cypress-red maple swamp] - fair quality.

An isolated, small community found within an otherwise hardwood swamp system. Significant in that this stand of bald cypress may represent the northern most naturally occurring population in North America. Additional species here include *Pinus taeda*, *Chamaecyparis thyoides* (scattered), *Liquidambar*, *Nyssa*, *Alnus serrulata*, *Clethra*, *Magnolia virginiana*, *Lindera benzoin*, *Rhododendron viscosum*, *Ilex opaca*, *Rosa palustris*, *Viburnum dentata* var. *lucida*, *Leucothoe*, *Toxicodendron radicans*, *Arisaema*, *Carex* spp., *Impatiens capensis*, *Iris versicolor*, *Boehmeria*, *Glyceria striata*, *Osmunda* spp., *Thelypteris palustris*, *Thalictrum pubescens*, *Symplocarpus*, *Viola* sp., *Woodwardia areolata*, and *Sphagnum* sp.

Rare Plants discovered along Spring Branch:

<i>Chamaecyparis thyoides</i>	S3	Atlantic white cedar
<i>Taxodium distichum</i>	S2	bald cypress

OWNERSHIP/PROTECTION STATUS: Private/not-protected.

THREATS: Pollution from run-off; logging.

ADDITIONAL SURVEY NEEDS: Surveys are needed both upstream and downstream from site.

II.6. Pratt Branch/Andrews Lake (Fig. 8):

The Pratt Branch above Andrews Lake was accessed via boat and surveyed from the headwaters of the millpond upstream to near RD 382. Most of this area was hard-hit by last winter's ice storm.

Natural Communities/Botanical Inventories:

- *Acer rubrum* Swamp Forest [red maple swamp] - fair quality.

Red maple is the dominant tree along this stretch, in some areas this tree forms 100% of the canopy. Scattered *Fraxinus pennsylvanica*, *Nyssa* and *Liquidambar* are also present. The understory is very diverse and contains such species as *Carpinus*, *Liriodendron*, *Ilex opaca*, *Quercus alba*, *Q. michauxii*, *Cornus florida*, *Clethra alnifolia* (dominant), *Vaccinium corymbosum*, *Ilex verticillata*, *I. opaca*, *Euonymus americanus*, *Viburnum dentata* var. *lucida*, *Leucothoe*, *Magnolia virginiana*, *Aralia spinosa*, *Itea*, *Sambucus canadensis*, *Lindera*, *Saururus*, *Gratiola virginiana*, *Peltandra virginica*, *Thalictrum pubescens*, *Scutellaria*, *Lobelia cardinalis*,

related to tidal wetlands; portions of Murderkill State Fish and Wildlife Area..

THREATS: Agricultural run-off; further development; additional logging.

ADDITIONAL SURVEY NEEDS: Additional surveys are needed along the Murderkill River between Frederica and South Bowers.

Zoological Inventories:

The lower portions of the Murderkill River ecosystem are very similar to the St. Jones River watershed, with brackish to salt marshes predominating. The importance of a forested buffer is also crucial to the ecological integrity of this watershed. Much of the surrounding uplands have been cleared and a minimal buffer remains. Like the St. Jones, the faunal diversity has been severely degraded in this system due to the loss of upland forests. Many species also face threats from the spread of *Phragmites* which may be enhanced by continued ecological disturbances taking place within the watershed. See Appendix 3 for a complete list of animal species observed in the Murderkill River watershed.

Freshwater (more frequently in the upper reaches), brackish and saltmarshes within the Murderkill ecosystem provide foraging and nesting areas for many species of birds as well as crucial feeding habitat for many migratory birds and invertebrates. The freshwater marshes provide habitat for an array of odonate species (see Appendix 3).

The Bronze copper (S2) was discovered nectaring within the freshwater/brackish marsh transition zone of the Murderkill River. This species was using the Murderkill for feeding and likely is reproducing in these wetlands. In addition, the bronze copper has been observed in this area in previous years. Also, the Great Blue Heron (S2B) was a regular forager throughout the breeding season and likely nested in the upper portions of this watershed. Other **Species of Special Concern** observed in this region were the Pileated woodpecker (S3) and the Great Blue Skimmer (S3). These species were found in the mature upland and palustrine forests of the upper Murderkill watershed. The forests along the Murderkill should be targeted for protection and restoration, as they not only provide crucial habitat for Pileated woodpeckers, Great Blue Herons, and the Great Blue Skimmer, but also support important migratory bird foraging areas as well as acting as an important wetland buffer.

The open high salt and brackish marshes supported impressive populations of Coastal plain swamp sparrows (S3B), Sharp-tailed sparrows (S3B) and Seaside sparrows (S3B). The greatest threat to these species is the encroachment of invasive plants such as phragmites. *Phragmites* invasion is accelerated by habitat altering practices such as road or powerline construction. *Phragmites* threatens the ecological integrity of this entire watershed and has already become well established in some areas. Efforts should be made to control this pest species immediately.

A Bald Eagle (S1B, LT) pair has been noted as nesting/breeding adjacent to the marshes of the

Murderkill River over the past several years. The eagle pair was not observed by Natural Heritage biologists during 1994 surveys (also check with Division of Fish and Wildlife, DNREC, non-game and endangered species personnel).

III. Choptank River (Figs. 10-11):

Extensive biotic surveys were undertaken in palustrine and terrestrial habitats along both sides of the Choptank River from Mud Millpond at RD 209, south to the Maryland State line and east along the Cow Marsh Branch to RD 208.

In general, the riparian habitats associated with the Choptank include some of the finest and most diverse habitats found in Kent County, and is home to many species of rare plants and several rare animals (see lists below). The floodplain swamps are primarily composed of red maple, with lesser amounts of ash in the canopy; the understory is floristically diverse. Walking in the swamp forest is difficult due to the soft and deep muck, although some areas have closely-spaced hummocks allowing for easier access.

Although much of the habitats surveyed were of good quality, the river and its adjacent habitats have not been immune from anthropogenic impacts. Much of the upland forests have experienced past logging events, and old sand pits and ponds have been created in several areas (e.g. Del DOT property on west side, along both sides of the eastern portion of the Cow Marsh Branch, and along the east side of the Choptank north of RD 211). Also refer to Fig. 11, a 1994 true color photograph of the area south of RD 211, which highlights the upland impacts; note the substantial upland forested buffers.

Natural Communities/Botanical Inventories:

■ *Acer rubrum-Fraxinus pennsylvanica* Floodplain Swamp [red maple-ash swamp] - good to excellent quality.

The floodplain forest along either side of the Choptank River and Cow Marsh Branch consists of a canopy dominated by red maple (*Acer rubrum*) and ash (*Fraxinus pennsylvanica*), with scattered individuals of *Betula nigra*, *Quercus palustris*, *Q. phellos*, *Carpinus caroliniana*, *Liquidambar styraciflua*, and *Magnolia virginiana*. The more abundant sub-canopy trees and shrubs include *Clethra alnifolia*, *Ilex opaca*, *I. verticillata*, *Magnolia virginiana*, *Itea virginica*, *Lindera benzoin*, and *Viburnum dentata* var. *lucida*. The herbaceous stratum is rather diverse and includes such typical floodplain species as *Saururus cernuus*, *Osmunda cinnamomea*, *O. regalis*, *Woodwardia areolata*, *Boehmeria cylindrica*, *Impatiens capensis*, *Sium suave*, *Lobelia cardinalis*, *Lilium superbum*, *Scutellaria* spp., *Carex* spp., *Mitchella repens*, *Arisaema triphyllum*, *Platanthera clavellata*, *Thelypteris palustris*, *Symplocarpus foetidus*, *Iris versicolor*, and the uncommon *Isoetes riparia*, *Ophioglossum vulgatum*, and *Dryopteris cristata*.

Due to the difficulty in accessing the swamp forest via foot and the long time involved in

traversing this habitat only a small portion of this swamp was surveyed and additional surveys are needed.

■ **Mixed Emergent Herbaceous Marsh**

A narrow emergent marsh occurs in several open areas along the edge of the Choptank River and Cow Marsh Branch and is comprised of such species as *Impatiens capensis*, *Peltandra virginica*, *Saururus cernuus*, *Zizania aquatica*, *Iris versicolor*, *Alisma subcordatum*, *Apios americana*, *Boehmeria cylindrica*, *Polygonum* spp., *Carex* spp., and *Pontederia cordata*, among others.

Although this community type occurs in limited quantity along the Choptank, only brief surveys were undertaken, and additional surveys are much needed.

■ **Mixed *Quercus* spp.-*Carya tomentosa* Mesic Forest Association [oak-hickory forest] - good quality immature/mature forest.**

The terrestrial habitats that grade into palustrine forest, and are associated with the Choptank River, consist of relatively diverse immature and mature stands of mixed hardwoods that include *Quercus* spp. (*alba*, *falcata*, *rubra*, *stellata*), *Liquidambar*, *Sassafras*, *Carya tomentosa*, *Liriodendron tulipifera*, *Fagus grandifolia*, *Ilex opaca*, *Pinus virginiana*, *Juniperus virginiana*, *Juglans nigra*, *Asimina triloba*, and *Carpinus caroliniana* among the tree species. The shrubs and herbs include *Cornus florida*, *Vaccinium* spp., *Gaylussacia frondosa*, *Magnolia virginiana*, *Ilex opaca*, *Euonymus americanus*, *Chimaphila maculata*, *C. umbellata*, *Cypripedium acaule*, *Galium* spp., *Carex pensylvanica*, *C. swanii*, *Deschampsia flexuosa*, *Aquilegia canadensis*, *Aralia nudicaulis*, *Panicum boscii*, *Asplenium platyneuron*, *Paronychia canadensis*, *Podophyllum peltatum*, *Asarum canadensis*, *Asclepias variegata*, *Tipularia discolor*, *Mitchella repens*, *Lycopodium lucidulum*, *L. digitatum*, *Opuntia humifusa*, *Smilacina racemosa*, *Silene stellata*, *Uvularia perfoliata*, *Smilax glauca*, *Lonicera japonica*, *Scutellaria elliptica*, and *Parthenocissus quinquefolius*.

All of the upland forests have been cleared at one time or another. If left alone, these should develop into mature forests. A very interesting, young second growth woods occurs on an "island" within the swamp; a short soil-constructed road connects it to the uplands of the "mainland." This "island" is floristically interesting and contains a number of rare species that include *Aquilegia canadensis* (S1), *Arabis canadensis* (S2), *Aristolochia serpenteria* (S3), *Asclepias variegata* (S1), *Deschampsia flexuosa* (S2), *Lycopodium tristachyum* (S2), *Paronychia canadensis* (S2), *Polygonum scandens* var. *crisatum* (S1), *Pycnanthemum incanum* (S1), and *Triosteum angustifolium* (S1). These species may require the semi-open conditions of young woods in order to persist.

Rare Plants discovered along Choptank River:

Surveys of the upland and wetland habitats associated with the Choptank River resulted in the

discoveries of numerous rare plant species (see List below). Significant discoveries included: (1) a large population of *Aquilegia canadensis* (S1), on the upland "island" (this is the first Coastal Plain population found in a more or less natural habitat); (2) an abundant population of the rare quillwort, *Isoetes riparia* (S1); (3) the hairy snoutbean, *Rhynchosia tomentosa* (S1), which had been ranked as an SH and apparently was last collected in 1937; (4) the bluntleaved grapefern, *Botrychium oneidense* (S1), a New State Record; (5) three birds or nodding pogonia, *Triphora trianthophora* (S1), which was previously ranked as an SH and was last collected sometime prior to 1860; and (6) a population of the large twayblade, *Liparis lilifolia* (S2), representing a new county record. The *Triphora* may have been the most significant discovery, as this species was only (formerly) known, in Delaware, from near Hockessin on the Piedmont, and throughout its range, only a few populations are known to occur on the Coastal Plain Province.

