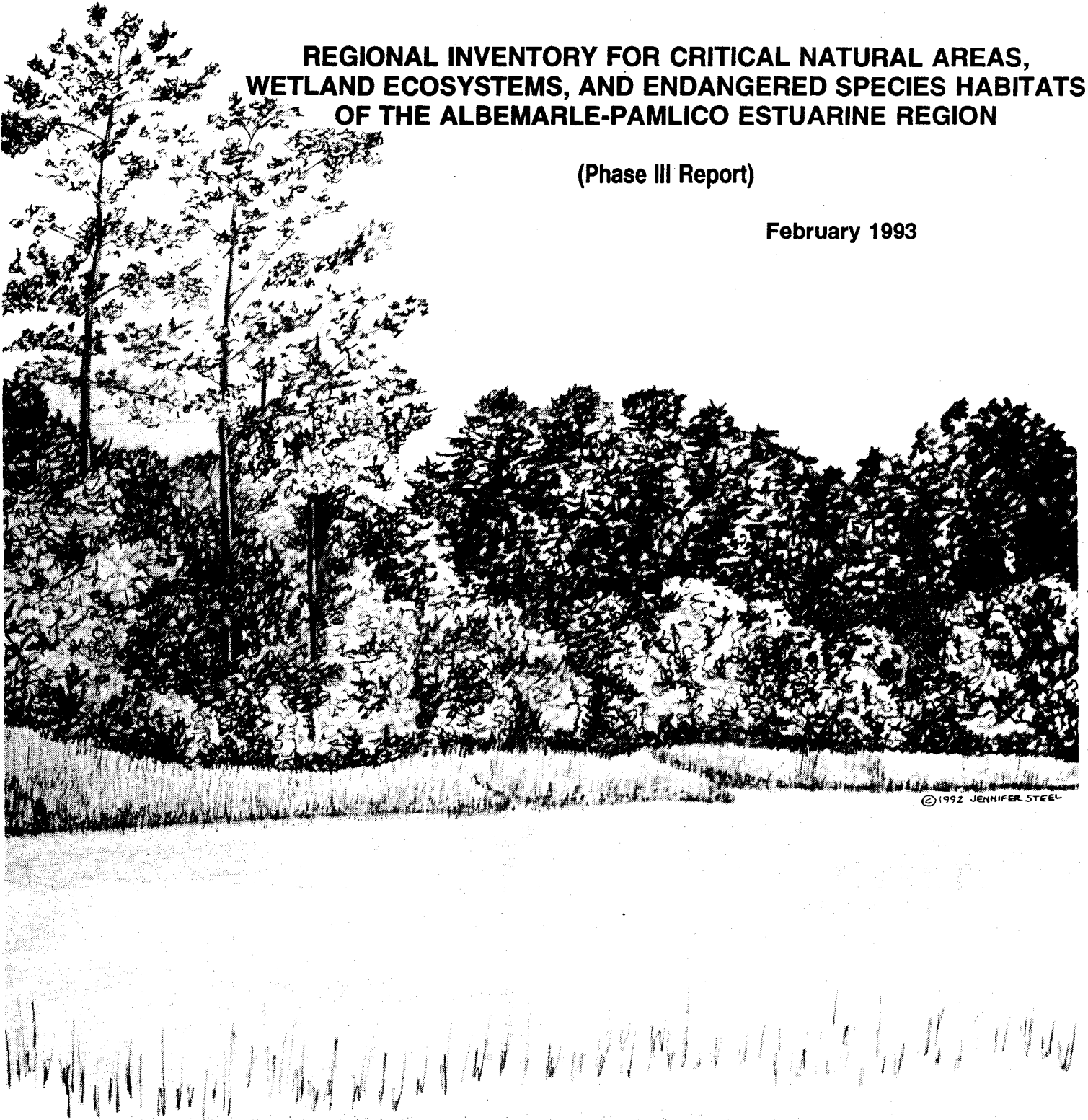


**REGIONAL INVENTORY FOR CRITICAL NATURAL AREAS,
WETLAND ECOSYSTEMS, AND ENDANGERED SPECIES HABITATS
OF THE ALBEMARLE-PAMLICO ESTUARINE REGION**

(Phase III Report)

February 1993



ALBEMARLE-PAMLICO ESTUARINE STUDY

NC Department of
Environment, Health,
and Natural Resources



Environmental
Protection Agency
National Estuary Program

REGIONAL INVENTORY FOR
CRITICAL NATURAL AREAS, WETLAND ECOSYSTEMS,
AND ENDANGERED SPECIES HABITATS
OF THE ALBEMARLE-PAMLICO ESTUARINE REGION: PHASE 3

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"The research on which the report is based was financed in part by the United States Environmental Protection Agency and the North Carolina Department of Environment, Health, and Natural Resources, through the Albemarle-Pamlico Estuarine Study."

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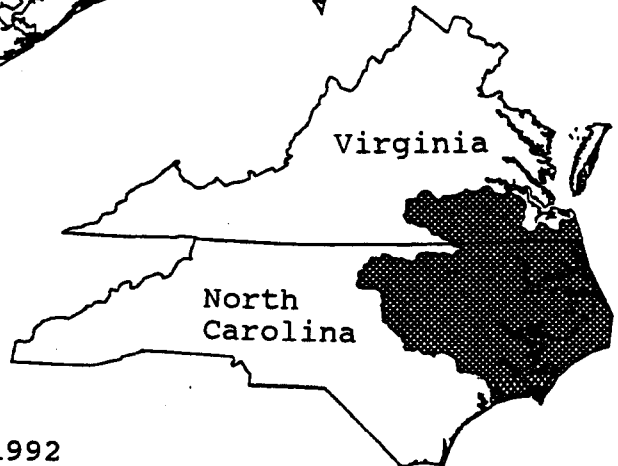
A/P Report No. 92-21
February, 1993

ALBEMARLE - PAMLICO ESTUARINE STUDY AREA



Scale 1:2,000,000

North Carolina Center for
Geographic Information and Analysis 1992



ACKNOWLEDGMENTS

The authors wish to thank the staff of the N.C. Natural Heritage Program for guidance and input during the writing of this report. Specifically, thanks go to Shawn Oakley for assisting in the production of the plant and animal species tables and the natural area maps, and to Ann Kelly for assisting in the production of the regional and county maps.

Others deserving thanks are John Alderman, Barry Dalton, Merrill Lynch, Laura Mansberg, Julie Moore, Lee Otte, Lance Peacock, Charles Roe, Rob Sutter, John Taggart, and Alan Weakley, whose previous field work and published and unpublished reports were quite valuable to this report. Also helpful in the preparation of this report were previously published county inventories for Durham, Orange, and Wake counties.

ABSTRACT

The rapid development of North Carolina's Coastal, Tidewater, and Piedmont regions has caused an urgent need to protect significant natural resources in this part of the state. However, before protection of natural resources and natural areas can be accomplished, it is important to have background information about these resources, such as locations of endangered and rare species and delineation and description of significant natural areas. The North Carolina Nature Preserves Act delegates responsibilities to the N.C. Natural Heritage Program for maintaining the statewide inventory of important natural areas and rare species habitats.

Funding from the Albemarle-Pamlico Estuarine Study has allowed a reconnaissance inventory to identify, describe, map, prioritize, and make protection recommendations for special natural areas, exceptional wetland ecosystems, and endangered and rare species habitats in the upper drainage basins of the Neuse, Tar, Roanoke, and Meherrin rivers in North Carolina. This area covers 17 counties: Durham, Edgecombe, Franklin, Granville, Greene, Halifax, Johnston, Lenoir, Nash, Northampton, Orange, Person, Vance, Wake, Warren, Wayne, and Wilson.

To determine which natural areas required survey work, biologists contracted by the N.C. Natural Heritage Program reviewed soil and topographic maps, aerial photos, numerous other reference materials, and consulted biologists familiar with these counties. After surveying many of the sites identified during the preliminary screening, 130 were identified as having biological or physiographical significance at the national, state, or regional level.

This report describes the natural communities, aquatic habitats, endangered and rare species, and geomorphology of the 17-county A/P III study area. It also provides site descriptions and maps of each of the 130 significant natural areas in this region.

Data from this project will be recorded in the N.C. Natural Heritage Program's central inventory management system, which is used by many agencies for environmental impact assessments, land use planning, resource management decisions, and conservation planning. It is hoped that this report will lead to increased protection of the natural heritage of the Albemarle-Pamlico Sound region.

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INTRODUCTION

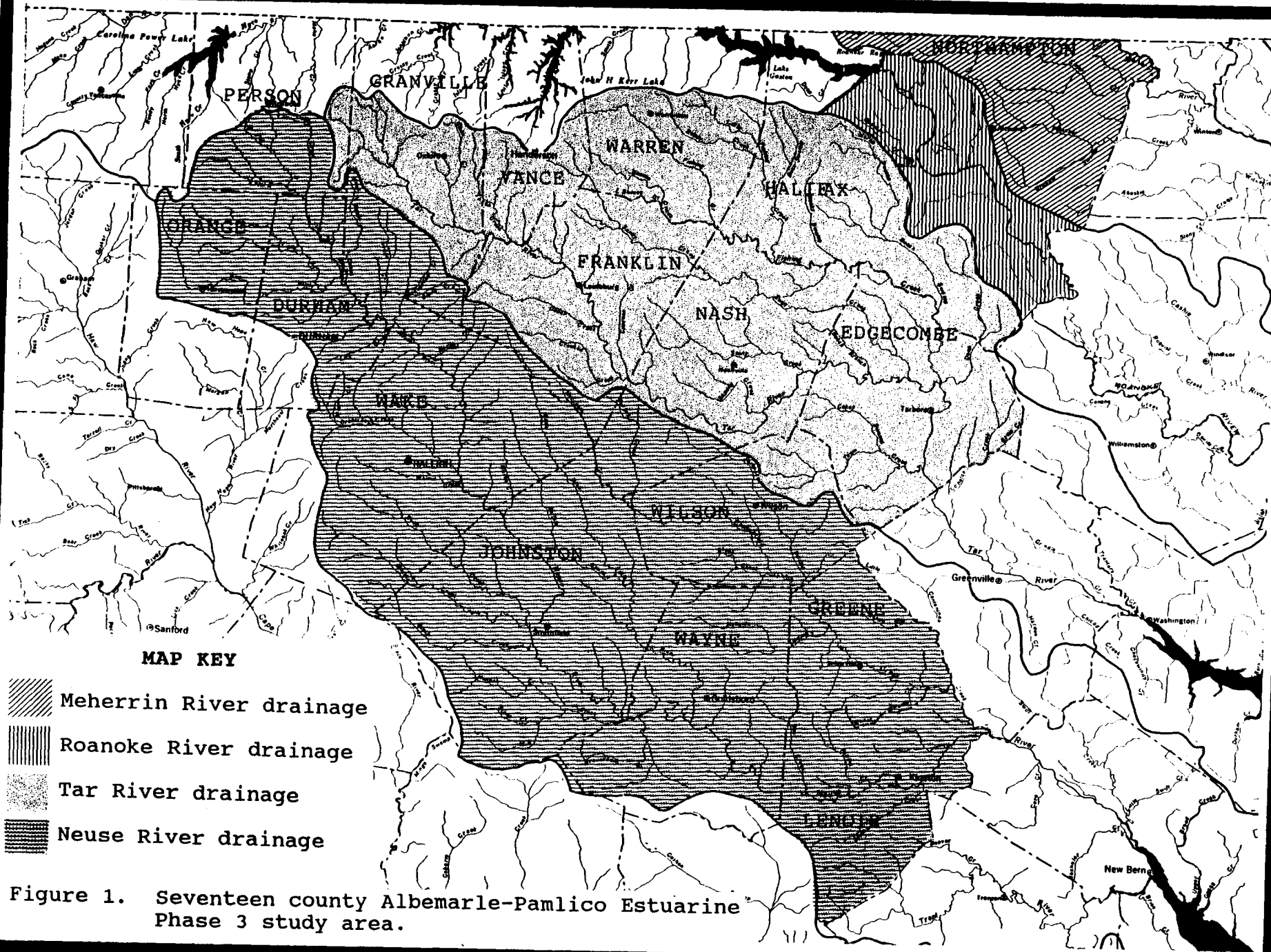
This report is the last of three regional inventories for critical natural areas and endangered species habitats in the Albemarle-Pamlico region of North Carolina. This report describes significant natural areas (sites) and resources in the upper drainage basins of the Neuse, Tar, Roanoke, and Meherrin rivers in 17 counties of North Carolina (hereafter, A/P III study area; Figure 1): Durham, Edgecombe, Franklin, Granville, Greene, Halifax, Johnston, Lenoir, Nash, Northampton, Orange, Person, Vance, Wake, Warren, Wayne, and Wilson. The first regional inventory (Frost et al. 1990) describes natural areas and resources in ten counties surrounding or adjacent to Albemarle Sound: Bertie, Camden, Chowan, Currituck, Gates, Hertford, Martin, Pasquotank, Perquimans, and Washington. The second regional inventory (LeGrand et al. 1992) contains natural area and resource descriptions for seven counties surrounding or adjacent to Pamlico Sound: Beaufort, Carteret, Craven, Hyde, Jones, Pamlico, and Pitt. The N.C. Natural Heritage Program administered these inventories with funds provided by the U.S. Environmental Protection Agency and the N.C. Department of Environment, Health, and Natural Resources.

This inventory report describes the general physiographic and biological features, natural communities, rare plants and animals, and most importantly the significant natural areas of the 17-county A/P III study area. The current protection status for each significant natural area in the 17-county area is also discussed in this report.

The A/P III study area in the Coastal Plain and Piedmont Provinces is relatively young in origin. Despite the relatively flat topography, the region contains many natural features, such as Carolina bays, diabase glades, and granitic flatrocks, that are rare on a national scale. However, habitat destruction and fire suppression in the study area have led to near extirpation of some original natural forest types such as longleaf pine forests and habitat for many wildlife species has been reduced nearly to the minimum required for survival. In parts of the study area, urban, commercial, and industrial development, clearcutting, and road construction are a concern.

Current protection of significant natural areas in the 17-county region is not adequate. However, some strides appear to have been made in land protection in the past decade. Private conservation organizations such as The Nature Conservancy and the Triangle Land Conservancy have protected a number of natural areas. In the vicinity of Falls Lake, several natural areas are protected by the U.S. Army Corps of Engineers. However, aquatic habitats and wetlands in the A/P III study area are poorly protected.

This inventory report should be of considerable use to town and county planning agencies, state and federal agencies, and private conservation groups in the protection of the natural



MAP KEY





-  Meherrin River drainage
-  Roanoke River drainage
-  Tar River drainage
-  Neuse River drainage

Figure 1. Seventeen county Albemarle-Pamlico Estuarine Phase 3 study area.

areas described. It is hoped that many of the unprotected significant sites will be protected by acquisition or other means within the coming years. Even if these significant areas are not protected, it is at least hoped that development will be avoided in these natural areas.

Readers should be aware that this is, by no means, a complete inventory. Coverage of such a large area (17 counties) is extremely difficult especially when some sites cannot be surveyed by foot but must instead be visited by boat or plane. The authors believe that the majority of the national and state significant sites in the A/P III study area have been included in this report. However, more field work would certainly uncover currently unknown significant natural areas with rare and endangered species. Additional field work in known sites may identify new features and change our understanding of the significance of those sites.

METHODS

A. SITE SELECTION FOR SURVEY WORK

The N.C. Natural Heritage Program database on rare and endangered plants and animals and natural communities was reviewed by Heritage staff. Topographic, soil, and orthophoto maps were also reviewed to identify potential sites for survey work. To identify other potential significant natural areas suitable for exploration, the sub-contractees Zack Murrell, Carl Nordman, and Ann Kelly, contacted local citizens, foresters, and other biologists familiar with the 17-county study area. From these data sources a list of natural areas for potential survey work was compiled in early 1991.

B. SURVEY WORK

Before survey work began, Murrell, Nordman, and Kelly met with the staff of the N.C. Natural Heritage Program to receive guidelines on conducting field work. They were provided with Site Survey Report forms designed by the N.C. Natural Heritage Program (see Appendix) to be completed for sites newly identified as significant natural areas.

Survey work began in the early spring of 1991 and continued into the fall of 1992. This work consisted primarily of inventories of poorly known sites or sites not previously surveyed, and secondarily of brief visits to sites already inventoried. The later was done to determine if the sites were still significant natural areas. Many of the sites not previously inventoried were surveyed and found to have been destroyed by development or clearcutting or were found to contained vegetation not considered to be mature or of high quality.

Murrell, Nordman, and Kelly surveyed all 17 counties, except Durham, Orange, and Wake which had previously been inventoried county-wide (Sutter et al. 1987, Sather and Hall 1988, and LeGrand 1987, respectively). Specifically, Murrell surveyed sites in Edgecombe, Franklin, Halifax, Nash, Northampton, Vance, and Warren counties; Nordman surveyed sites in Greene, Johnston, Lenoir, Wayne, and Wilson counties; and Kelly surveyed sites in Granville and Person counties.

The researchers did not make a conscious attempt to include in the inventory representatives of all of the natural communities present in the A/P III study area. Nor did the researchers make an attempt to survey for the best quality sites of rare and endangered species. In essence, the researchers attempted to survey sites based on the extent and condition of the natural communities, looking for coherent, defensible natural areas as well as rare natural communities.

C. SITE SIGNIFICANCE AND SELECTION FOR INVENTORY REPORT

Once completed by the researchers, Site Survey Report forms were returned to the N.C. Natural Heritage Program. These forms were then reviewed to determine the significance of each site. In this report, only those sites designated by the Heritage Program as having National, State, or Regional significance (denoted A, B, and C, respectively) were included.

From Site Survey Report forms completed by Murrell, Nordman, and Kelly and from natural areas information already in the Heritage Program's database, the authors selected 130 significant natural areas to be described in this report. These natural areas were chosen because of their ecological significance (based on quality and integrity of the natural communities), the population size and condition of rare plants or animals present at these sites, and the uniqueness or importance of the geomorphic features present at these sites.

The following are descriptions of the significance categories utilized in this inventory report.

NATIONAL significance (A). The natural area is considered to be of national importance. The site is one of the best (in the top 5 or 6) natural areas of its kind in the country featuring an exemplary natural community, rare species population, or outstanding geomorphic feature. Such a site is usually in relatively undisturbed condition and is often extensive in size, or the population sizes of the significant plants and animals present are large and healthy. Such a natural area is given an extremely high priority for protection.

STATE significance (B). The natural area is considered to be of statewide importance. The site contains one of the best (in the top 5 or 6) natural areas of its kind in the state featuring an exemplary natural community, rare species population, or outstanding geomorphic feature. However, there are other natural areas with similar ecological features that are more significant elsewhere in the state or in the country. Usually, the natural communities present are relatively undisturbed and the populations of the rare species present are fairly large. Such a natural area is given a very high priority for protection.

REGIONAL significance (C). The natural area is considered to be of regional importance. The site contains one of the best (in the top 5 or 6) natural areas of its kind in the region featuring an exemplary natural community, rare species population, or outstanding geomorphic feature. For this report, a site of regional significance is one of the most significant sites in the northwestern portion of the Coastal Plain and northeastern portion of the Piedmont. However, there are other natural areas with similar ecological features that are more significant elsewhere in the Coastal Plain or Piedmont of North

Carolina (or elsewhere within the same region if they are of National or State significance). Such a natural area is given a high priority for protection.

It should be noted that the ranking of sites can be a difficult task. The greatest difficulty in making such a determination concerns the abundance versus rarity of natural communities and the condition of these communities. For example, there is a general abundance of Mesic Mixed Hardwood Forest in the A/P III study area, and many of these forests are in mature condition. The more common the community, even if sites are pristine, the less significant each site becomes, on a national or statewide scale. On the other hand, certain communities, such as Diabase Glades and Bay Forests, are rather rare and few of those sites are in excellent condition. Thus, a mediocre quality Diabase Glade, of a rather small acreage, might be more significant than a much larger Mesic Mixed Hardwood Forest that is nearly pristine.

The areal extent of the various natural communities is also important to consider in determining site ranks. Some communities, for example Cypress Gum Swamps, may occur over several thousand acres while other communities, such as Granitic Flatrocks, are quite limited in extent. Thus, a Cypress-Gum Swamp of very small acreage (i.e., less than 100 acres) is not likely to be of National, State, or Regional significance, whereas a 1-acre Granitic Flatrock would be sufficient in size to be of National, State, or Regional significance, assuming that the site has a moderate to high integrity.

GENERAL FEATURES

A. SURVEY AREA

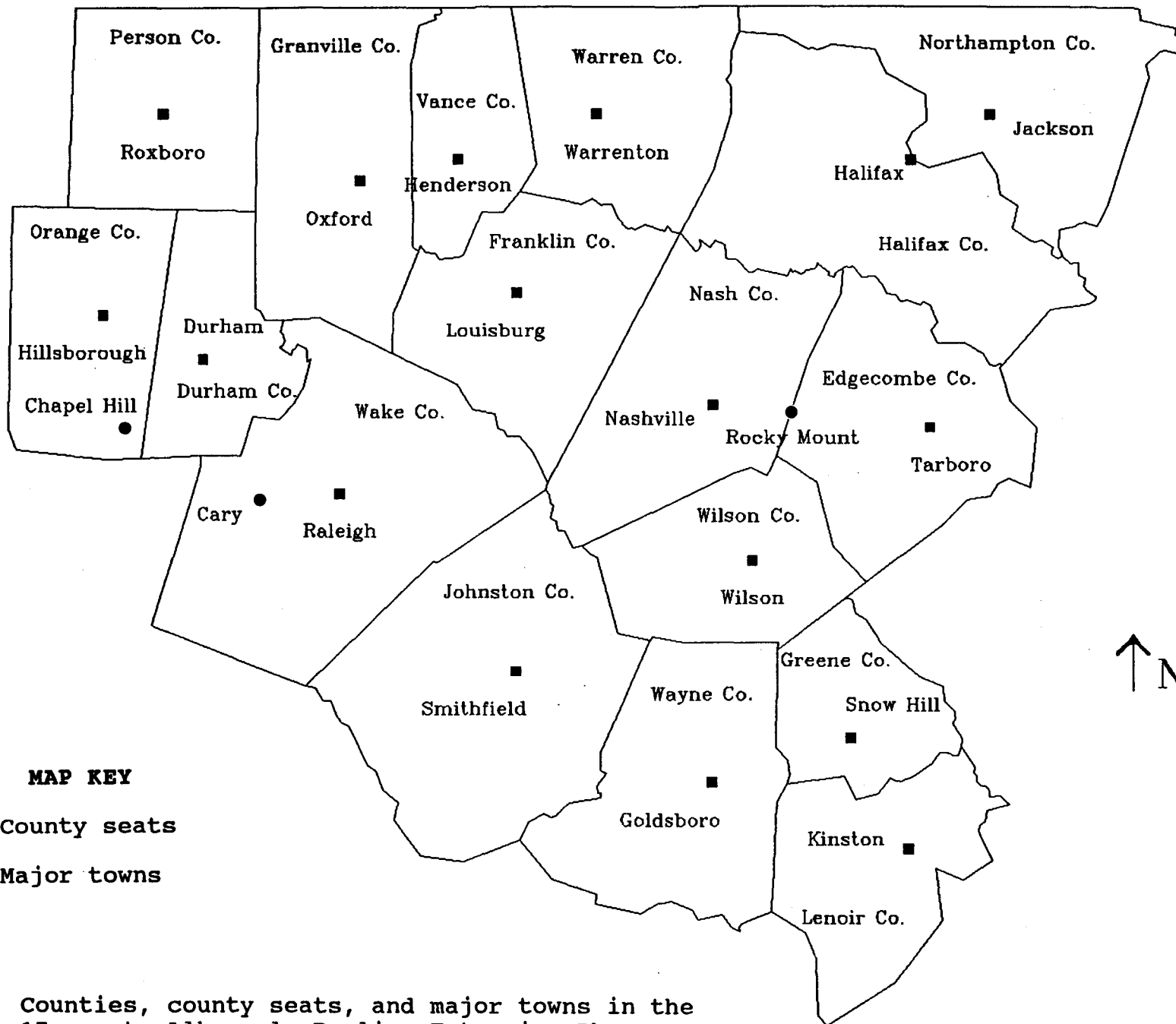
This A/P III study report covers a 17-county region composed of the upper drainage basins of the Neuse, Tar, Roanoke, and Meherrin rivers in the Coastal Plain and Piedmont Provinces of North Carolina. The 17 counties included in this report are Durham, Edgecombe, Franklin, Granville, Greene, Halifax, Johnston, Lenoir, Nash, Northampton, Orange, Person, Vance, Wake, Warren, Wayne, and Wilson (Figure 2). Because this report focuses on the upper drainage basins of the Neuse, Tar, and Roanoke rivers, portions of some of the 17 counties are excluded from this report (see Figure 1). Such counties include Granville, Orange, Person, Vance and Warren, which are only about half covered in this report.

These 17 counties show a wide range in population (Table 1). Seven of these counties contain fewer than 50,000 people each, according to the 1990 census, whereas three contain over 100,000 people each, and one contains over 400,000 people. The major population centers and areas of most rapid development in the A/P III study area are Raleigh, Durham, Chapel Hill, and Cary.

B. TOPOGRAPHY AND PHYSIOGRAPHY

The 17-county study area lies in the middle and upper regions of the western portion of the Coastal Plain and in the northeastern portion of the Piedmont. Throughout the 17-county study area the topography is mostly subdued, ranging from flat to gently rolling hills. The middle and upper regions of the Coastal Plain are well drained and flat to gently rolling, except along streams and near the western border of the Coastal Plain where the land is often more dissected and rolling. The topography in the Piedmont consists of well rounded hills and long rolling ridges with a northeast-southwest trend. In the eastern portion of the Piedmont is a group of prominent hills and ridges, locally called mountains, that are the remains of an ancient continuous mountain chain now largely reduced by erosion (Stuckey 1965). Also called monadnocks, these hills and ridges include Occoneechee Mountain in Orange County, Bowling's Mountain in Granville County, and Hager's Mountain in Person County. In the A/P III study area, elevations range from about 20 feet in the eastern counties of the Middle Coastal Plain to over 860 feet at the summit of Occoneechee Mountain in Orange County in the Piedmont.

The Coastal Plain part of the A/P III study area includes a series of north-south trending scarps that were former shorelines when the Atlantic Ocean was higher and extended much farther inland than at present. Such scarps show only a 10-15 foot drop in elevation from the higher terrace on the west to the lower terrace on the east. Terraces, which formed in shallow seas when



MAP KEY

- County seats
- Major towns

Figure 2. Counties, county seats, and major towns in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

Table 1. Counties, county seats, area, and population of the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

County	County Seat	Area ¹	Population ²
Durham	Durham	298	181,835
Edgecombe	Tarboro	505	56,558
Franklin	Louisburg	494	36,414
Granville	Oxford	534	38,345
Greene	Snow Hill	266	15,384
Halifax	Halifax	724	55,516
Johnston	Smithfield	795	81,306
Lenoir	Kinston	402	57,274
Nash	Nashville	540	76,677
Northampton	Jackson	538	20,798
Orange	Hillsborough	400	93,851
Person	Roxboro	398	30,180
Vance	Henderson	249	38,892
Wake	Raleigh	854	423,380
Warren	Warrenton	427	17,265
Wayne	Goldsboro	554	104,666
Wilson	Wilson	374	66,061
Total		8,352	1,394,402

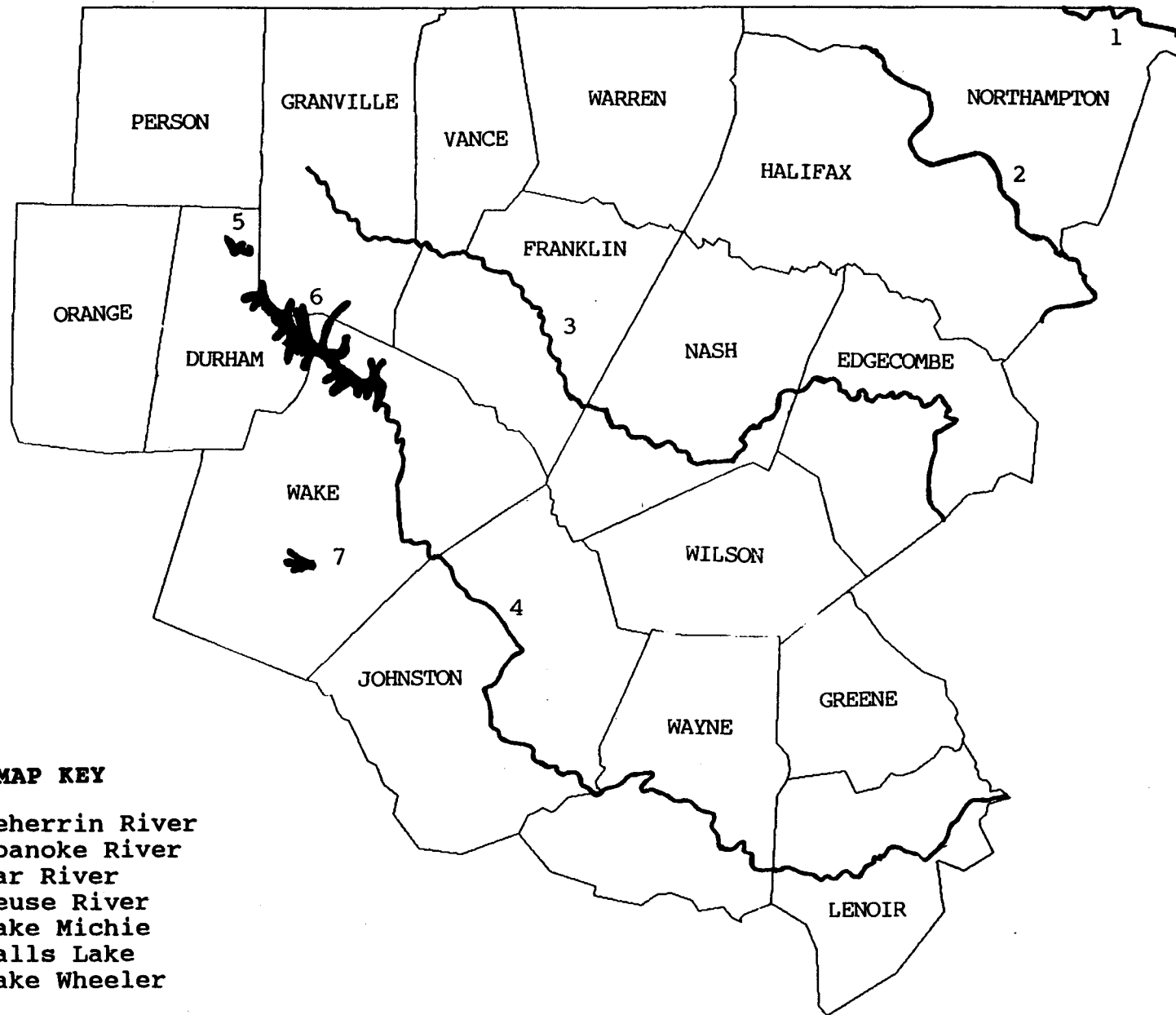
¹square miles; ²1990 census (N.C. Data Center 1992)

the scarp to the west was the shoreline at that time, became exposed with the lowering of the sea level. In the Middle Coastal Plain region, there are 3 major plains (terraces) between the scarps: Sunderland, Coharie, and Brandywine (Daniels et al. 1984). The Sunderland, which lies east of the Kenly Scarp, ranges in elevation from about 100-170 feet. The Coharie Terrace lies east of the Wilson Mills Scarp and ranges upward to about 215 feet in elevation. The Brandywine Terrace lies east of the Coats Scarp and has an elevational range of about 220-270 feet.

Other major topographic features in the A/P III study area include the Neuse, Tar, Roanoke, and Meherrin rivers (Figure 3). These rivers have their sources in the Piedmont and flow across the Coastal Plain to the Albemarle or Pamlico sounds (Stuckey 1965, Powell 1968). They are brownwater rivers; ones that carry a high sediment load and deposit rather rich mineral soils in their floodplains. The Neuse River rises in Person and Orange counties and flows southeast along the Durham-Granville and Durham-Wake county lines, then through Wake, Johnston, Wayne, Lenoir, and Craven counties, and then empties into Pamlico Sound. The Tar River rises in west central Person County and flows southeast through Granville, Franklin, Nash, Edgecombe, Pitt, and Beaufort counties to Washington, N.C. where it becomes the Pamlico River and empties into Pamlico Sound. The Roanoke River is formed in Montgomery County, Virginia, and enters North Carolina in northeast Warren County. From here it flows southeast across Warren County and along the Halifax-Northampton, Halifax-Bertie, Bertie-Martin, and Bertie-Washington county lines into Bachelor Bay of Albemarle Sound. The Meherrin River rises in Virginia and flows into North Carolina and forms the Northampton-Hertford county line and eventually flows southeast across Hertford County into the Chowan River.

A system of small and large tributaries drain into the major rivers. The larger tributaries tend to flow southeast. Middle Creek, for example, is a large tributary which flows southeast through Wake and Johnston counties and into the Neuse River. Streams commonly flow against the north-facing wall of floodplains and, therefore, have long, gentle north floodplain (i.e. south-facing) slopes and short, steep south floodplain (i.e. north-facing) slopes. Some bluffs formed on the south side of floodplains are nearly 100 feet high. Low flats and swamps are usually located on the north side of floodplains. Most floodplain floors are flat to nearly level.

There are over 300 Carolina Bays in the A/P III study area. These bays are located in Edgecombe, Greene, Johnston, Lenoir, Northampton, and Wayne counties. The highest concentration is in Johnston and Wayne counties, with over 130 bays each. This number of bays is small compared to the many thousands present in the southern half of the state's Coastal Plain. Some of the bays in the A/P III study area are over 1/2-mile long; however most are less than 1/4-mile long. As with all bays, they are oriented in a northwest-southeast manner and have an elliptical shape. Few have the characteristic sand rim on the southeastern edge of



MAP KEY

- 1. Meherrin River
- 2. Roanoke River
- 3. Tar River
- 4. Neuse River
- 5. Lake Michie
- 6. Falls Lake
- 7. Lake Wheeler

Figure 3. Major physiographic features in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

the bay, because many of the bays in the A/P III study area are not well developed. The origin of these geomorphic features has long been controversial, and nonconclusive explanations have been presented. Probably the most widely accepted theory is that the bays were formed when the receding seas left behind shallow pools of water, which were shaped into elliptical bodies by wind action on the water. None of the bays in the A/P III study area are water-filled. Over 90% of these bays have been destroyed by draining and converting to agricultural or timber land.

The only natural lakes present in the A/P III study area are small oxbows and beaver ponds. Old millponds, although not natural, may often function as natural ecosystems having the same natural communities, plants, and animals as beaver ponds. There are relatively few millponds in the study area, and only two, Mitchell's Millpond State Natural Area (Site WK8) and Noble's Millpond (Site LE1), are considered highly significant on a biological basis.

C. GEOLOGY AND SOILS

The Piedmont Region is underlain primarily by igneous and metamorphic rocks dating from the Triassic Period (190 million years ago) or older. The Coastal Plain, on the other hand, consists of relatively young sedimentary rocks and unconsolidated sediments which lap onto the older piedmont rocks. In the Fall Zone, where the Coastal Plain and Piedmont meet, young Coastal Plain sediments cap the upland ridges, while the Piedmont rocks are exposed in stream valleys.

Soils in the A/P III study area, as throughout the southeast, reflect the influence of millions of years in a warm moist climate. In almost all places, the rocks are deeply weathered into saprolite. Soils on most of the landscape have well-developed horizons. Most are in the Ultisol order and are highly leached and moderately to extremely acidic. Younger, less well-developed soils occur on younger substrates, such as alluvium along rivers and may be classified in the Inceptisol or Entisol orders.

Parent material has a strong effect on soils. The underlying sediments or weathered rocks determine the texture of the soil which affects soil drainage and fertility. Particularly in the Piedmont, soil texture can affect the chemistry of the soil as well. Exceptions to the prevailing acidity in the study area are found over mafic rocks, such as diabase and gabbro. These soils may be only mildly acidic to neutral, and are placed in the Alfisol order. Other geologic conditions that produce unusual soils include highly resistant rocks which produce rocky monadnocks or bare cliffs, and exfoliating granite, which produces flatrocks. These unusual geologic and soil conditions are responsible for many rare natural community types and provide habitat for many rare plant species in the A/P III study area.