Rare Plants Along the Choptank River:

(1) Terrestrial Habitats:

<i>Agalinis tenuifolia</i>	S1	Slender false-foxglove
<i>Aletris farinosa</i>	S2	White-tubed colicroot
<i>Andropogon gerardii</i>	S1	Big bluestem
<i>Aquilegia canadensis</i>	S1	American columbine
<i>Arabis canadensis</i>	S2	Sicklepod
<i>Arabis lyrata</i>	S1	Lyre-leaf rock-cress
<i>Aristolochia serpentaria</i>	S3	Virginia snakeroot
<i>Asclepias variegata</i>	S1	White milkweed
<i>Aster linariifolius</i>	S1	Stiff-leaved aster
<i>Castanea pumila</i>	S3	Chinquapin
<i>Chaerophyllum tainturieri</i>	SU	Southern chervil
<i>Chimaphila umbellata</i> ssp. <i>cisatlantica</i>	S1	Wintergreen
<i>Comandra umbellata</i>	S3	Bastard toadflax
<i>Commelina erecta</i> var. <i>erecta</i>	S1	Slender dayflower
<i>Cunila origanoides</i>	S2	Dittany
<i>Cyperus refractus</i>	S1	Reflexed flatsedge
<i>Deschampsia flexuosa</i>	S2	Crinkled hairgrass
<i>Desmodium laevigatum</i>	S3	Smooth tick-trefoil
<i>Helianthemum propinquum</i>	S3	Low frostweed
<i>Lechea villosa</i>	S2	Hairy pinweed
<i>Leptoloma cognatum</i>	S1	Mountain hairgrass
<i>Lespedeza hirta</i>	S2	Hairy bushclover
<i>Lespedeza steuvei</i>	S1	Tall bushclover
<i>Lycopodium tristachyum</i>	S2	Deep-root clubmoss
<i>Paronychia canadensis</i>	S2	Forked chickweed

<i>Paronychia fastigiata</i>	S1	Cluster-stemmed chickweed
<i>Polygonum scandens</i> var. <i> cristatum</i>	S1	Climbing false-buckwheat
<i>Pycnanthemum incanum</i>	S1	Mountain mint
<i>Pycnanthemum setosum</i>	S2	Awed mountain-mint
<i>Rhynchosia tomentosa</i>	S1	Hairy snoutbean
<i>Scutellaria elliptica</i>	S3	Hairy skullcap
<i>Sporobolus clandestinus</i>	S1	Rough dropseed
<i>Trichostema setaceum</i>	S1	Narrow-leaf blue curls
<i>Triosteum angustifolium</i>	S1	Yellowleaf tinker's weed
<i>Triphora trianthophora</i>	S1	Three birds
<i>Viola pedata</i>	S1	Birdfoot violet
<i>Woodsia obtusa</i>	S2	Bluntlobed woodsia

(2) Palustrine Habitats:

<i>Carex aggregata</i>	S1	A sedge
<i>Botrychium oneidense</i>	S1	Blunt-lobed grapefern
<i>Dryopteris cristata</i>	S2	Crested shieldfern
<i>Eleocharis quadrangulata</i>	S3	Square-stem spikerush
<i>Isoetes riparia</i>	S1	River quillwort
<i>Lysimachia hybrida</i>	S2	Lance-leaved loosestrife
<i>Ophioglossum vulgatum</i>	S2	Southern adder's tongue
<i>Rotala ramosior</i>	S3	Toothcup
<i>Triadenum walteri</i>	S3	Walter's St. John's-wort
<i>Xyris torta</i>	S2	Slender yellow-eyed grass

Although surveys for the Federally listed (Threatened) swamp pink, *Helonias bullata*, were unsuccessful (historical collections of the swamp pink are known from the Choptank River area), we are not ruling-out the possibility of rediscovering this plant here during future surveys.

Zoological Inventories:

The Choptank River drainage was surveyed for animal species from just below Mud Millpond (Road 207) to the Maryland state line. The floodplain of Cow Marsh Creek was surveyed from the Choptank River to Road 208 bridge. The floodplain and surrounding upland forests were included in inventory. Birds, reptiles, amphibians, butterflies, dragonflies and damselflies were targeted for in-depth inventory; other taxonomical groups represented on species lists are anecdotal observations. The Choptank River and surrounding uplands have proven to be extremely variable, yet support a unique suite of animal species which should make this ecosystem a conservation priority for the state of Delaware. See Appendix 4 for a complete list of animal species observed

in the Choptank River watershed.

Pristine palustrine forests cover most of the floodplain. These are interspersed with riparian open freshwater emergent and scrub-shrub wetlands which border the Cow Marsh and Choptank Rivers. Additionally, abandoned borrow pits exist adjacent to the Choptank north of Road 211, creating interesting species assemblages.

The palustrine forests are home to several forest interior neotropical migrant passerines such as the Kentucky warbler (S3B), Louisiana waterthrush (S3B), and Yellow-throated vireo (S3B) [see animal list below for additional species]. Many of these birds are in decline in Delaware, and deserve special conservation attention. The surrounding intact upland forests are crucial to conserve in order to maintain these species populations. These upland forests also support additional populations of nesting forest interior species.

Additional animal species of conservation concern which were found to be dependant on these palustrine forests, include the Barred owl (S2), Red-shouldered hawk (S2), and Pileated woodpecker (S3). All three of these species require extensive tracts of mature floodplain forests for successful reproduction. The existing upland forests which border this system are crucial in maintaining the ecological integrity of the floodplain forests and therefore the long-term existence of these species. All three of these species are important forest predators which have disappeared from most of Delaware's woodlands.

The Choptank River was historically known as a reliable nesting site for the Cerulean warbler (S1B, C2). This species is associated with mature deciduous floodplain forests, and is sensitive to the fragmentation of surrounding upland forests. Unfortunately, the cerulean warbler was not found during this survey. Its disappearance from the Choptank River is most likely associated with past timbering practices along this river corridor in which many large American beech (*Fagus grandifolia*) trees were extracted. However, there is potential that this species may either be extant within remote areas of these forests, or could recolonize the Choptank drainage in the future.

The high diversity of odonate species was reflective of the variety of different wetland habitats found within the study area. Palustrine forests, open freshwater marshes and seepages, riverine wetlands and abandoned borrow pits provided a diversity of wetland microhabitat which proved suitable for a diverse suite of species. Most notable was the Blue-faced meadowfly (S1), Blackwater bluet (S2), Blue corporal (S2), and Cyrano Darner (S3).

The Eastern pond mussel (formerly SH, now S1) was discovered submerged within a sandy/gravel bed in Cow Marsh Creek 0.2 miles east of the confluence of the Choptank River. This was the first discovery of this species in Delaware in over 15 years. The presence of this species may indicate relatively high water quality in this creek.

Additional rarities found during 1994 include the Eastern kingsnake and Eastern earth snake (S1). The Rough-green snake (S2) has been found within this survey area in recent years but was not

found in 1994. A population of Rough-green snakes probably remains extant since extensive habitat alteration has not recently taken place. Like most of the rare animal species found, long-term survival of these snakes is largely dependant on the ecological integrity of the upland forests which surround the Choptank riverine floodplains.

CONCLUSIONS

Although the 1994 surveys of the St. Jones, Murderkill, and Choptank River systems were not entirely comprehensive, the results of field inventories identified several areas of biodiversity significance and high quality habitats. At the same time, the surveys underscored the general lack of buffers in many areas along these river systems (especially along the St. Jones River and in the lower portion of the Murderkill River). Throughout the St. Jones and Murderkil Rivers, adequate vegetative buffers are lacking, while in comparson, a substantial amount of buffer is present along the Choptank; see Figs. 1-11.

Areas of high biological significance (i.e. quality habitat and rare species assemblages) include: the Browns Branch and Big Cripple Swamp, Black Swamp Creek, and the Murderkill at Killens Pond State Park; the Cypress Swamp and Tidbury Creek of the St. Jones River, and all of the Choptank River. The Choptank River contains exceptionally high quality habitats that should be a conservation priority.

The lower St. Jones River and Murderkill River include an abundance of salt marsh habitat critical to certain groups of fauna, especially migratory wading birds, shorebirds and wintering waterfowl and raptors. Near the mouths of these two rivers are important feeding areas for migrating shorebirds.

Additional surveys are needed in parts of the lower St. Jones and Murderkill watersheds, within the Big Cripple Swamp, the upper Browns Branch, along Black Swamp Creek, and throughout the Choptank River.