In the Piedmont portion of the A/P III study area, four geologic belts have been recognized. These belts run northeast-southwest and differ in the prevailing rock types. From west to east these belts are the Carolina Slate Belt, Triassic Basins, Raleigh Belt, and Eastern Slate Belt (Carpenter 1989). The Carolina Slate Belt, occupying portions of Durham, Granville, Orange, Person, and Vance counties, consists of heated and deformed sedimentary and volcanic rocks about 550-650 million years old. The major rocks are volcanic slates, breccias, flows, and basic and acid tuffs (Daniels et al. 1984). The volcanic igneous rocks in this belt rise above the surrounding slates as high rolling hills and small mountains. Most of the uneroded and moderately eroded soils of the Carolina Slate Belt have silt loam surfaces, over 30% silt, and very fine sand in the B horizon (Daniels et al. 1984).

The Triassic Basins, in portions of Durham, Granville, and Wake counties, are filled with sedimentary rocks about 190-200 million years old. These basins are at lower elevations than the surrounding belts and have soils developed from shale, sandstone, mudstone, siltstone, and conglomerate rocks (Daniels et al. 1984). Diabase dikes and sills are prominent in parts of the Triassic Basin.

The Raleigh Belt, occupying parts of Franklin, Granville, Johnston, Nash, Vance, Wake, and Warren counties, contains granite, granite gneiss, mica gneiss, and mica schist rocks dating back some 600 million years. The older rocks are more heavily metamorphosed than those in the belts on either side. The large Rolesville granitic pluton makes up much of the portion of the Raleigh Belt in the study area.

The Eastern Slate Belt occupies portions of Franklin, Halifax, Johnston, Nash, Northampton, Warren, and Wilson counties. It contains poorly exposed metamorphosed volcanic rocks (500-600 million years old) and sedimentary rocks (300 million years old) similar to those in the Carolina Slate Belt. This belt is overlain by upland alluvial and marine sedimentary sands, clays, and gravels of the Coastal Plain (Wilson et al. 1980).

The Coastal Plain, occupying all or parts of Edgecombe, Greene, Halifax, Johnston, Lenoir, Nash, Northampton, Wayne, and Wilson counties, is underlain by unconsolidated sands, clays, marls, and shell limestones (Stuckey 1965). The surficial materials are marine sediments and recently deposited riverine sediments in floodplains. Variations in soil drainage, related to soil texture and topography, is particularly important in the Coastal Plain in determining community types. In the flatter portions of the Coastal Plain, very small differences in elevation can make the difference between wetlands and very dry upland soils.

D. LAND USE

The 17-county A/P III study area contains roughly equal amounts of wooded and non-wooded land. The most heavily forested counties in this study area include the northern counties bordering Virginia, and several of the western counties, such as Durham and Wake counties. The counties that are least forested are those in the eastern portion of the study area; these are Coastal Plain counties that have considerable land in agriculture. In this study area the northern and western counties are about 60-70% wooded and the Coastal Plain counties are about 30-50% wooded (Clay et al. 1975). Some of the major blocks of forested land occur along the Roanoke and Neuse river floodplains. Other major blocks of forested land occur in the northern counties bordering Virginia; much of this land is owned by paper companies. Because the majority of the forested land in the study area exists in various stages of succession, generalizations about percentage of forest land are difficult to make and can be misleading. It certainly is not safe to say that because a county is heavily forested, it contains an abundance of natural areas or high quality natural communities.

Forestry is a major land use in the A/P III study area and is common throughout except for the highly populated counties (Wake, Orange, Durham) in the Piedmont. Unlike the A/P I and II study areas where pine plantations are common even in wetlands, in the A/P III study area clearcutting occurs most often in upland areas and is followed by revegetation through plant succession. Some clearcutting has occurred in floodplain areas, however, in riverine forests, for the most part, selective cutting occurs for valuable timber species, such as baldcypress (Taxodium distichum).

Probably about 50% of the land in the A/P III study area has been cleared for agriculture and development. Crops such as tobacco, soybeans, corn, and cotton are commonly grown. Although tobacco is the leading cash crop, more land is cultivated in corn and soybeans. Livestock farming is not prevalent and is a declining industry in the region.

Urban development is another major land use in the A/P III study area. This region is a mixture of many remote, sparsely populated areas and rapidly growing areas. The major population centers in the A/P III study area are Raleigh, Durham, Chapel Hill, Cary, Rocky Mount, Goldsboro, Kinston, and Wilson. The counties undergoing the most rapid population growth are Durham, Orange, and Wake counties.

Another form of land use in this study area is mining. Sand, stone, and gravel are mined in many counties; clay is mined in Halifax and Durham counties. Mining does not cover much acreage in the A/P III study area; however, some Piedmont Monadnock Forest and Granitic Flatrock natural communities have been damaged by mining.

E. NATURAL COMMUNITIES

1. General Comments

A general summary of the natural communities found in the 17-county A/P III study area is presented below and in Table 2. The natural communities are divided into terrestrial (mostly upland) and wetland (or palustrine) community types and are listed in order from mesic (moist) to xeric (dry). The names of the natural communities on the table, as well as in the text, are taken from Classification of the Natural Communities of North Carolina, Third Approximation (Schafale and Weakley 1990), with a few exceptions. For the purpose of this study, some of the community types were further divided into subtypes or types not recognized by Schafale and Weakley (1985).

Determination of natural community types is often a difficult task. Some sites of natural vegetation appear to represent mosaics of two or more community types. In other cases, sites are easily determined to be a particular natural community type, but the margins often grade into other communities in an indistinct manner. Perhaps most difficult in the determination of communities is the effect of human modification of the environment, for example fire frequency and ground water levels. With modification of these factors, natural succession can lead to very different vegetation than was natural on a given site.

Some of the natural communities extend over several thousand acres, whereas others occur as small pockets of just a few acres. Terrestrial communities in good condition are limited in the A/P III study area, because most of the upland forests have long ago been converted to cultivated fields, commercial, residential, and industrial development and pine plantations, or have been frequently clear-cut or thinned. The upland communities that are reasonably intact tend to occur along slopes, bluffs, or other sites that are inaccessible or unsuitable for development.

2. Terrestrial Communities

a. **Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant).** The Mesic Mixed Hardwood Forest (Coastal Plain Subtype) natural community is subdivided into three variants -- a Bluff/Slope Variant, an Upland Flats Variant, and a Swamp Island Variant. The Bluff/Slope Variant occurs primarily on the bluffs and dissected land above the floodplains of rivers, both brownwater rivers such as the Tar and the Neuse, and smaller blackwater rivers and creeks. Such sites are limited in terms of acreage, but generally are in good to excellent condition because the slopes have hindered clearing of the land. American beech (Fagus grandifolia) is the most characteristic canopy tree, but tuliptree (Liriodendron tulipifera), white oak (Quercus alba), northern red oak (Q. rubra), water oak (Q. nigra), and bitternut

Table 2. Natural communities in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area. Where an exemplary site exists the site code is given. Refer to end of table for definitions of ranks.

Natural Communities (page #) Exemplary Sites	Global Rank	N.C. Rank
TERRESTRIAL COMMUNITIES		
Basic Mesic Forest (Coastal Plain Subtype) (pg. 21) Sites: GA18, HA5, HA9, HA10, HA12, NO2	G5T3	S1?
Basic Mesic Forest (Piedmont Subtype) (pg. 21) Sites: OR3, VA3, VA4, WK13, WK14	G5T3	S2
Basic Oak-Hickory Forest (pg. 22) Sites: DU13, GA3, GA5, GA16	G4	S3
Diabase Glade (pg. 24) Sites: GA7, GA13	G1	S1
Dry-Mesic Oak-Hickory Forest (pg. 21) Sites: DU6, HA4, NO2, WK19	G5	S5
Dry Oak-Hickory Forest (pg. 22) Sites: DU6, FR7, OR2, PE2, PE3, VA1	G5	S4
Granitic Flatrock (pg. 24) Sites: FR2, FR3, FR4, FR5, FR8, FR9, FR13, GA1, WK8, WK11, WK14, WK15	G3	S2
Mesic Mixed Hardwood Forest (Coastal Plain Subtype): -Bluff/Slope Variant (pg. 15) Sites: HA3, NO1, NO2, NO3, NO5, NO6 -Swamp Island Variant (pg. 20) -Upland Forest Variant (pg. 20)	G5T5	S4
Mesic Mixed Hardwood Forest (Piedmont Subtype) (pg. 20) Sites: DU6, DU8, DU10, DU11, FR6, FR10, FR11, GA8, HA7, NA1, WK6, WK7, WK9, WK19	G5T5	S4
Mesic Pine Flatwoods (pg. 25)	G5	S3
Piedmont/Coastal Plain Acidic Cliff (pg. 23) Sites: DU6, DU8, OR2, WK4	G4	S2?

Piedmont/Coastal Plain Heath Bluff (pg. 23) Sites: DU6, GA8, HA3, JO1, JO3, WK19	G4?	S3
Piedmont Monadnock Forest (pg. 23) Sites: DU9, GA12, GA17, HA7, OR2, WK4, WK19	G5	S4
Pine/Scrub Oak Sandhill (pg. 25) Sites: JO1, WY3	G4	S3
Ultramafic Outcrop Barren (pg. 24) Sites: WK1	G1	S1
Xeric Hardpan Forest (pg. 22) Sites: DU1	G3G4	S3
Xeric Sandhill Scrub (pg. 25)	G5	S4
PALUSTRINE (WETLAND) COMMUNITIES		
Bay Forest (pg. 34)	G3G4	S3?
Coastal Plain Bottomland Hardwoods (Blackwater Subtype) (pg. 28)	G5T5	S3
Coastal Plain Bottomland Hardwoods (Brownwater Subtype) (pg. 27) Sites: ED1, ED7, ED8, HA1, HA8, JO4, NO1, NO4, NO6	G5T5	S4
Coastal Plain Levee Forest (Blackwater Subtype) (pg. 28)	G5T4	S3
Coastal Plain Levee Forest (Brownwater Subtype) (pg. 27) Sites: ED7, ED8, HA1, HA3, HA5, HA12, JO2, JO4, NO2, NO7	G5T5	S4
Coastal Plain Semipermanent Impoundment (pg. 30) Sites: HA11, LE1, NO7, WK10	G5	S4
Coastal Plain Small Stream Swamp (Blackwater Subtype) (pg. 29) Sites: ED2, ED3	G5	S5
Coastal Plain Small Stream Swamp (Brownwater Subtype) (pg. 28) Sites: HA3, HA12, NA2, WK10	G5T3T4	S2S3
Cypress-Gum Swamp (Blackwater Subtype) (pg. 29)	G5T5	S5
Cypress-Gum Swamp (Brownwater Subtype) (pg. 28) Sites: ED1, ED2, ED7, HA1, NO1, NO5, NO6, NO7, NO8	G5T5	S5

Floodplain Pool (pg. 32) Sites: FR12	G3?	S2
Low Elevation Seep (pg. 33) Sites: HA3, OR4	G4?	S3
Nonriverine Swamp Forest (pg. 33)	G2G3	S3
Nonriverine Wet Hardwood Forest (pg. 33)	G1	S1
Oxbow Lake (pg. 29) Sites: JO2, JO4, WI1	G5	S3
Peatland Atlantic White Cedar Forest (pg. 35)	G2	S2
Piedmont/Low Mountain Alluvial Forest (pg. 31) Sites: DU6, DU10, DU12, FR10, FR11, HA7, OR3, VA3, WK7, WK13, WK19, WR1	G5	S5
Piedmont/Mountain Bottomland Forest (pg. 31) Sites: DU6, GA7, NA1	G5	S3?
Piedmont/Mountain Levee Forest (pg. 30) Sites: DU6, DU7, FR12, GA6, NA1	G5	S3?
Piedmont/Mountain Semipermanent Impoundment (pg. 32) Sites: GA1, GA6, HA1	G5	S4
Piedmont/Mountain Swamp Forest (pg. 31) Sites: GA1	G2	S1
Pond Pine Woodland (pg. 34)	G4G5	S4
Rocky Bar and Shore (pg. 30) Sites: DU6	G5	S5
Sand and Mud Bar (pg. 30)	G5	S5
Upland Depression Swamp Forest (pg. 32) Sites: DU1, GA3, GA5, GA15	G3	S2
Wet Pine Flatwoods (pg. 35) Sites: ED5	G3G4	S3

The following definitions are adapted from Weakley 1991 and LeGrand 1991.

Global Rank. (These ranks, which apply to the status of a natural community type, are assigned by scientific experts, various natural heritage programs, and The Nature Conservancy.

This system is widely used by other agencies and organizations, as the best available scientific and objective assessment of a natural community's rarity.)

G1 = Critically imperiled globally because of extreme rarity or because of extreme threat; 5 or fewer occurrences or less than 2,000 acres of the community type remaining.

G2 = Imperiled globally because of rarity or threat; 6 to 20 occurrences or only 2,000-10,000 acres of the community type remaining.

G3 = Either very rare and local throughout its range or found locally in a restricted range (e.g., a single physiographic region) or because of threat; 21 to 100 occurrences or 10,000-50,000 acres of the community type remaining.

G4 = Apparently secure globally, though it may be quite rare in parts of its range.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range.

G? = Unranked, or rank uncertain.

G_G; **G_T**; **G_T_T** = The rank is believed to be between two or three ranks.

T = The rank of a subtype. As an example, G4T1 would apply to a subtype of a community with an overall rank of G4, but the subtype warrants a rank of G1.

North Carolina Rank. (These ranks, based on The Nature Conservancy's system of measuring rarity and threat status, is widely used by other agencies and organizations as the best available scientific and objective assessment of a community's rarity at the state level.)

S1 = Critically imperiled in North Carolina because of extreme rarity or extreme threat; 5 or fewer occurrences or less than 2,000 acres of the community type remaining in the state.

S2 = Imperiled in North Carolina because of rarity or threat; 6 to 20 occurrences or only 2,000-10,000 acres of the community type remaining in the state.

S3 = Rare or uncommon in North Carolina; 21 to 100 occurrences or 10,000-50,000 acres of the community type remaining in the state.

S4 = Apparently secure in North Carolina, with many occurrences.

S5 = Demonstrably secure in North Carolina and essentially ineradicable under present conditions.

S? = Unranked, or rank uncertain.

S_S = The rank is believed to be between two ranks.

hickory (Carya cordiformis) are also found in many such communities. The understory or shrub layer is composed of species such as flowering dogwood (Cornus florida), painted buckeye (Aesculus sylvatica), red maple (Acer rubrum), and American holly (Ilex opaca). On slopes along brownwater rivers, in the western portion of the study area, the herb layer may be rich and tends to be somewhat Piedmont-like in character. Slopes in the eastern portion of the study area, especially those along blackwater rivers, are usually much less diverse.

b. **Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Upland Flats Variant).** The Upland Flats Variant occurs on terraces and other undissected but fairly well drained upland sites. (The drier terraces and flats contain mainly Dry-Mesic Oak-Hickory Forests, whereas the wetter ones contain mostly Nonriverine Wet Hardwood Forests [discussed later]). This variant features a great range of vegetation, including a few xeric species and a few hydric species growing essentially together with the mesic species. Formerly, this community was probably fairly common over most of the Coastal Plain portion of the A/P III study area, but intact examples are relatively rare today. The most typical trees include American beech, swamp chestnut oak (Quercus michauxii), cherrypark oak (Q. pagoda), southern red oak (Q. falcata), and white oak. Mesic species such as flowering dogwood are frequently present with the more hydric American hornbeam (Carpinus caroliniana) and giant cane (Arundinaria gigantea).

c. **Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Swamp Island Variant).** The Mesic Mixed Hardwood Forest, Swamp Island Variant occurs on slight ridges within floodplains, swamps, or pocosins which are elevated above flood levels and moderately well drained. The mesic forests on these islands tend to have American beech as the characteristic canopy tree, as do the mesic forests on slopes. Tuliptree and several oak species are also often present. An uncommon shrub in the state -- silky camellia (Stewartia malacodendron) -- is a characteristic species of such mesic islands, and the rare southern twayblade (Listera australis) may often be found on these islands. However, the herbaceous flora is only moderately well-developed and is decidedly Coastal Plain in affinity, with very few species typical of Piedmont slopes. This is a scarce community subtype in the A/P III study area, being found mainly in the Roanoke river floodplain.

d. **Mesic Mixed Hardwood Forest (Piedmont Subtype).** The Piedmont Subtype occurs on bluffs and dissected lands in the Piedmont portion of the study area. It is widespread and many sites are in good condition, though most are small. American beech and northern red oak are the most characteristic species, though tuliptree and red maple may be important. Typical understory trees are flowering dogwood, red maple, American

holly, and hop-hornbeam (Ostrya virginiana). The herb layer ranges from sparse to fairly dense and diverse. As in the canopy, many herb species are similar to those in the Mesic Mixed Hardwood Forest, Coastal Plain Subtype; however, differences in species composition distinguish it.

e. **Basic Mesic Forest (Coastal Plain Subtype).** The Basic Mesic Forest occurs on sites similar to those of the Mesic Mixed Hardwood Forest, Coastal Plain Subtype, Bluff/Slope Variant, on slopes where calcareous alluvial soils are near the surface, as is the case along the Roanoke River. The soil is less acidic and more fertile than is typical for North Carolina soils. The canopy has trees typical of Mesic Mixed Hardwoods, with the addition of base-loving species, such as southern sugar maple (Acer floridanum) and black walnut (Juglans nigra). Species that normally occur in bottomlands, such as cherrybark oak, Shumard oak (Quercus shumardii), and American elm (Ulmus americana) often come upslope in these communities. The understory and shrub layers include a similar mix of mesic species, such as flowering dogwood and painted buckeye, base-loving species, such as hop-hornbeam and umbrella magnolia (Magnolia tripetala), and bottomland species, such as common spicebush (Lindera benzoin) and common pawpaw (Asimina triloba). The herb layer is often lush, with a diverse mix of mesic and base-loving species.

This is a very rare community in the North Carolina Coastal Plain and is especially rare in the A/P III study area. Nearly all known sites in this study area lie on slopes along the Roanoke River.

f. **Basic Mesic Forest (Piedmont Subtype).** The Piedmont Subtype occurs on moist slopes and dissected areas underlain by diabase, amphibolite, or other mafic (iron- and magnesium-rich) igneous or metamorphic rock. As in the Coastal Plain, the mafic rocks produce a soil less acidic and richer than typical. The canopy and understory species listed above for the Coastal Plain Subtype are also typical of this subtype. The herb layer is often very lush and diverse, with spectacular spring wildflower displays. A number of base-loving species join the typical suite of mesic species. This is among the most species-rich communities in the Piedmont; however, this is a relatively rare community in the study area.

g. **Dry-Mesic Oak-Hickory Forest.** Dry-Mesic and Dry Oak-Hickory Forests are believed to have been the most abundant upland natural community types in the Piedmont region. Dry-Mesic Oak-Hickory Forests occur on open slopes, dissected areas, and some upland ridgetops. On the Coastal Plain they are less extensive, occurring in well drained upland sites that are naturally sheltered from fire, such as steep bluffs or dissected terrain. Unlike in the mesic forests, floristic differences between Piedmont and Coastal Plain examples are not enough to identify subtypes. In the canopy of mature forests, white oak is

generally most abundant, with northern red oak, black oak (Q. velutina), southern red oak and also usually present, among a variety of other tree species. Hickories (Carya spp.) may or may not be present. If past cutting was extensive, loblolly pine (Pinus taeda) may be abundant. The understory layer is moderate in density, with flowering dogwood, red maple, and sourwood (Oxydendrum arboreum) often numerous. The shrub and herb layers are usually sparse.

h. Dry Oak-Hickory Forest. On slightly drier sites, such as on ridge tops, south-facing slopes, the crest of bluffs, and on sandy soils that are naturally sheltered from fire, a Dry Oak-Hickory Forest natural community may be present. As with the Dry-Mesic Oak-Hickory Forest, most such sites are small in acreage. Typical canopy species include southern red oak, white oak, and post oak (Quercus stellata), along with various hickories. Blackjack oak (Q. marilandica) or pines (P. taeda, P. palustris, P. echinata) are sometimes present. This community type usually features a shrub layer dominated by ericaceous plants, particularly blueberries (Vaccinium spp.).

i. Basic Oak-Hickory Forest. Like the Basic Mesic Forest, Basic Oak-Hickory Forest occurs on mafic rocks that produce relatively high Ph soil. It may range from dry to dry-mesic, depending on drainage. The canopy is generally dominated by combinations of white oak, black oak, post oak, pignut hickory (Carya glabra), and southern shagbark hickory (Carya carolinae-septentrionalis). Hickories are generally more numerous than in the typical oak-hickory forests. Other canopy species may include white ash (Fraxinus americana), tuliptree, black walnut, and pines in disturbed areas. Common understory trees include flowering dogwood, redbud (Cercis canadensis), and hop-hornbeam. The ericaceous shrub layer typical of dry, acidic uplands is absent. Species such as viburnums (Viburnum rafinesquianum, Viburnum dentatum, Viburnum prunifolium) are common, and a number of shrubs and herbs normally confined to moister situations may occur. Basic Oak-Hickory Forests are uncommon in the Piedmont and are quite scarce in the A/P III portion of that province. No examples are known from the Coastal Plain.

j. Xeric Hardpan Forest. Xeric Hardpan Forests occur in the Piedmont region on flat uplands where a dense clay hardpan restricts water infiltration and root penetration into the soil. In the study area, this occurs only on areas underlain by mafic rocks, so the soil has a relatively high Ph. The soil may actually pond water during wet periods, but is extremely dry in the summer. The canopy is dominated by post oak and blackjack oak, sometimes with southern shagbark hickory, pines, and other dry-site trees. The canopy is often somewhat open and stunted. Typical understory species include eastern redcedar (Juniperus virginiana), redbud, persimmon (Diospyros virginiana), and winged

elm (Ulmus alata). Where the canopy is open, the herb layer includes grass and forb species and genera shared with the prairies of the Midwest. They include a number of rare plant species that require large amounts of light. Historical evidence suggests that at least some of these communities once were more open, with some areas being prairies devoid of trees. The open condition was undoubtedly maintained by fire, which has now largely been eliminated. These communities are very rare in North Carolina.

k. **Piedmont Monadnock Forest.** The highest hills in the Piedmont, composed of unusually resistant rock such as rhyolite flows or quartzite, have rocky, dry, extremely acidic soils. These sites support Piedmont Monadnock Forest communities. The dominant tree is chestnut oak (Quercus montana), sometimes mixed with scarlet oak (Quercus coccinea), post oak, or pines. The typical understory trees are sourwood, red maple, and black gum (Nyssa sylvatica). A well-developed ericaceous shrub layer usually occurs. A number of species are shared with the chestnut oak forests of the mountains, but many of the montane species are absent and many typically Piedmont species are present instead.

l. **Piedmont/Coastal Plain Acidic Cliff.** Cliff communities occur where the ground is too steep or rocky to support forests or other communities. Cliffs are uncommon in the Piedmont region, where they occur along rivers and creeks. They occur in only a few places in the Coastal Plain, where major rivers have recently cut into relatively hard sediments. The best developed example in the study area is at Cliffs of the Neuse State Park. The vegetation is a very patchy mosaic of bare rock or sediment, herbs in shallow or unstable soils, and shrubs or trees in crevices and deeper soil accumulations. Moisture conditions may range from extremely dry to saturated over very short distances, allowing unusual combinations of species to occur together. Likewise, plants requiring full sunlight and typical forest herbs may occur together. While uncommon, the inaccessible topography generally has protected cliffs from destruction.

m. **Piedmont/Coastal Plain Heath Bluff.** Steep bluffs that are not Acidic Cliffs sometimes develop into a Heath Bluff community. The most prominent feature of the vegetation is a dense stand of mountain laurel (Kalmia latifolia) or Catawba rhododendron (Rhododendron catawbiense), species more typically associated with the mountains. American beech and other mesic hardwoods are usually present in a sparse to open canopy. Herbs are few beneath the dense shrubs, but galax (Galax aphylla), another typically montane species, is characteristic. This community type is often in good to excellent condition, again because the steep topography limits timber cutting and other human disturbances. They are uncommon in the Piedmont, and rare in the Coastal Plain, but are more common than Acidic Cliffs.

n. **Granitic Flatrock.** Granitic flatrocks are outcrops of granitic bedrock which is nearly flat and level with the adjacent ground surface. The unjointed masses of granitic rock erode by exfoliation, leaving a hard, solid, bare rock surface that weathers only very slowly. The bare rock is vegetated by a characteristic succession of plants, beginning with mosses. Small specialized plants such as rock spikemoss (Selaginella rupestris), Small's portulaca (Portulaca smallii), flatrock sandwort (Minuartia glabra), and fameflower (Talinum teretifolium) colonize the shallow soil accumulated in the moss mats. In slightly deeper soils, herbs that require full sunlight and can tolerate dry conditions occur. Eventually, dry-site trees and shrubs such as pines, eastern redcedar, and blueberries become established in the older soil mats, crevices, and on edges. Seepage areas with wetland herbs often occur along the upper edges of flatrocks. Small depressions that form water-filled pools in winter months also add to the fine-scale diversity of these communities. Soil mats are periodically destroyed by windthrow of trees, creating new bare rock surfaces. Granitic Flatrock communities are naturally rare, occurring in several clusters in the Piedmont region as a whole. One such cluster occurs within the study area, in eastern Wake County and adjacent Franklin County. The flatrocks are not generally threatened by agriculture or forestry, but may be destroyed by quarrying and may be damaged by vehicles, trampling, and trash dumping.

o. **Diabase Glade.** The rarest natural community type to occur within the study area, and probably one of the rarest in the eastern United States, is the Diabase Glade. They occur where mafic bedrock, in this case diabase, is near the surface. The soil is shallow and patchy, but high in Ph and calcium. The vegetation is a mosaic of stunted tree clumps and thickets alternating with herb-dominated openings. Drought-tolerant and base-loving woody species such as eastern redcedar, post oak, blackjack oak, coralberry (Symphoricarpos orbiculatus), fragrant sumac (Rhus aromatica), and Georgia hackberry (Celtis tenuifolia) dominate the thickets. The openings are dominated by a diverse mixture of herbs including species characteristic of Granitic Flatrocks, species typically considered weedy, and rare base-loving species. Of the three intact, well-developed Diabase Glades known, two occur in the study area, both in southern Granville County.

p. **Ultramafic Outcrop Barren.** Ultramafic rocks are associated with unusual vegetation throughout the world due to their unusual physical and chemical properties, including a high soil pH. One marginally developed Ultramafic Outcrop Barren community occurs within the study area, in northern Wake County. The vegetation at this site has an open canopy of post oak and blackjack oak over a grassy herb layer. An unusual mix of

dry-site and wet-site species is present; however, the most characteristic species of better-developed barrens are not present.

q. **Pine/Scrub Oak Sandhill.** These communities occur in the Coastal Plain, on frequently burned, well drained flats or slopes, on clayey to loamy soils, or sandy soils with clay underlying them. The canopy is dominated by longleaf pine (Pinus palustris), and is open to sparse. An understory of scrub oaks, such as turkey oak (Quercus laevis), blackjack oak, bluejack oak (Q. incana), and dwarf post oak (Q. margaretta) is present. Its height and density depend on the past frequency and season of fire. The ground cover is a mixture of low shrubs and herbs, dominated by wiregrass. There are fewer different species than in the Mesic Pine Flatwoods, but diversity may still be high if fire has been frequent. In the absence of fire, the scrub oaks become dense and suppress the ground cover. Only a few examples are known in the A/P III study area, primarily in Wayne and Johnston counties.

r. **Xeric Sandhill Scrub.** Xeric Sandhill Scrub communities occur in the Coastal Plain, on coarse, excessively drained sands. Such sites are very rare within the A/P III study area, with the only well-developed examples being in southern Wayne County. The sands in this area include remnants of small dune fields that developed on the northeast side of the Neuse River and the rims of Carolina bays. The sparse canopy generally consists exclusively of longleaf pine. The scrub oak understory is strongly dominated by turkey oak. The ground cover is sparse and low in diversity. Wiregrass (Aristida stricta) may be dominant or sparse. A number of species specially adapted for the dry, infertile conditions of the coarse sands are usually present. Lichens (Cladonia spp.) are often an important component, and there may be much unvegetated bare sand. These communities depend on fire to maintain their natural dynamics, but are slower than other longleaf pine communities to deteriorate in the absence of fire. They are, however, very slow to recover from cutting and soil disturbance.

s. **Mesic Pine Flatwoods.** Mesic Pine Flatwoods are believed to have once been abundant on the moist but well drained soils of the Coastal Plain. However, no intact examples were found in the A/P III study area. Because these soils are ideal for agriculture, and because these communities are very dependent on frequent fire, no examples are known to remain. Where they occur elsewhere in the Coastal Plain, the canopy is dominated by longleaf pine. There is little understory if fire is frequent. Where fire has been suppressed, hardwood trees quickly become abundant. Under frequent fire there is a rich herb layer dominated by wiregrass, with a high diversity of other species.

t. **Oak-Hickory Sandhill.** This is not believed to be a true natural community type, and is not included in the Classification of Natural Communities of North Carolina (Schafale and Weakley 1990) or in Table 2. It appears to be a semi-natural response to long suppression of fire in former Pine/Scrub Oak Sandhill and Mesic Pine Flatwoods communities. As scrub hardwoods and shrubs become denser, and leaf litter accumulates in the absence of fire, longleaf pines are no longer able to reproduce. The site is gradually invaded by species such as southern red oak, post oak, black oak, and hickories. Wiregrass and other species of open vegetation are suppressed and disappear, or remain only in small openings. The old longleaf pine trees can persist for a very long time in the canopy, producing a community of mixed character; eventually they will die, leaving the site to the hardwoods. This community type is rare in the A/P III study area and is limited to "sandhills" sites in Wayne and Johnston counties.

3. Palustrine (Wetland) Communities

Cowardin et al. (1979) devised a classification system for wetlands that is used by the U.S. Fish and Wildlife Service in mapping wetlands (National Wetlands Inventory). Cowardin et al. (1979) state that:

"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."

Only a small portion of the A/P III study area consists of wetlands. A larger proportion of the wetlands that did occur in this region, especially the nonriverine wetlands, has been destroyed. Based on the classification of communities in Schafale and Weakley (1990), this study area contains more than 25 palustrine (freshwater) natural community types. Many of these are located in three major floodplains located along the Neuse, Roanoke, and Tar rivers.

The differing hydrologic, topographic, and soil conditions of the Piedmont and Coastal Plain portions of the study area make for little overlap of natural community types between the two regions. Within the Coastal Plain many of the palustrine community types are separated by their occurrence in brownwater river systems, blackwater river systems, or on poorly drained

flats (nonriverine systems). Brownwater rivers originate in the Piedmont and carry many mineral sediments; they are often muddy and reddish in color, especially after heavy rains. The high sediment load is deposited on the banks or in backwaters, and natural levees are well-developed. Soils tend to resemble the Piedmont floodplains, but topography, hydrology, and vegetation are somewhat different. Blackwater rivers originate within the Coastal Plain and are generally much shorter than brownwater streams. The sediments are mainly organic in nature, and the waters are typically dark brown to blackish in color, but less turbid. Natural levees are rare or are poorly developed. Nonriverine areas are poorly drained basins or flats with no major stream outlets; they were once shallow areas flooded by seawater during higher stages of the ocean. Many have accumulations of organic matter on the surface, sometimes deep peat.

a. **Coastal Plain Levee Forest (Brownwater Subtype).** The Coastal Plain Levee Forest, Brownwater Subtype, occurs along the banks of the Roanoke, Neuse, and Tar rivers in the Coastal Plain portion of the A/P III study area. The levees receive the heaviest deposition of sediment, with its accompanying nutrients, but are higher and flooded for shorter periods than areas farther from the river. The levees contain a few tree species that are not found elsewhere in the floodplain forests. These trees are capable of establishing themselves on sand bars and grow well in sunlight or light shade. Characteristic canopy species of the levees include sugarberry (*Celtis laevigata*), American sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and American elm (*Ulmus americana*). The understory is also rich, with boxelder (*Acer negundo*) being characteristic. The shrub and herb layers are also rich, and feature species typically found on circumneutral to basic soils. Common shrubs are painted buckeye, common pawpaw (*Asimina triloba*), spicebush (*Lindera benzoin*), and giant cane (*Arundinaria gigantea*).

b. **Coastal Plain Bottomland Hardwoods (Brownwater Subtype).** As the river channel migrates, some levees are eroded away, whereas those on the opposite bank become farther removed from the channel and receive less sediment during flooding than formerly. They also take on a different set of canopy trees. The Coastal Plain Bottomland Hardwoods, Brownwater Subtype, occurs on such former levees, now being considered floodplain ridges. Bottomland forests also occur on terraces at the edges of the floodplains. These forests, when not heavily disturbed in the past, characteristically have oaks in the canopy, featuring species such as cherrybark oak (*Quercus pagoda*), swamp chestnut oak (*Q. michauxii*), willow oak (*Q. phellos*), and overcup oak (*Q. lyrata*), the last species being found in the wetter sites. Sweetgum and several hickory species (*Carya* spp.) also occur frequently. If there has been heavy logging, loblolly pine

(Pinus taeda) is often a major component, especially on the higher sites. The understory layer is fairly well-developed, and American hornbeam (Carpinus caroliniana) is often present. The shrub and herb layers are rather sparse, giving most mature bottomlands a rather park-like appearance.

c. **Cypress-Gum Swamp (Brownwater Subtype).** The Cypress-Gum Swamp, Brownwater Subtype, is common along the Roanoke, Neuse, and Tar rivers, though less common than downstream in the A/P I and A/P II study areas. These swamps may occur as backswamps (extensive flat basins behind the natural levees that are covered in floodwater for much of the year), or in the old river channels (sloughs), which are narrow and lie between ridges in the floodplain. These swamps have a relatively low plant species diversity and are dominated in the canopy by baldcypress (Taxodium distichum) and either water tupelo (Nyssa aquatica) or swamp tupelo (N. biflora). The former tupelo dominates where the water flow is greater, such as nearer the river channel; the latter prefers more stagnant or acidic waters. Most swamps contain no other canopy species. A common understory tree is water ash (Fraxinus caroliniana); swamp cottonwood (Populus heterophylla) also is commonly present in the understory or canopy. These swamps contain water for such long periods throughout the year that shrubs and herbs tend to be scarce, except where bare ground is exposed.

d. **Coastal Plain Small Stream Swamp (Brownwater Subtype).** Small Stream Swamp communities occur in floodplains that are too small for natural levees, cypress-gum swamps, and bottomland hardwoods to be distinguished as separate communities. The small size of the floodplain landforms, along with corresponding hydrologic differences in small streams, produces vegetation that may be a mixture of the components of the above three communities. The Brownwater Subtype is fairly rare, since most small brownwater streams flowing out of the Piedmont fairly quickly join larger rivers. The study area, however, contains the best examples in the state.

e. **Coastal Plain Levee Forest (Blackwater Subtype).** The levee forest, bottomland forest, and cypress-gum swamp have counterparts found on the larger blackwater rivers, but in the A/P III study area most of the blackwater streams are small and have almost no levees or bottomlands. No good examples of Coastal Plain Levee Forest, Blackwater Subtype, have been reported during the entire A/P Study; notable examples occur along the Waccamaw, Northeast Cape Fear, and Lumber rivers in the southern part of the state's Coastal Plain.

f. **Coastal Plain Bottomland Hardwoods (Blackwater Subtype).** The Coastal Plain Bottomland Hardwoods, Blackwater Subtype, is rare in the A/P III study area, and no outstanding examples have been found. Based on work done along the Waccamaw

River floodplain (Schafale et al. 1986), plus results from a few sites in the A/P III study area, typical canopy species include laurel oak (Quercus laurifolia), water oak (Q. nigra), loblolly pine, red maple (Acer rubrum), and sweetgum. Atlantic white cedar (Chamaecyparis thyoides), characteristic of blackwater and nonriverine swamps, may also be present. The understory and shrub layers generally feature a somewhat more evergreen or "bay" composition than found in brownwater floodplains, with redbay (Persea borbonia), titi (Cyrilla racemiflora), and sweet pepperbush (Clethra alnifolia) often present.

g. Cypress-Gum Swamp (Blackwater Subtype). The Cypress-Gum Swamp, Blackwater Subtype is somewhat more common in the A/P III study area than the above types, and is more likely to be in good condition. Baldcypress and swamp tupelo generally form the canopy. Pumpkin ash (Fraxinus tomentosa) is often present, but seldom in large numbers, in the canopy. The understory is dominated by water ash or red maple in most cases. The shrub and herb layers are usually sparse and may be absent in constantly flooded sites, except for floating aquatic herbs. However, aquatic herbs may be numerous in this community and in other types of cypress-gum swamps.

h. Coastal Plain Small Stream Swamp (Blackwater Subtype). Small Stream Swamp communities occur in small floodplains in which the characteristic fluvial landforms are too small to distinguish separate communities. As in the Brownwater Subtype, the vegetation in the Blackwater Subtype is generally a mixture of components of the communities of larger rivers. Many are very wet and grade into Cypress-Gum Swamp. Where surrounding upland soils are fine-textured and agriculture has been widespread, large amounts of clayey sediment may have been eroded into small blackwater streams. This sediment can have the same effect as sediment flowing in from the Piedmont, and over time blackwater communities can come to resemble brownwater ones, at least in some ways. This is one of the most common palustrine communities in the study area.

i. Oxbow Lake. Oxbow Lake communities occur in Coastal Plain floodplains, in abandoned segments of river channels that are detached from the main channel and remain permanently flooded. They may occur in either brownwater or blackwater river floodplains, though no blackwater examples are known from the study area. Even brownwater examples are rare, though several notable oxbows are located in the Neuse River floodplain. The central, aquatic portion of the Oxbow Lake community is not well studied. A variety of submerged and floating aquatic plants may be present. The edges are generally lined with baldcypress, tupelo, or (on brownwater rivers) sycamore or river birch (Betula nigra).

j. **Coastal Plain Semipermanent Impoundment.** These communities develop from swamp or bottomland communities by impoundment of water. The most common impounding agent is beavers, but occasionally natural sediment deposition can have the same effect. Old man-made millponds that mimic the aquatic community of beaver ponds are also included in this category, although their origin is not strictly natural. These impoundments, no matter the origin, feature much open water with a widely scattered canopy of baldcypress, often with swamp tupelo, water tupelo, red maple, or other remnant trees also present. Typically, there is little understory or shrub vegetation, but floating aquatic plants (including duckweeds [Lemna spp.] and water lily [Nymphaea odorata]) are common.

k. **Sand and Mud Bar.** These communities develop on soft riverbank sediments that do not support forest. They may occur in both the Piedmont and Coastal Plain. Most examples are primary successional communities, which establish on recently deposited material and gradually develop into forest. Others may be kept in early successional stages by repeated scouring. Lower bars, frequently flooded and scoured, consist largely of bare ground with scattered herbaceous plants. Panic grass (Panicum sp.) and dotted smartweed (Polygonum punctatum) are characteristic species. Other areas may have wetland shrubs such as swamp rose (Rosa palustris) and buttonbush (Cephalanthus occidentalis), or young trees of sycamore, river birch, baldcypress, or black willow (Salix nigra). Over time, as the bar builds up and the trees mature, a Coastal Plain Levee Forest will develop. Sand and Mud Bar communities are widespread along river but occupy very limited acreage. They are naturally dynamic and not generally subject to direct artificial destruction, but clearing and snagging operations, channelization, upstream dams, or other activities that alter river hydrology are a threat. Either reduction in flooding or increased flow rates will change the balance of creation, succession, and erosion of bars.

l. **Rocky Bar and Shore.** Rocky Bar and Shore communities occur only along Piedmont streams. The substrate may be either gravel bars or bedrock scoured by floods. Generally, bare rock is prominent in these communities. A bed of common water-willow (Justicia americana) may occur in gravel beds. Mosses may occur on stable, intermittently flooded rock. A variety of herbs, shrubs, and trees may occur in soil pockets on rock. Characteristic species include tag alder (Alnus serrulata), yellowroot (Xanthorhiza simplicissima), river birch, and sycamore.

m. **Piedmont/Mountain Levee Forest.** As in the Coastal Plain, natural levee deposits occur along major Piedmont rivers. They consist of medium to coarse-textured soils that are deposited as the river leaves its banks, and may be higher than

much of the interior of the floodplain. The canopy is a mixture of bottomland trees, with sycamore, river birch, boxelder, sweetgum, sugarberry, and cherrybark oak typical. Common understory trees and shrubs are American hornbeam, boxelder, common pawpaw, painted buckeye, and spicebush. A lush herb layer is usually present. Piedmont/Mountain Levee Forests are less extensive than the larger Coastal Plain Levee Forests and fewer are in good condition. Levee Forests are highly susceptible to invasion by exotic plant species, which may displace native species. Serious pests include Japanese honeysuckle (Lonicera japonica), Japanese grass (Microstegium vimineum), and Chinese privet (Ligustrum sinense).

n. **Piedmont/Mountain Bottomland Forest.** These communities occupy the topographic position equivalent to the Coastal Plain Bottomland Hardwoods in the Coastal Plain floodplains. They occur on the higher ridges and terraces away from the natural levee. Canopy trees may be a mix of bottomland trees, such as tuliptree (Liriodendron tulipifera), sweetgum, cherrybark oak, swamp chestnut oak, Shumard oak (Quercus shumardii), and loblolly pine. The highly fertile soils and infrequent flooding of the bottomland terraces make them prime farmland, and most were long ago cleared for agriculture. Many examples now exist as old field successional stands dominated by loblolly pine or tuliptree. Mature examples at or close to the climax state are very rare.

o. **Piedmont/Mountain Swamp Forest.** Piedmont/Mountain Swamp Forests occur in topographic position similar to the Cypress-Gum Swamps of the Coastal Plain -- sloughs and backswamp basins. These are the wettest parts of the floodplain. The canopy is dominated by flood-tolerant hardwood trees such as sweetgum, American elm, willow oak, overcup oak, red maple, and green ash. American hornbeam is the primary understory tree. The herb layer is generally sparse and consists of very flood-tolerant species such as lizard's-tail (Saururus cernuus) and jewelweed (Impatiens capensis). Piedmont/Mountain Swamp Forests are very rare. Well-developed examples occur only in the broad floodplains in the Triassic basins. The most extensive examples in the study area were destroyed by the construction of Falls and Jordan reservoirs. The most extensive remnants are in the floodplains of tributary streams to these two reservoirs.

p. **Piedmont/Low Mountain Alluvial Forest.** Like the Coastal Plain Small Stream Swamps, these communities occur in small floodplains where the fluvial landforms are not large enough to differentiate communities. Flooding on small Piedmont streams is generally irregular and of short duration. The forest is dominated by a mixture of the dominants mentioned in the above three communities. Mesophytic trees such as American beech (Fagus grandifolia) may be present in the highest parts.

g. **Floodplain Pool.** The Floodplain Pool community type is the Piedmont topographic equivalent of the Oxbow Lake. It occurs in abandoned channel segments isolated from the river. Oxbows in the Piedmont are smaller than those in the Coastal Plain, and most do not hold water all year. Most are small enough to be shaded by trees from the adjacent forest. A variety of flood-tolerant herbs may be present, particularly on the edges. Common species include lizard's-tail, false nettle (Boehmeria cylindrica), and sedges (Carex spp.). Floodplain Pools are often important breeding sites for amphibians, including some rare species. Because they dry up periodically and therefore do not regularly contain fish, amphibian larvae are relatively free from predation.

r. **Piedmont/Mountain Semipermanent Impoundment.** Like its Coastal Plain equivalent, these communities develop in beaver ponds and other impoundments that resemble them. In younger impoundments, trees from the pre-existing floodplain forest may remain. These gradually die, leaving dead snags for a period of time. If flood-tolerant species such as red maple, overcup oak, or willow oak were present, they may survive. In older ponds an aquatic community may become established. Aquatic herbs such as green arrow-arum (Peltandra virginica), cowlily (Nuphar luteum), and duckweed (Lemna perpusilla) may occur in the deeper water of the interior. Around the edges cottongrass bulrush (Scirpus cyperinus), sedges (Carex spp.), seedboxes (Ludwigia spp.), swamp rose, and tag alder may occur. Old drained ponds may remain very wet and support marshy vegetation of sedges and rushes, until succession eventually reestablishes a forest. Beavers were almost eliminated during the last century, but have slowly returned. Beaver ponds are now fairly common in the Piedmont part of the study area.

s. **Upland Depression Swamp Forest.** Upland Depression Swamp Forests occur in the Piedmont region on flat uplands where a dense clay hardpan in the soil restricts internal water drainage and a slight depression prevents surface runoff. Water stands at the surface during the winter and in wet summers. In the A/P III study area these hardpans occur only on areas underlain by mafic rocks, so the soil probably has a high Ph. The canopy is usually dominated by willow oak. Occasionally overcup oak, sweetgum, swamp white oak (Q. bicolor), or other wetland trees occur in this community type. The undergrowth is generally open, with scattered highbush blueberries. The most characteristic herbs are sedges (Carex spp.) and mosses. Upland Depression Swamp Forests are often associated with Xeric Hardpan Forests, and may grade directly into them. Occurrences of Upland Depression Swamp Forest are usually small, typically covering only one to three acres. Only a few examples occur in the A/P III study area, mainly over diabase and gabbro rocks in Granville County.

t. **Low Elevation Seep.** Low Elevation Seeps occur in small areas at the bases of bluffs and in small ravines, where seepage water keeps the soil perennially saturated. This is primarily a Piedmont community type, but a few examples occur in the Coastal Plain. Seeps can be recognized by dense stands of ferns of several species, such as cinnamon fern (Osmunda cinnamomea) and royal fern (O. regalis), as well as other wetland herbs such as lizard's-tail and jewelweed. Shrubs of wetlands, such as southern wild-raisin (Viburnum nudum) and highbush blueberry (Vaccinium corymbosum), are also characteristic. Most seeps are very small and are shaded by trees rooted in adjacent communities.

u. **Nonriverine Wet Hardwood Forest.** One of the most endangered natural communities in North Carolina is the Nonriverine Wet Hardwood Forest. Such forests apparently covered many thousands of acres of the Coastal Plain in pre-settlement times, especially in the eastern part of the study area. They most typically occur on wet mineral soils on the edges of the large peatlands. The great majority have been cleared for agriculture, as the sites are easy to drain and have fertile soils. Timber harvest and conversion to pine plantations have also been a major factor in the destruction of this community. Few good examples remain. Examples at the drier end of the spectrum often merge into Mesic Mixed Hardwood Forest, Upland Flats Subtype natural community, whereas examples at the wetter end of the spectrum merge with the Nonriverine Swamp Forest type. The Nonriverine Wet Hardwood Forest community occurs on flats with poor drainage and a seasonally high water table, but where water stands for only brief periods. The mature canopy is similar to the Bottomland Forest on brownwater rivers in that various oaks predominate. Such forests usually contain cherrybark oak and swamp chestnut oak as dominants in the canopy, with willow oak, tuliptree, sweetgum, loblolly pine, and a variety of other species also in the canopy. Loblolly pine may be abundant if there has been heavy cutting in the past. Nonriverine forests tend to contain more elements of swamp or bay forests (more "acidic-soils" plant species) and feature swamp tupelo, red maple, and pocosin shrubs more frequently than a site in a brownwater floodplain. They lack the species associated with more circumneutral conditions, such as sugarberry, sycamore, buckeye (Aesculus sp.), and a variety of maple species. Also, there are differences in hydrology and nutrient dynamics between these communities, as the Nonriverine Wet Hardwood Forests receive no nutrient-laden flood-carried sediments.

v. **Nonriverine Swamp Forest.** Nonriverine Swamp Forests were also apparently common in the Coastal Plain, but much acreage has been drained and timbered. Many of the wetlands on large upland flats, locally called pocosins, are, or were, Nonriverine Swamp Forest. This community can also occur in Carolina bays or other broad, shallow depressions. Baldcypress

and swamp tupelo are the dominant canopy trees of some Nonriverine Swamps, but the cutting and draining of the swamp forests has led to a domination now by red maple and swamp tupelo. Nonriverine Swamps tend to be less deeply flooded than riverine ones, but are saturated for longer periods in most years. They generally feature more diverse understory, shrub, and herb layers than riverine swamps. Pocosin and bay species such as sweetbay (Magnolia virginiana), titi (Cyrilla racemiflora), sweet pepperbush (Clethra alnifolia), and inkberry (Ilex glabra) are often common in Nonriverine Swamp Forests.

w. **Pond Pine Woodland.** The Pond Pine Woodland natural community type occurs sparingly on some of the broad upland flats and Carolina bays in the eastern part of the study area. Large peatlands, so prominent in the A/P I and II study areas, are absent in the A/P III study area. Pond Pine Woodlands feature a well-developed canopy of pond pines (Pinus serotina), generally 25 or more feet tall. Beneath is a dense layer of pocosin shrubs, primarily inkberry, fetterbush (Lyonia lucida), titi, and switchcane (Arundinaria tecta). In addition to the various pocosin/bay species of trees and shrubs, red maple and Atlantic white cedar can often be present. In some situations, Pond Pine Woodlands are apparently successional to Nonriverine Swamp Forest or Bay Forest in the absence of fire. However, in other situations, even in the long absence of fire, this community apparently maintains itself. Fires are generally catastrophic in these communities, but in the past may have been more frequent and less intense. Much of this community type in the A/P III study area has been converted to intensive silviculture or agriculture.

x. **Bay Forest.** The Bay Forest type defined in Schafale and Weakley (1990) consists of peatland communities dominated by bay species -- redbay, sweetbay, or loblolly bay (Gordonia lasianthus). The name is sometimes used more broadly by others, to include communities that are here described as Pond Pine Woodland or Nonriverine Swamp Forest. Bay Forests in the sense of Schafale and Weakley (1990) are uncommon in North Carolina, and their ecology is poorly known. Well defined examples in the A/P III study area are very rare, if not absent. They appear to be associated with the heads of developing streams near the edges of peatlands, but others occur in Carolina bays. It has been suggested that they may develop from Pond Pine Woodland or Atlantic White Cedar Forest in the long absence of fire. Broadleaf evergreen trees such as redbay, sweetbay, and loblolly bay dominate in the canopy, but species as varied as red maple, pond pine, baldcypress, swamp tupelo, or Atlantic white cedar may occur in the canopy or in the understory. Invariably, Bay Forests have a dense shrub layer of pocosin species such as fetterbush, inkberry, sweet gallberry (Ilex coriacea), sweet pepperbush, and others.

y. **Peatland Atlantic White Cedar Forest.** Atlantic white cedar stands were less common in the study area than in the A/P I and II study areas farther northeast, and those that were present have been largely removed by logging. They usually occur on shallow organic deposits on nonriverine flats. These communities feature a nearly solid canopy of Atlantic white cedar, though other wetland species such as baldcypress, loblolly pine, swamp tupelo, and red maple are often present. Though the interior of such a forest is usually dark, a variety of pocosin shrubs are usually present. Atlantic white cedar generally depends on severe fires to regenerate. Fire suppression has played a major role in the decline of white cedar. In the absence of fire, this community type is succeeded by bay forest or maple-gum swamp forest. This succession process was greatly accelerated by typical white cedar logging methods, which removed cedar but left understory shrubs and canopy trees such as swamp tupelo and bay species largely intact.

z. **Wet Pine Flatwoods.** Wet Pine Flatwoods communities occur on low, wet, usually sandy soils that have frequent fire. They are most typical of the middle and outer Coastal Plain south of the study area. They are dominated by longleaf pine or a combination of longleaf, pond, and loblolly pines. If frequently burned, the undergrowth consists of wiregrass, bracken fern (Pteridium aquilinum), and sparse low shrubs such as gallberry (Ilex glabra), huckleberry (Gaylussacia frondosa), sheep-kill (Kalmia carolina), and creeping blueberry (Vaccinium crassifolium). In the absence of fire, these shrubs become dense and crowd out the wiregrass and other herbs. Tall shrubs and trees may eventually invade the community with long absence of fire. Wet Pine Flatwoods are extremely rare north of the Neuse River. The only example found in the study area is the Hartsboro Flatwoods (Site ED5). This site has been invaded by tall shrubs and young hardwood trees during long absence of fire. No wiregrass is known on this site. This area may be beyond the natural range of wiregrass, making the few northern examples of Wet Pine Flatwoods very different from typical.

F. AQUATIC HABITATS

Unlike the A/P I and II inventory reports, the A/P III report discusses aquatic habitats. The A/P III study area contains fewer wetland habitats than the previous two areas, but has numerous aquatic habitats considered to be significant natural areas. These significant aquatic habitats are rivers and streams that support rare plants and animals. In the study area are 18 aquatic habitats of National, State, or Regional significance (Table 3). For a detailed discussion and map of these aquatic habitats see Inventory of Sites.

Table 3. Significant aquatic habitats in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

AQUATIC HABITATS	COUNTIES
Cedar Creek Aquatic Habitat	Franklin
Contentnea Creek Aquatic Habitat	Wilson
Crooked Creek Aquatic Habitat	Franklin
Eno River Aquatic Habitat	Durham, Orange
Fishing Creek Aquatic Habitat	Edgecombe, Halifax, Nash, Warren
Flat River Aquatic Habitat	Durham, Person
Little River (Franklin/Wake/Johnston/Wayne) Aquatic Habitat	Franklin, Johnston, Wake, Wayne
Little River (Orange/Durham) Aquatic Habitat	Durham, Orange
Meherrin River Aquatic Habitat	Northampton
Middle Creek (Wake/Johnston) Aquatic Habitat	Johnston, Wake
Mill Creek Aquatic Habitat	Johnston, Wayne
Moccasin Creek Aquatic Habitat	Franklin, Johnston, Nash, Wake, Wilson
Stony Creek Aquatic Habitat	Nash
Swift Creek (Wake/Johnston) Aquatic Habitat	Johnston, Wake
Swift Creek (Vance/Warren/Franklin/Nash/Edgecombe) Aquatic Habitat	Edgecombe, Franklin, Nash, Vance, Warren
Tar River--Middle and Lower Aquatic Habitats	Edgecombe, Franklin, Nash Vance
Tar River--Upper Aquatic Habitat	Granville
Turkey Creek Aquatic Habitat	Nash, Wilson

In determining the significance of aquatic habitats, both physical and biological characteristics are taken into consideration. The physical conditions of interest are the width and depth of the river or stream, the amount of light the river or stream receives, the amount of organic input the river or stream receives, and the type of substrate within the river or stream. All of these factors effect the flora and fauna that occur there. Rivers and streams with numerous shallow, fast flowing areas, significant amounts of plant and animal detritus, moderate amounts of sunlight, and numerous pebbles and rocks are ones that can support a variety of animal life. Aquatic habitats that are shallow are also more likely to support plant life. It is important to realize, however, that no matter how favorable these physical conditions may be to flora and fauna, sedimentation or pollution in the habitat can lead to fish and mussel kills, algal blooms, and other biologically harmful effects.

Aquatic habitats can support plants such as water-willow (Justicia americana), water nymphs (Najas spp.), riverweed (Podostemum ceratophyllum), pondweeds (Potamogeton spp.), arrowheads (Sagittaria spp.), water-weeds (Elodea spp.), and harperella (Ptilimnium nudosum), a Federally Endangered plant. In addition to plants, aquatic habitats can support numerous types of animals such as amphibians, crustaceans, fish, insects, and mollusks. Some of the rare animals that can be found in aquatic habitats in the A/P III study area include the dwarf wedgemussel (Alasmidonta heterodon) and the Tar spiny mussel (Elliptio steinstansana), both Federally Endangered; the Tar River crayfish (Procambarus medialis), a Federal Candidate species; and the Neuse River waterdog (Necturus lewisi), Thorey's grayback dragonfly (Tachopteryx thoreyi), and the Carolina darter (Etheostoma collis), all species of Special Concern in North Carolina.

Of particular importance in the significant aquatic habitats discussed in this report are the mussel species. Almost all of the 18 significant aquatic habitats in the A/P III study area contain rare mussel species. Mussels are of particular interest because, as canaries are to gold mines, mussel species are to aquatic habitats. In other words, these animals act as indicators of water quality. If an aquatic habitat is disturbed by sedimentation and pollution, the likelihood of having healthy, reproducing populations of mussels is relatively slim. In this study area are 16 species of rare mussels. Two of these species are Federally Endangered, five are Federal Candidates, three are State Endangered, and seven are State Threatened. For more information on rare mussel species in the A/P III study area see the Animal Life section of this report and Table 5.

G. PLANT LIFE

1. Rare and Endangered Plant Species

The 17-county A/P III study area contains 98 rare plant species. Of these, 94 are rare vascular plant species and four are rare species of mosses and liverworts (Table 4). Despite the large number of rare plant species, only four are Federally listed as Endangered: smooth coneflower (Echinacea laevigata), small whorled pogonia (Isotria medeoloides), harperella (Ptilimnium nodosum), and Michaux's sumac (Rhus michauxii). The smooth coneflower grows in glades, woodlands, and open areas over mafic rocks. This plant is an erect perennial about 2-3.5 feet tall, with glabrous stems and thick, fleshy roots. Its flowers are discoid and radiate; rays are deep to pale pink and the disks purple. The leaves are alternate, lance-ovate to elliptic, 4-6 inches long, and glabrous.

The small whorled pogonia is a terrestrial herb, 3.5-10 inches tall, with a green to purple tinged stem and 1-2 small, yellowish green flowers just above its 2-6 elliptic, whorled leaves. It flowers and fruits from May to June and is found in forests on slopes and along streams. Harperella is a annual herb, 1.5-3.5 feet tall, with small, white flowers in a compound, terminal umbel and with leaves that are hollow, cylindrical, and filiform. This plant flowers and fruits in July and August and is found in rocky river beds. Michaux's sumac is an upright, densely pubescent shrub about 6-16 inches tall. Its leaves are once-pinnately compound with 9-13 sessile, oblong-lanceolate leaflets. The inflorescence is a terminal, erect panicle and the fruits are red drupes. It flowers in June and fruits from August to September and grows in sandy or rocky soils in sandhills and sandy forests.

One plant in the A/P III study area is a Federally Threatened species. This plant is the Virginia jointvetch (Aeschynomene virginica) which grows in tidal marshes and wet ditches. A total of 12 plant species are Federal Candidates (category C2) for listing. These plants are found in a variety of habitats and are listed below. Pondspice (Litsea aestivalis) grows in limesink ponds and other pools. Swamp forests are the preferred habitat of the reclining bulrush (Scirpus flaccidifolius) and Plagiochila columbiana, a liverwort, grows on thin soils on boulders in floodplains. Georgia indigo-bush (Amorpha georgiana var. georgiana), a Federal Candidate and State Endangered species, prefers moist sandhill areas and sandy terraces. Spring-flowering goldenrod (Solidago verna), a Federal Candidate and State Endangered species, prefers moist pineland sites. Savannas, sandhill seeps, and moist sandhill/pocosin ecotones are the habitats in which Carolina asphodel (Tofieldia glabra) can be found. Carolina least trillium (Trillium pusillum var. pusillum), a Federal Candidate and State Endangered species, grows in moist hardwood forests. Carolina birdfoot-trefoil (Lotus helleri) is found in open woods over clay soils and along

Table 4. Endangered, threatened, and rare plant species in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area. Where a species occurs in an identified natural area, the site code is given. Refer to end of table for definitions of ranks and statuses.

Scientific Name (Common Name) Habitat Sites	N.C. Status	U.S. Status	N.C. Rank	Global Rank
VASCULAR PLANTS				
<i>Aeschynomene virginica</i> (Virginia jointvetch) Habitat: tidal marshes and wet ditches (Lenoir)	E	T	S1	G2
<i>Agalinis decemloba</i> (Piedmont gerardia) Habitat: dry, open sites (Durham, Granville, Wake) Sites: GA2, WK19	SR		S2?	G3G4
<i>Amorpha georgiana</i> var. <i>georgiana</i> (Georgia indigo-bush) Habitat: moist sandhill areas and sandy terraces (Lenoir)	E	C2	S1	G2T2
<i>Amphicarpum purshii</i> (pinebarrens goober grass) Habitat: pine savannas, pocosins, shallow peat burns in pocosin/savanna ecotones (Wilson)	SR		S3	G3?
<i>Anemone berlandieri</i> (southern thimbleweed) Habitat: thin soils around rock outcrops (Orange)	C		S1	G3G4
<i>Asplenium bradleyi</i> (Bradley's spleenwort) Habitat: acidic rock outcrops and cliffs (Orange) Sites: OR2	C		S1	G4
<i>Aster depauperatus</i> (serpentine aster) Habitat: diabase glades (Granville) Sites: GA2, GA11, GA13	E	C2	S1	G2Q
<i>Aster laevis</i> var. <i>concinus</i> (smooth blue aster) Habitat: forests, woodland borders especially over mafic rocks (Durham, Granville, Wake) Sites: GA11, WK19	C		S2	G5T3
<i>Baptisia albescens</i> (thin-pod white wild indigo) Habitat: open woodlands, clearings (Person)	SR		S2	G4
<i>Baptisia australis</i> var. <i>minor</i> (prairie blue wild indigo) Habitat: glades and open forests on basic soils (Durham*, Granville, Orange, Person) Sites: DU4, DU5, DU13, GA4, GA9, GA11, GA13, GA14	C		S2	G5?T5?

<i>Berberis canadensis</i> (American barberry)	SR		S2	G3G4
Habitat: open forests and glades on basic soils (Durham, Granville, Orange, Person)				
Sites: DU5, GA5, GA13, GA14, GA19				
<i>Buchnera americana</i> (American bluehearts)	C		SH	G3?
Habitat: glades, open forests, streambanks, over mafic or calcareous rocks (Durham, Wake)				
<i>Calamovilfa brevipilis</i> (pinebarren sandreed)	E	3C	S3	G3
Habitat: savannas, sandhill seeps (Johnston, Nash)				
<i>Camassia scilloides</i> (wild hyacinth)	T		S1	G4G5
Habitat: rich levees, slopes, and bottomlands (Northampton, Vance)				
Sites: NO2, VA4				
<i>Cardamine douglassii</i> (Douglass's bittercress)	SR		S2	G5
Habitat: bottomlands, rich lower slopes (Durham, Granville, Northampton, Orange, Wake)				
Sites: DU2, DU12, GA6, GA11, NO4				
<i>Carex bushii</i> (Bush's sedge)	SR		S1	G4
Habitat: open wet areas (Durham, Granville, Johnston, Nash, Orange)				
<i>Carex crus-corvi</i> (crowfoot sedge)	SR		S1	G5
Habitat: swamp forests (Edgecombe)				
Sites: ED7				
<i>Carex decomposita</i> (cypress knee sedge)	SR	3C	SH	G3G4
Habitat: blackwater swamp forests (Warren)				
<i>Carex meadii</i> (Mead's sedge)	SR	3C	S1	G4G5
Habitat: low wet places over diabase (Durham, Granville, Orange)				
<i>Carex reniformis</i> (kidney sedge)	SR		SH	G4?
Habitat: swamps, open wet areas (Johnston, Wake)				
<i>Carex tenax</i> (wire sedge)	SR		S1	G5?
Habitat: xeric sandhills (Wayne)				
<i>Carex tetanica</i> (rigid sedge)	SR		S1	G4G5
Habitat: bogs and swamps (Wake, Warren, Wilson)				
<i>Carex vestita</i> (velvet sedge)	C		S1	G5
Habitat: low woods (Durham)				
<i>Carex woodii</i> (Wood's sedge)	SR		S2	G4Q
Habitat: forested slopes, cove forests, and northern hardwoods (Orange)				

<i>Carya laciniosa</i> (big shellbark hickory) Habitat: brownwater river levees (Halifax) Sites: HA1, HA8	C		S1	G5
<i>Chamaesyce cordifolia</i> (heartleaf sandmat) Habitat: sandhills (Wayne)	SR		SH	G5
<i>Cirsium carolinianum</i> (Carolina thistle) Habitat: forests and disturbed areas, mostly on basic soils (Granville, Wake) Sites: GA6, WK19	C		S1	G5
<i>Cyperus granitophilus</i> (granite flatsedge) Habitat: granite flatrocks, other rock outcrops (Franklin, Wake) Sites: FR2, FR4, FR9, WK8, WK15	SR	3C	S1	G3Q
<i>Delphinium exaltatum</i> (tall larkspur) Habitat: grassy balds, glades, woodlands, mostly over mafic rock (Durham, Granville) Sites: DU5, GA6	E-SC	C2	S1	G3
<i>Desmodium ochroleucum</i> (creamy tick-trefoil) Habitat: sandy or rocky woodland openings (Durham, Orange, Wake)	SR		S1?	G5?
<i>Didiplis diandra</i> (water purslane) Habitat: sluggish streams and ponds (Edgecombe, Nash, Wake, Warren)	SR		S1	G5
<i>Dionaea muscipula</i> (venus flytrap) Habitat: savannas, seepage bogs, pocosin edges (Lenoir)	C-SC	3C	S3	G3
<i>Dodecatheon meadia</i> (shooting star) Habitat: rich, rocky woods, over mafic or calcareous rocks (Orange)	SR		S2	G5
<i>Echinacea laevigata</i> (smooth coneflower) Habitat: glades, woodlands, and open areas over mafic rocks (Durham, Granville, Orange) Sites: DU5, GA5, GA6, GA10, GA11	E-SC	E	S1	G2?
<i>Eleocharis melanocarpa</i> (blackfruit spikerush) Habitat: clay-based Carolina bays, limesink ponds (Johnston, Wayne)	C		S1?	G4
<i>Enemion biternatum</i> (isopyrum) Habitat: rich bottomlands, levees, and lower slopes (Durham, Franklin, Granville, Halifax, Northampton, Orange, Person, Vance) Sites: DU3, DU7, DU8, FR12, GA18, HA5, HA10, NO2, VA2, VA4	SR		S2	G5
<i>Eupatorium incarnatum</i> (pink thoroughwort) Habitat: rich woods and thin woodlands over diabase, calcareous rocks, other basic rocks, or rich alluvium (Durham, Warren)	SR		S1	G5

<i>Fothergilla major</i> (large witch-alder) Habitat: dry ridgetop or bluff forests (Orange) Sites: OR2	C		S2	G3
<i>Galactia mollis</i> (soft milk-pea) Habitat: sandhills (Wayne)	SR		S1	G4G5
<i>Gnaphalium helleri</i> var. <i>helleri</i> (Heller's rabbit tobacco) Habitat: dry woodlands, openings, and glades, especially over mafic rocks (Franklin, Granville, Halifax, Orange, Person, Wake)	SR		S2?	G?T?
<i>Gnaphalium helleri</i> var. <i>micradenium</i> (small rabbit tobacco) Habitat: dry woodlands (Granville, Person) Sites: GA11	SR		SH	G?T?
<i>Helenium brevifolium</i> (littleleaf sneezeweed) Habitat: bogs, seeps, riverbanks, other wet sites (Lenoir, Wake)	C		S1	G3
<i>Hexalectris spicata</i> (crested coralroot) Habitat: dry or mesic woods on basic soils (Durham, Franklin, Granville, Johnston, Orange)	SR		S2	G3G4
<i>Hexastylis lewisii</i> (Lewis's heartleaf) Habitat: forests, pocosin edges (Durham, Granville, Halifax, Lenoir, Nash, Orange, Person, Vance, Wake) Sites: DU1, DU2, GA3, PE3, VA1, WK2, WK7, WK19	C	3C	S3	G3
<i>Hypericum adpressum</i> (bog St. John's-wort) Habitat: boggy places (Halifax, Northampton)	C		SH	G2G3
<i>Isoetes piedmontana</i> (Piedmont quillwort) Habitat: granite flatrocks and diabase glades (Franklin, Wake) Sites: FR2, FR4, WK8	T		S1	G4Q
<i>Isotria medeoloides</i> (small whorled pogonia) Habitat: forests, especially with white pine (Orange)	E	E	S1	G2
<i>Liatris squarrulosa</i> (Earle's blazing star) Habitat: diabase glades, open woods especially over mafic rocks; also sandhills (Durham, Granville, Orange) Sites: DU5, GA4, GA5, GA6, GA9, GA11, GA13, GA14	SR		S2	G4G5
<i>Listera australis</i> (southern twayblade) Habitat: moist hardwood forests, swamps, wet woods under rhododendron (Halifax) Sites: HA2	SR		S2	G4

<i>Lithospermum canescens</i> (hoary puccoon) Habitat: diabase glades, open woods over diabase (Durham, Granville) Sites: DU4, DU5, DU13, GA2, GA5, GA6, GA9, GA11, GA13, GA14, GA19	SR		S1	G5
<i>Litsea aestivalis</i> (pondspice) Habitat: limesink ponds, other pools (Wayne)	C	C2	S2	G4G5
<i>Lotus helleri</i> (Carolina birdfoot-trefoil) Habitat: open woods over clay soils, roadsides (Granville, Person, Warren) Sites: GA2, GA9, GA11	C	C2	S2	G3
<i>Magnolia macrophylla</i> (bigleaf magnolia) Habitat: rich deciduous forests (Wake)	SR		S1S2	G5
<i>Marshallia sp. 1</i> (glade Barbara's buttons) Habitat: diabase barrens (Granville) Sites: GA11	C		S1	G1?
<i>Matelea decipiens</i> (glade milkvine) Habitat: thin woodlands over mafic or calcareous rocks (Durham, Franklin, Orange, Wake) Sites: DU8, DU13, GA4, GA6, GA7, GA11, GA13, WK3	SR		S2	G5
<i>Monotropsis odorata</i> (sweet pinesap) Habitat: dry forests and bluffs (Durham, Orange, Person, Wake) Sites: OR2, WK4	C		S2	G3
<i>Nestronia umbellula</i> (nestronia) Habitat: upland forests (Durham, Franklin, Granville, Orange, Vance, Wake) Sites: GA5, GA6, GA15, GA19, WK8, WK11, WK19	C	C2	S3	G3G4
<i>Orbexilum pedunculatum</i> var. <i>pedunculatum</i> (Sampson's snakeroot) Habitat: open woodlands (Orange)	SR		S1?	G?T?
<i>Panax trifolius</i> (dwarf ginseng) Habitat: cove forests, northern hardwoods, other rich forests (Durham, Orange, Wake) Sites: WK19	SR		S2	G5
<i>Panicum flexile</i> (wiry panic grass) Habitat: glades and openings over mafic rocks (Durham, Granville, Orange)	SR		S1	G3G5
<i>Parthenium auriculatum</i> (glade wild quinine) Habitat: glades and openings over mafic rocks (Durham, Franklin, Granville, Orange, Person, Warren) Sites: DU5, GA11	C		S1	G3?Q

<i>Parthenium radfordii</i> (wavyleaf wild quinine) Habitat: clay soils in sandhills (Franklin) Sites: FR9	C	C2	S2	G2Q
<i>Phacelia ranunculacea</i> (buttercup phacelia) Habitat: bottomlands, rich lower slopes (Vance) Sites: VA3	C		S2	G4
<i>Platanthera peramoena</i> (purple fringeless orchid) Habitat: bogs, forests (Orange, Warren) Sites: DU10, OR3	C	3C	S1	G5
<i>Porteranthus stipulatus</i> (Indian physic) Habitat: forests and open woods, mainly over mafic rocks (Durham, Granville, Orange, Person, Wake) Sites: GA5, GA6, GA18, PE2, PE3, WK19	SR		S2	G5
<i>Portulaca smallii</i> (Small's portulaca) Habitat: granite flatrocks and diabase glades (Franklin, Granville, Wake) Sites: FR1, FR2, FR3, FR4, FR5, FR7, FR8, FR9, FR10, FR11, FR12, FR13, GA13, WK8, WK15	T	3C	S2	G3
<i>Prunus pumila</i> var. <i>susquehanae</i> (Susquehanna cherry) Habitat: rocky forests (Durham)	SR		S1	G5T4T5
<i>Ptilimnium nodosum</i> (harperella) Habitat: rocky riverbeds (Granville) Sites: AH17	E	E	S1	G2
<i>Quercus prinoides</i> (dwarf chinquapin oak) Habitat: dry, rocky slopes (Person)	C		S1?	G5
<i>Ranunculus ambigens</i> (water-plantain spearwort) Habitat: open wet areas (Orange)	SR		SH	G4G5
<i>Ranunculus flabellaris</i> (yellow water-crowfoot) Habitat: pools in blackwater swamps (Edgecombe) Sites: ED7	C		S1	G5
<i>Rhus michauxii</i> (Michaux's sumac) Habitat: sandhills, sandy forests, woodlands, woodland edges (Durham, Franklin, Johnston, Orange, Wake, Wilson) Sites: FR7, WK17, WK19	E-SC	E	S1	G1
<i>Rhynchospora pallida</i> (pale beakrush) Habitat: savannas, sandhill seeps, and pocosins (Nash, Wilson)	SR		S2S3	G3
<i>Ruellia humilis</i> (low wild-petunia) Habitat: diabase glades (Durham*, Granville, Wake) Sites: DU4, DU5, DU13, GA9, GA11, GA13, GA14, WK1	T		S1	G5

<i>Ruellia purshiana</i> (Pursh's wild-petunia) Habitat: glades and woodlands, mostly over mafic or calcareous rocks (Durham, Granville, Orange) Sites: GA6, GA7, GA14	SR		S1S2	G4
<i>Sagittaria stagnorum</i> (water arrowhead) Habitat: blackwater streams, rivers, and lakes (Wilson)	SR		S1	G4G5
<i>Saxifraga pensylvanica</i> (swamp saxifrage) Habitat: bogs, seeps (Wake)	C		S1	G5
<i>Scirpus etuberculatus</i> (Canby's bulrush) Habitat: blackwater creeks (Johnston, Wayne)	SR		S1S2	G3G4
<i>Scirpus flaccidifolius</i> (reclining bulrush) Habitat: swamp forests (Northampton)	C	C2	SH	G1G2Q
<i>Scirpus pendulus</i> (rufous bulrush) Habitat: wet places over mafic rocks (such as diabase) (Durham, Granville) Sites: DU5, GA4	SR		S1	G5
<i>Scutellaria australis</i> (southern skullcap) Habitat: alluvial forests (Granville, Johnston, Orange)	C		SH	G?
<i>Scutellaria leonardii</i> (shale-barren skullcap) Habitat: diabase glades (Durham, Granville, Orange) Sites: DU3, DU4, DU5, GA4, GA14	C		S1	G3G5Q
<i>Scutellaria nervosa</i> (veined skullcap) Habitat: alluvial forests (Durham, Granville, Northampton, Wake, Warren) Sites: GA14, NO2	SR		S1	G5
<i>Senecio pauperculus</i> (balsam ragwort) Habitat: fens, bogs, and diabase glades (Nash) Sites: GA5, GA11	SR		S2?	G5
<i>Silphium terebinthinaceum</i> (prairie dock) Habitat: diabase glades, other open or semi-open sites over mafic rock (Granville, Wake) Sites: DU4, DU5, DU13, GA2, GA4, GA5, GA6, GA9, GA11	C		S2	G4G5
<i>Solidago ptarmicoides</i> (prairie goldenrod) Habitat: diabase glades (Granville) Sites: GA11	E		S1	G5
<i>Solidago rigida ssp. glabrata</i> (Southeastern bold goldenrod) Habitat: diabase glades (Durham, Granville, Person) Sites: GA2, GA4, GA5, GA11	SR		S2	G5T?