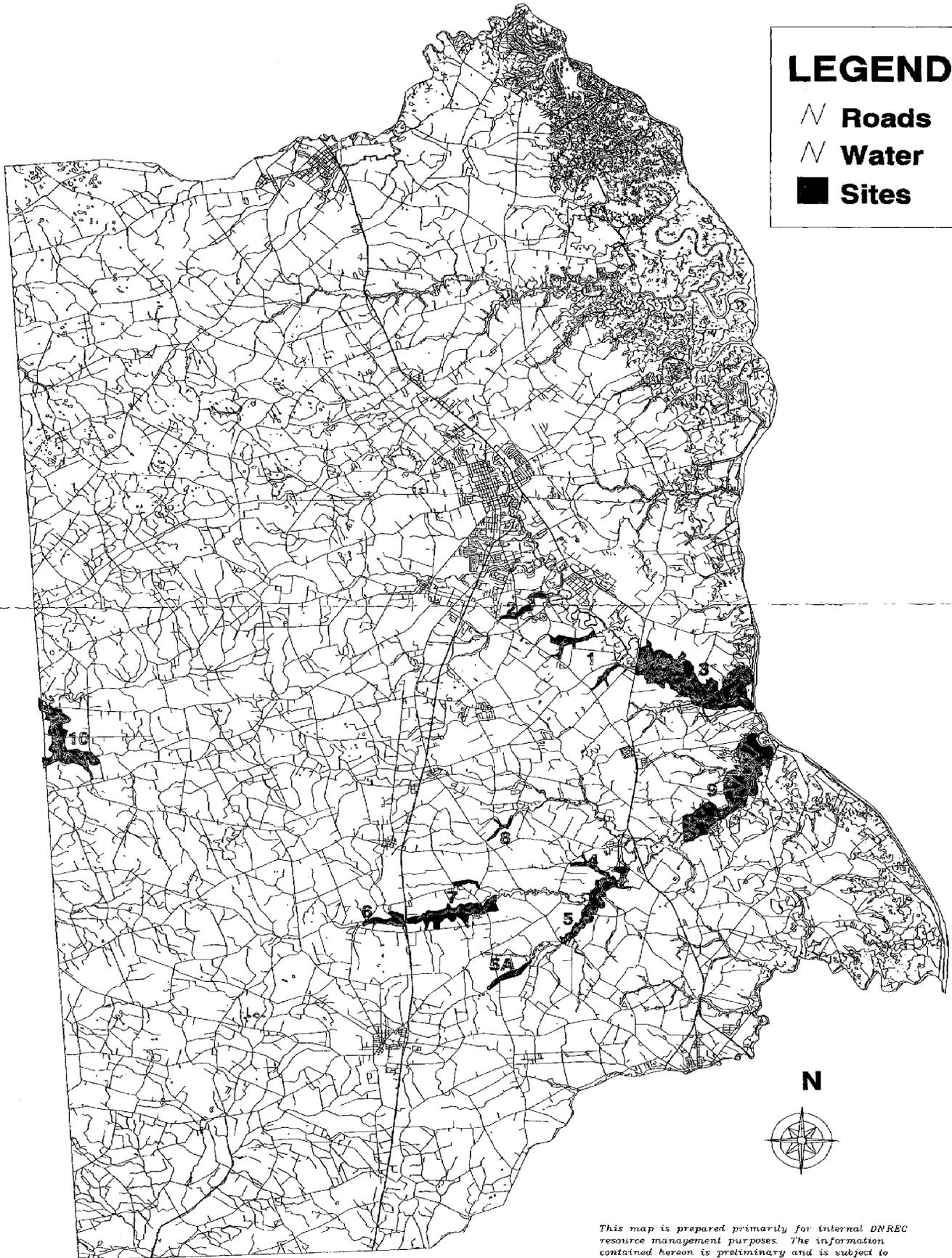
Kent County Survey Sites

LEGEND

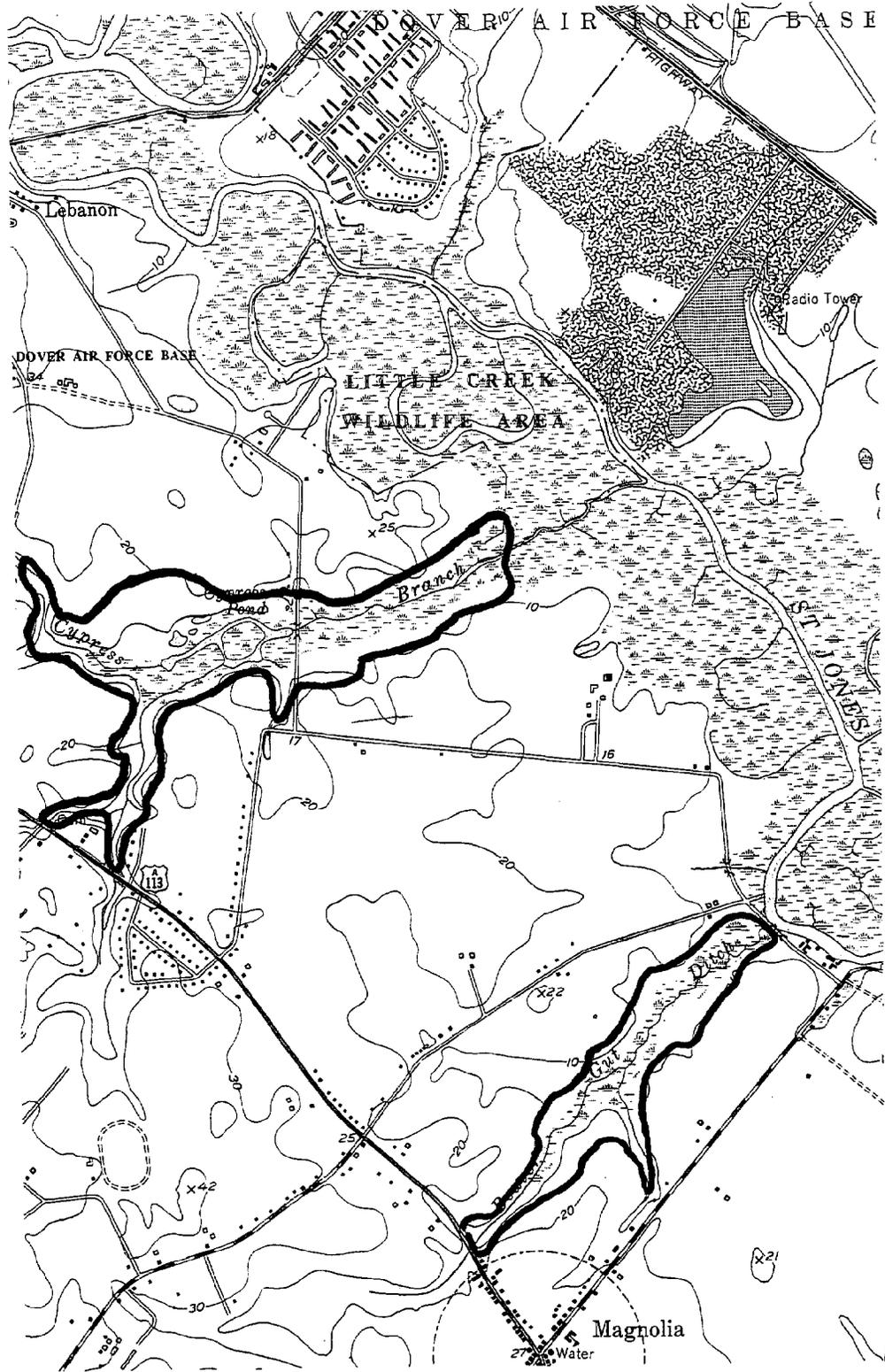
 Roads

 Water

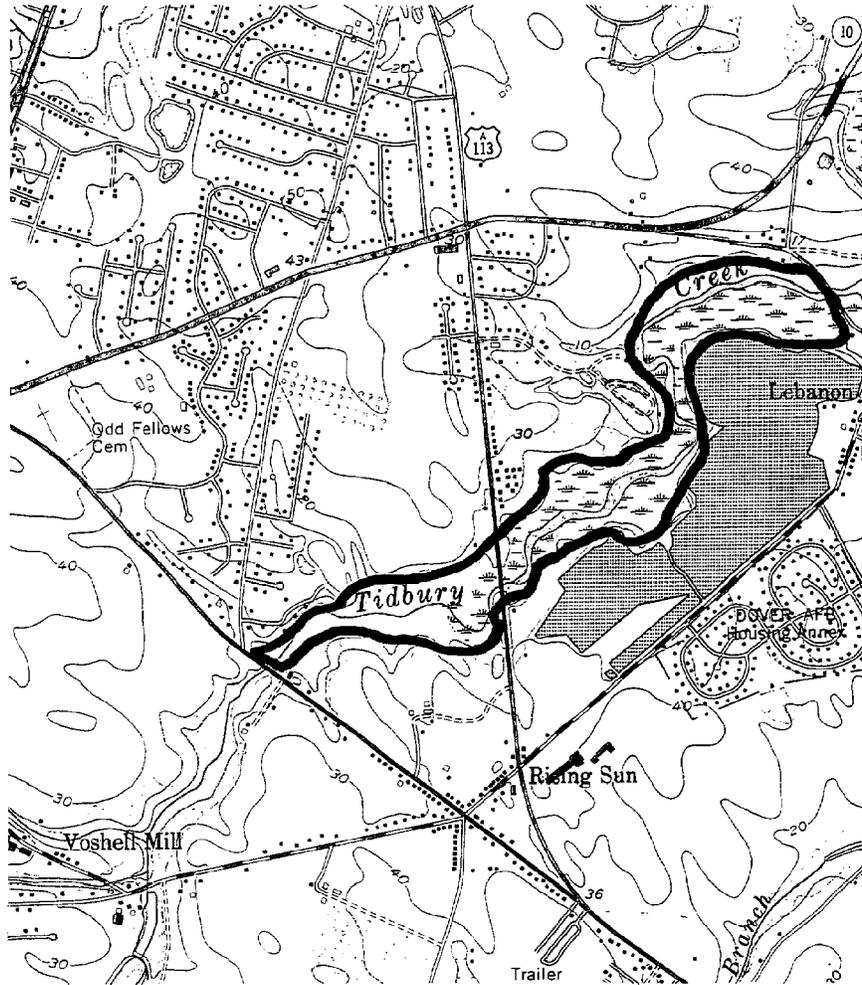
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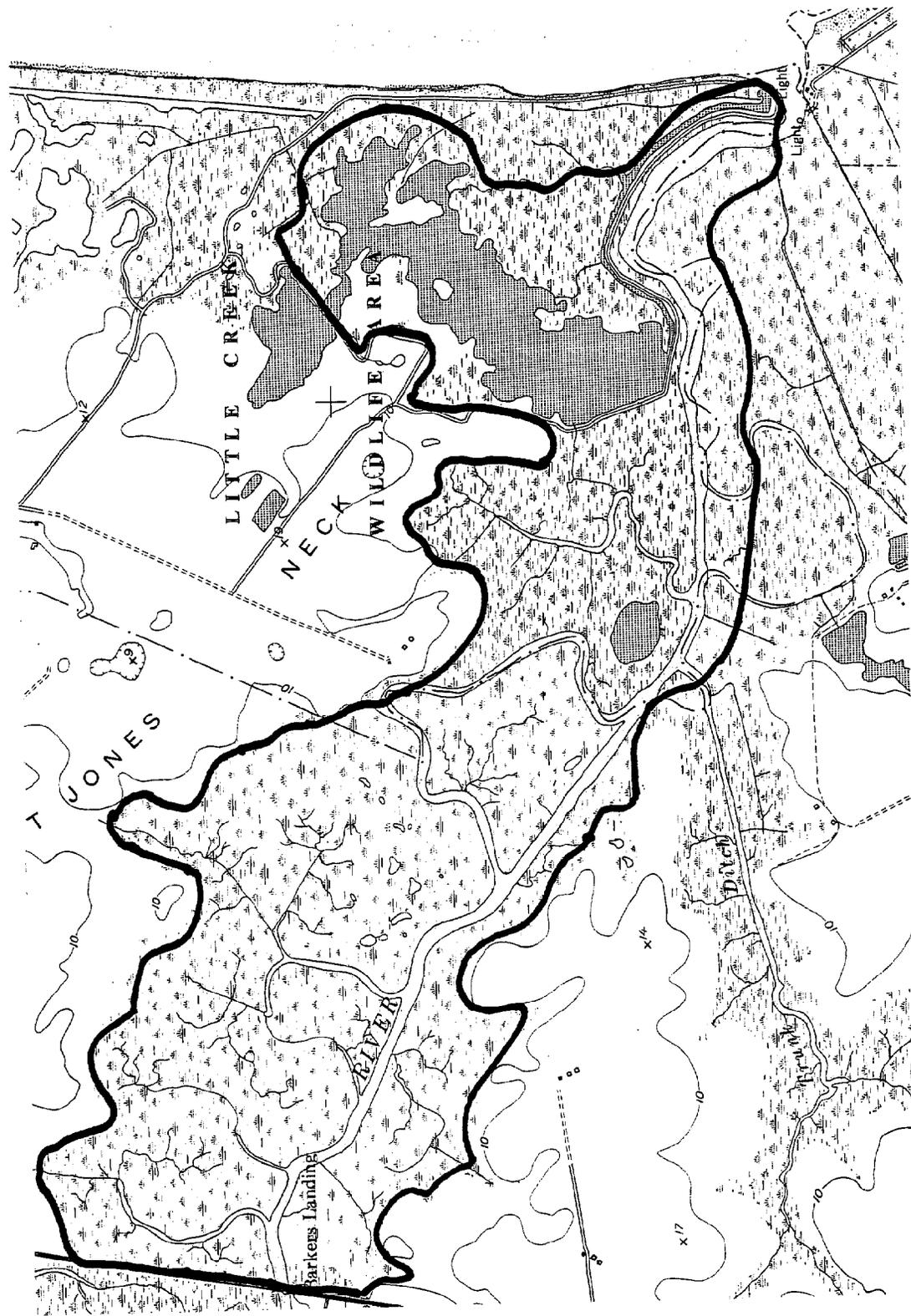
This map is prepared primarily for internal DNREC resource management purposes. The information contained hereon is preliminary and is subject to change or modification at any time. Use of this information by others is at their own risk and the DNREC in no way guarantees the accuracy of the information.



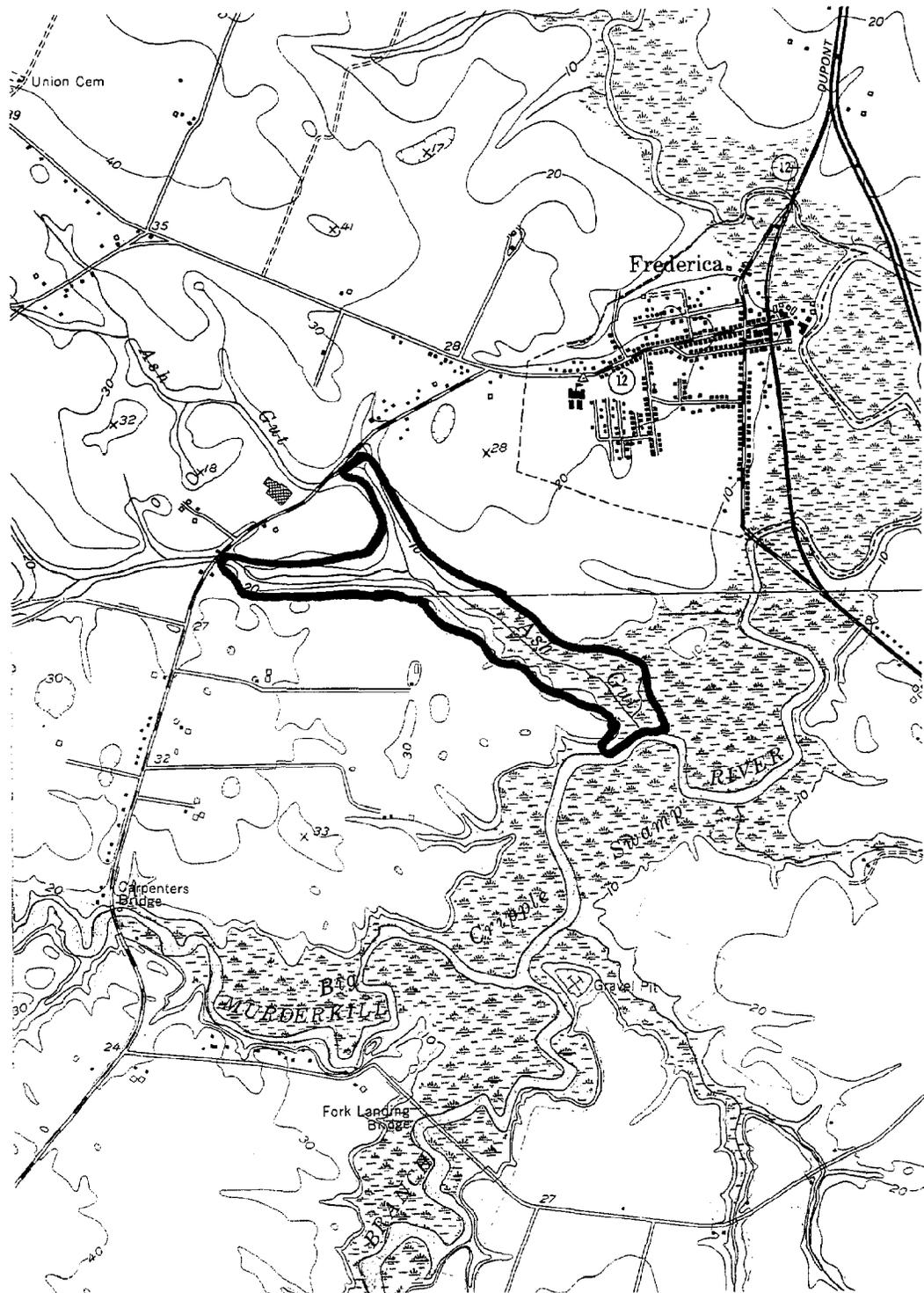
**FIG. 1. Beaver Gut Ditch (below); Cypress Branch.
(Frederica Quadrangle)**



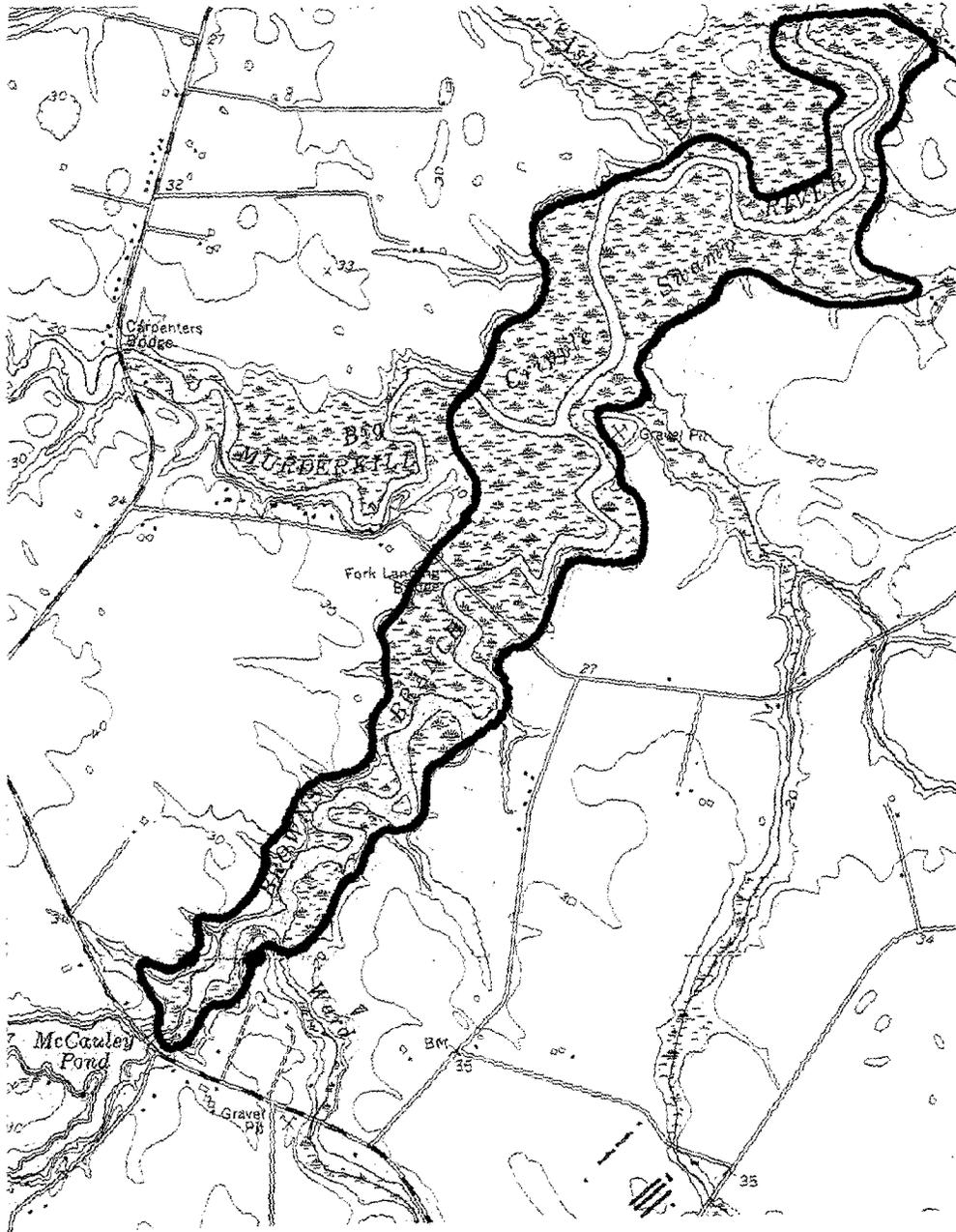
**FIG. 2. Tidbury Creek.
(Wyoming Quadrangle).**



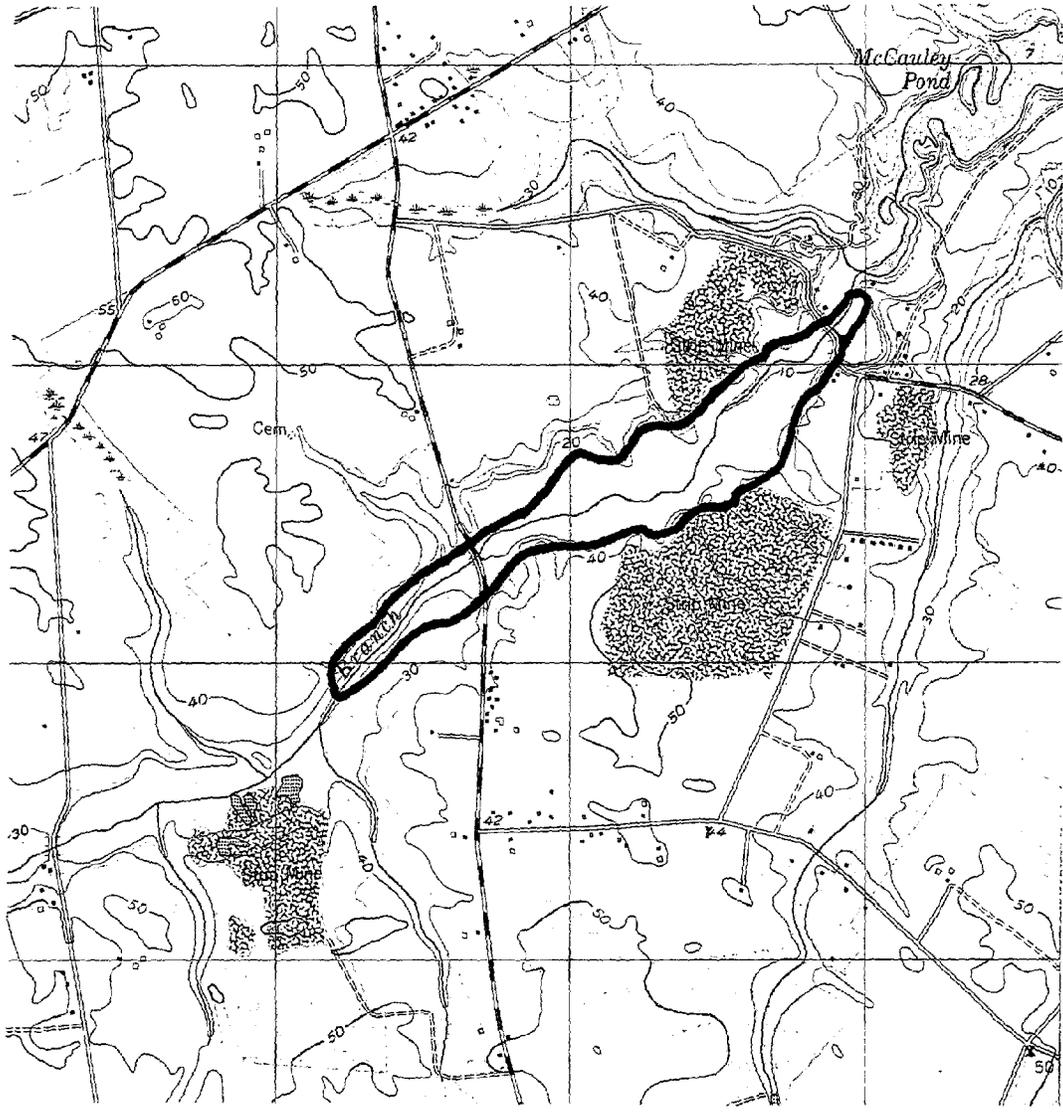
**FIG. 3. Lower St. Jones River.
(Frederica Quadrangle)**



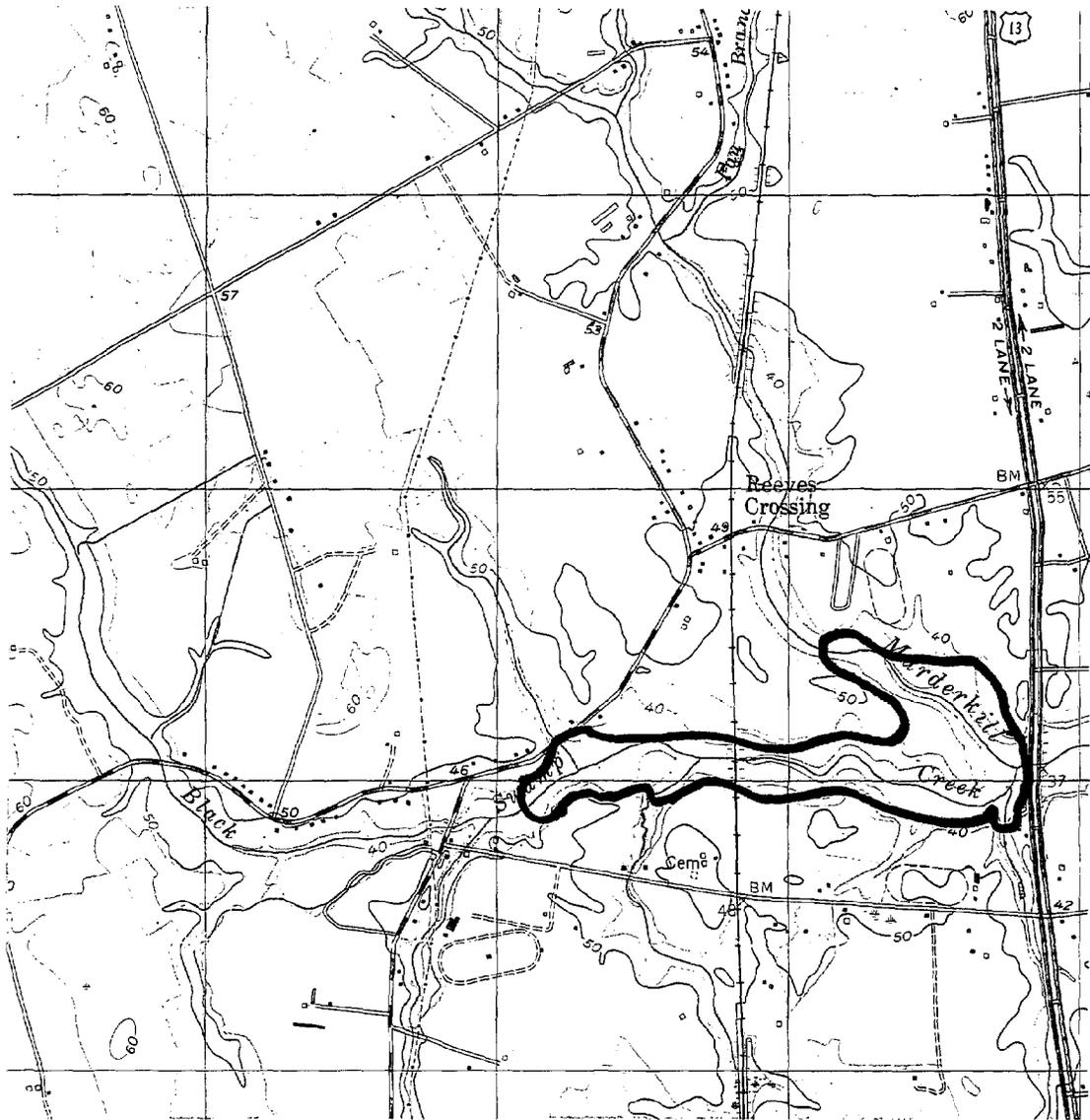
**FIG. 4. Ash Gut.
(Frederica, Milford Quadrangles)**