<i>Solidago verna</i> (spring-flowering goldenrod) Habitat: mesic to moist pinelands, pocosin ecotones (Johnston)	E	C2	S3	G3
<i>Thermopsis mollis</i> (Appalachian golden-banner) Habitat: dry ridges and open woodlands (Durham, Franklin, Granville, Wake, Warren)	SR		S2?	G3G4
<i>Tofieldia glabra</i> (Carolina asphodel) Habitat: savannas, sandhill seeps, moist sandhill/pocosin ecotones (Johnston, Wilson)	C	C2	S3	G3
<i>Trichostema brachiatum</i> (glade bluecurls) Habitat: diabase glades, other dry calcareous or mafic outcrops (Granville, Orange) Sites: GA7, GA13	C		S1	G4G5
<i>Trillium pusillum</i> var. <i>pusillum</i> (Carolina least trillium) Habitat: ecotones between savannas and nonriverine wet hardwood forests, over marl (Halifax, Johnston, Nash, Wake) Sites: HA2, NA2	E	C2	S1	G3T1
<i>Trillium sessile</i> (sessile-flowered trillium) Habitat: rich alluvial levees and slopes (Halifax, Northampton) Sites: HA5, HA10, NO2	SR		S1	G4G5
<i>Urtica chamidryoides</i> (dwarf stinging nettle) Habitat: rich alluvial levees (Halifax) Sites: HA1, HA12	SR		S1	G4G5
MOSSES				
<i>Campylopus oerstedianus</i> (Oersted's campylopus) Habitat: granite flatrocks (Wake) Sites: WK8	C		S1	G1G3
<i>Entodon compressus</i> (flattened entodon) Habitat: on moist calcareous rocks (Person)	C		S1	G3G4
<i>Hygrohypnum closteri</i> (Closter's brook-hypnum) Habitat: on rocks submersed in streams (Orange)	SR		S1	G3
LIVERWORTS				
<i>Plagiochila columbiana</i> (a liverwort) Habitat: on thin soil over boulders on floodplains (Durham, Orange)	C	C2	SH	G1

The following definitions are adapted from Weakley 1991.

North Carolina Status. (Endangered, Threatened, and Special Concern species have legally protected status in North Carolina.)

E - Endangered. Any species of plant whose continued existence as a viable component of the state's flora is in jeopardy. Endangered species may not be removed from the wild except when a permit is obtained for research, propagation, or rescue which will enhance the survival of the species. Sale or distribution of wild-collected Endangered species is not permitted.

T - Threatened. Any species of plant likely to become an endangered species within the foreseeable future. Regulations are the same as for Endangered species.

SC - Special Concern. Any species of plant which requires population monitoring, but which may be collected and sold under specific regulations. Special Concern species which are not also listed as Endangered or Threatened may be collected from the wild and sold under specific regulations. Propagated material only of Special Concern species which are also listed as Endangered or Threatened may be traded or sold under specific regulations.

C - Candidate. Any species for which there is not evidence of declining numbers or threats to the species in North Carolina, but which, because of small numbers of populations, rare habitat, or distribution, may become threatened in the future; or a species suspected of being endangered or threatened, but for which sufficient information is not currently available to support such a status classification.

SR - Significantly Rare. Any other species which has not been determined to be an Endangered, Threatened, Special Concern, or Candidate species, but which has been determined to need monitoring. For most species in this category, actual biological status has not been determined, either because taxonomic validity is unresolved, or because the species is frequently overlooked in the field and could be more common than present data indicate, or because it is a peripheral species common in an adjacent state.

United States Status. (These statuses are designated by the U.S. Fish and Wildlife Service.)

E - Endangered. A taxon threatened with extinction throughout all or a significant portion of its range.

T - Threatened. A taxon likely to become endangered in the foreseeable future.

C1 - Candidate 1. A taxon for which the Fish and Wildlife Service has on file enough substantial information to list as endangered or threatened. Listing is "warranted but precluded by other pending proposals of higher priority." The Fish and Wildlife Service is "directed to make prompt use of the emergency listing provisions if the well-being of any such species is at significant risk."

C2 - Candidate 2. A taxon for which there is some evidence of vulnerability, but for which there are not enough data to support listing as endangered or threatened at this time. Listing is "warranted but precluded by other pending proposals of higher priority." The Fish and Wildlife Service is "directed to make prompt use of the emergency listing provisions if the well-being of any such species is at significant risk."

3A - Candidate 3A. A taxon for which the Fish and Wildlife Service has persuasive evidence of extinction.

3B - Candidate 3B. A name that, on the basis of current taxonomic understanding, does not represent a distinct taxon.

3C - Candidate 3C. A taxon that has proven to be more abundant or widespread than previously believed and/or those that are not subject to any identifiable threat. They may be reevaluated for possible inclusion in categories 1 or 2.

P - Proposed. This prefix indicates a species which has been formally proposed for listing as Endangered, Threatened, or Special Concern, but has not yet completed the legally mandated listing process.

North Carolina Rank. (These ranks are based on The Nature Conservancy's system of measuring rarity and threat status and are widely used by other agencies and organizations, as the best available scientific and objective assessment of a species' rarity at the state level.)

S1 = Critically imperiled in North Carolina because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in North Carolina because of rarity (6 to 20 occurrences or few remaining individuals) or because of some factor(s) making it very vulnerable to extirpation from North Carolina.

S3 = Rare or uncommon in North Carolina (on the order of 21 to 100 occurrences).

S4 = Apparently secure in North Carolina, with many occurrences.

S5 = Demonstrably secure in North Carolina and essentially ineradicable under present conditions.

SH = Of historical occurrence in North Carolina, perhaps not having been verified in the past 20 years, and suspected to be still extant.

S S = The rank is believed to be between two ranks.

S? = Unranked, or rank uncertain.

Global Rank. (These ranks, which apply to the status of a species throughout its range, are based on data on the species' status rangewide and are assigned by a consensus of scientific experts, the various natural heritage programs, and The Nature Conservancy. This system is widely used by other agencies and organizations, as the best available scientific and objective assessment of a species' rarity throughout its range.)

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently secure globally; may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally; may be quite rare in parts of its range, especially at the periphery.

G G = The rank is believed to be between two ranks.

G? = Unranked, or rank uncertain.

G Q = Questionable taxonomic assignment.

T = The rank of a subspecies or variety. As an example, G4T1 would apply to a subspecies of a species with an overall rank of G4, but the subspecies warranting a rank of G1.

roadsides. Wavyleaf wild quinine (Parthenium radfordii) prefers clay soils in sandhill areas and nestronia (Nestronia umbellula) inhabits upland forests. Serpentine aster (Aster depauperatus), a Federal Candidate and State Endangered species, grows in diabase glades. Tall larkspur (Delphinium exaltatum), a Federal Candidate, State Endangered, and Special Concern species, grows in glades, woodlands, and open areas over mafic rock.

Several rare plants found in the region are considered State Endangered or State Threatened, but are not Federally designated as Endangered, Threatened, or Candidates for listing. The State Endangered species include pinebarrens sandreed (Calamovilfa brevipilis), a grass of savannas and sandhill seeps, and prairie goldenrod (Solidago ptarmicoides), an herb of diabase glades. State Threatened plants found in the region are wild hyacinth (Camassia scilloides), an herb of rich levees, slopes, and bottomlands; Piedmont quillwort (Isoetes piedmontana), an herb of granite flatrocks and diabase glades; Small's portulaca (Portulaca smallii), an herb of granite flatrocks and diabase glades; and low wild-petunia (Ruellia humilis), an herb which grows in diabase glades.

Several additional rare plants occurring in the A/P III study area deserve mention. Venus' flytrap (Dionaea muscipula), a carnivorous plant, is a state candidate species and is of Special Concern in North Carolina. Its populations require monitoring because of its economic value and frequent taking without proper permits. It is endemic to the Carolinas and, despite its limited range, may be locally common if its habitat (savannas and flatwoods) is properly maintained by burning. Other rare plants worth noting are the orchids in the A/P III study area. These include crested coralroot (Hexalectris spicata), found in dry or mesic woods on basic soils, and purple fringeless orchid (Platanthera peramoena) found in bogs and forests.

2. Significant Botanical Habitats

Habitats where rare plant species or high diversities of plant species occur are important to identify and protect. The rare plants present in the A/P III study area are found in various types of habitats including forests, glades, bottomlands, swamps, savannas, sandhills, and outcrops. The most significant botanical habitats, however, are areas over mafic soils and rock (such as diabase glades), bottomlands, and levees, and longleaf pine habitats (such as sandhills and flatwoods).

Habitats in the A/P III study area that contain mafic soil or rock are often significant botanical sites. Mafic areas contain basic soils and provide habitat for about 34 rare plant species. Diabase glades are a specific type of mafic community found in Granville and Durham counties. They provide habitat for about 12 rare species of plants, including serpentine aster (Aster depauperatus), prairie goldenrod (Solidago ptarmicoides),

and glade bluecurls (Trichostema brachiatum). Other glades and openings over mafic rocks provide habitat for additional species of rare plants including prairie blue wild indigo (Baptisia australis var. minor), wiry panic grass (Panicum flexile), Pursh's wild-petunia (Ruellia purshiana), and prairie dock (Silphium terebinthinaceum). Forests over mafic rock also provide habitat for rare plant species, including smooth blue aster (Aster laevis var. concinus), American barberry (Berberis canadensis), Earle's blazing star (Liatris squarrulosa), Indian physic (Porteranthus stipulatus), and crested coralroot.

Other very significant botanical habitat types in the A/P III study area include bottomlands and levees. About 13 rare plant species grow in such habitats. Found in levees and bottomlands are species such as wild hyacinth, big shellbark hickory (Carya laciniosa), and isopyrum (Enemion biternatum). Other rare species of floodplains include southern skullcap (Scutellaria australis), veined skullcap (S. nervosa), and dwarf stinging nettle (Urtica chamidryoides).

Sandhills and pine flatwoods are important rare plant habitats containing about 14 of the rare plant species found in the A/P III study area. Some of these plants are found in sandhill seeps, for example pinebarrens sandreed, pale beakrush (Rhynchospora pallida), and Carolina asphodel. Of these 14 plants, three are found only in sandhills; these are wire sedge (Carex tenax), heartleaf sandmat (Camaesyce cordifolia), and soft milk-pea (Galactia mollis).

Many wet habitats often provide the appropriate soil and moisture conditions needed for many rare plants to grow. Boggy habitats, for example, contain about eight of the rare plant species found in the A/P III study area. They include species such as the purple fringeless orchid, bog St. John's-wort (Hypericum adpressum), and large-flowered Barbara's buttons. Swamps are important botanical habitats and contain about six rare plant species in the A/P III study area. Rare plant species found in this habitat type include cypress knee sedge (Carex decomposita), reclining bulrush, and yellow water-crowfoot (Ranunculus flabellaris). Limesink ponds and other pools provide habitat for a few rare species such as blackfruit spikerush (Eleocharis melanocarpa) and pondspice. Some rare species, such as water arrowhead (Sagittaria stagnorum), occur along the shores or in the shallow water of lakes. Streams and rivers provide habitat for about four species of rare plants in this region. These species include harperella, Canby's bulrush (Scirpus etuberculatus), and Closter's brook-hypnum (Hygrohypnum closteri).

A number of rare plants take advantage of habitats disturbed by man. Roadside areas provide habitat for rare plants such as the Federally Endangered Michaux's sumac and the Federal Candidate Carolina birdfoot-trefoil. Powerline clearings through forests, despite being unsightly and creating fragmented forests, may also provide habitat for dozens of herbaceous plants. Special management of habitats such as powerline rights-of-way or

roadsides may be needed in order to assure that these habitats remain suitable for rare or endangered species.

H. ANIMAL LIFE

1. Rare and Endangered Animal Species

The A/P III study area contains 54 animal species (Table 5), 23 of these are vertebrate species and 31 are invertebrate species. Four of the vertebrate species are mammals, 11 are birds, four are amphibians, and four are fishes. For the invertebrate species, the listing is rather incomplete, but there are at least 16 rare mollusks, two rare crustaceans, six rare butterflies and moths, two dragonflies, one scorpionfly, and four beetles. There are certainly many other rare invertebrates, such as moths, beetles, and crustaceans, that are neither being tracked by the Natural Heritage Program nor are listed as candidates for listing by the U.S. Fish and Wildlife Service.

Of the 54 rare animal species, only four are listed as Federally Endangered. Two of these are vertebrate species, the bald eagle (Haliaeetus leucocephalus) and the red-cockaded woodpecker (Picoides borealis), and two are invertebrate species, the dwarf wedgemussel (Alasmidonta heterodon) and the Tar spiny mussel (Elliptio steinstansana). The bald eagle has attempted to nest at several sites in the A/P III study area, but these are not identified in this inventory for security purposes. Nesting habitat usually includes a tall, living pine for a nest site, generally within a swamp or otherwise extensive forest near open water. Eagles visit many sites in the study area during the year, particularly the larger reservoirs. The red-cockaded woodpecker formerly nested throughout most of the North Carolina Coastal Plain, but clearing of longleaf pine forests, fire suppression, and other factors have left the species restricted to very small and fragmented populations. The dwarf wedgemussel is found in the Tar and Neuse river drainages, mainly near the Fall Line. The Tar spiny mussel is endemic to North Carolina and is found in the Tar River drainage, primarily in Swift Creek.

The A/P III study area contains no Federally Threatened animal species; however, 13 animal species are Federal Candidates for listing (C2 category). Two Federal Candidates are mammals, the southeastern bat (Myotis austroriparius) and Rafinesque's big-eared bat (Plecotus rafinesquii). Both bats roost in buildings and hollow trees, and forage in wet woods and near water. Three bird species are Federal Candidates, Bachman's sparrow (Aimophila aestivalis), Henslow's sparrow (Ammodramus henslowii), and the cerulean warbler (Dendroica cerulea).

Although most Bachman's sparrows in North Carolina breed in open longleaf pine forests, those in the A/P III study area breed in clearcuts and abandoned fields. The Henslow's sparrow nests mainly in recently cut-over and burned pocosins where a thick grass cover and very small saplings are present. The cerulean

Table 5. Endangered, threatened, and rare animal species in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

Where a species occurs in an identified natural area, the site code is given. Refer to end of table for definitions of ranks and statuses.

Scientific Name (Common Name) Habitat Sites	N.C. Status	U.S. Status	N.C. Rank	Global Rank
MAMMALS				
<i>Myotis austroriparius</i> (southeastern bat) Habitat: roosts in buildings, hollow trees; forages near water (Wake)	SC	C2	S2	G4
<i>Myotis septentrionalis</i> (northern long-eared bat) Habitat: roosts in hollow trees and buildings (warmer months), in caves and mines (winter) (Wake)	SC		SUB,S2N	G4
<i>Plecotus rafinesquii</i> (Rafinesque's big-eared bat) Habitat: roosts in old buildings, caves, and mines, usually near water (Wayne)	SC	C2	S3	G4
<i>Sciurus niger</i> (fox squirrel) Habitat: open forests, mainly longleaf pine/scrub oak forests (Edgecombe) Sites: ED8	SR*		S3	G5
BIRDS				
<i>Accipiter cooperii</i> (Cooper's hawk) Habitat: forests and woodlands (for nesting) [breeding evidence only] (Halifax, Orange) Sites: OR2	SC		S2B,S3N	G4
<i>Accipiter striatus</i> (sharp-shinned hawk) Habitat: forests and woodlands (for nesting) [breeding evidence only] (Orange)	SR		S2B,S4N	G5
<i>Aimophila aestivalis</i> (Bachman's sparrow) Habitat: open longleaf pine forests, old fields [breeding season only] (Halifax, Wake, Warren)	SC	C2	S3B,S2N	G3
<i>Ammodramus henslowii</i> (Henslow's sparrow) Habitat: clearcut pocosins and other damp weedy fields [breeding season only] (Edgecombe, Wilson)	SR	C2	S2B,S1N	G4
<i>Anhinga anhinga</i> (anhinga) Habitat: wooded lakes or ponds, or open swamps (for nesting) [breeding evidence only] (Halifax) Sites: HA11	SR		S2B,SZN	G5

Coragyps atratus SC S3 G5
(black vulture)
Habitat: forested areas for nesting; forests or open country for foraging
[not tracking] (Orange, Wake)
Sites: HA1, NO7, WK19

Dendroica cerulea SR C2 S3B,SZN G5
(cerulean warbler)
Habitat: mature hardwood forests; steep slopes and coves in mountains,
natural levees in Coastal Plain [breeding season only] (Halifax,
Northampton)
Sites: HA1, HA5, HA8, HA12, NO2, NO7

Haliaeetus leucocephalus E E S1B,S2N G3
(bald eagle)
Habitat: mature forests near large bodies of water (for nesting); lakes and
sounds [nesting sites; regular non-breeding sites] (Durham,
Northampton, Vance, Wake)

Ictinia mississippiensis SR S1B G5
(Mississippi kite)
Habitat: mature, extensive bottomland forests, mainly in Roanoke River
floodplain [regular summer locations only] (Halifax, Johnston)
Sites: HA1, HA11, NO7

Picoides borealis E E S2 G2
(red-cockaded woodpecker)
Habitat: mature open pine forests, mainly in longleaf pine [breeding evidence
only] (Edgecombe, Halifax, Johnston, Lenoir, Nash, Wake, Wayne,
Wilson)
Sites: WY2

Vireo gilvus SR S2B,SZN G5
(warbbling vireo)
Habitat: groves of hardwoods along rivers and streams [breeding season only]
(Halifax)

AMPHIBIANS

Ambystoma tigrinum T S2 G5
(tiger salamander)
Habitat: breeds in fish-free semipermanent ponds; forages in adjacent woods,
usually sandy pinewoods (Wake)
Sites: WK12

Hemidactylium scutatum SC S3 G5
(four-toed salamander)
Habitat: pools, bogs, and other wetlands in hardwood forests (Durham,
Granville, Nash, Orange, Person, Wake)
Sites: OR4, WK4, WK10, WK19

Hyla andersonii SR 3C S3 G4
(pine barrens treefrog)
Habitat: pocosins, bay forests, boggy areas (Johnston, Wayne)

Necturus lewisi SC 3C S3 G3
(Neuse River waterdog)
Habitat: rivers and large streams in Neuse and Tar drainages (endemic to
North Carolina) (Durham, Edgecombe, Franklin, Granville, Greene,
Halifax, Johnston, Lenoir, Nash, Orange, Person, Vance, Wake,
Warren, Wayne, Wilson)
Sites: AH1, AH2, AH3, AH4, AH5, AH6, AH7, AH8, AH10, AH11, AH12, AH13, AH14,
AH15, AH16, AH17, AH18, DU6, ED7, HA7, WK7, WK8, WK19

FRESHWATER FISHES

<i>Ambloplites cavifrons</i> (Roanoke bass)	SR*		S3	G3
Habitat: streams in Neuse and Tar systems (Durham, Edgecombe, Franklin, Granville, Halifax, Johnston, Nash, Orange, Person, Wake)				
Sites: AH4, AH5, AH6, AH7, AH8, AH16, AH17, DU6				
<i>Etheostoma collis</i> (Carolina darter)	SC		S3	G3
Habitat: streams in the Piedmont (Durham, Franklin, Granville, Orange)				
Sites: AH4, DU6				
<i>Lampetra aepyptera</i> (least brook lamprey)	SC		S2	G5
Habitat: Tar and Neuse drainages (Wake)				
Sites: AH7, AH10				
<i>Noturus furiosus</i> (Carolina madtom)				
Neuse River Population (Pop. 1)	SC	3C	S2	G3T2
Habitat: Neuse River drainage (Durham, Greene, Johnston, Lenoir, Wayne, Wilson)				
Sites: AH2, AH4, AH7, AH10, AH11, AH14				
Tar River Population (Pop. 2)	SR	3C	S3	G3T3
Habitat: Tar River drainage (Edgecombe, Franklin, Halifax, Nash, Vance)				
Sites: AH5, AH15, AH16				
MOLLUSKS -- FRESHWATER BIVALVES				
<i>Alasmidonta heterodon</i> (dwarf wedgemussel)	E	E	S1	G1
Habitat: Tar and Neuse drainages, mainly near Fall Line (Franklin, Granville, Johnston, Nash, Wake)				
Sites: AH1, AH3, AH7, AH10, AH12, AH13, AH14, AH17, AH18				
<i>Alasmidonta undulata</i> (triangle floater)	T		S2	G4
Habitat: most river systems in Piedmont and upper Coastal Plain (Edgecombe, Franklin, Granville, Johnston, Nash, Orange, Person, Wilson)				
Sites: AH2, AH5, AH6, AH7, AH10, AH12, AH14, AH15, AH16, AH17, AH18, DU6				
<i>Anodonta implicata</i> (alewife floater)	SC		S2	G5G4
Habitat: Chowan River (Northampton)				
Sites: AH9				
<i>Elliptio lanceolata</i> (yellow lance)	T	C2	S2	G4G3
Habitat: Tar and Neuse systems, mainly near the Fall Line (Edgecombe, Franklin, Granville, Johnston, Nash, Vance, Wake)				
Sites: AH3, AH7, AH10, AH13, AH14, AH15, AH16, AH17, FR12				
<i>Elliptio roanokensis</i> (Roanoke slabshell)	T		S1	G2Q
Habitat: Neuse, Tar, and Roanoke rivers (Edgecombe, Johnston, Wake, Wayne)				
Sites: AH14, AH15				
<i>Elliptio steinstansana</i> (Tar spiny mussel)	E	E	S1	G1
Habitat: Tar River drainage, primarily Swift Creek (endemic to North Carolina) (Edgecombe, Franklin, Nash)				
Sites: AH15, AH16				

<i>Fusconaia masoni</i> (Atlantic pigtoe)	T	C2	S1	G3
Habitat: most Atlantic drainages, in lower Piedmont and upper Coastal Plain (near Fall Line) (Durham, Edgecombe, Franklin, Granville, Halifax, Johnston, Nash, Orange, Person, Wake, Wayne, Wilson)				
Sites: AH2, AH4, AH5, AH6, AH7, AH8, AH10, AH14, AH15, AH16, AH17, AH18, FR12				
<i>Lampsilis cariosa</i> (yellow lampmussel)	T	C2	S1	G4
Habitat: Eno, Flat, Middle, Swift, and Tar systems; restricted mainly to Fall Line (Durham, Edgecombe, Franklin, Johnston, Orange, Person)				
Sites: AH2, AH4, AH5, AH6, AH7, AH8, AH13, AH15, AH16, AH17, DU6, FR12				
<i>Lampsilis radiata</i> (eastern lampmussel)	SC		S2	G5G4
Habitat: a number of river systems (Edgecombe, Franklin, Johnston)				
Sites: AH4, AH5, AH6, AH10, AH14, AH15, AH16				
<i>Lasmigona subviridis</i> (green floater)	E	C2	S1	G4G3
Habitat: Tar, Neuse, and Cape Fear systems downstate; New and Watauga systems in mountains (Granville, Johnston, Nash, Orange, Person, Wake, Wilson)				
Sites: AH4, AH6, AH7, AH14, AH16, AH17, AH18, DU6				
<i>Leptodea ochracea</i> (tidewater mucket)	SC		S2	G4
Habitat: Meherrin, Roanoke, and Chowan rivers; abundant in Lake Waccamaw (Northampton)				
Sites: AH9				
<i>Ligumia nasuta</i> (eastern pondmussel)	SC		S2	G4G3
Habitat: Chowan, Meherrin, and Roanoke systems (Northampton)				
Sites: AH9				
<i>Strophitus undulatus</i> (squawfoot)	T		S2	G5G4
Habitat: Tar, Neuse, Cape Fear, and Pee Dee systems, perhaps other systems in Piedmont (Franklin, Granville, Johnston, Nash, Orange, Person, Wake, Wilson)				
Sites: AH2, AH4, AH5, AH6, AH7, AH8, AH10, AH12, AH13, AH14, AH15, AH17, AH18, DU6				
<i>Toxolasma pullus</i> (Savannah lilliput)	T	C2	S2	G3
Habitat: a number of Atlantic drainages, most numerous in University Lake near Chapel Hill (Orange)				
<i>Villosa constricta</i> (notched rainbow)	SR		S3	G4
Habitat: most Atlantic drainages, mainly in lower Piedmont (Durham, Franklin, Granville, Johnston, Nash, Orange, Person, Vance, Wake, Warren, Wilson)				
Sites: AH2, AH4, AH5, AH6, AH7, AH8, AH12, AH13, AH14, AH15, AH16, AH17, AH18, OR3				
<i>Villosa delumbis</i> (eastern creekshell)	SR		S3?	G3G4
Habitat: wide ranging habitat from cobble, boulder to silt and sand in Coastal Plain (Durham, Granville, Orange, Person)				
Sites: AH6, AH17				

CRUSTACEANS

- Diacyclops jeannelli putei* SR S1 G?
 (Carolina well diacyclops)
 Habitat: found in a dug well in Orange County
- Procambarus medialis* SR C2 S? G2
 (Tar River crayfish)
 Habitat: requirements for habitat not well known (Halifax, Johnston, Lenoir)

INSECTS -- DRAGONFLIES

- Gomphus septima* SR C2 S1 G2
 (Septima's clubtail dragonfly)
 Habitat: streams near Fall Line (Durham)
 Sites: AH4
- Tachopteryx thoreyi* SR S3? G4
 (Thorey's grayback dragonfly)
 Habitat: nymph lives in mud of bogs and small pools; adults occur along small wooded streams (Franklin, Granville, Orange, Wake, Warren)
 Sites: DU6, OR4, WK19

INSECTS -- SCORPIONFLIES

- Merope tuber* SR S? G3G5
 (earwig scorpionfly)
 Habitat: woodlands near permanent streams (Wake)
 Sites: WK19

INSECTS -- MOTHS

- Lithophane lemmeri* SR 3C S1S3 G3G4
 (Lemmer's noctuid moth)
 Habitat: requirements for habitat not well known (Wake)

INSECTS -- BUTTERFLIES

- Erynnis martialis* UNK S3? G4
 (mottled dusky wing)
 Habitat: upland woods, brushy fields; host plant is New Jersey tea (*Ceanothus americanus*) (Wake)
- Hesperia metea* UNK S3? G4G5
 (cobweb skipper)
 Habitat: dry barren sites, such as pine/oak sandhills and upland woods; host plants are mainly broomsedge (*Andropogon*) (Orange, Wake)
- Incisalia augustus* UNK S3? G5
 (brown elfin)
 Habitat: dry acidic areas with an abundance of ericads, such as pine/oak heaths; host plants are ericaceous shrubs (Orange)
 Sites: OR2
- Papilio cresphontes* SR S2 G5
 (giant swallowtail)
 Habitat: primarily coastal in maritime forests or thickets; host plants are prickly ash (*Zanthoxylum*) and hoptree (*Ptelea*) (Orange, Wake)
- Speyeria diana* SR C2 S3 G3
 (diana)
 Habitat: rich woods and adjacent edges and openings, often near streams; believed extirpated from the Piedmont; host plants are violets (*Viola* spp.) (Nash, Wake)

INSECTS -- BEETLES

<i>Anillinus carolinae</i> (a ground beetle) Habitat: in moist soils under stones (Orange)	SR	S?	G?
<i>Limulodes paradoxus</i> (horse-shoe crab beetle) Habitat: requirements for habitat not well known (Wake)	UNK	S?	G?
<i>Mayetia bulla</i> (a short-winged mold beetle) Habitat: in soils (Orange)	SR	S?	G?
<i>Mayetia pearsei</i> (a short-winged mold beetle) Habitat: in soils (Orange)	SR	S?	G?

The following definitions are adapted from LeGrand 1991.

North Carolina Status. (Endangered, Threatened, and Special Concern species of mammals, birds, reptiles, amphibians, and mollusks have legally protected status in North Carolina.)

E - Endangered. Any native or once-native species of wild animal whose continued existence as a viable component of the state's fauna is in jeopardy or any species of wild animal determined to be an 'endangered species' pursuant to the Endangered Species Act.

T - Threatened. Any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a threatened species pursuant to the Endangered Species Act.

SC - Special Concern. Any species of wild animal native or once-native to North Carolina which is determined to require monitoring, but which may be taken under regulations adopted under the provisions of this Article (Article 25 of Chapter 113 of the General Statutes).

SR - Significantly Rare. Any other species which has not been determined to be an Endangered, Threatened, or Special Concern species, but which exists in the state in small numbers and has been determined to need monitoring. (This is a N.C. Natural Heritage Program designation.)

UNK - Undetermined (Unknown). A species for which insufficient data are available for precise assessment. (This is a N.C. Natural Heritage Program designation).

* - Species is a game animal, and therefore (by law) cannot be listed for State protection as E, T, or SC.

United States Status. (These statuses are designated by the U.S. Fish and Wildlife Service.)

E - Endangered. A taxon threatened with extinction throughout all or a significant portion of its range.

T - Threatened. A taxon likely to become endangered in the foreseeable future.

C1 - Candidate 1. A taxon for which the Fish and Wildlife Service has on file enough substantial information to list as endangered or threatened. Listing is "warranted but precluded by other pending proposals of higher priority."

C2 - Candidate 2. A taxon for which there is some evidence of vulnerability, but for which there are not enough data to support listing as endangered or threatened at this time. Listing is "warranted but precluded by other pending proposals of higher priority."

3A - Candidate 3A. A taxon for which the Fish and Wildlife Service has persuasive evidence of extinction.

3B - Candidate 3B. A name that, on the basis of current taxonomic understanding, does not represent a distinct taxon.

3C - Candidate 3C. A taxon proven to be more abundant or widespread than previously believed and/or not subject to any identifiable threat. They may be reevaluated for possible inclusion in categories 1 or 2.

North Carolina Rank. (These ranks are based on The Nature Conservancy's system of measuring rarity and threat status and are widely used by other agencies and organizations, as the best available scientific and objective assessment of a species' rarity at the state level.)

S1 = Critically imperiled in North Carolina because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation in the state.

S2 = Imperiled in North Carolina because of rarity (6 to 20 occurrences or few remaining individuals) or because of some factor(s) making it very vulnerable to extirpation from North Carolina.

S3 = Rare or uncommon in North Carolina (on the order of 21 to 100 occurrences).

S4 = Apparently secure in North Carolina, with many occurrences.

S5 = Demonstrably secure in North Carolina and essentially ineradicable under present conditions.

SU = Possibly in peril in North Carolina but status uncertain; need more information.

S S = The rank is believed to be between two ranks.

S? = Unranked, or rank uncertain.

B = Rank of the breeding population in the state. Used for migratory species only.

N = Rank of the non-breeding population in the state. Used for migratory species only.

Z = Population is not of significant conservation concern. For example, the status "SZN" indicates that the population in the non-breeding seasons (generally in migration or in winter) is transitory, without any regular locales of occurrence whereby the species can be protected. Where a number is listed with the "B" or "N" modifier, there are definable locales of occurrence that can be identified for protection.

Global Rank. (These ranks to the status of a species throughout its range and are assigned by a scientific experts, various natural heritage programs, and The Nature Conservancy. This system is widely used by other agencies and organizations, as the best available scientific and objective assessment of a species' rarity throughout its range.)

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently secure globally; may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally; may be quite rare in parts of its range, especially at the periphery.

G G = The rank is believed to be between two ranks.

G? = Unranked, or rank uncertain.

G Q = Questionable taxonomic assignment.

T = The rank of a subspecies or variety. As an example, G4T1 would apply to a subspecies of a species with an overall rank of G4, but the subspecies warranting a rank of G1.

warbler inhabits mature hardwood forests, steep slopes and coves in mountains, and natural levees in the Coastal Plain during breeding season.

Five mollusks in the A/P III study area are Federal Candidates for listing, the yellow lance (Elliptio lanceolata), the Atlantic pigtoe (Fusconaia masoni), the yellow lampmussel (Lampsilis cariosa), the green floater (Lasmigona subviridus), and the Savannah lilliput (Toxolasma pullus). The yellow lance, also a State Threatened species, occurs in the Tar and Neuse river systems, mainly near the Fall Line. The Atlantic pigtoe, also a State Threatened species, occurs in most Atlantic drainages in the lower Piedmont and upper and lower Coastal Plain, mainly near the Fall Line. The yellow lampmussel, also a State Threatened species, inhabits a number of river systems mainly near the Fall Line. The green floater, also a State Endangered species, occurs in the Tar, Neuse, and Cape Fear river systems downstate, and in the New and Watauga systems in the mountains. The Savannah lilliput, also a State Threatened species, inhabits a number of Atlantic drainages, but is most numerous in University Lake near Chapel Hill.

One crayfish, the Tar River crayfish (Procambarus medialis), endemic to eastern North Carolina and found in the A/P III study area, is a Federal candidate species. Two insects are also Federal candidate species: Septima's clubtail dragonfly (Gomphus septima), found along streams near the Fall Line, and diana (Speyeria diana), a butterfly that inhabits rich woods and adjacent edges and openings often near streams. This butterfly is believed to be extirpated from the Piedmont.

No animal species in the A/P III study area are considered State Endangered that are not also Federally listed. One salamander and three mussel species in the A/P III study area are State Threatened, but are not Federally listed. These are the tiger salamander (Ambystoma tigrinum), the triangle floater (Alasmidonta undulata), the Roanoke slabshell (Elliptio roanokensis), and the squawfoot (Strophitus undulatus). The tiger salamander breeds in fish-free semipermanent ponds and forages in adjacent woods, usually sandy pinewoods. The triangle floater occurs in most river systems in the Piedmont and upper and lower Coastal Plain. The Roanoke slabshell inhabits the Neuse, Tar, and Roanoke rivers near the Fall Line. The squawfoot occurs in the Tar, Neuse, Cape Fear, and Pee Dee river systems and perhaps in other Piedmont river systems.

2. Significant Wildlife Habitats

The most significant habitats for wildlife in the A/P III study area are the aquatic habitats of rivers and streams. Three large rivers are located in the A/P III study area, the Neuse, Tar, and Roanoke rivers. These rivers, along with the numerous streams and creeks located in their drainages, provide habitat for the four rare fish species and 16 rare mussel species found

in the A/P III study area. Other species such as the Neuse River waterdog (Necturus lewisi), Tar River crayfish, and Septima's clubtail dragonfly also inhabit these rivers and streams.

Habitats such as pools, seeps, bogs, levees, lakes, and ponds are also important wildlife habitats. They provide habitat for about 12 of the rare animal species found in the A/P III study area. Falls Lake, for example, provides foraging habitat for bald eagles. Examples of other species that inhabit such areas are the tiger salamander, the four-toed salamander (Hemidactylum scutatum), pine barrens treefrog (Hyla andersonii), and Thorey's grayback dragonfly (Tachopteryx thoreyi).

Swamp forests and bottomland forests contain about four rare animal species in the A/P III study area. However, these habitats frequently are rich in wildlife species, including the rare Mississippi kite (Ictinia mississippiensis) and cerulean warbler. Bottomland hardwoods, in particular those dominated by oaks, contain some of the densest breeding bird populations of any habitat in North Carolina. Swamp forests are important waterfowl and amphibian habitats. Because of their often extensive size, some covering 10,000 or more acres, swamps and bottomlands provide habitat for large mammals such as the black bear (Ursus americanus) and bobcat (Felis rufus).

The A/P III study area contains very little longleaf pine habitat. Sandy longleaf pine forests, such as flatwoods and pine/scrub oak communities, are important habitats for many snakes and glass lizards, and provide habitat for such rare animals as the cobweb skipper (Hesperia metea). Animals such as frogs and salamanders spend most of their life cycles in burrows in such sandhill sites, even though they lay eggs in temporary or other small ponds and pools.

Other upland forests are also important wildlife habitats. Mature hardwood forests are not common in the uplands of the study area. The majority of these occur on ravine slopes and provide habitat for rare animals such as Cooper's hawk (Accipiter cooperii), the sharp-shinned hawk (A. striatus), and the mottled dusky wing (Erynnis martialis).

Wildlife habitats consist of more categories than simply the mature natural communities listed above. Habitats also include edges of communities and various seral stages within a single community, such as croplands, weedy fields, and pine thickets. The younger stages of communities, such as fields and shrub thickets, are often valuable to wildlife. Fields and shrub/sapling thickets that mature into pine forests experience a decrease in animal diversity. However, this diversity generally begins to increase when the pines are mature and deciduous saplings begin to appear beneath them. Pine forests eventually succeed to hardwood forests, except where fires maintain habitat in pine. Diversity and wildlife values usually continue to increase with an increasing amount of hardwood cover and fruit production, such as acorns and berries.

DISCUSSION

A. SUMMARY OF RESULTS

Of the sites identified in the A/P III study area as potentially containing significant or critical natural resources and requiring survey work, 130 were identified as having biological or physiographical significance at the national, state, or regional level. All of these 130 natural areas are described in this report (see Figure 4 and Inventory of Sites section). Eighteen of these 130 significant natural areas are aquatic habitats and the remainder are terrestrial or wetland habitats.

Of the 130 significant natural areas in the A/P III study area, 18 are of National significance, 44 are of State significance, and 68 are of Regional significance. Of the 18 Nationally significant areas, 11 are terrestrial or wetland sites and seven are aquatic habitats. Five of the Nationally significant terrestrial and wetland sites are in Granville County, two are in Wake County, and one is in each of the following counties: Durham, Franklin, Nash, and Northampton. Six of these Nationally significant sites are Registered Natural Heritage Areas and one is a Dedicated Natural Heritage Area (discussed in more detail in the Recommendations for Protection section). All aquatic habitats in the state are owned by the state of North Carolina and none have a specific protection status.

Many of the 130 significant natural areas in the A/P III study area are afforded some type of protection. Thirty-two of the 130 significant natural areas, for example, are Registered Natural Heritage Areas that are publicly or privately owned. Two of the natural areas are Dedicated Natural Heritage Areas and seven of the natural areas are protected by land conservation organizations (for more details see Recommendations for Protection section).

The Protection Priorities section includes a list which gives the suggested priority of protection. Natural area complexes are discussed along with significant geomorphic themes, watersheds, and aquatic habitats. It should be noted that the priority rankings of the natural areas in this inventory report are based solely on their biological and geomorphic significance, and not on the degree of threat or amount of protection afforded them; for many sites, the threats are not known.

B. AREAS FOR FURTHER SURVEY WORK

As with most types of inventory and survey work, there is never enough time and money available to do a complete and thorough survey. A comprehensive survey of the 17-county A/P III study area would likely require many thousands of hours of field work. In fact, most previous county-wide inventories of natural

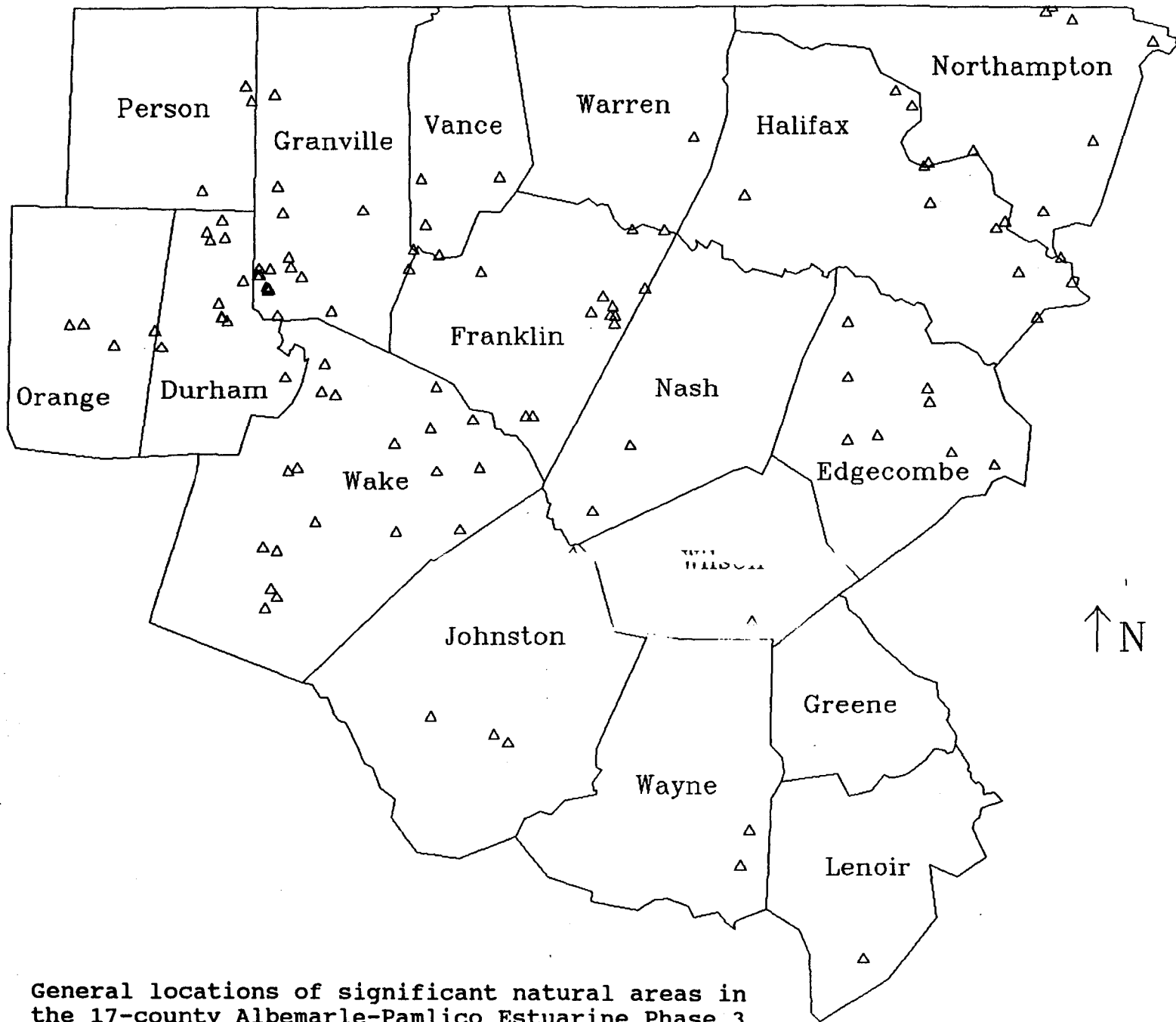


Figure 4. General locations of significant natural areas in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

areas have required two years to complete. Obviously, many portions of the 17-county region need better coverage.

Many of the sites identified from various sources as containing or potentially containing significant natural resources had been previously inventoried and were not revisited for this study. Durham, Orange, and Wake counties had previously been surveyed in county-wide inventories (Sutter et al. 1987, Sather and Hall 1988, LeGrand 1987, respectively) and therefore were not surveyed during this study. The remaining 14 counties had no previous systematic inventories, though a number of individual sites had already been surveyed and described.

It should be noted that the quality of the previously surveyed sites may have changed since the sites were last visited. Many of these sites have not been revisited for several years and may have been altered by clearcutting or development. In fact, this holds true for sites visited in 1991 and 1992 as well. Sites afforded some form of protection, however, are less likely to have been disturbed since the last site visit.

All counties in the A/P III study area have at least one site of National, State, or Regional significance, except for Greene County. Due to extensive use of land for agriculture and a low diversity of geomorphic features, this county contains little high quality natural habitat. One site in Greene County near Contentnea Creek (on Stantonsburg quadrangle map) that probably contains high quality habitat could not be visited during this study due to its inaccessibility.

Additional survey work seems warranted in several counties. Halifax and Northampton counties, for example, are large and have considerable amounts of forested land. Although a survey of natural areas in the Roanoke River floodplain was conducted by Lynch (1981), this floodplain is so extensive that additional significant natural areas likely remain to be identified and described. Similarly, the Tar River floodplain in Edgecombe County is extensive and requires further survey work. Johnston County, in particular its Neuse River floodplain, is another large county that needs more survey work. Additionally, survey work to identify granitic flatrocks in Franklin and Wake counties is also warranted.

Because of time and funding limitations, the majority of the survey work conducted for this study was botanically oriented. Animals recorded during site visits were seen while surveying vegetation at the natural areas. The N.C. Natural Heritage Program, however, is conducting a survey specifically for animal species in Durham County. This survey will be completed in June 1993 and will supplement the Durham County inventory written by Sutter et al. in 1987.

Some aquatic habitat inventories have been conducted in the A/P III study area; however, they were usually restricted to areas around bridges. Certainly, more comprehensive aquatic surveys in lakes, streams, and rivers could be done at a later date.

There was no intent in this inventory to describe "wildlife habitats" or "wildlife corridors", which are generally based on areal extent of forested areas, often without concern for the quality of the forests. This inventory includes only those areas of high quality, reasonably mature forests, rare or uncommon natural communities, or significant sites of endangered or rare species.

C. THREATS TO NATURAL RESOURCES

As with all parts of North Carolina, a strain is being placed on the natural resources of the 17-county A/P III study area. Nearly all of the threats are human-induced. The A/P III study area is more heavily populated than the 10-county A/P I and the 7-county A/P II study areas; therefore, threats from development to natural resources are consequently greater in this region than in the two previously studied regions.

The major threat to natural resources in the A/P III study area is from urban sprawl. The greatest development pressures in the A/P III study area are occurring in Durham, Orange, and Wake counties, specifically in the vicinity of Raleigh, Durham, Chapel Hill, and Cary. Land consumption for housing and commercial use has dramatically increased in these areas in the past 20 years.

In addition to housing and commercial development, construction of new roads poses a major threat in some portions of the study area. With the construction of new highways, for example, fragmentation of river and creek floodplains and extensive upland forests often occurs. In and near cities, new roads are continuously being constructed for new housing developments. The widening of existing highways can also have a negative impact on natural communities.

A threat in this study area that is mostly absent in the A/P I and II study areas is the proliferation of reservoirs. Falls Lake, for example, has flooded thousands of acres of prime bottomland forests in Durham, Wake, and Granville counties. Other reservoirs (Kerr, Gaston, and Roanoke Rapids) have disrupted the natural flow of the Roanoke River. A number of reservoirs are in the planning stages; if all are constructed, major damage to aquatic habitats, especially populations of rare mollusks, will occur.

Threats from timber harvesting exist in all 17 counties in the A/P III study area. The counties bordering Virginia have the most sites disturbed by logging. In this region, timber harvests usually come in the form of clearcutting; pine plantations are not common in the A/P III study area. After the trees are harvested and the land is cleared, the site is usually abandoned and allowed to undergo natural revegetation. Some natural communities can recover their previous composition fairly well after cutting. Others, such as Atlantic white cedar forests and longleaf pine forests, need a special combination of fire or other environmental factors to recover.

Agriculture has long ago removed thousands of acres of former natural vegetation in the A/P III study area. Presently, the clearing of forests for farmland is not widespread. Many small-scale farmlands are present in the eastern portion of the study area. Not as much agriculture occurs in the heavily forested counties bordering Virginia or in the counties around Raleigh and Durham which are more heavily developed for housing and commercial purposes.

Runoff from croplands and other cleared lands is another threat to natural resources, especially to the well-being of the aquatic habitats in rivers and streams. Runoff of fertilizers, pesticides, animal wastes, and various chemicals from such lands can cause such things as algal blooms and mussel and fish kills.

Mining for sand, stone, gravel, and clay is also a concern because it often occurs in Piedmont Monadnock Forest and Granitic Flatrock natural communities. These community types are not common in this study area and such activities may destroy the last examples.

Exclusion of fire in certain forested areas is also a threat. Many of the pine forests and sandhill communities need occasional or frequent fires to maintain their integrity. A lack of fire leads, in these cases, to a conversion of the natural community into a "fire-suppression" community with the loss of many component species. Infrequent fire in longleaf pine (Pinus palustris) habitats, for example, leads to a more mesic community of loblolly pines (P. taeda), oaks, and hickories.

D. RECOMMENDATIONS FOR PROTECTION

1. Agencies and Organizations Involved in Protection

At least 80 of the 130 significant natural areas in the A/P III study area are privately owned. The majority of these sites are owned by individuals and companies whose names are not disclosed in this report.

Of the privately owned significant natural areas in the A/P III study area, seven are owned by local land conservation organizations. There are only a few local land conservancy organizations in the 17-county A/P III study area which can purchase or otherwise protect significant natural areas. One such group is the Triangle Land Conservancy which protects natural areas in Chatham, Durham, Johnston, Lee, Orange, and Wake counties. They partially or entirely own three of the significant natural areas included in this report: Swift Creek Bluffs (Site WK13), The Rocks (Site WK15), and Flower Hill--Moccasin Creek (Site JO3). They also have an easement on a privately owned site.

Another land conservation organization in the A/P III study area is the Eno River Preservation Association, which protects land along the Eno River by purchasing tracts of land, and in turn, selling the tracts to the state of North Carolina to become

part of the Eno River State Park. One of their sites, Eno River Blue Wild Indigo Slope (Site DU4), is maintained by the Association and is not part of the Eno River State Park.

The major land conservation organization in the state is The Nature Conservancy--North Carolina Chapter. It has been involved in the protection of a number of natural areas in the A/P III study area, including Camassia Slopes (Site NO2), Larkspur Ridge (Site HA5), and Turkey Creek Preserve (Site NA2). This organization will undoubtedly play a key role in the protection of other sites in the A/P III study area in upcoming years.

Another private landowner in the A/P III study area worth mentioning is Duke University which owns one significant natural area in this region, Stony Creek Spring (Site OR4).

Several state agencies are involved in land protection in the A/P III study area. The Division of Parks and Recreation, within the N.C. Department of Environment, Health, and Natural Resources, plays several major roles in land protection in this region and throughout the state. The Division of Parks and Recreation operates State Parks, State Natural Areas, State Recreation Areas, and State Lakes, Rivers, and Trails. Six such facilities are significant natural areas in the 17-county study area: Cliffs of the Neuse State Park (Site WY1), Eno River State Park (Site DU6), Hemlock Bluffs State Natural Area (Site WK4), Medoc Mountain State Park (Site HA7), Mitchell's Millpond State Natural Area (Site WK8), and William B. Umstead State Park (Site WK19).

The N.C. Natural Heritage Program, located within the Division of Parks and Recreation, maintains and administers the N.C. Registry of Natural Heritage Areas. These are areas, both in public and in private ownership, that contain significant biological and ecological features which the owners have signed a non-binding agreement to protect. There are approximately 300 such registered areas in the state, 32 of which are in the A/P III study area. The Heritage Program also administers the Dedicated State Nature Preserve system, whereby non-Federally owned land is protected in perpetuity by the granting of a conservation easement to the state of North Carolina by the owner. There are presently 11 Dedicated Nature Preserves in North Carolina, two of which, Camassia Slopes (Site NO2) and Flat River Slopes above Lake Michie (Site DU8), are located in the A/P III study area.

Other state agencies involved in land protection in the A/P III study area include the N.C. Department of Agriculture which administers two significant natural areas, Knap of Reeds Creek Ravine (Site GA8) and Picture Creek Diabase Barrens (Site GA11). One site, Bennett Place (Site DU1), is administered by the N.C. Department of Cultural Resources. The N.C. Department of Corrections administers part of one site, Camassia Slopes (Site NO2). Six sites are administered by the Department of Human Resources: Knap of Reeds Creek Diabase--Forest and Glades (Site GA7), Murdoch Center Diabase Sill (Site GA9), South Butner Cedar Glades (Site GA13), South Butner Diabase Swamp (Site GA15), South

Butner Hardwood Forest (Site GA16), and Umstead Hospital Pine-Oak Forest (Site GA19). One site, Walnut Creek Sumac Site (Site WK17), is partially owned by the N.C. Department of Transportation. The N.C. Wildlife Resources Commission administers a portion of one site, Buzzard Point/Ventosa Plantation (Site HA1) in the A/P III study area, and manages ten of the natural areas owned by the U.S. Army Corps of Engineers.

Several of the significant natural areas are administered by state universities. N.C. State University administers five sites in the A/P III study area: Flat River Slopes above Lake Michie (Site DU8), Hill Forest Chestnut Oak-Shortleaf Pine Forest (Site DU9), Hill Forest Dial Creek Hardwood Forest (Site DU10), Hill Forest Slocum Camp Hardwood Forest (Site DU11), and Lake Raleigh Hardwood Forest (Site WK6).

All rivers and streams in North Carolina are owned by the state; therefore, all significant aquatic habitats discussed in this report are listed as "Waters of the State" in their site descriptions. In the A/P III study area, there are 18 aquatic habitats considered to be of National, State, or Regional significance, and all are state owned.

The only Federal agency that owns land in the A/P III study area is the U.S. Army Corps of Engineers. They partially or entirely own 11 of the significant sites, nine of which are part of the Falls Lake project in Durham, Granville, and Wake counties. These 11 natural areas are: Cabin Branch Creek (Site DU2), Catsburg Natural Area (Site DU3), Flat River Bend (Site DU7), Lick Creek Bottomland Forest (Site DU12), Penny's Bend--Eno River (Site DU13), Beaverdam Lake Swamps and Arkose Outcrops (Site GA1), Knap of Reeds Creek Diabase--Clearings and Levee (Site GA6), Northside Diabase Area (Site GA10), Adam Mountain (Site WK1), Old Still Creek Forest (Site WK9), and Upper Barton Creek Bluffs and Ravine (Site WK16).

Local government agencies also play a role in the protection of natural areas in the A/P III study area. Four of the significant natural areas in this region are partially or entirely owned by local governments. These sites include: Flat River Slopes above Lake Michie (Site DU8), Occoneechee Mountain (Site OR2), Sevenmile Creek Sugar Maple Bottom (Site OR3), and Walnut Creek Sumac Site (Site WK17). One site, Hemlock Bluffs State Natural Area (Site WK4), is partly owned by the state and partly by the town of Cary.

2. Protection Priorities

a. **General Comments.** It is hoped that all of the sites described in this inventory will be afforded some measure of protection in future years. Further field work will most likely reveal additional significant natural areas in the 17-county area and it is hoped that these too will be protected.

Recommendations for protection are determined by several factors. First, the more significant the natural area, the

higher the priority for protection should be. Second, the size of a site is important; therefore, it is better to preserve large tracts of a natural community than smaller ones. Third, the contiguity of a site with other sites is important. Sites that are isolated from others are likely to be less important in conserving biological diversity in future years than adjacent sites that are protected as a complex or unit. Fourth, protection should focus on natural communities or rare species that are essentially unprotected or poorly protected in the A/P III study area, or in the state or nation. There is, for example, a more pressing need to preserve a Basic Oak-Hickory Forest, which is nearly unprotected in the A/P III study area, than there is to protect a Cypress-Gum Swamp, which is well represented in the region, even if both sites are given the same significance rating.

Protection priorities also need to take into account the degree of threat to a given site. Natural areas that appear to be, or are known to be, in immediate threat of destruction might take priority over sites that have apparently little threat to them. In most cases, however, threats are poorly known or can only be speculated. Thus, the biological significance of a site is usually the primary factor involved in setting protection priorities.

b. Natural Area Complexes. Below is a suggested priority of protection list that groups sites adjacent to each other as a complex, in the hope that protection can be achieved for the entire complex rather than for just a specific site. The suggested priority of protection for these complexes is listed in descending order of significance and the locations of these complexes are shown in Figure 5. The reader should refer to the Inventory of Sites section and to Table 6 for the listing of the significance of each individual natural area.

1) **Roanoke River Complex.** This natural area complex lies along the majority of the Roanoke River in Northampton and Halifax counties. It is the most significant natural area complex in the A/P III study area because of the extremely high quality and extent of its bottomland and swamp forests. Within this complex are 11 significant natural areas: Bull Neck Swamp and Bluffs (Site NO1), Buzzard Point/Ventosa Plantation (Site HA1), Camassia Slopes (Site NO2), Hills Ferry Bluffs (Site HA3), Larkspur Ridge (Site HA5), Looking Glass Run Swamp and Bluffs (Site HA6), Norfleet Cottonwood Forest (Site HA8), North Looking Glass Run Bluffs (Site HA9), Phlox Woods (Site HA10), Pierce's Farm Heronry (Site HA11), and Roanoke Big Oak Woods (Site HA12). Two of these natural areas (Camassia Slopes and Larkspur Ridge) are partially or entirely owned by The Nature Conservancy. One of the 11 natural areas is of National significance and five are protected as Registered Natural Heritage Areas.

The Roanoke River National Wildlife Refuge acquisition boundary lies primarily in the A/P I study area, with only

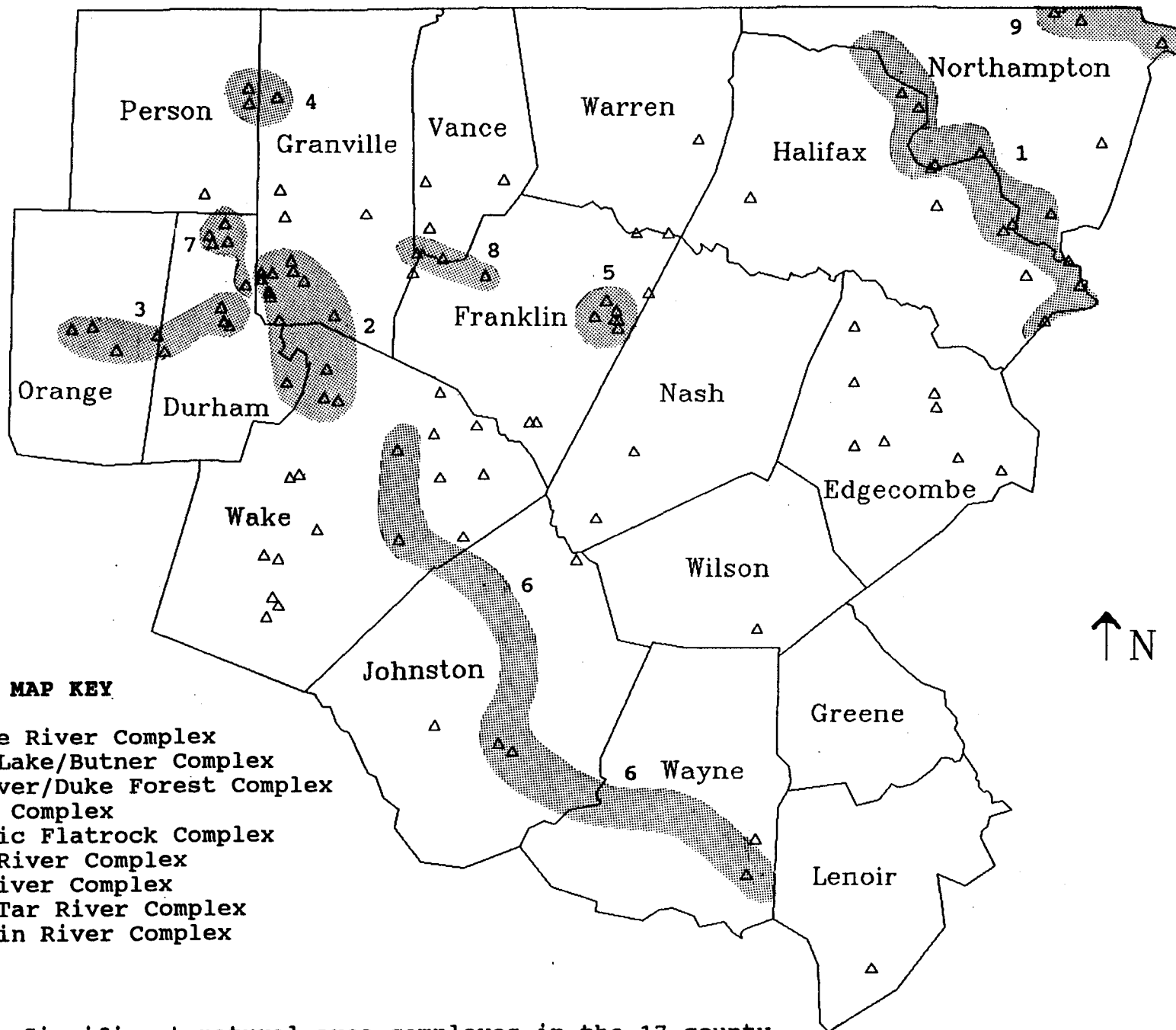


Figure 5. Significant natural area complexes in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

several small sections of the refuge planned for the A/P III study area. As a result, protection of the floodplain in the A/P III study area may lie mostly with private individuals, conservation organizations such as The Nature Conservancy, or with the N.C. Wildlife Resources Commission.

2) Falls Lake/Butner Complex. This natural area complex is in Granville, Durham, and Wake counties. It is significant because it contains high quality natural areas over a diabase sill, in addition to natural areas in bottomlands and rich slopes. This complex is located in the Falls Lake and Butner area and contains 17 significant natural areas: Adam Mountain (Site WK1), Beaverdam Lake Swamps and Arkose Outcrops (Site GA1), Creedmoor Lake Diabase Area (Site GA2), Knap of Reeds Creek Diabase--Clearings and Levee (Site GA6), Knap of Reeds Creek Diabase--Forest and Glades (Site GA7), Knap of Reeds Creek Ravine (Site GA8), Lick Creek Bottomland Forest (Site DU13), Murdoch Center Diabase Sill (Site GA9), Northside Diabase Area (Site GA10), Old Still Creek (Site WK9), Picture Creek Diabase Barrens (Site GA11), South Butner Cedar Glades (Site GA13), South Butner Diabase--Pine Forest (Site GA14), South Butner Diabase Swamp (Site GA15), South Butner Hardwood Forest (Site GA16), Umstead Hospital Pine-Oak Forest (Site GA19), and Upper Barton Creek Bluffs and Ravine (Site WK16). Three of these natural areas (Knap of Reeds Creek Diabase--Clearings and Levee, Picture Creek Diabase Barrens, and South Butner Cedar Glades) are of National Significance. Six of the 17 sites are protected as Registered Natural Heritage Areas and six are managed by the N.C. Wildlife Resources Commission. Though nearly all of these sites are on publicly owned land, the majority receive no protection. Future expansion of Butner threatens several sites. It is hoped that many of these sites can be preserved from development and protected in some manner.

3) Eno River/Duke Forest Complex. This natural area complex is in Orange and Durham counties. It is significant because of its high quality bottomland forests and uplands that include several monadnocks and a diabase sill. This complex is located along the Eno River and incorporates parts of Duke Forest. Within the complex are ten significant natural areas: Bennett Place (Site DU1), Cabin Branch Creek Bottomland-Swamp (Site DU2), Catsburg Natural Area (Site DU3), Eno River Blue Wild Indigo Slope (Site DU4), Eno River Diabase Sill (Site DU5), Eno River State Park (Site DU6), Occoneechee Mountain (Site OR2), Penny's Bend--Eno River (Site DU13), Sevenmile Creek Sugar Maple Bottom (Site OR3), and Stony Creek Spring (Site OR4). One of these sites (Eno River Diabase Sill) is of National significance. Seven of the nine sites are protected as Registered Natural Heritage Areas. Most of these sites are in various public ownership or are owned by Duke University. The university's site is not a Registered Natural Heritage Area, however, it receives some protection as a research facility.

4) Gabbro Complex. This natural area complex is in Person and Granville counties and is significant because of the high quality deciduous forests located over gabbro rock. Within this complex are three significant natural areas: Dennys Store Gabbro Forest (Site GA3), Goshen Gabbro Forest (Site GA5), and Vernon Hill Church Road Dry Forest (Site PE3). One of these sites (Goshen Gabbro Forest) is of National significance. All three sites are privately owned and none are not protected. They are highly threatened by logging which is common in that region. Efforts have been initiated to protect at least portions of the Goshen Gabbro Forest.

5) Granitic Flatrock Complex. This natural area complex is in eastern Franklin County. It is significant because of the high quality cluster of granitic flatrocks present over the Rolesville Pluton, which underlies much of Franklin and Wake counties. Within this complex are six significant natural areas: Big Peachtree Creek Flatrock (Site FR1), Bog Flatrock (Site FR2), Cedar Rock Church Flatrock (Site FR4), North Big Peachtree Creek Flatrock (Site FR8), Overton Rock (Site FR9), and West Big Peachtree Creek Flatrock (Site FR13). All of these sites are of State or Regional significance. Overton Rock is protected as a Registered Natural Heritage Area, but the other five sites have no form of protection. Threats to flatrocks include trash dumping, ORV usage, and quarrying. The best protection of the remaining flatrocks is through registry or through acquisition by local governments.

6) Neuse River Complex. This natural area complex is in Wake, Johnston, and Wayne counties. It is significant because of the high quality bottomland forests located along the Neuse River, particularly in Johnston County. Within this complex are five significant natural areas: Cliffs of the Neuse State Park (Site WY1), Cowbone Oxbows (Site JO2), Horseshoe Farm Bottomland Forest (Site WK5), Sage Pond--Neuse River Floodplain (Site JO4), and Walnut Creek Sumac Site (Site WK17). One of these sites (Walnut Creek Sumac Site) is of National significance. The two of the six sites are receiving protection: Cliffs of the Neuse State Park and Walnut Creek Sumac Site. The later is being managed cooperatively by many agencies to protect the rare plant species located there. Logging is the primary threat to the bottomland forests located in this complex. Acquisition of the extensive bottomlands in Johnston County should be a high priority.

7) Flat River Complex. This natural area complex is in northern Durham County. It is significant because of the high quality hardwood forests, especially the rich or rocky slopes, found there. This complex is located along the Flat River and contains five significant natural areas: Flat River Bend (Site DU7), Flat River Slopes above Lake Michie (Site DU8), Hill Forest Chestnut Oak-Shortleaf Pine Forest (Site DU10), Hill Forest Dial

Creek Hardwood Forest (Site DU11), and Hill Forest Slocum Camp Hardwood Forest (Site DU12). All of these sites are of State or Regional significance and are protected; four are Registered Natural Heritage Areas and one is a Dedicated State Nature Preserve. The biggest threat to the complex is the proposed reservoir north of the Flat River Slopes above Lake Michie natural area. This reservoir could alter the hydrology of the Flat River and could flood significant lands in northern Durham and southern Person counties.

8) Upper Tar River Complex. This natural area complex is in Granville, Vance, and Franklin counties and is located along the upper parts of the Tar River. It is significant because of the high quality rich slopes and natural levees located there. Within this complex are three significant natural areas: Tar River--Wilton Slopes (Site GA18), Tar River Camassia Slopes (Site VA4), and Tar River Levee (Site FR12). All three sites are of Regional significance, are privately owned, and are not protected. Logging appears to be the major threat to the complex. Registry agreements are probably the best form of protection, at least as a temporary measure.

9) Meherrin River Complex. This natural area complex is in Northampton County and is significant because it contains bottomland forests, slopes, and bluffs. This complex is located along the Meherrin River and contains four significant natural areas: Meherrin River Bluffs North of Kirby (Site NO3), Meherrin River Bottomland Forest (Site NO4), Meherrin River Oxbow Bluffs (Site NO5), and Meherrin River Slopes and Swamp (Site NO6). All of these sites are of State or Regional significance, are privately owned, and are not protected. This is a somewhat overlooked river in the state because the larger, neighboring rivers, the Roanoke and Chowan rivers, receive most of the protection efforts in the northern Coastal Plain, and because most of the Meherrin River lies in Virginia. Registry appears to be the best protection method for the natural areas in this complex.

c. **Geomorphic Themes.** Many of the significant natural areas in the A/P III study area can be thought of as belonging to certain "geomorphic themes" that are rare in the region. These geomorphic themes include diabase/gabbro areas, granitic flatrocks, monadnocks, and sandhills. This study area contains some of the higher concentrations of diabase/gabbro and granitic flatrocks in the eastern United States. Examples of these geomorphic themes are scattered throughout the study area and therefore cannot be tied together geographically and incorporated into complexes. (Geomorphic themes that are common in the study area, such as slopes, bluffs, and floodplains are not considered here.) The suggested priority of protection for these geomorphic themes is listed below in descending order of significance and examples of each are given.

1) **Diabase/Gabbro Areas.** These areas are significant because they are very rare in the A/P III study area and quite rare in the eastern United States. The soils they contain are composed of diabase and gabbro which are basic and rich in minerals. This theme is restricted in the A/P III study area to Durham and Granville counties and to the extreme eastern portion of Person County. A total of 18 significant sites over diabase or gabbro have been identified in this study. Five of these are of National significance: Eno River Diabase Sill (Site DU5), Goshen Gabbro Forest (Site GA5), Knap of Reeds Creek Diabase--Clearings and Levee (Site GA6), Picture Creek Diabase Barrens (Site GA11), and South Butner Cedar Glades (Site GA13). Although many of the 18 sites are located on public lands, especially near Butner, few of them are officially protected.

2) **Granitic Flatrocks.** These areas contain exposures of the Rolesville Pluton and are primarily limited to portions of Franklin and Wake counties. As opposed to the basic rocks in the preceding theme, these granitic rocks weather to an acidic soil. There are 13 significant flatrocks in the A/P III study area, one of which is of National significance: Mitchell's Millpond State Natural Area (Site WK8). Only a few of the 13 flatrock natural areas are protected.

3) **Monadnocks.** Scattered in the Piedmont areas of the eastern United States are monadnocks which are hills or small mountains that contain rocks more resistant to erosion than those of the surrounding terrain. In the A/P III study area, monadnocks are limited mainly to the extreme northwestern corner of the region. A total of five monadnocks are described in this report, none of which are of National significance. Relatively few of the monadnocks are protected in the A/P III study area.

4) **Sandhills.** This theme is not well represented in the A/P III study area, but is common in counties immediately south of this region. Only two sites in the A/P III study area are considered to be sandhills: Black Creek Bluff and Sandhill (Site JO1) and Walnut Creek Sandhills (Site WY2). Neither site is protected, and one of these is probably scheduled for development.

d. Watersheds. The A/P III study area contains several significant watersheds (see Figure 1) with high quality natural communities and aquatic habitats. The condition of these watersheds has an effect on the water quality of the Albemarle and Pamlico sounds; therefore, their protection is important not only to the A/P III study area, but also to the A/P I and II study areas. The three major watersheds in the A/P III study area are the Roanoke River watershed, Tar River watershed, and Neuse River watershed. Also significant, yet much smaller than the Roanoke, Tar, and Neuse watersheds, is the Meherrin River watershed. The Roanoke, Tar, Neuse, and Meherrin rivers are all

brownwater rivers. The Tar, Neuse, and Meherrin rivers have their headwaters in the Piedmont and the Roanoke River has its headwaters in the Blue Ridge Province.

1) Roanoke River Watershed. The portion of the Roanoke River watershed covered in this report occurs in Halifax and Northampton counties. This watershed is Nationally significant because of the wide floodplain and numerous rich slopes located along the Roanoke River. These rich slopes support numerous significant natural communities. The Roanoke River floodplain is very wide, much wider than the Neuse and Tar floodplains, and contains rich mineral soils. The Roanoke River does not support significant aquatic habitats. Rare species of aquatic animals do exist in the Roanoke, however, the populations are not healthy. Along with the Tar and Neuse rivers, the Roanoke River provides spawning habitat for certain species of marine and estuarine fish.