**FIG. 5. Browns Branch/Big Cripple Swamp.
(Milford Quadrangle)**



**FIG. 5A. Browns Branch Above McCauley Pond.
(Harrington Quadrangle)**



**FIG. 6. Black Swamp Creek.
(Harrington Quadrangle)**

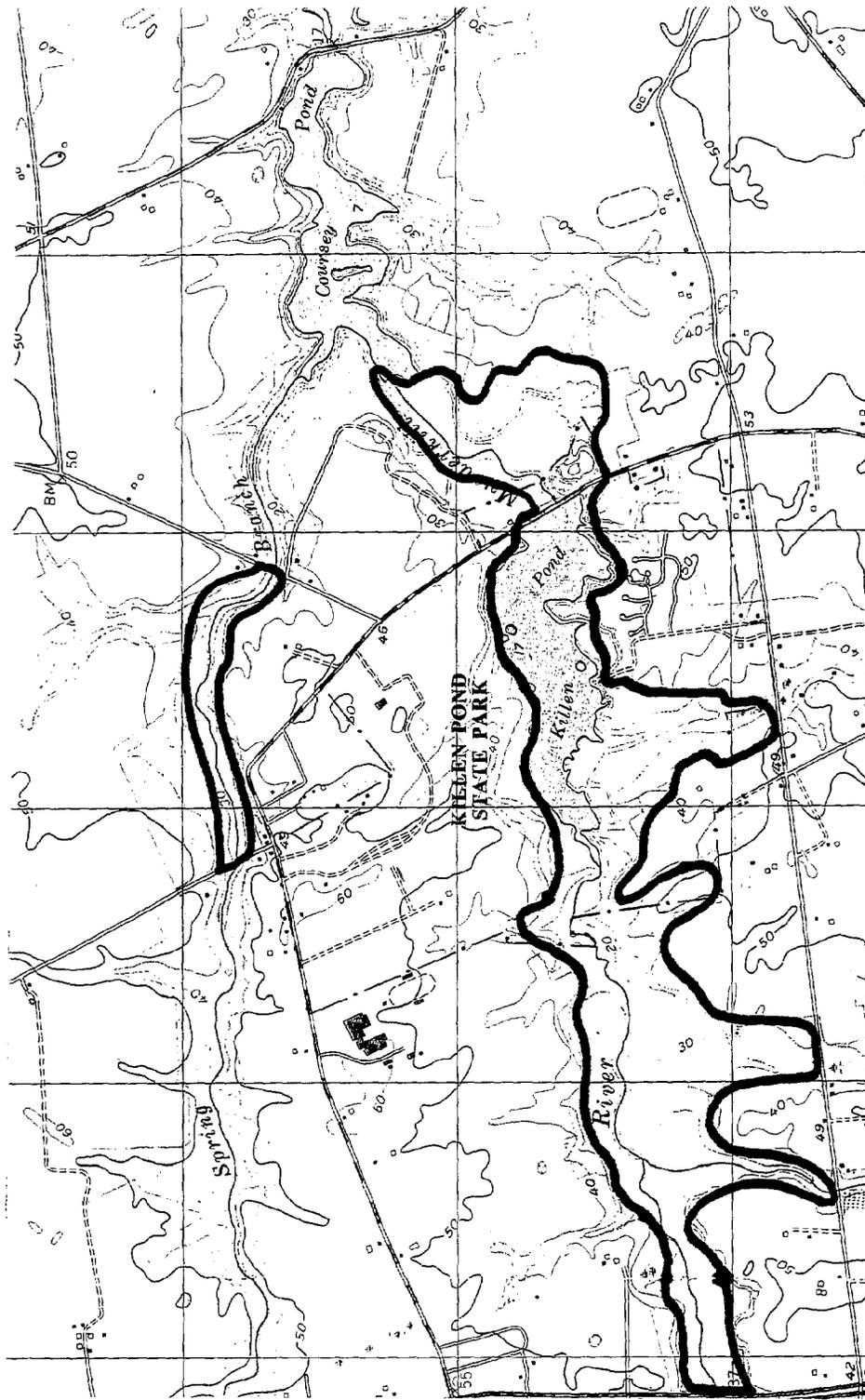


FIG. 7. Murderkill River/Killens Pond State Park (below); Spring Branch.

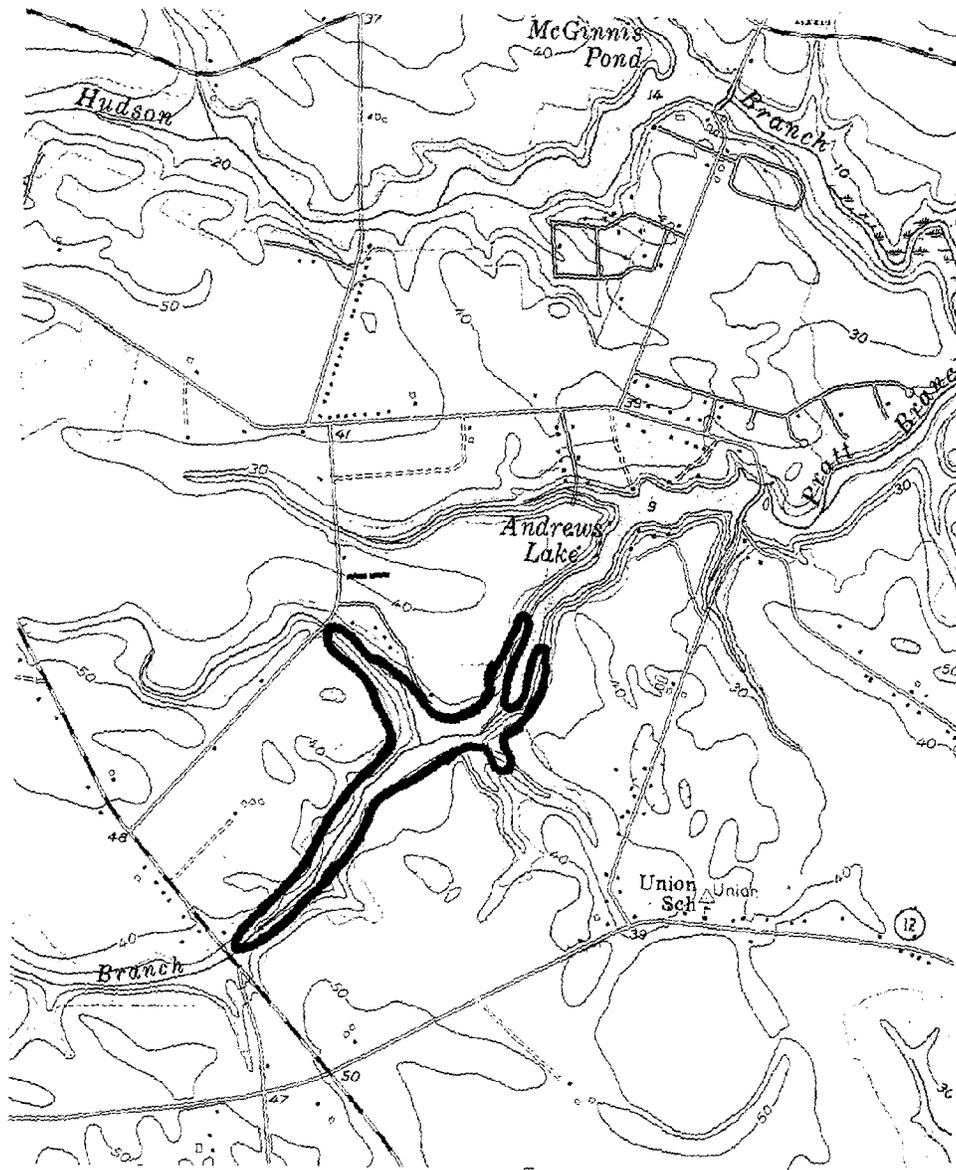
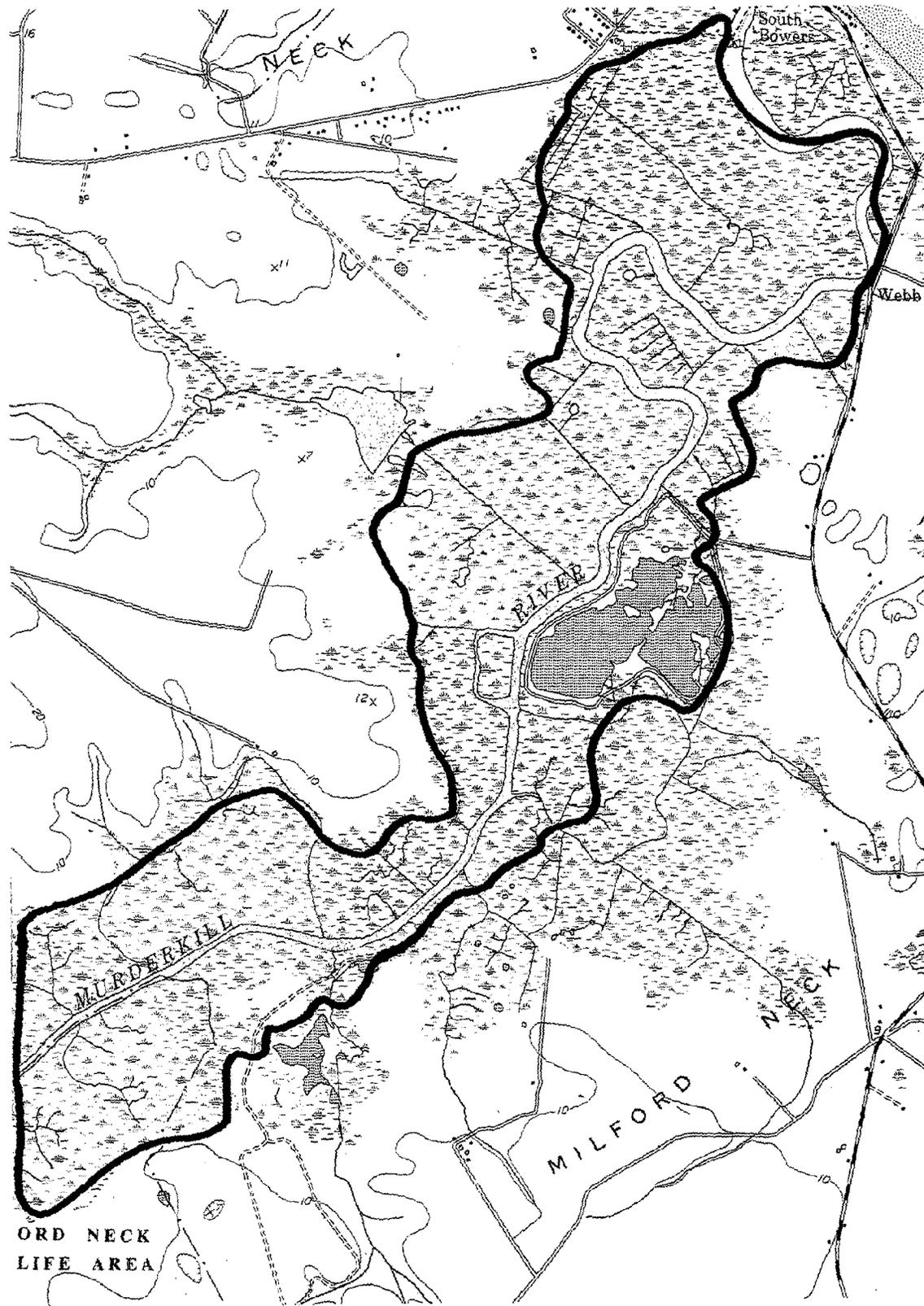