2) Tar River Watershed. The Tar River watershed covers a significant portion of the A/P III study area. This watershed includes parts of Person, Granville, Vance, Franklin, Warren, Halifax, Nash, and Edgecombe counties. Seven significant aquatic habitats are located within this watershed: Cedar Creek Aquatic Habitat (Site AH1), Crooked Creek Aquatic Habitat (Site AH3), Fishing Creek Aquatic Habitat (Site AH5), Stony Creek Aquatic Habitat (Site AH13), Swift Creek (Vance/Warren/Franklin/Nash/Edgecombe) Aquatic Habitat (Site AH15), Tar River--Middle and Lower Aquatic Habitats (Site AH16), and Tar River--Upper Aquatic Habitat (Site AH17). Much like the Roanoke River watershed, the Tar River watershed contains numerous rich slopes that support significant natural communities. The Tar River floodplain is much narrower than the Roanoke River floodplain. The upper portions of the Tar River and its tributaries contain no reservoirs and are frequently rocky and fast-flowing. Because of this, they are suitable to rare aquatic animals such as the dwarf wedgemussel (Alasmidonta heterodon) and the Tar spiny mussel (Elliptio steinstansana).

3) Neuse River Watershed. The Neuse River watershed covers the A/P III study area to the west and south of the Tar River watershed. This is a large portion of the study area covering parts of the following counties: Person, Granville, Orange, Durham, Wake, Franklin, Nash, Wilson, Johnston, Wayne, Greene, and Lenoir. Ten significant aquatic habitats are located in this watershed: Contentnea Creek Aquatic Habitat (Site AH2), Eno River Aquatic Habitat (Site AH4), Flat River Aquatic Habitat (Site AH6), Little River (Orange/Durham) Aquatic Habitat (Site AH8), Little River (Franklin/Wake/Johnston/Wayne) Aquatic Habitat (Site AH7), Middle Creek Aquatic Habitat (Site AH10), Mill Creek Aquatic Habitat (Site AH11), Moccasin Creek Aquatic Habitat (Site AH12), Swift Creek (Wake/Johnston) Aquatic Habitat (Site AH14), and Turkey Creek Aquatic Habitat (Site AH18). The Neuse River

watershed contains rich slopes with significant natural communities. The Neuse River floodplain is moderately wide, particularly in Johnston County. Like the Tar River, the Neuse River and its tributaries are narrow and therefore suitable to many rare aquatic animals. However, several reservoirs are located in the upper Neuse River drainage, and others are in the planning stage.

4) Meherrin River Watershed. The Meherrin River watershed in the A/P III study area is actually a large drainage of the Chowan River watershed that lies in the A/P I study area. The Meherrin River watershed, or drainage, covers a large portion of Northampton County. The Meherrin River contains several rare animal species and is considered to be a significant aquatic habitat (Site AH9). Much like the Roanoke River, the Meherrin River contains rich bottomlands and many swampy areas. This watershed is often overlooked in North Carolina, with most protection efforts focused on the nearby Roanoke and Chowan river floodplains. The Meherrin River does, however, contain several significant natural areas and therefore deserves protection efforts. Because a significant portion of the river lies in Virginia, protection efforts should be coordinated with agencies in that state.

e. **Aquatic Habitats.** In the A/P III study area there are 18 significant aquatic habitats, eight of which are of National significance. None of the 18 aquatic habitats are under any form of protection for their aquatic resources. Preservation of these habitats will provide not only adequate habitat conditions for the rare aquatic species they contain but will also ensure good quality water for human consumption.

1) Protection of Water Quality. To protect aquatic habitats it is important that both point and non-point sources of pollution be limited. Point sources of pollution refer to discharges from localized and traceable points of origin. This category includes primarily discharges from wastewater treatment plants and smaller package plants but also covers transient spills associated with railroad or trucking accidents. Non-point source pollution refers to the broader and more diffuse runoff (such as fertilizers, pesticides, herbicides, and sedimentation) from agricultural fields, timbering operations, construction sites, and other operations involving earth-moving. Also included is stormwater runoff from impervious surfaces such as roads, parking lots, and buildings.

Most of the regulatory efforts aimed at improving water quality have been designed to control the more manageable point sources of pollution. A number of available technologies can be used with wastewater treatment plants and with packaging plants to greatly reduce the impacts their discharge (effluent) has on aquatic ecosystems. To decrease the harmful effects that effluents have on aquatic habitats the following need to be

accomplished: 1) increase in the effluent the level of dissolved oxygen; 2) decrease in the effluent the level of BOD (biological oxygen demand)-- elevated levels of BOD in a stream decrease the amount of oxygen available to aquatic organisms; 3) decrease in the effluent the amount of inorganic nutrients which contribute to eutrophication; and 4) decrease in the effluent the amount of toxicants which are directly lethal to aquatic organisms.

Three procedures can be used with treatment plants and packaging plants to decrease the harmful effects of their effluents. These techniques include the use of: 1) oxidation ditches; 2) tertiary filtration using activated carbon; and 3) ultraviolet light or dechlorination. Oxidation ditches are used with wastewater treatment plants and have been proven to be highly effective in removing both phosphorus and nitrogen (two inorganic nutrients) from the effluent. Oxidation ditches have also been found to increase the level of dissolved oxygen in the effluent. Tertiary filtration using activated carbon can be used with treatment plants and packaging plants to decrease BOD levels by removing from the effluent organic compounds, some of which are toxic to aquatic organisms. Wastewater treatment plants can substitute the use of ultraviolet light for chlorination. Also the simple addition of a dechlorination process following the chlorination process can be used by treatment plants and packaging plants. Adding this step may produce the greatest benefits of all by reducing two of the most important toxic substances affecting aquatic ecosystems: chlorine and chloramines (the later is formed by the interaction of chlorine and nitrogenous compounds).

Although more difficult to regulate, given its broad scale of occurrence, non-point source pollution can also be greatly reduced through application of just a few simple measures. Several such measures include the use of contour plowing, grassed waterways, and flash-board risers in drainage ditches. These are all effective in reducing erosion and siltation associated with agricultural activities. Similarly, the proper construction and placement of logging roads and skid trails can reduce erosion and siltation associated with timbering operations.

With regard to highway, sewerline, and other types of construction projects, a number of best-management practices are recommended for the reduction of siltation and runoff. These practices include the use of: 1) silt fences; 2) stormwater retention ponds; and 3) quick re-vegetation measures. Permanent retention ponds are recommended for the control of stormwater runoff from parking areas and other types of sites covered with a large impervious surfaces.

One particularly effective measure recommended for timber harvest sites, construction areas, and agricultural lands is the maintenance of forested buffer strips between the land use site and the shorelines of streams and rivers. Forested buffer strips reduce the amount of fertilizer, pesticide, and herbicide run-off and siltation that aquatic habitats receive from nearby timber harvest sites, construction areas, and agricultural lands.

Forested buffers are also beneficial because they: 1) act as corridors through which birds, mammals, reptiles, amphibians, and invertebrates can move between larger natural areas; 2) prevent stream channel erosion; 3) provide shade which helps prevent increases in water temperature, especially important in coastal plain areas where air temperatures are high; and 4) provide woody debris in streams, an important food source for many aquatic organisms (Groffman et al. 1990, Burns 1992, McGrath 1992, Prince 1992, U.S.F.S. 1992).

Numerous studies have been conducted on the optimal buffer widths necessary for maintaining water quality. Studies indicate that buffers of 100-200 feet, at a minimum, are needed on both sides of a stream to maintain aquatic species diversity and to provide habitat for populations of forest interior breeding birds (Erman et al. 1977, Tassone 1981, Wilcove et al. 1986, Bushman and Therres 1988, Groffman et al. 1990). Within these buffers no-harvest-zones are needed. The U.S. Forest Service (1992) states that 30-foot no-harvest-zones are needed along perennial streams to maintain woody debris within streams. Studies also suggest that no more than 30% canopy removal should occur within the remaining portion of the buffer (Bushman and Therres 1988). Buffers of adequate size will also reduce edge effects such as tree blow downs from storms and exotic species invasion.

The specific buffer width needed along a particular stream depends on a number of factors which include: 1) the type of biological resources present in habitat; 2) the type of land use occurring along the aquatic habitat; and 3) the degree of slope present along the aquatic habitat. Erman et al. (1977) states that a minimum of 100-foot buffers are needed to maintain aquatic macroinvertebrate diversity in streams 20 feet or more wide. Organisms, such as rare mussel species, that are more sensitive to pollution and sedimentation require 150-200 foot buffer strips (J. Alderman, pers. comm.). Studies done on forest interior breeding birds suggest that buffers at least 100-200 feet wide are needed to maintain their populations (Tassone 1981, Wilcove et al. 1986, Bushman and Therres 1988, Groffman et al. 1990).

In determining adequate buffer size, the type of land use occurring along the stream needs to be taken into consideration. Erosion rates differ for land uses such as highway construction, general construction, roadsides, cropland, urban areas, pasture land, and disturbed forested areas (NCDEM 1979). Erosion rates provided by the U.S. Soil Conservation Service indicate, for example, that highway construction has higher erosion rates than cropland and disturbed forest areas (NCDEM 1979).

Another important consideration in determining adequate buffer width is the degree of slope along the aquatic habitat. Studies have shown that areas with steeper slopes require wider buffers (McGrath 1992). For example, in critical habitat areas 210-foot buffers are needed in areas with a 40 degree slope, whereas critical habitat areas with a 90 degree slope require 410-foot buffers (McGrath 1992).

A number of state and federal agencies are working actively to put the above recommendations into action. The Environmental Protection Agency, for example, provides grants for riparian acquisition and stabilization, hydrological regime stabilization and repair, stormwater and urban runoff control, and watershed reforestation. Similar financial incentive programs, as well as planning assistance, are provided by the U.S. Soil Conservation Service and the U.S. Agricultural Stabilization and Conservation Service. The Forest Stewardship Program, sponsored by a consortium of state and federal agencies, also provides this kind of help for watershed and water quality protection, as well as enhancement of wildlife habitat.

Through its strong regulatory authority, the N.C. Division of Environmental Management plays a particularly important role in protecting aquatic habitats. In addition to general monitoring of water quality and setting limits on wastewater discharge, two approaches to water quality protection by this agency merit special attention. The first is an innovative basinwide approach to water quality protection, which sets allowable limits to discharges based on the total amount of effluents entering the basin, from both point as well as non-point sources (NCDEHNR 1992). A pilot basinwide plan is now being prepared for the Neuse River basin, which includes ten of the significant aquatic habitats identified in this report. Plans will subsequently be drawn up for the remaining 16 river basins in the state.

The second approach the N.C. Division of Environmental Management takes in protecting water quality is through provision of special levels of protection to streams and other bodies of water possessing exceptional water resources. This is accomplished through designating aquatic habitats as either Outstanding Resource Waters (ORW) or as High Quality Waters (HQW). Designating a stream, river, or estuarine area as ORW prevents any new discharges from being added to the watershed and places strict limits on the amount of land that can be developed in the watershed. Because of its high levels of restrictions, designation of ORW's is used only sparingly. The less restrictive HQW designation, in contrast, only requires that wastewater plants meet modern standards of treatment and that a plan be implemented for the control of non-point sources of pollution. New discharges are permitted for HQW's and there are no limits on the amount of development that can take place in the watershed.

Although ORW and HQW designations are based primarily on water quality considerations for human consumption, there is also a provision that allows protection of habitats that are critical for the survival of rare aquatic organisms. Candidates for such protection are streams identified as Critical Habitats for species on the state list of threatened and endangered species. Streams designated as Critical Habitats by the Wildlife Resources Commission are eligible for consideration for HQW status by the Division of Environmental Management (not for ORW status, as has

often been mistaken in debates about this procedure). This form of protection is still only theoretical, however, and the exact procedures leading to protection are currently under debate.

2) Protection of Free-flowing Rivers and Streams. Many of the aquatic habitats identified in this report are endangered not so much by the degradation of water quality, but more by habitat loss and fragmentation. Major contributors to this habitat loss are reservoirs, inter-basin transfers of water, flood-control projects, clearing-and-snagging operations, and other human activities that alter the natural stream flow to which lotic organisms are highly attuned.

Drowning of rivers and streams through construction of impoundments has several significant impacts. Mussels, fish, and other organisms adapted to the warm and highly oxygenated water of fast-moving streams typically cannot survive or reproduce in the cold, still, dark, and anoxic conditions found in the bottoms of impoundments. Dams also act virtually as complete barriers to movements of aquatic species. Even if an aquatic habitat can be restored in a given reach, recolonization by native species may be impeded by dams.

Habitat fragmentation is further increased where releases from an impoundment create environmental conditions that are unfavorable for the natural fauna. River reaches below dams are drastically altered when water is released from the cold, anoxic bottom layer of the reservoir. Waters drawn from the bottom of a reservoir also often contain high amounts of heavy metals and other pollutants. These adverse effects are further enhanced in the free-flowing reaches below the reservoirs during times of low-flow levels. During such periods, many aquatic organisms may become confined to stream pools, where problems of anoxia and high levels of pollutants add significantly to the overall stresses that occur during periods of low-flow levels.

Further problems are created by the artificial cycle of high and low flows used to control lake levels and floods. Obvious problems exist with decreased release levels occurring during times of drought. Low flows lead to dewatering of the reaches below the dams, causing heat and anoxia related mortality in many benthic organisms, particularly mussels. The scouring floods that result from releases made under high water conditions are equally detrimental, washing away entire mussel beds and riparian communities. More subtle effects include disruption of spawning cycles that are often timed by the natural seasonal rise and fall of water levels. The constant re-working of bottom sediments caused by artificial release cycles also has adverse impacts on native fauna which require more stable conditions. Conversely, such artificial releases favor invasion by such "weedy" species as the Asiatic clam (*Corbicula*).

As is true for the water quality problems discussed previously, there are several ways in which reservoir impacts can also be reduced. The first, of course, is the careful selection of new reservoir sites to avoid our best remaining natural

aquatic communities. Water conservation measures should also be put into routine practice by individuals, businesses, and communities before pressures on limited supplies of freshwater become too great.

There are also a number of means of reducing the adverse effects of reservoirs. Fish ladders can be used to reduce the barrier effect. Withdrawal of water from the upper layers of a reservoir, either through use of spillways or multi-level withdrawal structures, can solve many of the problems associated with the poor water quality of bottom releases. Wherever possible, releases should be made in run-of-the-river mode to maintain the natural flow cycle of rivers. At low flow conditions, however, minimum flow levels should be guaranteed.

f. Concluding Comments. The authors hope that agencies and organizations involved in the protection of natural resources take an active role in the protection of significant natural areas in the A/P III study area. Such protection efforts are not only beneficial to the natural resources in the A/P III study area, but also to the Albemarle and Pamlico sounds as well. Obviously, the protection of these sounds must first focus on the wetlands immediately adjacent to the sounds, however, the wetland, upland, and nonriverine sites farther up the rivers that feed these sounds must also be protected.

The most pressing protection need in the A/P III study area is the preservation of upland forests and aquatic habitats. Upland habitats such as longleaf pine forests and hardwood forests over mafic rocks are in special need of protection. Also important is the protection of upland areas over diabase which often contain dozens of rare plant species and unusual natural communities. The protection of upland forests, particularly along streams and rivers, is important to the health of the Albemarle and Pamlico sounds, as these forests help prevent soil erosion which can lead to sedimentation problems.

Stronger protection of aquatic habitats is needed not only to improve water quality, but also to protect declining populations of rare aquatic animals such as freshwater mussels. Strict enforcement of regulations regarding water quality of rivers and streams is important in this regard. Important to the health of the Albemarle and Pamlico sounds is the prevention or reduction of runoff and siltation from agricultural fields, timber harvest sites, and construction areas into streams and rivers that feed these sounds.

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INVENTORY OF SITES

This Inventory of Sites section is the primary component of this report. It is divided into two subsections: Aquatic Habitats and Terrestrial and Palustrine Natural Areas. It includes site descriptions and maps for each of the 130 significant natural areas in the A/P III study area. Table 6 summarizes the sites and briefly gives the significance and protection status of each. The sites are listed in alphabetical order by county rather than in order of significance.

In the site descriptions, each natural area is given a site name and site code. For all 18 aquatic habitats, the site code starts with "AH". For terrestrial sites, the letters in the site codes are the first two letters of the county name, except for the following counties: Granville (GA), Wake (WK), Warren (WR), and Wayne (WY). Two of the 130 natural areas are located in more than one county and have received the following codes: Eno River State Park, located in Durham and Person counties, is Site DU6, and Dennys Store Gabbro Forest, located in Granville and Person counties, is Site GA3.

The geographical size of each natural area is given in acres. For many of the sites, the size is poorly known, as it is very difficult to survey the boundaries of some areas, for example swamps. The acreages given do not include buffer land often needed for additional protection around each site. The site significance is given both a letter code (A, B, or C) and a descriptive term (National, State, or Regional, respectively). The county (or counties) in which each site is located is given. The 7.5 minute U.S. Geological Survey topographic quadrangle maps for each site are listed. The location of each site is also included.

Significant features of each natural area are presented in each site description. These features usually include the significant natural communities and state and federally listed rare plants and animals present at the site. For definitions of the ranks and statuses of the state and federally listed rare plants and animals see Tables 4 and 5.

The majority of the information known about the site is given in the general description. This information includes the biology and geomorphology of the site, the type and quality of the vegetation or natural communities found there, and the noteworthy plants and animals present at the site. In some of the general descriptions dbh (diameter at breast height) values (in inches or feet) are given for some of the larger trees at these sites.

Ownership information is given for each site when possible. Names of private owners are not listed, however names of owners of public lands are given. The protection status of each natural area, such as whether each site is a State Park or a Dedicated State Nature Preserve, is presented. Management and protection information about how the site should or could be managed to

promote or perpetuate the significant features and comments on what means of protection appear to be available are mentioned.

Additional comments about each site are also given, such as degree of threat (if known) or completeness of the site inventory. References are also given for each site, though many such references are simply the Site Survey Reports completed by researchers for the N.C. Natural Heritage Program. Copies of all Site Survey Reports are kept at the Natural Heritage Program office in Raleigh, N.C.

Each site description also provides a map of the natural area showing its approximate boundaries. (This is not done for the aquatic habitats which instead are all shown in Figure 6.) The natural area maps are to the 1:24,000 scale (7.5 minute U.S. Geological Survey quadrangle maps) unless otherwise indicated; on these 7.5 minute maps, 1 inch equals 2000 feet. A number of the large sites required maps at the 1:100,000 scale; on these maps, 1 inch equals 1.6 miles (or 1 centimeter equals 1 kilometer).

Table 6. List of the natural areas and their significance and protection status in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

Natural areas are listed in alphabetical order by county. Significance levels: A = National; B = State; C = Regional (western portion of the Coastal Plain and eastern portion of the Piedmont). Protection status: DSNP = Dedicated State Nature Preserve; NNL = National Natural Landmark; RNHA = Registered Natural Heritage Area; SNA = State Natural Area; SP = State Park; TLCP = Triangle Land Conservancy Preserve; TNCP = The Nature Conservancy Preserve.

Site Name	Site Code	Sign. Level	Significant Features and Protection Status
AQUATIC HABITATS			
Cedar Creek Aquatic Habitat	AH1	B	A rare mussel species and a rare salamander species
Contentnea Creek Aquatic Habitat	AH2	C	Five rare mussel species, a rare amphibian species, and a rare fish species
Crooked Creek Aquatic Habitat	AH3	A	Two rare mussel species and a rare salamander species
Eno River Aquatic Habitat	AH4	A	Six rare mussel species and many other rare animal species
Fishing Creek Aquatic Habitat	AH5	C	Six rare mussel species, two rare fish species, and a rare amphibian species
Flat River Aquatic Habitat	AH6	B	Eight rare mussel species, a rare salamander species, and a rare fish species
Little River (Franklin/Wake/Johnston/Wayne) Aquatic Habitat	AH7	A	Eight rare mussel species, one rare salamander species, and three rare fish species
Little River (Orange/Durham) Aquatic Habitat	AH8	B	Four rare mussel species, a rare salamander species, and a rare fish species
Meherrin River Aquatic Habitat	AH9	C	Three rare mussel species
Middle Creek (Wake/Johnston) Aquatic Habitat	AH10	B	Six rare mussel species, two rare fish species, and a rare salamander species
Mill Creek Aquatic Habitat	AH11	C	One rare fish species, a rare amphibian species, and several populations of mussels
Moccasin Creek Aquatic Habitat	AH12	B	Four rare mussel species and a rare amphibian species

Stony Creek Aquatic Habitat	AH13	B	Five rare mussel species and a rare amphibian species
Swift Creek (Wake/Johnston) Aquatic Habitat	AH14	A	Nine rare mussel species, one rare fish species, and a rare amphibian species
Swift Creek (Vance/Warren/Franklin/Nash/Edgecombe) Aquatic Habitat	AH15	A	Nine rare mussel species, one rare salamander species, and one rare fish species
Tar River--Middle and Lower Aquatic Habitats	AH16	B	Eight rare mussel species, one rare salamander species, and two rare species of fish
Tar River--Upper Aquatic Habitat	AH17	A	Nine rare mussel species, several other rare animal species, and a rare plant species
Turkey Creek Aquatic Habitat	AH18	A	Six rare mussel species and one rare salamander species

TERRESTRIAL AND PALUSTRINE NATURAL AREAS

DURHAM COUNTY

Bennett Place	DU1	C	Good quality Upland Depression Swamp and Xeric Hardpan Forest with a rare plant species; RNHA
Cabin Branch Creek Bottomland -Swamp	DU2	C	A few rare plant species; RNHA
Catsburg Natural Area	DU3	B	Good quality Basic Mesic Forest (Piedmont Subtype) with a few rare plant species; RNHA
Eno River Blue Wild Indigo Slope	DU4	B	Many rare plant species; RNHA
Eno River Diabase Sill	DU5	A	Diabase Sill with many rare plant species; part RNHA
Eno River State Park and Vicinity	DU6	C	Eight good quality natural communities and many rare animal species; SP and part RNHA
Flat River Bend Forest	DU7	B	Outstanding example of Piedmont/Mountain Levee Forest with a rare plant species; RNHA
Flat River Slopes above Lake Michie	DU8	B	Mature hardwood forest with a few rare plant species; part DSNP
Hill Forest Chestnut Oak -Shortleaf Pine Forest	DU9	C	Good quality Piedmont Monadnock Forest; RNHA
Hill Forest Dial Creek Hardwood Forest	DU10	C	Several good quality natural communities; RNHA
Hill Forest Slocum Camp Hardwood Forest	DU11	C	Good quality Mesic Mixed Hardwood Forest; RNHA

Lick Creek Bottomland Forest	DU12	C	Good quality Piedmont/Low Mountain Alluvial Forest with a rare plant species; RNHA
Penny's Bend--Eno River Bluffs	DU13	B	Good quality Basic Mesic Forest (Piedmont Subtype) with several rare plant species; RNHA
EDGECOMBE COUNTY			
Beech Branch--Tar River Meander Loop	ED1	C	Well-developed meander loop with several natural communities
Cokey Swamp	ED2	C	Coastal Plain Small Stream Swamp (Blackwater Subtype)
Conetoe Creek Bottomland Forest	ED3	C	Extensive Coastal Plain Small Stream Swamp (Blackwater Subtype)
Fishing Creek Floodplain Forest	ED4	C	Large complex of various floodplain, terrace, and slope habitats
Hartsboro Flatwoods	ED5	C	Good quality Wet Pine Flatwoods (the only one in the A/P III study area)
Mildred Wet Hardwood Forest	ED6	C	Good quality Nonriverine Wet Hardwood Forest
Swift Creek Swamp Forest	ED7	B	Extensive floodplain with good quality natural communities, a few rare plant species, and a rare animal species
Tar River Floodplain	ED8	C	Extensive forested area with numerous terrace and bottomland habitats with a rare animal species
FRANKLIN COUNTY			
Big Peachtree Creek Flatrock	FR1	B	Granitic Flatrock with a large population of Small's portulaca
Bog Flatrock	FR2	B	Granitic Flatrock with a seepage area and a few rare plant species
Bunn Flatrock	FR3	C	Granitic Flatrock with a rare plant species
Cedar Rock Church Flatrock	FR4	C	Granitic Flatrock with several rare plant species
County Line Flatrocks	FR5	B	A series of Granitic Flatrocks with a rare plant species
Lower Shocco Creek Bluffs	FR6	C	High quality Mesic Mixed Hardwood Forest (Piedmont Subtype)
Norris Creek Plant Site	FR7	A	One of the largest known populations of Michaux's sumac in the state's Piedmont region

North Big Peachtree Creek Flatrock	FR8	C	Small Granitic Flatrocks with a large population of Small's portulaca
Overton Rock	FR9	B	Good quality Granitic Flatrock with several rare plant species; RNHA
Red Bud Creek Slopes	FR10	C	Good quality Mesic Mixed Hardwood Forest (Piedmont Subtype) and Piedmont/Low Mountain Alluvial Forest
Shocco Creek--Centerville Bluffs	FR11	C	Good quality Mesic Mixed Hardwood Forest (Piedmont Subtype) and Piedmont/Low Mountain Bottomland Forest
Tar River Levee	FR12	C	Good quality Piedmont/Mountain Levee Forest and Floodplain Pool with a rare plant species and several rare aquatic species
West Big Peachtree Creek Flatrock	FR13	C	Very high quality Granitic Flatrock with a very large population of Small's portulaca

GRANVILLE COUNTY

Beaverdam Lake Swamps and Arkose Outcrops	GA1	B	Rare example of arkose outcrop (Granitic Flatrock community) and swamp forests and beaver ponds; RNHA
Creedmoor Lake Diabase Area	GA2	C	Diabase area with many rare plant species
Dennys Store Gabbro Forest	GA3	C	One of the more extensive areas of gabbro in the state with a rare plant species
Diabase Sill near Clay	GA4	B	Diabase Sill with many rare plant species, several of which are large populations
Goshen Gabbro Forest	GA5	A	Extensive and high quality Basic Mesic Forest, Upland Depression Swamp Forests, Xeric Hardpan Forest with many rare plant species
Knap of Reeds Creek Diabase --Clearings and Levee	GA6	A	Diabase area with good quality natural levee and beaver ponds with many rare plant species; RNHA
Knap of Reeds Creek Diabase --Forest and Glades	GA7	A	One of only two known Diabase Glades in the state; with a few rare plant species
Knap of Reeds Creek Ravine	GA8	C	Scenic steep and rocky slopes with acidic cliff natural communities
Murdoch Center Diabase Sill	GA9	C	Diabase area with many rare plant species

Northside Diabase Area	GA10	B	Diabase area with a mixed scrub community and a rare plant species; RNHA
Picture Creek Diabase Barrens	GA11	A	Diabase area with an outstanding cluster of many plant species
Pyrophyllite Ridge Monadnocks	GA12	C	Cluster of several monadnocks with a Piedmont Monadnock Forest
South Butner Cedar Glades	GA13	A	Best quality Diabase Glade in the state and one of two best Diabase Glades known globally with many rare plant species; RNHA
South Butner Diabase--Pine Forest	GA14	B	Diabase area with several rare plant species
South Butner Diabase Swamp	GA15	B	High quality Upland Depression Swamp Forest and good quality Basic Oak-Hickory Forest with a rare plant species
South Butner Hardwood Forest	GA16	B	Good quality Basic Oak-Hickory Forest over diabase
Tallyho Monadnock	GA17	C	Good quality Piedmont Monadnock Forest
Tar River--Wilton Slopes	GA18	B	Good quality slopes and bottomlands with a few rare plant species
Umstead Hospital Pine-Oak Forest	GA19	B	Xeric Hardpan Forest and Basic Oak-Hickory Forest with a few rare plant species

GREENE COUNTY

No known sites of National, State, or Regional significance.

HALIFAX COUNTY

Buzzard Point/Ventosa Plantation	HA1	B	Many good quality floodplain communities, a wading bird rookery, and a few rare plant and animal species; part RNHA and part State Game Land
Conoconnara Swamp Forest	HA2	B	Semipermanent Impoundment with large populations of Virginia least trillium and southern twayblade
Hills Ferry Bluffs	HA3	B	Several exemplary and diverse natural communities on slopes, bluffs, and in floodplains
Kehukee Swamp Uplands	HA4	B	High quality Dry-Mesic Oak-Hickory Forest
Larkspur Ridge	HA5	B	Good quality Coastal Plain Levee Forest and Basic Mesic Forest with a few rare plant species and one rare animal species; TNCP

Looking Glass Run Swamp and Bluffs	HA6	C	High quality Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) and Cypress-Gum Swamp (Brownwater Subtype)
Medoc Mountain State Park	HA7	C	Several good quality upland and bottomland communities with a rare animal species; SP and RNHA
Norfleet Cottonwood Forest	HA8	B	Exemplary floodplain communities, special wildlife habitat, a rare plant species and a rare animal species
North Looking Glass Run Bluffs	HA9	C	Good quality Basic Mesic Forest (Coastal Plain Subtype)
Phlox Woods	HA10	C	Good quality Basic Mesic Forest (Coastal Plain Subtype) and a few rare plant species; RNHA
Pierce's Farm Heronry	HA11	C	Wading bird rookery with two rare animal species
Roanoke Big Oak Woods	HA12	B	Exemplary Coastal Plain Levee Forest, Coastal Plain Small Stream, and Basic Mesic Forest with a rare plant and a rare animal species; RNHA
JOHNSTON COUNTY			
Black Creek Bluff and Sandhill	JO1	C	Good quality Piedmont/Coastal Plain Heath Bluff and Pine/Scrub Oak Sandhill
Cowbone Oxbows	JO2	C	Outstanding example of a Coastal Plain Levee Forest (Brownwater Subtype) and Oxbow Lakes
Flower Hill--Moccasin Creek Bluffs	JO3	C	Good quality Piedmont/Coastal Plain Heath Bluff; part RNHA and part TLCP
Sage Pond--Neuse River Floodplain	JO4	C	Good quality Coastal Plain Semipermanent Impoundment, Coastal Plain Levee Forest, and Coastal Plain Bottomland Hardwoods
LENOIR COUNTY			
Noble's Millpond	LE1	C	High quality Coastal Plain Semipermanent Impoundment
NASH COUNTY			
Tar River--Spring Hope Slopes	NA1	C	Good quality Piedmont/Mountain Levee Forest, Piedmont/Mountain Bottomland Forest, and Mesic Mixed Hardwood Forest
Turkey Creek Preserve	NA2	A	Good quality Coastal Plain Small Stream Swamp and largest known population of least trillium in North Carolina; RNHA and TNCP

NORTHAMPTON COUNTY

Bull Neck Swamp and Bluffs	NO1	B	Excellent quality Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) and good quality Cypress-Gum Swamp
Camassia Slopes	NO2	A	Four good quality natural communities, several rare plant species, and a rare animal species; RNHA, DSNP, and TNCP
Meherrin River Bluffs north of Kirby	NO3	C	High quality Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant)
Meherrin River Bottomland Forest	NO4	C	Mature bottomland hardwood forest with a rare plant species
Meherrin River Oxbow Bluffs	NO5	C	Oxbow area with a high quality bluff and good quality Mesic Mixed Hardwood Forest and Cypress-Gum Swamp
Meherrin River Slopes and Swamp	NO6	B	High quality oxbow and several high quality natural communities
Occoneechee Neck Floodplain Forest	NO7	B	Best mature floodplain forest along the upper Roanoke River with a wading bird rookery and several rare animal species
Urahaw Swamp	NO8	C	Very high quality Cypress-Gum Swamp (Brownwater Subtype)

ORANGE COUNTY

Eno River State Park and Vicinity	DU6	C	Eight good quality natural communities and many rare animal species; SP and part RNHA
Occoneechee Mountain	OR2	B	Several good quality natural communities including Piedmont Monadnock Forest and Piedmont Coastal Plain Acidic Cliff with several rare plant species and a rare animal species
Sevenmile Creek Sugar Maple Bottom	OR3	C	High quality Piedmont/Low Mountain Alluvial Forest and Basic Mesic Forest (Piedmont Subtype) with a rare plant species and a rare animal species
Stony Creek Spring	OR4	C	Good quality Low Elevation Seep and a few rare animal species

PERSON COUNTY

Dennys Store Gabbro Forest	GA3	C	One of the more extensive areas of gabbro in the state with a rare plant species
Mount Tirzah Oak-Hickory Forest	PE2	C	Good quality Dry Oak-Hickory Forest and a rare plant species

Vernon Hill Church Road Dry Forest PE3 C Good quality Dry Oak-Hickory Forest with a very large population of Lewis's heartleaf

VANCE COUNTY

Cattail Creek Woods VA1 C Good quality Dry Oak-Hickory Forest with a large population of Lewis's heartleaf

Ruin Creek Slopes VA2 B Several natural communities including Basic Mesic Forest (Piedmont Subtype) with a rare plant species

Tabbs Creek Rich Slopes VA3 C High quality Basic Mesic Forest and Piedmont Mountain Bottomland Forest with a rare plant species

Tar River Camassia Slopes VA4 C Good quality Basic Mesic Forest (Piedmont Subtype) with a few rare plant species

WAKE COUNTY

Adam Mountain WK1 B Good quality Ultramafic Outcrop Barren (only known example in the state's Piedmont) with a rare plant species; RNHA

Camp Branch Plant Site WK2 C Dense colony of Lewis's heartleaf

Crabtree Creek--Ebenezer Church Road Slopes WK3 C Area of ridges and ravines over mafic rock with a rare plant species

Hemlock Bluffs State Natural Area WK4 B Good quality Piedmont/Coastal Plain Heath Bluff with a disjunct population of Canada hemlock, and a rare animal species; SP and RNHA

Horseshoe Farm Bottomland Forest WK5 C Good quality Piedmont/Mountain Levee Forest

Lake Raleigh Hardwood Forest WK6 C Mesic Mixed Hardwood Forest with a rich herbaceous layer

Middle Creek Bluffs and Slopes WK7 C Floodplain with slopes, bluffs, a rare animal species, and a rare plant species

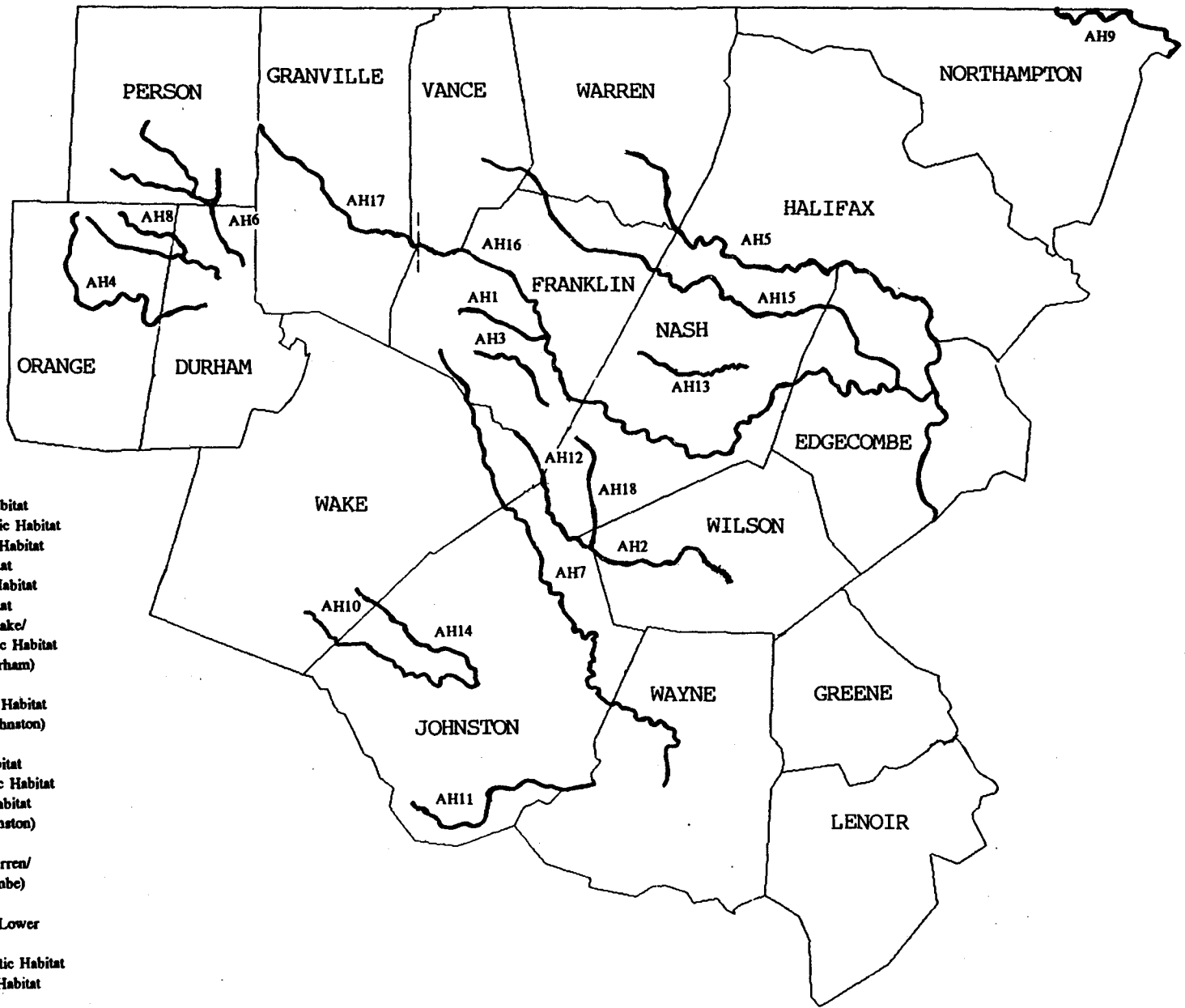
Mitchell's Millpond State Natural Area WK8 A Extensive Granitic Flatrock communities with several rare plant species, and a rare animal species; SNA, SP, and RNHA

Old Still Creek Forest WK9 C Good quality Mesic Mixed Hardwood Forest; RNHA

Robertson's Millpond and Buffalo Creek WK10 C Good quality Coastal Plain Semipermanent Impoundment with a rare animal species; part RNHA

Southwest Rolesville Granitic Flatrocks	WK11	B	A series of small to medium Granitic Flatrocks with a rare plant species
Sunset Lake Salamander Ponds	WK12	C	Two ponds with populations of tiger salamander
Swift Creek Bluffs	WK13	B	High quality Piedmont/Low Mountain, Alluvial Forest, Mesic Mixed Hardwood Forest, and Floodplain Pools; TLCP
Temple Rock	WK14	C	Good quality Granitic Flatrock; RNHA and conservation easement
The Rocks	WK15	B	Good quality Granitic Flatrocks with a few rare plant species; RNHA and TLCP
Upper Barton Creek Bluffs and Ravine	WK16	C	Good quality Basic Mesic Forest (Piedmont Subtype); RNHA
Walnut Creek Sumac Site	WK17	A	One of the largest populations of Michaux's sumac in the state
Wild Cat Hollow	WK18	C	Small caves in weathered granite boulders, extremely rare in the eastern part of the state; RNHA
William B. Umstead State Park	WK19	B	Extensive forest representing many upland natural communities with many rare plant and animal species; NNL, SP, and RNHA
WARREN COUNTY			
Reedy Creek Hardwood Forests	WR1	C	Very extensive Piedmont/Mountain Bottomland Forest
WAYNE COUNTY			
Cliffs of the Neuse State Park	WY1	C	Seven natural community types present highlighted by excellent example of Piedmont/Coastal Plain Acidic Cliff; SP and RNHA
Walnut Creek Sandhills	WY2	C	Extensive Pine/Scrub Oak Sandhill, rare in the A/P III study area, and a rare animal species
WILSON			
Stantonsburg Oxbow Lake	WI1	C	Good quality Oxbow Lake

AQUATIC HABITATS



MAP KEY

- AH1. Cedar Creek Aquatic Habitat
- AH2. Contentnea Creek Aquatic Habitat
- AH3. Crooked Creek Aquatic Habitat
- AH4. Eno River Aquatic Habitat
- AH5. Fishing Creek Aquatic Habitat
- AH6. Flat River Aquatic Habitat
- AH7. Little River (Franklin/Wake/
Johnston/Wayne) Aquatic Habitat
- AH8. Little River (Orange/Durham)
Aquatic Habitat
- AH9. Meherrin River Aquatic Habitat
- AH10. Middle Creek (Wake/Johnston)
Aquatic Habitat
- AH11. Mill Creek Aquatic Habitat
- AH12. Moccasin Creek Aquatic Habitat
- AH13. Stony Creek Aquatic Habitat
- AH14. Swift Creek (Wake/Johnston)
Aquatic Habitat
- AH15. Swift Creek (Vance/Warren/
Franklin/Nash/Edgecombe)
Aquatic Habitat
- AH16. Tar River—Middle and Lower
Aquatic Habitats
- AH17. Tar River—Upper Aquatic Habitat
- AH18. Turkey Creek Aquatic Habitat

Figure 6. Significant aquatic habitats in the 17-county Albemarle-Pamlico Estuarine Phase 3 study area.