FIG. 8. Pratt Branch/Andrews Lake.
(Wyoming Quadrangle)



**FIG. 9. Lower Murderkill River.
(Frederica Quadrangle)**

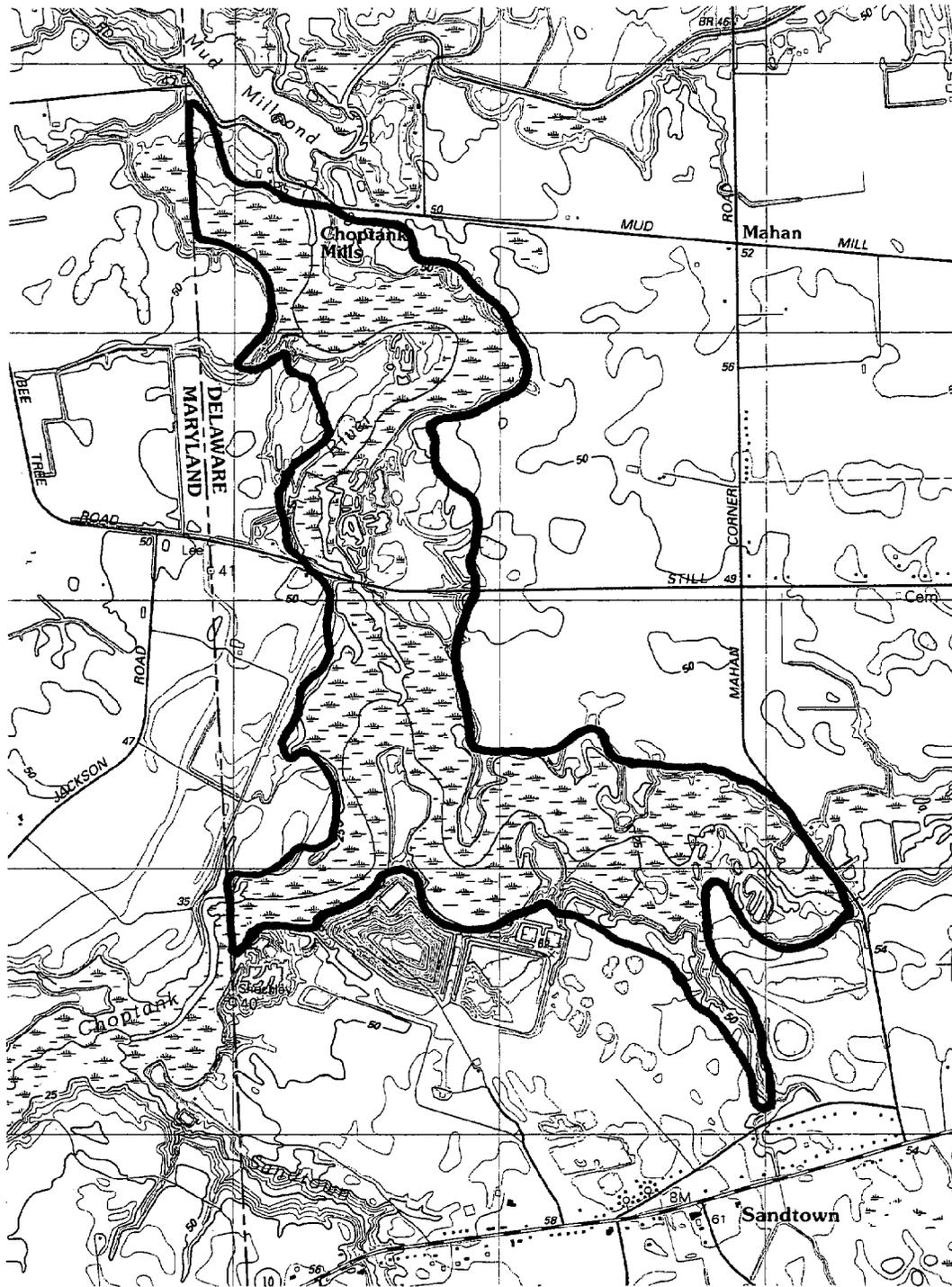


FIG. 10. Choptank River.
(Marydel Quadrangle)



FIG. 11. Choptank River below RD 211 (note County landfill, sand pits and ponded areas in the wetland)

Appendix I. Comprehensive Zoological Species List for St. Jones River, Murderkill River, and Choptank River watersheds

<u>Birds</u>		<u>State Rank</u>
Acadian flycatcher	<i>Empidonax virescens</i>	S4B
American goldfinch	<i>Carduelis tristis</i>	S5
American black duck	<i>Anas rubripes</i>	S4B
American crow	<i>Corvus brachyrhynchos</i>	S5
American robin	<i>Turdus migratorius</i>	S5
American redstart	<i>Setohaga ruticilla</i>	S1B
Bald eagle	<i>Haliaeetus leucocephalus</i>	S1B
Barn swallow	<i>Hirundo rustica</i>	S5B
Barred owl	<i>Strix varia</i>	S2
Belted kingfisher	<i>Ceryle alcyon</i>	S4B
Black and white warbler	<i>Mniotilta varia</i>	S4B
Black skimmer	<i>Rynchops niger</i>	S1B
Blue grosbeak	<i>Guiraca caerulea</i>	S4B
Blue jay	<i>Cyanocitta cristata</i>	S5
Blue-grey gnatcatcher	<i>Poliophtilla caerulea</i>	S4B
Boat-tailed grackle	<i>Quiscalus major</i>	S4
Brown creeper	<i>Certhia americana</i>	S4N
Brown thrasher	<i>Toxostoma rufum</i>	S5B
Brown-headed cowbird	<i>Molothrus ater</i>	S5
Carolina wren	<i>Thryothorus ludovicianus</i>	S4
Carolina chickadee	<i>Parus carolinensis</i>	S5
Cedar waxwing	<i>Bombycilla cedrorum</i>	S4
Chipping sparrow	<i>Spizella passerina</i>	S5B
Clapper rail	<i>Rallus longirostris</i>	S5
Coastal plain swamp sparrow	<i>Melospiza georgiana</i>	S3B
	<i>nigrescens</i>	
Common tern	<i>Sterna hirundo</i>	S1B, S3N
Common grackle	<i>Quiscalus quiscula</i>	S5
Common yellowthroat	<i>Geothlypis trichas</i>	S5B
Common snipe	<i>Gallinago gallinago</i>	S3N
Double-crested cormorant	<i>Phalacrocorax auritus</i>	S4
Downy woodpecker	<i>Picoides pubescens</i>	S5
Eastern pheobe	<i>Sayornis pheobe</i>	S5B
Eastern kingbird	<i>Tyrannus tyrannus</i>	S5B
Eastern wood pewee	<i>Contopus virens</i>	S4B
European starling	<i>Sturnus vulgaris</i>	SE
Field sparrow	<i>Spizella pusilla</i>	S5

Fish crow	<i>Corvus ossifragus</i>	S5
Forster's tern	<i>Sterna forsteri</i>	S1B,S3N
Glossy ibis	<i>Plegadis falcinellus</i>	S2B
Gray catbird	<i>Dumetella carolinensis</i>	S5B
Great egret	<i>Casmerodius albus</i>	S2B
Great blue heron	<i>Ardea herodias</i>	S2B
Great crested flycatcher	<i>Myiarchus crinitus</i>	S5B
Great black-backed gull	<i>Larus marinus</i>	S1B,S5N
Green-backed heron	<i>Butorides striatus</i>	S5B
Hairy woodpecker	<i>Picoides villosus</i>	S5
Hermit thrush	<i>Catharus guttatus</i>	S4N
Herring gull	<i>Larus Argentatus</i>	S3B,S5N
House finch	<i>Carpodacus mexicanus</i>	SE
Indigo bunting	<i>Passerina cyanea</i>	S5B
Kentucky warbler	<i>Oporornis formosus</i>	S3B
Killdeer	<i>Charadrius vociferus</i>	S5B
Laughing gull	<i>Larus atricilla</i>	S3B,S4N
Least tern	<i>Sterna antillarum</i>	S1B,S2N
Lincoln's sparrow	<i>Melospiza lincolnii</i>	SZN
Louisiana waterthrush	<i>Seiurus motacilla</i>	S3B
Mallard	<i>Anas platyrhynchos</i>	S5B
Marsh wren	<i>Cistothorus palustris</i>	S4B
Mourning dove	<i>Zenaida macroura</i>	S5
Northern flicker	<i>Colaptes auratus</i>	S5
Northern cardinal	<i>Cardinalis cardinalis</i>	S5
Northern harrier	<i>Circus cyaneus</i>	S1B,S3N
Northern parula	<i>Parula americana</i>	S1B
Northern bobwhite	<i>Colinus virginianus</i>	S5
Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	S4B
Orchard oriole	<i>Icterus spurius</i>	S4B
Osprey	<i>Pandion haliaetus</i>	S4B
Ovenbird	<i>Seiurus aurocapillus</i>	S5B
Pileated woodpecker	<i>Dryocopus pileatus</i>	S3
Pine warbler	<i>Dendroica pinus</i>	S4B
Prothonotary warbler	<i>Protonotaria citrea</i>	S4B
Red eyed vireo	<i>Vireo olivaceus</i>	S5B
Red knot	<i>Calidris canutus</i>	S2N
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	S5
Red-shouldered hawk	<i>Buteo lineatus</i>	S2B,SZN
Red-tailed hawk	<i>Buteo jamaicensis</i>	S5
Red-winged blackbird	<i>Agelaius phoeniceus</i>	S5
Ring-billed gull	<i>Larus Delawarensis</i>	S5N
Royal tern	<i>Sterna maxima</i>	S3N

Ruby crowned kinglet	<i>Regulus calendula</i>	S4N, SZN
Ruby-throated hummingbird	<i>Archilochus colubris</i>	S5B
Ruddy turnstone	<i>Arenaria interpes</i>	S2N
Sanderling	<i>Calidris alba</i>	S3N
Scarlet tanager	<i>Piranga piranga</i>	S4B
Seaside sparrow	<i>Ammodramus maritimus</i>	S3
Sharp-shinned hawk	<i>Accipenser striatus</i>	S3N
Sharp-tailed sparrow	<i>Ammodramus caudacutus</i>	S3B, S2N
Snowy egret	<i>Egretta thula</i>	S1B
Song sparrow	<i>Melospiza melodia</i>	S5
Tree swallow	<i>Tachycineta bicolor</i>	S4B
Tufted titmouse	<i>Parus bicolor</i>	S5
Turkey vulture	<i>Cathartes aura</i>	S5
White-eyed vireo	<i>Vireo griseus</i>	S5B
White-throated sparrow	<i>Zonotrichia albicollis</i>	S5N
Willet	<i>Catoptrophorus semipalmatus</i>	S4B
Wood duck	<i>Aix sponsa</i>	S4B
Woodthrush	<i>Zonotrichia albicollis</i>	S5B
Yellow warbler	<i>Dendroica petechia</i>	S4B
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	S4B
Yellow-breasted chat	<i>Icteria virens</i>	S4B
Yellow-rumped warbler	<i>Dendroica coronata</i>	S5N
Yellow-throated vireo	<i>Vireo flavifrons</i>	S3B

Mammals

Beaver	<i>Castor canadensis</i>	S3
Gray squirrel	<i>Sciurus carolinensis</i>	S5
Muskrat	<i>Ondatra zibethicus</i>	S5
River otter	<i>Lutra canadensis</i>	S3
White-tailed deer	<i>Odocoileus virginianus</i>	S5