SITE NAME: Cedar Creek Aquatic Habitat

SITE CODE: AH1

SIZE: about 6 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Franklin

QUADRANGLE: Louisburg

LOCATION: Cedar Creek lies in the Tar River Basin and flows through Franklin County in the Piedmont Province of North Carolina. The significant part of the aquatic habitat includes only the lower reach, extending from its confluence with Camping Creek downstream to its mouth on the Tar River.

SIGNIFICANT FEATURES:

1. This aquatic habitat supports the dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered.
2. Also present is the Neuse River waterdog (Necturus lewisi), an amphibian that is state listed as Special Concern.

GENERAL DESCRIPTION:

Cedar Creek is a relatively short stream emptying directly into the Tar River. The upper reach runs through the typical rolling terrain of the Piedmont and is fairly narrow throughout its course. Once it passes the confluence with Camping Creek, however, it broadens significantly, becoming roughly 20-30 feet wide as it flows through a wide tract of bottomlands. At one point, located about two miles from the mouth, the channel becomes extensively braided. This reach is underlain by the Rolesville Pluton, a massive intrusion of granite, which may account for the relatively flat nature of lower Cedar Creek. The granitic bedrock also contributes the coarse sand and gravel preferred by several species of mollusks, including the dwarf wedgemussel (Alasmidonta heterodon).

Although Cedar Creek has not received a comprehensive biological survey, the most significant reach appears to occur below its confluence with Camping Creek, since the dwarf wedge mussel has only been recorded in this section (Alderman 1991). The Neuse River waterdog (Necturus lewisi) is also found there, as are one or more non-listed species of mussels (Elliptio spp.).

The concentration of these species in the lower reach is probably the result of a combination of factors. Both the waterdog and the dwarf wedgemussel generally prefer wider streams and slower currents. As mentioned above, the dwarf wedgemussel also prefers gravelly or sandy substrates; a specimen of this species was found in a sand-bottomed reach located just below an area of bedrock. This reach may also be far enough downstream from the Franklinton Wastewater Plant to have recovered some of its water quality.

The entire course of Cedar Creek, however, has been given a biological rating of only Fair to Good-Fair by the Division of Environmental Management (Water Quality Section 1985; Water

Quality Section 1991). Point-sources of pollution, such as the discharge from the Franklinton facility, as well as non-point sources have been identified as major threats to the aquatic species in Cedar Creek (Alderman 1992). Currently, the population of the dwarf wedgemussel is considered to be quite precarious, with only a 10% probability of surviving over the next 30 years (Alderman 1992).

OWNERSHIP: Waters of the State.

PROTECTION STATUS: Proposed for Critical Habitat status but not yet adopted.

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The Franklinton Wastewater Plant appears to be the major cause of water quality degradation in this basin and should be upgraded in order to allow recovery of the aquatic species found in the Cedar Creek Aquatic Habitat. Any plan for reservoir construction or increased withdrawals from Cedar Creek that would lead to dewatering could also pose a significant threat to the ecosystem and should be carefully evaluated to determine if less damaging alternatives can be selected. Sedimentation and runoff should also be controlled. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the habitat protection under state regulations.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: The Cedar Creek Aquatic Habitat has been proposed by the Nongame and Endangered Wildlife Program of the N.C. Wildlife Resources Commission as a Critical Habitat for the dwarf wedgemussel (Nongame and Endangered Wildlife Program 1992). Under this designation, Cedar Creek could be considered for High Quality Waters status, which would provide habitat protection under regulations of the Environmental Management Commission.

REFERENCES:

Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.

- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission; Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.
- _____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Contentnea Creek Aquatic Habitat

SITE CODE: AH2

SIZE: about 8 miles long

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wilson

QUADRANGLE: Lucama, Wilson

LOCATION: Contentnea Creek is located in the Neuse River Basin and flows through Wilson, Greene, Pitt and Lenoir Counties within the Piedmont and Coastal Plain Provinces of North Carolina. Only the upper reach of Contentnea Creek, from the Buckhorn Dam to Wiggin's Mill Reservoir in Wilson County, has been identified as a significant aquatic habitat.

SIGNIFICANT FEATURES:

1. Two federally listed species of mussels are present in this aquatic habitat: Atlantic pigtoe (Fusconaia masoni) and yellow lampmussel (Lampsilis cariosa), both Federal Candidate and State Threatened species.

2. Two species of mussels state-listed as Threatened are found in the upper reach of Contentnea Creek: the triangle floater (Alasmidonta undulata) and the squawfoot (Strophitus undulatus).

3. Another mussel found in this stream, the notched rainbow (Villosa constricta), is considered significantly rare in North Carolina.

4. Two rare aquatic vertebrates found in Contentnea Creek are the Neuse River waterdog (Necturus lewisi) and the Carolina madtom (Noturus furiosus, pop. 1), both state-listed as Special Concern.

GENERAL DESCRIPTION:

Contentnea Creek is formed in the lower Piedmont Province by the confluence of Moccasin and Turkey Creeks. The headwaters of this stream are impounded by the Buckhorn Reservoir, and the free-flowing reach does not begin until just west of NC 581. Only the small section of this stream located between Buckhorn Dam and Wiggin's Mill Reservoir is known to contain populations of the rare mussels and vertebrates that define the significant portion of the aquatic habitat.

This initial free-flowing reach is located within the lower Piedmont, where it crosses several bands of crystalline rock, including meta-argillites and metamudstones below Buckhorn Dam and a felsic volcanic area located just below NC 42. Throughout this reach, the stream possesses a fairly wide floodplain, although it broadens even more significantly once it reaches the Coastal Plain below Wilson. Substrates in this area range from cobble to sand, gravel, silt, and detritus.

Nine species of freshwater mussels occur in this aquatic habitat, probably as an isolated fragment of the rich molluscan fauna present upstream in Moccasin and Turkey Creeks. The rarest species are the Atlantic pigtoe (Fusconaia masoni) and yellow lampmussel (Lampsilis cariosa), both Federal Candidate and State Threatened species, the triangle floater (Alasmidonta undulata) and squawfoot (Strophitus undulatus), both state-listed as Threatened, and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina. The additional species are all fairly widespread in the state, including the eastern elliptio (Elliptio complanata), variable spike (E. ictarina), Atlantic spike (E. producta), and eastern floater (Anodonta cataracta) (Alderman 1991).

Two other rare species inhabiting Contentnea Creek are the Neuse River waterdog (Necturus lewisi) and Carolina madtom (Noturus furiosus). Both of these species extend much further downstream in Contentnea than the rare mussels.

Water quality within this aquatic habitat has been rated as Good-Fair in terms of its diversity of aquatic insects; a rating of Excellent was obtained in terms of chemical/physical parameters from just below Buckhorn Dam (Water Quality Section 1985). Below Wilson, where the stream receives effluents from the town's wastewater plant, water quality deteriorates to a biological rating of Fair, which probably sets some of the limits on the downstream occurrence of the mussels.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The most significant threat to this site, as well as to the Turkey and Moccasin Creek Aquatic Habitats, is the proposed expansion of the Buckhorn Reservoir. The city of Wilson should strongly consider other alternatives for increasing their municipal water supply.

Existing point sources also need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: Contentnea Creek was initially considered for designation as Critical Habitat, as part of the larger system including the more significant Turkey Creek and Moccasin Creek. However, this stream is not one of the streams under current consideration by the N.C. Wildlife Resources Commission for this designation.

REFERENCES:

- Alderman, J.M. 1991. Survey for the dwarf wedge mussel (Alasmidonta heterodon) in Contentnea Creek. Nongame Project Report. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Crooked Creek Aquatic Habitat

SITE CODE: AH3

SIZE: about 5 air miles long

SITE SIGNIFICANCE: A (National)

COUNTY: Franklin

QUADRANGLE: Louisburg, Bunn West

LOCATION: Crooked Creek lies in the Tar River Basin and flows through Franklin County in the Piedmont Province of North Carolina. The most significant portion of the aquatic habitat occurs in the vicinity of SR 1001, extending from Clifton's Pond downstream to NC 98.

SIGNIFICANT FEATURES:

1. Crooked Creek contains a population of the dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered.
2. Also present is the yellow lance (Elliptio lanceolata), a Federal Candidate and State Threatened species.
3. The Neuse River waterdog (Necturus lewisi), a state listed amphibian of Special Concern, is also found in this stream.

GENERAL DESCRIPTION:

Crooked Creek is a relatively short stream that empties directly into the Tar River. The upper reach runs through the typical rolling terrain of the Piedmont and is fairly narrow throughout its course; during low flow conditions it may be as only as wide as ten feet or less. As is true of the neighboring Cedar Creek drainage, the lower reach (below NC 98) flows through a wide tract of bottomlands, parts of which, at least formerly, supported sizable stands of swamp forest. The entire course of this stream is underlain by the Rolesville Pluton, a massive intrusion of granite which contributes the coarse sand and gravel preferred by several species of mollusks, including the dwarf wedgemussel (Alasmidonta heterodon).

Although Crooked Creek has not received a comprehensive biological survey, the most significant reach appears to extend downstream from Clifton's Pond at least as far as NC 98. The dwarf wedgemussel has only been recorded in this section, from the vicinity of the SR 1001 bridge crossing, and the yellow lance mussel (Elliptio lanceolata) has likewise been recorded only at the NC 98 crossing (Alderman 1991). Other non-listed species of mussels (Elliptio spp.), on the other hand, are common all the way up to Clifton's Pond, and the Neuse River waterdog (Necturus lewisi) probably occurs from the pond all the way downstream to the Tar River.

Although point-sources of pollution have not been identified as a major threat to this aquatic habitat (Alderman 1992) and the

stream has been given a biological rating of Good-Fair (Water Quality Section 1985), the populations of both the dwarf wedgemussel and the yellow lance mussel appear to be on the verge of extirpation; the dwarf wedgemussel is given only a 10% chance of surviving in this drainage over the next 30 years (Alderman 1992). Sedimentation resulting from clear-cutting and agriculture is probably the principle cause of their decline in this watershed.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (primarily package plants) should be maintained or modified to ensure the continued integrity of Crooked Creek Aquatic Habitat. Sedimentation and runoff should also be controlled. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the habitat protection under state regulations.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: Crooked Creek has been proposed by the Nongame and Endangered Wildlife Program of the N.C. Wildlife Resources Commission as a Critical Habitat for the dwarf wedgemussel (Nongame and Endangered Wildlife Program 1992). Under this designation, Crooked Creek could be considered for High Quality Waters status, which would provide habitat protection under regulations of the Environmental Management Commission.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.

Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.

Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

NAME: Eno River Aquatic Habitat

SITE CODE: AH4

SIZE: about 15 air miles long

SITE SIGNIFICANCE: A (National)

COUNTY: Orange, Durham

QUADRANGLE: Cedar Grove, Efland, Hillsborough, Northwest Durham

LOCATION: The Eno River Aquatic Habitat is located in the headwaters of the Neuse River Basin and is entirely contained within the Piedmont Province of North Carolina. The significant portion of the aquatic habitat extends from just above the confluence of the West and East Forks of the Eno in the northern portion of Orange County to its entry into the Durham Triassic Basin downstream from US 501 in Durham.

SIGNIFICANT FEATURES:

1. Three Federal Candidate mussel species are present in this aquatic habitat: the Atlantic pigtoe (Fusconaia masoni) and the yellow lampmussel (Lampsilis cariosa), also State Threatened species; and the green floater mussel (Lasmigona subviridis), also a State Endangered species.

2. Three additional rare species of mussels also occur in the Eno River: the squawfoot (Strophitus undulatus), state-listed as Threatened; the eastern lampmussel (Lampsilis radiata), state-listed as Special Concern; and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.

3. The Neuse River waterdog (Necturus lewisi), a salamander state-listed as Special Concern, occurs in the Eno.

4. Two species of fish of state-listed as Special Concern found in Eno are the Carolina darter (Etheostoma collis) and the Carolina madtom (Noturus furiosus, pop. 1). The Roanoke bass (Ambloplites cavifrons), considered significantly rare in North Carolina, is also native to the Eno River.

5. Septima's clubtail dragonfly (Gomphus septima), a globally rare species and a Federal Candidate species, has been reported from the Eno, as has the panhandle pebblesnail (Somatogyrus virginicus), a globally rare freshwater snail.

GENERAL DESCRIPTION:

The Eno River is one of the main headwater tributaries of the Neuse River. It is located entirely within the Piedmont Province and over most of its course flows through the Carolina Slate Belt. Within this section, which is the most biologically significant, it possesses extensive areas of riffles interspersed between long, deep pools. The riffle areas are particularly well-developed in the reach located just west of the river's entry into the lowlands of the Durham Triassic Basin. Due to the strong stream-cutting action created by a sharp drop in elevation, the Eno has carved out a series of steep scenic bluffs

within this reach, much of which has been protected within the Eno River State Park. The river is also broad enough along this reach to lack an over-arching canopy and the riffle areas consequently support rich growths of herbaceous water willow (Justicia americana).

Nearly all the rare species found in the Eno occur upstream from the Triassic Basin. This is due partly to the presence in this reach of the riffle and pool habitats preferred by several species of the rare mussels; the Carolina darter, Septima's clubtail, and panhandle pebblesnail also occur only in this type of habitat. The other reason is that the water quality is generally higher in this section, which has been rated as Good to Excellent according to both biological and chemical-physical parameters (Water Quality Planning Branch 1992). Even though the reach downstream from the city of Durham's Wastewater Plant has also been given a Good rating, fish kills have been noted in this reach (Water Quality Planning Branch 1992) and native mussels become very scarce from below the plant all the way to Falls Lake (S. Hall, pers. obs.).

At the upstream end, species of non-listed Elliptio mussels have been found as far as the bridge over the West Fork of the Eno located just west of Creedmoor (Howard and Hartley 1992); they probably occur as far up as the limits of the perennial flow. The rarer species occur further downstream, however. Notched rainbow mussels (Villosa constricta) and Carolina darters (Etheostoma collis), both of which are associated with small piedmont streams, have been recorded as far upstream as the vicinity of the confluence of the two forks of the Eno located southwest of Lake Orange. The squawfoot (Strophitus undulatus) has also been found upstream from Corporation Lake (Howard and Hartley 1992).

The remaining rare species are all found below Corporation Lake. Apart from the Neuse River waterdog, which prefers broader and slower reaches, most of the rare species are concentrated between US 70 east of Hillsborough and Guess Road, at the downstream boundary of the Eno River State Park (Alderman 1991; Howard and Hartley 1992). Septima's clubtail and the panhandle pebblesnail have only been recorded at Guess Road (Schweitzer 1989; Bill Adams, pers. comm.).

OWNERSHIP: Eno River State Park includes an approximately 18 river mile reach of the river. The Eno River Association, a private conservation organization, also owns land adjoining the park. West Point on the Eno is a county park located immediately downstream from the state park boundary at Guess Road. Duke Forest, owned by Duke University, occupies land on both sides of the river just west of Hillsborough. The river itself is considered to be Waters of the State while adjoining lands along the river are privately owned.

PROTECTION STATUS: Proposed for Critical Habitat Status but not yet adopted.

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The Eno River Wastewater Plant located east of US 15-501 is slated for closure within the next several years, which should greatly improve water quality within the Durham Basin reach of the Eno. The transfer of discharge to Ellerbe Creek may, however, create dewatering problems that may become significant during times of drought. The construction of new reservoirs to supply the rapidly growing population of this region may also have adverse effects on the level of stream flow.

Other point sources, including the Hillsborough wastewater plant and several package plants, should be maintained or modified to ensure the continued integrity of the Eno River Aquatic Habitat. The elimination of chlorine from the effluents discharged by these plants should be a major goal, since both chlorine and chloramines are well-known to be quite toxic to mollusks and other aquatic organisms.

Sedimentation and non-point runoff should also be controlled. This will be one of the major goals of the Basinwide Water Quality Management Plan, if it becomes adopted. Further acquisition of land by the Eno River State Park will also aid in controlling erosion and runoff from properties that might otherwise be developed, timbered, or plowed.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

Official designation of the Eno as Critical Habitat and as High Quality Waters would also afford important protection by requiring both modernization of all treatment plants discharging into the Eno and the control of erosion and runoff from adjoining uplands in the basin.

COMMENTS: The Eno River Aquatic Habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.

- Howard, J. and S. Hartley. 1992. Status survey of the mollusks of the Eno River. Nongame Small Grants Project Interim Report.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Schweitzer, D. 1989. A review of Category 2 Insects in USFWS Regions 3, 4, 5. Report to US Fish and Wildlife Service, 1 Gateway Center, Newton Corners, MA.
- Water Quality Planning Branch. 1992. Neuse River Basinwide Water Quality Management Plan. Draft Report to the North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Fishing Creek Aquatic Habitat

SITE CODE: AH5 **SIZE:** about 42 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Warren, Nash, Halifax, Edgecombe

QUADRANGLE: Inez, Centerville, Essex, Ringwood, Enfield, Whitakers, Draughn, Tarboro

LOCATION: Fishing Creek is located in the Tar River Basin of Warren, Nash, Halifax, and Edgecombe counties in the Coastal Plain and Piedmont Provinces of North Carolina. The significant portion of the aquatic habitat begins at NC 58 in Warren County and extends to the confluence with the Tar River at Tarboro.

SIGNIFICANT FEATURES:

1. Two species of freshwater mussels listed as Federal Candidates inhabit the Fishing Creek Aquatic Habitat: the Atlantic pigtoe (Fusconaia masoni) and the yellow lampmussel (Lampsilis cariosa), also listed as State Threatened.
2. Two species of mussel state-listed as Threatened occur in this aquatic habitat: the squawfoot (Strophitus undulatus) and the triangle floater (Alasmidonta undulata).
3. The eastern lampmussel (Lampsilis radiata), state-listed as Special Concern, also occurs in Fishing Creek, as does the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.
4. The Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, ranges throughout Fishing Creek.
5. Two rare species of fish found in this aquatic habitat are the Roanoke bass (Ambloplites cavifrons) and Carolina madtom (Noturus furiosus, pop. 2), both considered significantly rare in North Carolina.

GENERAL DESCRIPTION:

Fishing Creek is one of the larger tributaries of the Tar River. It originates in the Piedmont close to Middleburg in Vance County, with its headwaters located less than a mile from Anderson Creek in the Roanoke River Basin. From its source down to NC 58 in Warren County, the channel is fairly narrow and the floodplain constrained by fairly steep bluffs. Perhaps because of wastewater discharges from Warrenton and Norlina (via Owen's Creek), only the Neuse River waterdog of all the rare species found in Fishing Creek occurs as far upstream as US 401.

Below NC 58, which marks the beginning of the significant portion of the aquatic habitat, the floodplain widens and the stream becomes more meandering, though it remains fairly narrow until joining Shocco Creek near the Franklin/Nash county line. The landscape in this Piedmont reach is underlain by schists, gneisses, mudstones, and meta-argillites of the Eastern Slate

Belt, and the stream substrates consist mainly of gravel, sand, and clay. Similar substrates also exist in the coastal plain reach of Fishing Creek, which extends from the Nash/Edgecombe county line to its confluence with the Tar River at Tarboro.

Although not as well studied, Fishing Creek appears to be less diverse in aquatic species than its sister stream, Swift Creek. The Endangered Tar spiny mussel has not been recorded in either Fishing Creek or its main tributaries, Shocco and Little Fishing Creek, and its mussel beds are generally far less extensive and more widely spaced.

On the other hand, several of the rare mussels found in Swift Creek occur at least sparingly within Fishing Creek. These include the Atlantic pigtoe (Fusconaia masoni), squawfoot (Strophitus undulatus), triangle floater (Alasmidonta undulata), and yellow lampmussel (Lampsilis cariosa), all of which are state-listed as Threatened, the eastern lampmussel (Lampsilis radiata), state-listed as Special Concern, and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina (Alderman 1991). Additionally, the Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, occurs throughout Fishing Creek, and the significantly rare Roanoke bass (Ambloplites cavifrons) and Carolina madtom (Noturus furiosus) inhabit at least the wider portion of the stream below its confluence with Shocco Creek.

Water quality has been rated as Good-Fair to Good in terms of insect diversity over nearly the entire course of Fishing Creek; below the confluence with Beech Swamp in Edgecombe County it is rated as only Fair (Water Quality Section 1985, Water Quality Section 1991). Only the two municipal wastewater plants previously mentioned discharge into Fishing Creek. Most adverse impacts on water quality within this drainage are due to non-point runoff from clearcuts and agricultural fields.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (particularly the wastewater plants at Warrenton and Norlina) need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring

in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: Fishing Creek has not been proposed as Critical Habitat.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.
- _____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Flat River Aquatic Habitat

SITE CODE: AH6

SIZE: about 12 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Person, Durham

QUADRANGLE: Hurdle Mills, Timberlake, Rougemont, Lake Michie

LOCATION: The Flat River is located in the Neuse River Basin of Person and Durham counties in the Piedmont Province of North Carolina. The significant portion of the aquatic habitat extends upstream from the head of Lake Michie in northern Durham County to US 501 on the North Fork of the Flat, to Hurdle Mills on the South Fork, and to SR 1734 on Deep Creek.

SIGNIFICANT FEATURES:

1. Three species of mussels listed as Federal Candidates inhabit the Flat River Aquatic Habitat: the Atlantic pigtoe (Fusconaia masoni) and yellow lampmussel (Lampsilis cariosa), also listed as State Threatened; and the green floater (Lasmigona subviridus), also listed as State Endangered. The green floater population located in this aquatic habitat is the best population of this species in the state.

2. Other rare mussels inhabiting the Flat River include the triangle floater (Alasmidonta undulata) and squawfoot (Strophitus undulatus), state-listed as Threatened; the eastern lampmussel (Lampsilis radiata), state-listed as Special Concern; the eastern creekshell (Villosa delumbis) and notched rainbow (Villosa constricta), both considered significantly rare in North Carolina.

3. The Neuse River waterdog (Necturus lewisi), a salamander state-listed as Special Concern, also occurs in this habitat, as does the Roanoke bass (Ambloplites cavifrons), considered significantly rare in North Carolina.

GENERAL DESCRIPTION:

The Flat River, along with the Eno and Little Rivers, is one of the main headwater tributaries of the Neuse. It originates in Person County, where it has two main forks, both of which contain significant aquatic habitats. Deep Creek, which also extends across the Durham/Person County line constitutes a third major branch and is also included within this aquatic habitat. The Flat, along with its tributaries, is entirely contained within the Piedmont Province and over most of its length flows over rolling terrain underlain by metamorphic rocks of the Carolina Slate Belt.

From southern Person County into Durham County, the main stem of the Flat drops down into the Durham Triassic Basin. This sharp change in elevation has caused the Flat to carve out a highly scenic gorge, part of which has been impounded by Lake

Michie. Riffles alternate with deep pools over most of the upper reaches and within the gorge upstream from Lake Michie, the river becomes choked with boulders and extensive growths of water willow (Justicia americana). Below the lake there is another steep-walled section just above the point where the river enters the broad lowlands of the Durham Basin. Below that point, the river becomes deep, slow-flowing, and meandering just before it flows into Falls of the Neuse Reservoir.

Virtually all the rare mussels recorded from the Flat occur above Lake Michie and as far upstream as the separate North and South Forks, as well as the lower portion of Deep Creek; particularly significant mussel beds occur within the main gorge and in the South Fork upstream from US 501.

A total of twelve species of mussels have been identified within this watershed, including the following rare species: green floater (Lasmigona subviridus), triangle floater (Alasmidonta undulata), yellow lampmussel (Lampsilis cariosa), Atlantic pigtoe (Fusconaia masoni), and squawfoot (Strophitus undulatus), eastern lampmussel (Lampsilis radiata), eastern creekshell (Villosa delumbis) and notched rainbow (Villosa constricta) (Alderman 1991). The green floater population located in this aquatic habitat is the best population of this species in the state (Alderman 1992). Two rare aquatic vertebrates, the Neuse River waterdog (Necturus lewisi) and the Roanoke bass (Ambloplites cavifrons), have also been recorded in the Flat River near the Person/Durham county line.

Water quality has been rated as Good to Excellent in terms of insect diversity within the entire reach upstream from Lake Michie; a rating of Excellent in terms of chemical/physical parameters was also obtained at the lake (Water Quality Section 1985, Water Quality Section 1991). No major point-sources of pollution exist along the Flat River, although several small package plants discharge into it. The major threats to water quality within the Flat come from non-point runoff from agricultural fields, clearcuts, and increasingly from construction sites and impervious surfaces within new residential areas.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (primarily package plants) need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, construction sites, and impervious surfaces. Official designation of the

aquatic habitat as Critical Habitat and as High Quality Waters would afford the necessary level of protection.

Another major threat to this aquatic community is the possible expansion of Lake Michie to meet the water supply needs of the city of Durham. Given the great importance of the upper Flat River, along with its magnificent scenic beauty, the city should strongly consider other alternatives.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: The Flat River is extremely important as a water supply resource and as a refuge for aquatic endangered and threatened species. This aquatic habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.
- _____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Little River (Franklin/Wake/Johnston/Wayne) Aquatic Habitat

SITE CODE: AH7 **SIZE:** about 27 air miles long

SITE SIGNIFICANCE: A (National)

COUNTY: Franklin, Wake, Johnston, Wayne

QUADRANGLE: Rolesville, Bunn West, Zebulon, Flowers, Stancils Chapel, Kenly West, Princeton, Northwest Goldsboro

LOCATION: The Little River of the northeastern Neuse River basin flows through Franklin, Wake, Johnston, and Wayne counties. The most significant portion of the aquatic habitat begins near the Franklin-Wake county line and extends downstream to its confluence with the Neuse River in Wayne County.

SIGNIFICANT FEATURES:

1. This aquatic habitat supports an outstanding population of the dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered. Four other candidates for federal listing also occur in the Little River: the green floater (Lasmigona subviridis), which is state-listed as Endangered; the yellow lance (Elliptio lanceolata), Atlantic pigtoe (Fusconaia masoni), and yellow lampmussel (Lampsilis cariosa), all of which are state-listed as Threatened.

2. Two other state-listed mussel species are also present in this aquatic habitat: the triangle floater (Alasmidonta undulata) and the squawfoot (Strophitus undulatus), both state-listed as Threatened. The notched rainbow (Villosa constricta), considered significantly rare in North Carolina, also occurs in there.

3. The Neuse River waterdog (Necturus lewisi), a salamander state-listed as Special Concern, is found throughout Little River basin.

4. Three rare species of fish found in the Little River Aquatic Habitat are the least brook lamprey (Lampetra aepyptera) and the Carolina madtom (Noturus furiosus, pop. 1), both state-listed as Special Concern, and the Roanoke bass (Ambloplites cavifrons), considered significantly rare in North Carolina.

GENERAL DESCRIPTION:

The Little River is one of the larger tributaries of the Neuse River and empties directly into it close to Goldsboro. Most of its course, including the significant portion of the aquatic habitat, is contained within the Piedmont region. The upper reach is fairly swift flowing and crosses over the massive granitic intrusion of the Rolesville Pluton. Substrates in this section range from bare bedrock, as at Mitchell's Millpond, to beds of coarse sand and gravel. The lower reach, which enters the Coastal Plain in Wayne County, is more meandering and swampy.

The eight species of the rare mussels found in this river have been found only in the piedmont portion of the river, and only within Wake and Johnston Counties. The majority of the records are from the reach located between the Franklin/Wake County and the confluence with Buffalo Creek in Johnston County (Alderman 1991). The most significant of these species is the endangered dwarf wedgemussel (Alasmidonta heterodon), whose population in the Little River is considered one of the best remaining in the state (Alderman 1992). Also ranked highly are the populations of green floater (Lasmigona subviridis) and triangle floater (Alasmidonta undulata) (Alderman 1992). On the other hand, populations of the Atlantic pigtoe (Fusconaia masoni), yellow lampmussel (Lampsilis cariosa), and squawfoot (Strophitus undulatus) are ranked as only fair to poor; of all these species, only the green floater is estimated to have better than a 50% chance of surviving over the next 30 years in this basin (Alderman 1992)

Of the four rare vertebrates that inhabit this stream, the Neuse River waterdog (Necturus lewisi) is the most wide ranging, occurring as far upstream as Franklin County and downstream to just above the mouth. The lower, meandering course of the Little River is also inhabited by the Roanoke bass (Ambloplites cavifrons) and the Carolina madtom (Noturus furiosus). The least brook lamprey (Lampetra aepyptera), on the other hand, has been recorded only in the upper reaches within the Piedmont.

There are no significant point-sources of pollution along the Little River and its water quality is rated as good to good-fair based on chemical/physical criteria (Water Quality Section 1985). An excellent biological rating was obtained at two sample stations, based on the diversity of aquatic insects in general, and of mayflies, stoneflies, and caddisflies more specifically (Water Quality Section 1985). The main threats are sedimentation and pollutants issuing from non-point sources such as agricultural fields and clearcuts.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (primarily package plants) should be maintained or modified to ensure the continued integrity of Little River Aquatic Habitat. No new point sources or expansions of existing point sources should be allowed in the Little River Aquatic Habitat. Measures need to be taken to control sedimentation in the aquatic habitat. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the habitat protection by state law.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as

toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: The Little River Aquatic Habitat is extremely important as a refuge area for aquatic endangered and threatened species and as a water resource. This aquatic habitat has been proposed to the N.C. Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Little River (Orange/Durham) Aquatic Habitat

SITE CODE: AH8

SIZE: about 9 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Durham, Orange

QUADRANGLE: Caldwell, Rougemont

LOCATION: The Little River is located in the headwaters of the Neuse River Basin of Durham and Orange counties. The significant portion of the aquatic habitat includes the entire main stem upstream from the Little River Reservoir in northwestern Durham County and both the North and South Forks as far west as NC 57 in Orange County.

SIGNIFICANT FEATURES:

1. Two species of mussels inhabiting the Little River Aquatic Habitat are Federal Candidate species: the yellow lampmussel (Lampsilis cariosa) and the Atlantic pigtoe (Fusconaia masoni); both these species are also state-listed as Threatened.

2. Two other rare mussels that occur in this habitat are the squawfoot (Strophitus undulatus), state-listed as Threatened, and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.

3. The Neuse River waterdog (Necturus lewisi), a salamander state-listed as Special Concern, is found in this aquatic habitat, as is the Roanoke bass (Ambloplites cavifrons), considered significantly rare in North Carolina.

GENERAL DESCRIPTION:

The Little River, like the Eno and Flat Rivers, is one of the headwater tributaries of the Neuse River. It originates as two separate forks in western Orange County which join just after crossing the Orange/Durham county line. The entire course of this stream is contained within the Piedmont Province, and over most of its length, it flows through rolling hills underlain by metamorphic rocks of the Carolina Slate Belt.

Again like the Flat and Eno, the Little River flows across a steep escarpment that marks the western boundary of the Durham Triassic Basin. Due to this sudden drop in elevation, the Little River has carved out a spectacular gorge as it flows into the Durham Basin, although the lower part has been impounded by the Little River Reservoir. Riffles alternate with deep pools over most of the upper reaches and within the gorge upstream from the reservoir, the river becomes choked with boulders and extensive growths of water willow (Justicia americana). Below the lake, the river enters the broad lowlands of the Durham Basin, where it becomes slower, deeper, and more meandering just before joining the Eno River.

Although the two rare vertebrates found in the Little River, the Neuse River waterdog (Necturus lewisi) and Roanoke bass (Ambloplites cavifrons), may occur throughout most of the watershed wherever deep pools exist, the rare mussels that give this stream its greatest significance are concentrated in the region above the reservoir and east of NC 57 in Orange County. The terrain within this region possesses greater relief than either the headwater areas further west in Orange County or in the Triassic Basin further downstream, and riffles and boulder gardens are particularly well-developed. At least seven species of mussels have been recorded in the Little River, including the following rare species: the yellow lampmussel (Lampsilis cariosa), Atlantic pigtoe (Fusconaia masoni), squawfoot (Strophitus undulatus), and notched rainbow (Villosa constricta) (Alderman 1991).

Water quality over the entire course of the Little River has been rated as Good to Excellent in terms of its insect diversity (Water Quality Section 1985, Water Quality Section 1991). No major point-sources of pollution exist along the Little River, although small package plants may discharge into it. The major threats to water quality within the Little River come from non-point runoff from agricultural fields, clearcuts, and increasingly from construction sites and impervious surfaces within new residential areas.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (primarily package plants) need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the necessary level of protection.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: This aquatic habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission

to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to US Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C., Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.
- _____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Meherrin River Aquatic Habitat

SITE CODE: AH9

SIZE: about air 7 miles long in the A/P III study area

SITE SIGNIFICANCE: C (Regional)

COUNTY: Northampton; (Hertford -- A/P II study area)

QUADRANGLE: Margarettsville, Boykins, Sunbeam, Murfreesboro;
(Winton -- A/P II study area)

LOCATION: The Meherrin River is located in the Chowan River Basin of southeast Virginia and northeast North Carolina. It crosses the state line at several places along the border between Southampton County, Virginia and Northampton County, North Carolina. It joins the Chowan River just north of Winton in Hertford County, North Carolina.