Reptiles and Amphibians

Gray treefrog	<i>Hyla versicolor</i>	S4
Green frog	<i>Rana camitans</i>	S5
New Jersey chorus frog	<i>Pseudacris triseriata</i>	S4
Northern spring peeper	<i>Hyla crucifer</i>	S5
Southern leopard frog	<i>Rana sphenoccephala</i>	S5
Diamond-backed terrapin	<i>Malaclemys terrapin</i>	S4
Eastern box turtle	<i>Terrapene carolina</i>	S5
Eastern kingsnake	<i>Lampropeltis getula</i>	S2
Eastern earth snake	<i>Virginia valeriae</i>	S1

Northern watersnake	<i>Nerodia sipedon</i>	S5
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Dragonflies

River cruiser	<i>Macromia</i> spp.	
Black mantled glider	<i>Tramea lacerata</i>	S3
Blue corporal	<i>Libellula deplanata</i>	S2
Blue dasher	<i>Pachydiplax longipennis</i>	S5
Blue-faced meadowfly	<i>Sympetrum ambiguum</i>	S1
Cherry-faced meadowfly	<i>Sympetrum internum</i>	S4
Common Baskettail	<i>Tetragoneuria cynosura</i>	S4
Common whitetail	<i>Libellula lydia</i>	S5
Cyano darner	<i>Nasiaeschna pentacantha</i>	S3
Eastern Pond hawk	<i>Erythemis simplicicollis</i>	S5
Eastern amberwing	<i>Perithemis tenera</i>	S5
Fawn darner	<i>Boyeria vinosa</i>	S4
Great blue skimmer	<i>Libellula vibrans</i>	S3
Mocha emerald	<i>Somatochlora linearis</i>	S4
Needhams skimmer	<i>Libellula needhami</i>	S5
Ruby meadowfly	<i>Sympetrum rubicundulum</i>	S4
Seaside dragonlet	<i>Erythrodiplax berenice</i>	S5
Slaty skimmer	<i>Libellula incesta</i>	S5
Fragile forktail	<i>Ischnura posita</i>	S5
Blackwater bluet	<i>Enallagma weewa</i>	S2
Blue-fronted dancer	<i>Argia apicalis</i>	S4
Blue-tipped dancer	<i>Argia tibialis</i>	S4
Eastern forktail	<i>Ischnura verticallis</i>	S5
Eastern red damsel	<i>Amphiagrion saucium</i>	S4
Ebony jewelwing	<i>Calopteryx maculata</i>	S5
Familiar bluet	<i>Enallagma civile</i>	S5
Slender spreadwing	<i>Lestes rectangularis</i>	S4
Sparkling jewelwing	<i>Calopteryx dimidiata</i>	S3
Stream bluet	<i>Enallagma exulans</i>	S5
Turquoise bluet	<i>Enallagma divagens</i>	S4
Violet dancer	<i>Argia fumipennis violacea</i>	S5

Butterflies

Orange sulfur	<i>Colias eurytheme</i>	S5
American painted lady	<i>Vanessa virginiensis</i>	SZB
Black swallowtail	<i>Papilio polyxenes</i>	S4
Bronze copper	<i>Lycaena hyllus</i>	S2
Buckeye	<i>Junonia coenia</i>	SZB

Clouded sulfur	<i>Colias philodice</i>	S5
Dogface butterfly	<i>Colias cesonia</i>	SE
European cabbage white	<i>Pieris rapae</i>	SE
Least skipperling	<i>Ancyloxypha numitor</i>	S5
Monarch	<i>Danaus plexippus</i>	S5
Pearly crescentspot	<i>Phyciodes tharos</i>	S5
Red admiral	<i>Vanessa atalanta</i>	SZB
Red spotted purple	<i>Limenitis arthemis</i>	S5
Silver spotted skipper	<i>Epargyreus clarus</i>	S5
Spring azure	<i>Celastrina ladon</i>	S5
Tiger swallowtail	<i>Papilio glaucus</i>	S5
Variiegated fritillary	<i>Euptoieta claudia</i>	SZB

Bivalves

Eastern pondmussel	<i>Ligumia nasuta</i>	S1
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APPENDIX 2. Animal species found during 1994 inventory of the St. Jones River*. Those in boldface represent Species of Special Concern.

* (B = Nesting within study area; M = migrant through study area; W = wintering within study area; a combined rank is given if species equally depends on study area for migratory, breeding or wintering space)

<u>Common name</u>	<u>Scientific Name</u>	<u>Status*</u>
<u>BIRDS</u>		
American avocet	<i>Recurvirostra americana</i>	M
American black duck	<i>Anas rubripes</i>	B
American robin	<i>Turdus migratorius</i>	B
American goldfinch	<i>Carduelis tristis</i>	B
Bald eagle	<i>Haliaeetus leucocephalus</i>	B (nest failed)
Barn swallow	<i>Hirundo rustica</i>	B
Belted kingfisher	<i>Ceryle alcyon</i>	B
Black skimmer	<i>Rynchops niger</i>	B?
Blue jay	<i>Cyanocitta cristata</i>	B
Boat-tailed grackle	<i>Quiscalus major</i>	B
Brown-headed cowbird	<i>Molothrus ater</i>	B
Carolina chickadee	<i>Parus carolinensis</i>	B
Carolina wren	<i>Thryothorus ludovicianus</i>	B
Clapper rail	<i>Rallus longirostris</i>	B
Common grackle	<i>Quiscalus quiscula</i>	B
Common snipe	<i>Gallinago gallinago</i>	?
Common tern	<i>Sterna hirundo</i>	M
Common yellowthroat	<i>Geothlypis trichas</i>	B
Eastern kingbird	<i>Tyrannus tyrannus</i>	B
Eastern wood pewee	<i>Contopus virens</i>	B
European starling	<i>Sturnus vulgaris</i>	B
Fish crow	<i>Corvus ossifragus</i>	B
Forster's tern	<i>Sterna forsteri</i>	M
Glossy ibis	<i>Plegadis falcinellus</i>	M
Great black-backed gull	<i>Larus marinus</i>	M
Great blue heron	<i>Ardea herodias</i>	MB
Great egret	<i>Casmerodius albus</i>	M
Great crested flycatcher	<i>Myiarchus crinitus</i>	B
Green-backed heron	<i>Butorides striatus</i>	B

Gray catbird	<i>Dumetella carolinensis</i>	B
Herring gull	<i>Larus argentatus</i>	M
Killdeer	<i>Charadrius vociferus</i>	B
Laughing gull	<i>Larus atricilla</i>	M
Least tern	<i>Sterna antillarum</i>	M
Mallard	<i>Anas platyrhynchos</i>	B
Marsh wren	<i>Cistothorus palustris</i>	B
Mourning dove	<i>Zenaida macroura</i>	B
Northern cardinal	<i>Cardinalis cardinalis</i>	B
Northern harrier	<i>Circus cyaneus</i>	M
Red eyed vireo	<i>Vireo olivaceus</i>	B
Red-tailed hawk	<i>Buteo jamaicensis</i>	B
Red-winged blackbird	<i>Agelaius phoeniceus</i>	B
Red knot	<i>Calidris canutus</i>	M
Ring-billed gull	<i>Larus Delawarensis</i>	B
Royal tern	<i>Sterna maxima</i>	M
Ruby crowned kinglet	<i>Regulus calendula</i>	W
Ruddy turnstone	<i>Arenaria interpes</i>	M
Sanderling	<i>Calidris alba</i>	M
Seaside sparrow	<i>Ammodramus maritimus</i>	B
Scarlet tanager	<i>Piranga piranga</i>	B
Sharp-shinned hawk	<i>Accipenser striatus</i>	M
Snowy egret	<i>Egretta thula</i>	M
Song sparrow	<i>Melospiza melodia</i>	B
Tree swallow	<i>Tachycineta bicolor</i>	B
Tufted titmouse	<i>Parus bicolor</i>	B
Turkey vulture	<i>Cathartes aura</i>	B
Yellow-rumped warbler	<i>Dendroica dominica</i>	M
Yellow warbler	<i>Dendroica petechia</i>	B
Willet	<i>Catoptrophorus semipalmatus</i>	B

REPTILES AND AMPHIBIANS

Diamond-backed terrapin	<i>Malaclemys terrapin</i>	B
Northern spring peeper	<i>Hyla crucifer</i>	B
Southern leopard frog	<i>Rana sphenoccephala</i>	B

MAMMALS

River otter	<i>Lutra canadensis</i>	B
Muskrat	<i>Ondatra zibethicus</i>	B
White-tailed deer	<i>Odocoileus virginianus</i>	B

DRAGONFLIES

Seaside dragonlet	<i>Erythrodiplax berenice</i>	B
Eastern Pond hawk	<i>Erythemis simplicicollis</i>	B

DAMSELFLIES

Familiar bluet	<i>Enallagma civile</i>	B
Eastern amberwing	<i>Perithemis tenera</i>	B
Blue-fronted dancer	<i>Argia apicalis</i>	B

BUTTERFLIES

Buckeye	<i>Junonia coenia</i>	M
European cabbage white	<i>Pieris rapae</i>	B
Orange sulfur	<i>Colias eurytheme</i>	B
Monarch	<i>Danaus plexippus</i>	B
Dogface butterfly	<i>Colias cesonia</i>	?

APPENDIX 3. Animal species found during 1994 inventory of the Murderkill River*. Those in boldface represent Species of Special Concern.

* (B = Nesting within study area; M = migrant through study area; W = wintering within study area; a combined rank is given if species equally depends on study area for migratory, breeding or wintering space)

<u>Common name</u>	<u>Scientific name</u>	<u>Status*</u>
<u>BIRDS</u>		
Acadian flycatcher	<i>Empidonax vireescens</i>	B
American crow	<i>Corvus brachyrhynchos</i>	B
American goldfinch	<i>Carduelis tristis</i>	B
American robin	<i>Turdus migratorius</i>	B
Barn swallow	<i>Hirundo rustica</i>	B
Belted kingfisher	<i>Ceryle alcyon</i>	B
American black duck	<i>Anas rubripes</i>	B
Blue-grey gnatcatcher	<i>Poliioptilla caerulea</i>	B
Blue grosbeak	<i>Guiraca caerulea</i>	B
Bluejay	<i>Cyanocitta cristata</i>	B
Carolina chickadee	<i>Parus carolinensis</i>	B
Carolina wren	<i>Thryothorus ludovicianus</i>	B
Cedar waxwing	<i>Bombycilla cedrorum</i>	B
Clapper rail	<i>Rallus longirostris</i>	B
Coastal plain swamp sparrow	<i>Melospiza georgiana nigrescens</i>	B
Common grackle	<i>Quiscalus quiscula</i>	B
Common tern	<i>Sterna hirundo</i>	M
Common yellowthroat	<i>Geothlypis trichas</i>	B
Double-crested cormorant	<i>Phalacrocorax auritus</i>	M/F
Downy woodpecker	<i>Picoides pubescens</i>	B
Eastern kingbird	<i>Tyrannus tyrannus</i>	B
Eastern pheobe	<i>Sayornis pheobe</i>	B
Eastern wood pewee	<i>Contopus virens</i>	B
European starling	<i>Sturnus vulgaris</i>	B
Fish crow	<i>Corvus ossifragus</i>	B
Great blue heron	<i>Ardea herodias</i>	M\B
Great crested flycatcher	<i>Myiarchus crinitus</i>	B
Green-backed heron	<i>Butorides striatus</i>	B
Hairy woodpecker	<i>Picoides villosus</i>	B

Herring gull	<i>Larus Argentatus</i>	M/W
House finch	<i>Carpodacus mexicanus</i>	B/W
Indigo bunting	<i>Passerina cyanea</i>	B
Least tern	<i>Sterna antillarum</i>	M/F
Mallard	<i>Anas platyrhynchos</i>	B/W
Marsh wren	<i>Cistothorus palustris</i>	B
Mourning dove	<i>Zenaida macroura</i>	B
Northern bobwhite	<i>Colinus virginianus</i>	B
Northern cardinal	<i>Cardinalis cardinalis</i>	B
Northern flicker	<i>Colaptes auratus</i>	B
Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	B
Orchard oriole	<i>Icterus spurius</i>	B
Osprey	<i>Pandion haliaetus</i>	B
Pileated woodpecker	<i>Dryocopus pileatus</i>	B
Pine warbler	<i>Dendroica pinus</i>	B
Prothonotary warbler	<i>Protonotaria citrea</i>	B
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	B
Red-eyed vireo	<i>Vireo olivaceus</i>	B
Red-winged blackbird	<i>Agelaius phoeniceus</i>	B
Seaside sparrow	<i>Ammodramus maritimus</i>	B
Scarlet tanager	<i>Piranga piranga</i>	B
Sharp-tailed sparrow	<i>Ammodramus caudacutus</i>	B
Song sparrow	<i>Melospiza melodia</i>	B
Snowy egret	<i>Egretta thula</i>	F
Tree swallow	<i>Tachycineta bicolor</i>	B
Tufted titmouse	<i>Parus bicolor</i>	B
Turkey vulture	<i>Cathartes aura</i>	B
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	B
Yellow-rumped warbler	<i>Dendroica coronata</i>	M/W
White-eyed vireo	<i>Vireo griseus</i>	B
Wood duck	<i>Aix sponsa</i>	B
Woodthrush	<i>Zonotrichia albicollis</i>	W
Willet	<i>Catoptrophorus semipalmatus</i>	B

MAMMALS

River otter	<i>Lutra canadensis</i>	B
White-tailed deer	<i>Odocoileus virginianus</i>	B

AMPHIBIANS

Gray treefrog	<i>Hyla versicolor</i>	B
Northern spring peeper	<i>Hyla crucifer</i>	B

Southern leopardfrog	<i>Rana sphenoccephala</i>	B
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DRAGONELIES

A river cruiser	<i>Macromia</i> spp.	B
Black mantled glider	<i>Tramea lacerata</i>	M?/B?
Cherry faced meadowfly	<i>Sympetrum internum</i>	B
Common whitetail	<i>Libellula lydia</i>	B
Eastern amberwing	<i>Perithemis tenera</i>	B
Great blue skimmer	<i>Libellula vibrans</i>	B
Needhams skimmer	<i>Libellula needhami</i>	B
Seaside dragonlet	<i>Erythrodiplax berenice</i>	B

DAMSELFLIES

Blue fronted dancer	<i>Argia apicalis</i>	B
Eastern forktail	<i>Ischnura verticallis</i>	B
Familiar bluet	<i>Enallagma civile</i>	B

BUTTERFLIES

Alfalfa butterfly	<i>Colias eurytheme</i>	B
American painted lady	<i>Vanessa virginiensis</i>	B
Black swallowtail	<i>Papilio polyxenes</i>	B
Bronze copper	<i>Lycaena hyllus</i>	B
Buckeye	<i>Junonia coenia</i>	B
Clouded sulfur	<i>Colias philodice</i>	B
Dogface butterfly	<i>Colias cesonia</i>	B
Least skipperling	<i>Ancyloxypha numitor</i>	B
Monarch	<i>Danaus plexippus</i>	B
Pearly crescentspot	<i>Phyciodes tharos</i>	B
Red spotted purple	<i>Limenitis arthemis</i>	B
Silver spotted skipper	<i>Epargyreus clarus</i>	B
Spring azure	<i>Celastrina ladon</i>	B
Tiger swallowtail	<i>Papilio glaucus</i>	B
Variiegated fritillary	<i>Euptoieta claudia</i>	M/B?

APPENDIX 4. Animal species observed along the Choptank River during the 1994 field season*. Those in boldface represent Species of Special Concern.

* (B = Nesting within study area; M = migrant through study area; W = wintering within study area; a combined rank is given if species equally depends on study area for migratory, breeding or wintering space).

<u>Common name</u>	<u>Scientific name</u>	<u>Status*</u>
<u>BIRDS</u>		
Acadian flycatcher	<i>Empidonax virescens</i>	B
American crow	<i>Corvus brachyrhynchos</i>	B
American goldfinch	<i>Carduelis tristis</i>	B
American robin	<i>Turdus migratorius</i>	B
American redstart	<i>Setohaga ruticilla</i>	M
Barred owl	<i>Strix varia</i>	B**
Black and white warbler	<i>Mniotilta varia</i>	M
Blue-gray gnatcatcher	<i>Poliotilla caerulea</i>	B
Blue grosbeak	<i>Guiraca caerulea</i>	B
Blue jay	<i>Cyanocitta cristata</i>	B
Brown creeper	<i>Certhia americana</i>	M/W
Brown thrasher	<i>Toxostoma rufum</i>	B
Carolina chickadee	<i>Parus carolinensis</i>	B
Carolina wren	<i>Thryothorus ludovicianus</i>	B
Cedar waxwing	<i>Bombycilla cedrorum</i>	B
Chipping sparrow	<i>Spizella passerina</i>	B
Common grackle	<i>Quiscalus quiscula</i>	B
Common yellowthroat	<i>Geothlypis trichas</i>	B
Downy woodpecker	<i>Picoides pubescens</i>	B
Eastern pheobe	<i>Sayornis pheobe</i>	B
Eastern wood pewee	<i>Contopus virens</i>	B
Field sparrow	<i>Spizella pusilla</i>	M
Fish Crow	<i>Corvus ossifragus</i>	B
Gray catbird	<i>Dumetella carolinensis</i>	B
Great blue heron	<i>Ardea herodias</i>	M
Great crested flycatcher	<i>Myiarchus crinitus</i>	B
Green-backed heron	<i>Butorides striatus</i>	B
Hairy woodpecker	<i>Picoides villosus</i>	B
Hermit thrush	<i>Catharus guttatus</i>	M
Indigo bunting	<i>Passerina cyanea</i>	B
Kentucky warbler	<i>Oporornis formosus</i>	B

Lincoln's sparrow	<i>Melospiza lincolnii</i>	M
Louisiana waterthrush	<i>Seiurus motacilla</i>	B
Northern cardinal	<i>Cardinalis cardinalis</i>	B
Northern flicker	<i>Colaptes auratus</i>	B
Northern parula	<i>Parula americana</i>	M
Ovenbird	<i>Seiurus aurocapillus</i>	B
Pileated woodpecker	<i>Dryocopus pileatus</i>	B
Pine Warbler	<i>Dendroica pinus</i>	B
Prothonotary warbler	<i>Protonotaria citrea</i>	B
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	B
Red-eyed vireo	<i>Vireo olivaceus</i>	B
Red-shouldered hawk	<i>Buteo lineatus</i>	B
Red-winged blackbird	<i>Agelaius phoeniceus</i>	B
Ruby-throated hummingbird	<i>Archilochus colubris</i>	B
Scarlet tanager	<i>Piranga piranga</i>	B
Tufted titmouse	<i>Parus bicolor</i>	B
Turkey vulture	<i>Cathartes aura</i>	B
White-eyed vireo	<i>Vireo griseus</i>	B
White-throated sparrow	<i>Zonotrichia albicollis</i>	W
Woodthrush	<i>Hylocichla mustelina</i>	B
Wood duck	<i>Aix sponsa</i>	B
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	B
Yellow-breasted chat	<i>Icteria virens</i>	B
Yellow-rumped warbler	<i>Dendroica dominica</i>	M
Yellow-throated vireo	<i>Vireo flavifrons</i>	B

MAMMALS

Beaver	<i>Castor canadensis</i>	B
Gray squirrel	<i>Sciurus carolinensis</i>	B
White-tailed deer	<i>Odocoileus virginianus</i>	B

REPTILES AND AMPHIBIANS

Chorus frog	<i>Pseudacris triseriata</i>	B
Green frog	<i>Rana camitans</i>	B
Southern leopard frog	<i>Rana sphenoccephala</i>	B
Eastern box turtle	<i>Terrapene carolina</i>	B
Eastern earth snake	<i>Virginia valeriae</i>	B
Eastern kingsnake	<i>Lamprpeltis getula</i>	B
Northern watersnake	<i>Nerodia sipedon</i>	B

DRAGONFLIES

Blue corporal	<i>Libellula deplanata</i>	B
Blue dasher	<i>Pachydiplax longipennis</i>	B
Blue-faced meadowfly	<i>Sympetrum ambiguum</i>	B
Common Baskettail	<i>Tetragoneuria cynosura</i>	B
Common whitetail	<i>Libellula lydia</i>	B
Cyano darner	<i>Nasiaeschna pentacantha</i>	B
Eastern pondhawk	<i>Erythemis simplicicollis</i>	B
Familiar bluet	<i>Enallagma civile</i>	B
Fawn darner	<i>Boyeria vinosa</i>	B
Fragile forktail	<i>Ischnura posita</i>	B
Great blue skimmer	<i>Libellula vibrans</i>	B
Mocha emerald	<i>Somatochlora linearis</i>	B
Ruby meadowfly	<i>Sympetrum rubicundulum</i>	B
Slaty skimmer	<i>Libellula incesta</i>	B

DAMSELFLIES

Blackwater bluet	<i>Enallagma weewa</i>	B
Blue-tipped dancer	<i>Argia tibiallis</i>	B
Eastern red damsel	<i>Amphiagrion saucium</i>	B
Ebony jewelwing	<i>Calopteryx maculata</i>	B
Slender spreadwing	<i>Lestes rectangularis</i>	B
Sparkling jewelwing	<i>Calopteryx dimidiata</i>	B
Stream bluet	<i>Enallagma exulans</i>	B
Turquoise bluet	<i>Enallagma divagens</i>	B
Violet dancer	<i>Argia fumipennis violacea</i>	B

BUTTERFLIES

Dogface	<i>Colias cesonia</i>	M
European cabbage white	<i>Pieris rapae</i>	B
Monarch	<i>Danaus plexippus</i>	M/B
Orange sulfur	<i>Colias eurytheme</i>	B
Pearl crescent-spot	<i>Phyciodes tharos</i>	B
Red admiral	<i>Vanessa atalanta</i>	M/B
Red-spotted purple	<i>Limenitis arthemis</i>	B
Silver spotted skipper	<i>Epargyreus clarus</i>	B
Tiger swallowtail	<i>Papilio glaucus</i>	B

BIVALVES

Eastern pondmussel

Ligumia nasuta

B

APPENDIX 5. Rare Species State Ranking Criteria.

EXPLANATION OF STATE RANKS FOR SPECIES OF SPECIAL CONCERN

Ranks are based on a system developed by The Nature Conservancy to measure the rarity of a species. Each taxon is given a global and state rank. The global rank reflects the rarity of the species throughout the world and the state rank reflects the rarity within Delaware. State and global ranks are used to prioritize conservation and protection efforts so that the rarest of species receive immediate attention. The primary criteria for ranking species is the number of known distinct occurrences or populations. Ranks for individual species are annually updated and are based on current knowledge.

STATE RANKS

S1 Extremely rare; typically 5 or fewer known occurrences in the state; or only a few remaining individuals; may be especially vulnerable to extirpation.

S2 Very rare; typically between 6 and 20 known occurrences; may be susceptible to becoming extirpated.

S3 Rare to uncommon; typically 21 to 100 known occurrences; S3 ranked species are not yet susceptible to becoming extirpated in the state but may be if additional populations are destroyed.

S4 Common; apparently secure under present conditions; typically 100 or more known occurrences, but may be fewer with many large populations; usually not susceptible to immediate threats.

S5 Very common; demonstrably secure under present conditions.

SU Status uncertain; an uncommon species considered to be of concern and of conservation priority in the state, but there is inadequate data to determine rarity. Also includes uncommon species of uncertain nativity in the state.

SH Historically known from the state but not verified for an extended period (usually 15 years); there are expectations that the species may be rediscovered.

SX Species has been determined or presumed to be extirpated. All historical occurrences have been searched or all known sites have been destroyed, and a thorough search of potential habitat has been completed.

SA Accidental in state, including species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded; examples include European strays or western birds on the East Coast and vice-versa.

SB Regularly occurring species that are known to breed in the state (typically applies to birds).

SE Exotic in the state, not a part of the native flora; may be native elsewhere in North America (e.g. western United States).

SN Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in the state; this category includes migratory birds, bats, sea turtles, and cetaceans which do not breed in a given state but pass through twice a year or may remain in the winter (or, in a few cases, the summer).

SR Reported from the state, but without persuasive documentation that would provide a basis for either accepting or rejecting the report.

SRF Species reported falsely (in error) from the state, but this error persists in the literature.

ST Species whose taxonomic status are uncertain (i.e. may not be taxonomically distinct from other closely related taxa).

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