SIGNIFICANT FEATURES: Three mussels state-listed as Special Concern are found in the Meherrin River Aquatic Habitat: the alewife floater (Anodonta implicata), the tidewater mucket (Leptodea ochracea), and the eastern pondmussel (Ligumia nasuta).

GENERAL DESCRIPTION:

Although the North Carolina portion of the Meherrin River is contained entirely within the Coastal Plain Province, its headwaters are located in the Piedmont of Virginia. Owing to the substantial silt loads carried by rivers crossing the Fall Line, the Meherrin is classified as a brownwater stream rather than as one of the nutrient-poor blackwater streams that originate strictly within the Coastal Plain. As is characteristic of coastal plain rivers, the North Carolina portion of the Meherrin meanders extensively across a wide floodplain and forms several large swamps. Substrates are entirely composed of soft sediments, including sand, gravel, and silt.

Although this river has not been thoroughly inventoried, particularly in terms of its fauna, the presence of three state-listed species of freshwater mussels indicates its potential significance as an aquatic habitat. The alewife floater (Anodonta implicata), tidewater mucket (Leptodea ochracea), and eastern pondmussel (Ligumia nasuta), all associated with slow-moving coastal plain streams, occur just upstream from the confluence with the Chowan River (A/P II study area), as do the non-listed and more widespread Atlantic spike (Elliptio producta) and eastern elliptio (Elliptio complanata) (Alderman 1991). The populations inhabiting at least this lower reach of the Meherrin appear to be particularly healthy, judging from the large number of individuals that have been found there, and by the presence of gravid females belonging to several of the species (Alderman 1991). Currently, it is not known whether significant

1991). Currently, it is not known whether significant populations also occur further upstream, but the alewife floater and eastern elliptio have been found as far upstream as the NC 35 bridge crossing in Northampton County (in the A/P III study area).

Water quality in the Meherrin is ranked as Good-Fair in terms of its insect diversity within its entire course in North Carolina; a chemical/physical rating of Good was determined for the reach near the confluence with the Chowan River (Water Quality Section 1985; Water Quality Section 1991).

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources should be maintained or modified to ensure the continued integrity of this aquatic habitat. Sedimentation and runoff should also be controlled.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: The Meherrin River has not been proposed as Critical Habitat.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.
- _____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Middle Creek Aquatic Habitat

SITE CODE: AH10

SIZE: about 19 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Wake, Johnston

QUADRANGLE: Angier, Edmondson, Powhatan

LOCATION: This aquatic habitat is in the Neuse River Basin of Wake and Johnston Counties in the Piedmont Province of North Carolina. The significant portion of this aquatic habitat includes the reach of Middle Creek from its confluence with Terrible Creek in Wake County to its confluence with the Neuse River in Johnston County.

SIGNIFICANT FEATURES:

1. The dwarf wedgemussel (Alasmidonta heterodon), federally and state-listed as Endangered, is present in this aquatic habitat. Two other species that are candidates for federal listing also occur there: the Atlantic pigtoe (Fusconaia masoni) and the yellow lance (Elliptio lanceolata), both of which are state-listed as Threatened.

2. Three other state-listed species of mussels are also present in Middle Creek: the triangle floater (Alasmidonta undulata) and the squawfoot (Strophitus undulatus), both listed as Threatened, and the eastern lampmussel (Lampsilis radiata), listed as Special Concern.

3. The Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, occurs in this aquatic habitat.

4. Two rare species of fish found in this aquatic habitat are the least brook lamprey (Lampetra aepyptera) and the Carolina madtom (Noturus furiosus, pop. 1), both state-listed as Special Concern.

GENERAL DESCRIPTION:

Middle Creek originates near Apex in Wake County. It is entirely contained within the Piedmont Province, and over most of its course flows over a gently rolling terrain underlain by metamorphic rocks of the Raleigh Belt.

The species that gives this creek its special significance is the endangered dwarf wedgemussel (Alasmidonta heterodon). However, this mussel has not been observed in this stream since 1984 (Alderman pers. comm.), and given the current poor water quality in Middle Creek, it is possible that it has been extirpated from this basin. The same may also be true for the least brook lamprey (Lampetra aepyptera), which also is highly dependent on clean water. On the other hand, the Neuse River waterdog (Necturus lewisi) is somewhat more tolerant and may still persist in this stream.

Water quality has been rated as Poor in terms of insect diversity in the reach from Apex to the confluence with Terrible Creek, and only improves to Fair below that point (Water Quality Section 1985). The major factor in the decline of water quality within Middle Creek appears to be the wastewater treatment plants at Apex and Cary. Other factors may include non-point discharges from agricultural fields and clearcuts.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (particularly the wastewater treatment plants at Apex and Cary) need to be upgraded to ensure the survival of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, construction sites, and impervious surfaces.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: Middle Creek has not been proposed as Critical Habitat.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Mill Creek Aquatic Habitat

SITE CODE: AH11

SIZE: about 14 air miles long

SITE SIGNIFICANCE: C (Regional)

COUNTY: Johnston, Wayne

QUADRANGLE: Peacocks Crossroads, Newton Grove North, Grantham

LOCATION: Mill Creek is located in the Neuse River Basin of Johnston County within the Coastal Plain Province of North Carolina. The significant portion of this aquatic habitat includes the entire stream below Moorewood Pond to its confluence with the Neuse.

SIGNIFICANT FEATURES:

1. A rare species of fish found in the Mill Creek Aquatic Habitat is the Carolina madtom (Noturus furiosus, pop. 1), state-listed as Special Concern.

2. Another species found in this stream that is also state-listed as Special Concern is the Neuse River waterdog (Necturus lewisi).

3. Large, reproducing populations of several non-listed species of freshwater mussels also occur in the Mill Creek Aquatic Habitat.

GENERAL DESCRIPTION:

Mill Creek is a small tributary of the Neuse River located within the upper Coastal Plain. Over most of its course it is fairly narrow but it widens significantly as it enters the Neuse River floodplain to the east of Bentonville. As is characteristic of coastal plain streams, its course meanders over a wide bottomland and passes through several swamps. Substrates for the most part consist of coarse sand and gravel. Water quality in Mill Creek has been rated as Good-Fair in terms of its insect diversity but has been rated as Good near its confluence with the Neuse in terms of chemical/physical parameters (Water Quality Section 1985).

This stream has been only partly inventoried for aquatic animals but is known to contain populations of Neuse River waterdog (Necturus lewisi) and Carolina madtom (Noturus furiosus), both of which are state-listed as Special Concern. Although no state-listed mussels have been recorded from Mill Creek, large beds of eastern elliptio (Elliptio complanata) and variable spike (Elliptio icterina) have been observed (J. Alderman, pers. comm.), which suggest that rarer species can also still be discovered.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources, such as package plants, should be maintained or modified to ensure the continued integrity of this aquatic habitat. The elimination of chlorine from the discharge, through addition of dechlorination processes, should be strongly encouraged. Non-point sources pose the greatest threat to water quality in this stream and measures should be implemented to control runoff particularly from cultivated fields and clearcuts.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: Mill Creek has not been proposed as Critical Habitat. More survey work for rare mussels is recommended for this creek considering that large, reproducing populations of non-listed mussels are found there.

REFERENCES:

Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Moccasin Creek Aquatic Habitat

SITE CODE: AH12

SIZE: about 11 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Franklin, Wake, Nash, Johnston, Wilson

QUADRANGLE: Zebulon, Middlesex, Stancils Chapel

LOCATION: The Moccasin Creek Aquatic Habitat is located in the Neuse River Basin of Franklin, Wake, Nash, Johnston, and Wilson Counties. The most significant portion of this aquatic habitat includes the reach downstream from Bunn Lake on the Wake/Franklin county line to Buckhorn Reservoir in Wilson County.

SIGNIFICANT FEATURES:

1. The dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered, occurs in this aquatic habitat.
2. Three other rare mussels found in this stream include the triangle floater (Alasmidonta undulata) and squawfoot (Strophitus undulatus), both state-listed as Threatened, and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.
3. The Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, also occurs in Moccasin Creek.

GENERAL DESCRIPTION:

Moccasin Creek originates in the granite flatrock area along the Franklin/Wake county line northwest of Zebulon -- the region underlain by the massive granitic intrusion of the Rolesville Pluton. The stream is narrow to begin with but widens out below Bunn Lake where it enters the zone of highly metamorphosed rock composing the Eastern Slate Belt. From that point down to its mouth, it possesses an extensive floodplain and a widely meandering channel. Substrates range from cobble to sand, gravel, silt, clay, and organic detritus.

Although the Neuse River waterdog (Necturus lewisi) occurs as far upstream as Bunn Lake, the rare species of mussels have all been found in the lower reach of Moccasin Creek, in the vicinity of NC 231 just upstream from the impoundment of Buckhorn Reservoir. Species recorded at this site during a survey conducted in 1991 (Alderman 1991) include all four of the rare species found in Moccasin Creek: the dwarf wedgemussel (Alasmidonta heterodon), triangle floater (A. undulata), squawfoot (Strophitus undulatus), and notched rainbow (Villosa constricta). Additionally present are three other more wide-ranging species, the eastern elliptio (Elliptio complanata), variable spike (E. icterina), and the Atlantic spike (E. producta); the first two have also been found upstream as far as US 264 near the Wake/Johnston/Nash county line.

Water quality within Moccasin Creek has been rated as Good-Fair in terms of its insect diversity (Water Quality Section 1985). No major point sources occur within its basin but package plants and non-point discharges appear to have greatly reduced the mussel fauna within this stream. The probability that the three listed species will survive in this stream over the next 30 years is estimated to be only between 5 and 10% (Alderman 1992).

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The most significant threat to this site, as well as to the Contentnea Creek and Turkey Creek Aquatic Habitats, is the proposed expansion of the Buckhorn Reservoir. The city of Wilson should strongly consider other alternatives for increasing their municipal water supply.

Existing point sources also need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, construction sites, and impervious surfaces.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: Moccasin Creek has not been proposed for Critical Habitat status.

REFERENCES

- Alderman, J. 1991. Survey for the dwarf wedge mussel (*Alasmidonta heterodon*) in Contentnea Creek. Nongame Project Report. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Stony Creek Aquatic Habitat

SITE CODE: AH13

SIZE: about 8 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Nash

QUADRANGLE: Castalia, Spring Hope, Nashville

LOCATION: Stony Creek is located in the Tar River Basin of Nash County. The significant portion of the aquatic habitat lies between Boddies Millpond and SR 1003 north of Nashville.

SIGNIFICANT FEATURES:

1. Three federally listed mussel species are present in this aquatic habitat: the dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered; and the yellow lance (Elliptio lanceolata) and the yellow lampmussel (Lampsilis cariosa), both Federal Candidate and State Threatened species.

2. Two other rare mussels are also found in this aquatic habitat: the squawfoot (Strophitus undualtus), listed as State Threatened, and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.

3. The Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, also occurs in this stream.

GENERAL DESCRIPTION:

Stony Creek originates at the confluence of Big and Little Peachtree Creeks in western Nash County. Its free-flowing section begins below Boddies Millpond and continues to its junction with the Tar River at Rocky Mount. The entire course of Stony Creek lies within the Piedmont Province and is underlain primarily by mudstones, meta-argillites, and other metamorphosed rocks of the Eastern Slate Belt. The topography in this region is generally of low relief, and Stony Creek possesses a fairly wide floodplain over most of its length. Stream substrates vary from cobble and bedrock to gravel, sand, and silt.

Although the Neuse River waterdog (Necturus lewisi) occurs above Boddies Millpond and may also range all the way to the Tar River, mussel beds have been found only within the reach between the millpond and Nashville (Alderman 1991). The downstream limit of this aquatic habitat is probably set by the Nashville wastewater outfall just downstream from SR 1003.

The most significant species that occurs within this reach is the endangered dwarf wedgemussel (Alasmidonta heterodon). The dwarf wedgemussel and the squawfoot (Strophitus undualtus) are found only above SR 1302. Other mussels found in the Stony Creek Aquatic Habitat include the rare yellow lance (Elliptio lanceolata), yellow lampmussel (Lampsilis cariosa), and notched rainbow (Villosa constricta). The yellow lance and the yellow lampmussel are found in this aquatic habitat near Rocky Mount.

Water quality has been rated as Good-Fair in terms of insect diversity for the reach upstream from Nashville but only Fair downstream to the Tar (Water Quality Section 1985). No major point-sources of pollution exist within the significant reach above US 64, but non-point runoff from agricultural fields and clearcuts pose some risk to water quality.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (particularly the wastewater plant at Nashville) need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, construction sites, and impervious surfaces.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point sources of pollution, such as toxic spills and discharges from wastewater plants, and non-point runoff occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: This aquatic habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Species Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Swift Creek (Wake/Johnston) Aquatic Habitat

SITE CODE: AH14

SIZE: about 17 air miles long

SITE SIGNIFICANCE: A (National)

COUNTY: Johnston, Wake

QUADRANGLE: Garner, Edmondson, Powhatan

LOCATION: Swift Creek is located in the Neuse River Basin of Johnston and Wake counties in the Piedmont Province of North Carolina. The significant portion of the aquatic habitat includes the reach below Lake Benson Dam in Wake County to the confluence with Middle Creek in Johnston County.

SIGNIFICANT FEATURES:

1. Four federally listed mussel species occur in Swift Creek: the dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered; and the yellow lance (Elliptio lanceolata), the Atlantic pigtoe (Fusconaia masoni), and the green floater (Lasmigona subviridis), listed as Federal Candidate species and State Threatened species.

2. Five other rare species of mussels also occur in this aquatic habitat: the triangle floater (Alasmidonta undulata), the Roanoke slabshell (Elliptio roanokensis), and the squawfoot (Strophitus undulatus), all state-listed as Threatened; the eastern lampmussel (Lampsilis radiata), state-listed as Special Concern; and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.

3. The Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, occurs in Swift Creek.

4. The Carolina madtom (Noturus furiosus pop. 1), state-listed as Special Concern, is located in the Swift Creek Aquatic Habitat.

GENERAL DESCRIPTION:

Swift Creek originates near Cary in Wake County, where two significant terrestrial natural areas occur along its slopes: Hemlock Bluffs State Park and Swift Creek Bluffs. The significant portion of the aquatic habitat, however, does not begin until below the dam at Lake Benson, but extends from that point downstream to its confluence with Middle Creek near Smithfield in Johnston County.

This stream is contained entirely within the Piedmont Province. After passing through relatively steep terrain near its origin, it enters a more gently rolling landscape below Lake Benson, underlain by the metamorphic rocks of the Raleigh Belt and Eastern Slate Belt, as well as by a segment of the granitic Rolesville Pluton. Substrates consist primarily of coarse sand and gravel, particularly in the reach below Lake Benson.

The most significant species in Swift Creek is the endangered dwarf wedgemussel (Alasmidonta heterodon), recorded from the reach just above I-40 in Wake County to just above its confluence with Middle Creek in Johnston County; specimens have also been found in White Oak Creek within 200 yards of its junction with Swift Creek (Alderman 1992a).

Twelve additional species of mussels occur in this same section, including the following rare species: green floater (Lasmigona subviridis), triangle floater (Alasmidonta undulata), yellow lance (Elliptio lanceolata), Atlantic pigtoe (Fusconaia masoni), Roanoke slabshell (Elliptio roanokensis), squawfoot (Strophitus undulatus), eastern lampmussel (Lampsilis radiata), and notched rainbow (Villosa constricta) (Alderman 1991). The yellow lance has also been found just below the dam at Lake Benson, and the two rare vertebrates found in Swift Creek, the Neuse River waterdog (Necturus lewisi) and Carolina madtom (Noturus furiosus), also probably range throughout this entire reach.

Water quality has been rated as Good-Fair in terms of insect diversity over the entire length of Swift Creek (Water Quality Section 1985). No large point sources of pollution exist within this watershed (Cary discharges its wastewaters into Crabtree Creek), and the most significant threats to water quality come from non-point sources.

In addition to traditional problems associated with runoff from agricultural areas and clearcuts, which threaten to extirpate the dwarf wedgemussel from Whiteoak Creek (Alderman 1992b), an increasing volume of stormwater is flowing off impervious surfaces and construction sites within the rapidly urbanizing area around Cary and southeast Wake County. Much of this discharge may be captured behind Lake Wheeler and Lake Benson, however, and the mussels in the lower reach of Swift Creek are given a 40% chance of surviving over the next 30 years (Alderman 1992a).

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the necessary level of protection.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological

resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: This aquatic habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Species Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992a. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992b. Survey for the dwarf wedge mussel (Alasmidonta heterodon) in Whiteoak Creek. Nongame Project Report. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Swift Creek (Vance/Warren/Franklin/Nash/Edgecombe)
Aquatic Habitat

SITE CODE: AH15

SIZE: about 47 air miles long

SITE SIGNIFICANCE: A (National)

COUNTY: Vance, Warren, Franklin, Nash, Edgecombe

QUADRANGLE: Henderson, Vicksboro, Ingleside, Gold Sand,
Centerville, Castalia, Essex, Red Oak, Drake, Whitakers,
Hartsease, Tarboro

LOCATION: Swift Creek is located in the Tar River Basin of
Vance, Warren, Franklin, Nash, and Edgecombe counties. This
aquatic habitat includes Sandy Creek and Swift Creek from
Henderson to its confluence with the Tar River in Edgecombe
County.

SIGNIFICANT FEATURES:

1. The Tar spiny mussel (Elliptio steinstansana), federally
listed as Endangered, has its only reproducing population located
within this Swift Creek Aquatic Habitat.

2. Three other federally listed species of mussels are
found in this aquatic habitat: the yellow lance (Elliptio
lanceolata), the yellow lamp mussel (Lampsilis cariosa), and the
Atlantic pigtoe (Fusconaia masoni), all Federal Candidate and
State Threatened species.

3. Five other rare species of mussels are also present:
the triangle floater (Alasmidonta undulata), the Roanoke
slabshell (Elliptio roanokensis), and the squawfoot (Strophitus
undulatus), state-listed as Threatened; the eastern lamp mussel
(Lampsilis radiata), state-listed as Special Concern; and the
notched rainbow (Villosa constricta), considered significantly
rare in North Carolina.

4. The Neuse River waterdog (Necturus lewisi), state-listed
as Special Concern, occurs in this aquatic habitat, as does the
Carolina madtom (Noturus furiosus, pop. 2), whose Tar River
population is considered significantly rare.

GENERAL DESCRIPTION:

Along with the Upper Tar, Little Tennessee, and Lake
Waccamaw, Swift Creek is one of the premier aquatic habitats
within North Carolina. Its headwaters lie within Henderson in
Vance County (where the stream is named Sandy Creek; it is
renamed Swift Creek after it crosses the Franklin/Nash county
line). From its source down to Gold Rock in Nash County, Swift
(Sandy) Creek flows through the Piedmont Province. The terrain
in this region is gently rolling and underlain initially by the
massive granitic intrusion of the Rolesville Pluton and then by
other granitic and strongly metamorphosed formations of the

Eastern Slate Belt. Substrates in this section run the entire range from cobble and bedrock to sand, gravel, and silt.

Below I-95 at Gold Rock, Swift Creek enters the Coastal Plain Province, where its floodplain widens dramatically. The channel narrows below this point and becomes tightly meandering. Substrates in this reach down to the confluence with the Tar River near Tarboro are composed primarily of soft sediments, including sand, gravel, and silt.

The entire subbasin from the Vance/Warren county line is considered to be significant. However, most of the significant species in this aquatic habitat are found in Franklin County. A few of the rare animals species present in Swift Creek occur as far upstream as the Vance/Warren county line, including the notched rainbow (Villosa constricta), Atlantic pigtoe (Fusconaia masoni), and probably the Neuse River waterdog (Necturus lewisi).

The most significant species in the entire watershed is the Tar spiny mussel (Elliptio steinstansana). This population is the last healthy and reproducing colony of this species on earth. Although this species occurs from NC 58 in Franklin County to NC 97 in Edgecombe County, most of the population occurs within the Piedmont section of Swift Creek located between SR 1310 and NC 48 in Nash County (Alderman, pers. comm.).

In addition to the spiny mussel, sixteen other species of mussels inhabit Swift Creek, including the following eight rare species: triangle floater (Alasmidonta undulata), yellow lance (Elliptio lanceolata), Roanoke slabshell (Elliptio roanokensis), Atlantic pigtoe (Fusconaia masoni), yellow lampmussel (Lampsilis cariosa), squawfoot (Strophitus undulatus), eastern lampmussel (Lampsilis radiata), and the notched rainbow (Villosa constricta) (Alderman 1991). Not only is this one of the most diverse mussel faunas remaining in North Carolina, but it is also one of the most vigorous; virtually all species are represented by a complete range of size classes and by actively reproducing individuals (Alderman, pers. comm.).

Water quality has been rated as Good to Good-Fair in terms of insect diversity over the entire length from the Vance/Warren county line to its confluence with the Tar in Edgecombe County (Water Quality Section 1985; Water Quality Section 1991). Although there are a few small package treatment plants discharging into Swift Creek, no major point sources exist along its entire course, which probably accounts for the continued presence of the rich mussel community (Alderman, pers. comm.).

A number of other significant threats exist, however, as have been thoroughly documented by Christopher McGrath (1992). These include spills of toxic chemicals, such as the one that caused a massive die-off of mussels in 1990, dewatering of the stream for agricultural irrigation, and a proliferating number of non-point sources.

Particularly significant is the great increase in clearcutting that has taken place throughout the Swift Creek Basin within just the last few years. Almost no sizable tracts of mature forest are left anywhere along its length, and in many

places the cutting has extended right up to the shoreline of the creek. This may have a number of detrimental effects on the mussel populations, including increased insolation of the creek due to the destruction of the riparian canopy, increased flooding resulting in channel scouring, and massive amounts of silt deposition in the creek.

Runoff from agricultural fields also contributes to the stream's sediment load. It also carries fertilizers and other nutrients into the creek, as well as pesticides and other toxic chemicals. Nutrients, including phosphorus and nitrogenous compounds, have been implicated in the heavy growth of aquatic macrophytes within Swift Creek (Water Quality Section 1991). As in the case of other forms of eutrophication, this rapid plant growth may ultimately result in lowered oxygen availability in the stream, which may be particularly devastating to the mussel community.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Existing point sources (primarily package plants) need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the necessary level of protection.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts, construction sites, and impervious surfaces occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: This aquatic habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- McGrath, C. 1992. Threat analysis for the Swift Creek population of the Tar River spiny mussel. Nongame Project Report; N.C. Wildlife Resources Commission, Nongame and Endangered Wildlife Program, Raleigh
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.
- _____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Tar River--Middle and Lower Aquatic Habitats

SITE CODE: AH16

SIZE: about 63 air miles long

SITE SIGNIFICANCE: B (State)

COUNTY: Vance, Franklin, Nash, Edgecombe

QUADRANGLE: Kittrell, Ingleside, Louisburg, Justice, Bunn East, Spring Hope, Bailey, Winstead Crossroads, Nashville, Rocky Mount, Hartsease, Tarboro, Old Sparta, Speed

LOCATION: The Middle Tar River Aquatic Habitat includes the main stem of the Tar River as it crosses most of Franklin and Nash Counties. It extends from the Granville/Vance/Franklin county line in the Piedmont Province down to the Tar River Reservoir in the Coastal Province. The Lower Tar includes the reach below the reservoir to the Edgecombe/Pitt county line.

SIGNIFICANT FEATURES:

1. The Tar spiny mussel (Elliptio steinstansana), federally listed as Endangered, has been recorded in both the Middle and Lower Tar River Aquatic Habitats.

2. Four rare mussels federally listed as Candidate species are present in this aquatic habitat: the yellow lance (Elliptio lanceolata), the Atlantic pigtoe (Fusconaia masoni), and the yellow lamp mussel (Lampsilis cariosa), also listed as State Threatened; and the green floater (Lasmigona subviridis), also listed as State Endangered.

3. The state-listed as Threatened triangle floater (Alasmidonta undulata), is also found in the Middle and Lower Tar.

4. The eastern lamp mussel (Lampsilis radiata), state-listed as Special Concern, is found in the Lower Tar.

5. Another mussel found in the Middle Tar Aquatic Habitat is the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.

6. The Neuse River waterdog (Necturus lewisi), state listed as Special Concern, occurs throughout the Tar River.

7. Two rare species of fish found in the Middle and Lower Tar are the Roanoke bass (Ambloplites cavifrons) and the Carolina madtom (Noturus furiosus pop. 2); both are considered significantly rare in North Carolina.

GENERAL DESCRIPTION:

Most of the Tar River from Vance to Pitt County flows through a gentler topography than found in the Granville County section. Although the Middle Tar lies primarily in the Piedmont Province and the Lower is contained entirely within the Coastal Plain, both reaches overlap greatly in terms of species; the presence of the Tar spiny mussel in both reaches is a particularly significant unifying feature.

After the river flows out of its steep gorge in eastern Granville County, it enters a much less rugged terrain underlain initially by the strongly metamorphosed rocks of the Raleigh Belt and then the more extensive granitic intrusion of the Rolesville Pluton. This middle reach of the Tar possesses a fairly low gradient and its course is somewhat meandering; broad areas of bottomland forests occur along its margins. Substrates in this reach range from cobble in its upper section to coarse sand and gravel in the lower part.

Below US 64 in Nash County, the Tar floodplain widens out fairly quickly but is still underlain by metamorphosed granite and other crystalline rock until it passes into Edgecombe County, where it enters the Coastal Plain proper. From that point to just below Tarboro, the river becomes extensively meandering; from Tarboro to the Pitt county line, however, it becomes nearly straight. Substrates in this reach of the Tar consist almost exclusively of sand, gravel, and silt.

Just as the dwarf wedgemussel distinguishes the Upper Tar River Aquatic Habitat, the Tar spynussel (Elliptio steinstansana), also federally listed as Endangered, distinguishes the Middle and Lower Tar River Aquatic Habitats. Historically, this species probably occurred throughout much of the Tar River (Alderman 1989), but was probably most abundant in the middle and lower reaches, given its habitat preference for coarse sand and gravel. Today, however, it has been all but extirpated as a breeding species in the main stem of the Tar and only a few relict individuals persist below Tarboro; one live specimen was also found in 1991 just above US 64 in Nash County (Alderman 1991). The only viable population of this species is now found in the Swift Creek Aquatic Habitat (Alderman 1989; Alderman 1992).

Other species of mussels found in the Middle and Lower Tar include several that also occur in the Granville County reach: the green floater (Lasimigona subviridis), triangle floater (Alasmidonta undulata), yellow lance (Elliptio lanceolata), Atlantic pigtoe (Fusconaia masoni), yellow lampmussel (Lampsilis cariosa), and notched rainbow (Villosa constricta) (Alderman 1991). Concentrations of these state-listed species can be found at several points along the Tar within Franklin, Nash, and Edgecombe Counties, and are perhaps more viable indicators of the long term significance of the Middle and Lower Tar River Aquatic Habitats than the spiny mussel.

Also present in the Lower Tar, but not recorded from Granville County (but present in other Piedmont streams) is the eastern lampmussel (Lampsilis radiata), state-listed as Special Concern. Along with the yellow lampmussel and yellow lance, these two species occur at Old Sparta, the last point on the Tar where there is a concentration of rare mussels.

Both of the rare vertebrates present in the Tar, the Neuse River waterdog (Necturus lewisi), Roanoke bass (Ambloplites cavifrons), have also been recorded in the vicinity of Old Sparta, either in the Tar or just upstream in Town Creek. As is

true for many of the mussel species, these animals range over most of the Tar River, from the lower reach to at least as far as the Granville/Vance/Franklin county line; the Neuse River waterdog and Roanoke bass have also been recorded in the Upper Tar.

Water quality in the middle reach of the Tar has been rated Good in terms of insect diversity from just east of Bunn in Franklin County down to its confluence with Sapony Creek in Nash County. The rest of this reach has been rated as Good-Fair biologically, with excellent ratings in terms of chemical/physical parameters obtained from points near Louisburg and below the Tar River Reservoir (Water Quality Section 1985).

Important point sources of pollution along the middle Tar exist at Franklinton (via Cedar Creek) and at Louisburg, which has had significant NPDES permit violations during the recent past (Alderman 1992). Over most of this reach, non-point runoff from clearcuts and agricultural fields has had a major impact on the river ecosystem.

None of the rare mussels inhabiting this reach are given better than 30% chance of surviving over the next 30 years (Alderman 1992). Populations of the yellow lance, which were considered good to very good within this reach during the early 1980's, are now is rated as only poor to fair (Alderman 1992).

Even that level is encouraging compared to the status of mussels inhabiting the lower portion of the Tar. As mentioned above, the Tar spiny mussel is represented in this reach by only a few ancient specimens that are no longer reproducing, and the yellow lance and green floater have apparently been extirpated from the Lower Tar within just the past 30 years (Alderman 1992). Of the remaining state-listed species, most are given no more than a 5 to 10% chance of surviving over the next 30 years (Alderman 1992).

The most probable cause for the demise of the mussel fauna in the Lower Tar is a long history of NPDES permit violations by the Rocky Mount wastewater plant, many episodes of which resulted in massive fish-kills and presumably die-offs of mussels as well. Even though water quality has been consistently rated as Good-Fair in terms of insect diversity from Rocky Mount to the confluence with Buck Swamp, and as Good from that point to the Pitt county line (Water Quality Section 1985; Water Quality Section 1991), insects can return to a stream fairly quickly following a die-off, owing to their flying abilities. Mussels, in sharp contrast, may take decades to recover from even one such a catastrophe, let alone a long succession of them.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The Tar River is extremely important as a water supply and as a refuge area for aquatic endangered and threatened species.

Existing point sources (particularly the wastewater plants at Louisburg and Rocky Mount) should be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the necessary level of protection.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point sources of pollution, such as toxic spills and discharges from wastewater plants, and non-point runoff occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: The Middle Tar River Aquatic Habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1989. Status survey of the Tar River spiny mussel. In: N.C. Wildlife Resources Commission. 1989. Population status, distribution and biology of the Tar River spiny mussel, Elliptio (Canthytia) steinstansana (Johnson & Clarke), in North Carolina. Final Rep. to US Fish and Wildlife Service.
- _____. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

_____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Tar River--Upper Aquatic Habitat

SITE CODE: AH17

SIZE: about 20 air miles long

SITE SIGNIFICANCE: A (National)

COUNTY: Granville

QUADRANGLE: Moriah, Berea, Stem, Wilton, Kittrell

LOCATION: The Tar River--Upper Aquatic Habitat is located in the headwaters of the Tar Basin. The most significant reach lies between NC 158 in Granville County and SR 1203 (Franklin Co.) on the Granville/Vance/Franklin county line. This reach of the Tar is included entirely within the Piedmont Province of North Carolina.

SIGNIFICANT FEATURES:

1. One of only two North Carolina populations of harperella (Ptilimnium nodosum), federally listed as Endangered, occurs in the Upper Tar River Aquatic Habitat.

2. The state's best population of the dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered, occurs in the Upper Tar.

3. Four Federal Candidate species have been found within this aquatic habitat: the green floater mussel (Lasmigona subviridis), also listed as State Endangered; and the yellow lance (Elliptio lanceolata), the Atlantic pigtoe (Fusconia masoni), and the yellow lampmussel (Lampsilis cariosa), also listed as State Threatened species.

4. Four other rare mussel species are present in the Upper Tar: the triangle floater (Alasmidonta undulata) and the squawfoot (Strophitus undulatus), state-listed as Threatened; and the notched rainbow (Villosa constricta) and the eastern creekshell (Villosa delumbis), considered significantly rare in North Carolina.

5. The Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, occurs in this aquatic habitat.

6. One species of fish considered significantly rare in North Carolina occurs in this reach of the Tar, the Roanoke bass (Ambloplites cavifrons).

GENERAL DESCRIPTION:

The headwaters of the Tar River differ both geologically and biologically from the Middle and Lower Tar River Aquatic Habitats described in this report. From its source in Person County down to I-85 in central Granville County, the Tar flows through a rolling terrain underlain by rocks of the Carolina Slate Belt. Stream substrates in this reach run the entire range from cobble to sand and gravel. Below I-85, the Tar passes briefly through a flat area representing the northernmost projection of the Durham Triassic Basin. It then plunges into a spectacular gorge

beginning at NC 96 and continuing all the way to the county line. Riffles are common throughout the length of this gorge and the river is occasionally choked by extensive boulder gardens.

Biologically, the most distinctive features of the Upper Tar are the populations of the federally endangered dwarf wedgemussel (Alasmidonta heterodon) and harperella (Ptilimnium nodosum). The dwarf wedgemussel occurs from just below NC 158 down to SR 1138 south of Berea. The terrain is less rugged here than further downstream in the gorge and the channel is less than thirty feet wide. Riffles and pools predominate along this reach, with the dwarf wedgemussel occurring almost exclusively within the pools. This species is often found just below the banks, frequently lying on submerged root mats or logs.

Other species found in association with the dwarf wedgemussel in this stream segment include the state-listed squawfoot (Strophitus undulatus), yellow lampmussel (Lampsilis cariosa), and Neuse River waterdog (Necturus lewisi). The non-listed eastern elliptio (Elliptio complanata), variable spike (E. icterina), eastern creekshell (Villosa delumbis), and notched rainbow (V. constricta) also occur in this segment and several of these species extend upstream as far as the Person county line (Alderman 1991).

The rest of the rare species are recorded from further downstream. A particularly rich area occurs within the gorge below NC 96. The population of harperella occurs on a gravel bar located at the head of the gorge and ten species of mussels have been found within the gorge itself, including the state-listed green floater (Lasmigona subviridus), yellow lance (Elliptio lanceolata), triangle floater (Alasmidonta undulata), Atlantic pigtoe (Fusconaia masoni), squawfoot (Strophitus undulatus), and yellow lampmussel (Lampsilis cariosa) (Alderman 1991). The significantly rare Roanoke bass (Ambloplites cavifrons) also occurs in this reach as well as further upstream.

Water quality within the Upper Tar River Aquatic Habitat has been rated as Good to Good-Fair based on its insect diversity; a Water Quality Index rating of Excellent based on chemical/physical parameters was obtained from one sample station within this reach (Water Quality Section 1985). No major point sources exist within this reach and the most significant threats to water quality appear to come from non-point sources. If water quality is maintained at least at the current levels, the probability of the dwarf wedgemussel surviving over the next 30 years in this drainage is estimated to be as high as 80% (Alderman 1992).

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The Tar River is extremely important as a water supply and as a refuge area for aquatic endangered and threatened species.

Existing point sources (primarily package plants) should be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the necessary level of protection.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point sources of pollution, such as toxic spills and discharges from wastewater plants, and non-point runoff occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: The Tar River has been proposed by the Nongame and Endangered Wildlife Program of the NC Wildlife Resources Commission as a Critical Habitat for the dwarf wedgemussel and other state-listed species (Nongame and Endangered Wildlife Program 1992). Under this designation, the Tar River could be considered for High Quality Waters status, which would provide habitat protection under regulations of the Environmental Management Commission.

REFERENCES:

- Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.
- _____. 1991. Biological assessment of water quality in North Carolina streams: benthic macroinvertebrate data base and long term changes in water quality, 1983-1990. North Carolina Division of Environmental Management, Raleigh, N.C.

SITE NAME: Turkey Creek Aquatic Habitat

SITE CODE: AH18

SIZE: about 11 air miles long

SITE SIGNIFICANCE: A (National)

COUNTY: Nash, Wilson

QUADRANGLE: Middlesex, Stancils Chapel

LOCATION: Turkey Creek is located in the Neuse River Basin of Franklin, Nash, and Wilson counties. The significant portion of the aquatic habitat begins just downstream from Murray's Millpond (at NC 231) in Nash County and continues all the way to Buckhorn Reservoir in Wilson County.

SIGNIFICANT FEATURES:

1. Three federally listed mussel species are found in the Turkey Creek Aquatic Habitat: the dwarf wedgemussel (Alasmidonta heterodon), federally listed as Endangered; the Atlantic pigtoe (Fusconaia masoni), a Federal Candidate and State Threatened species; and the green floater (Lasmigona subviridus), a Federal Candidate and State Endangered species.

2. Three other rare mussel species are also found in this aquatic habitat: the triangle floater (Alasmidonta undulata) and the squawfoot (Strophitus undulatus), state-listed as Threatened; and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.

3. The Neuse River waterdog (Necturus lewisi), a salamander state-listed as Special Concern, is found in this aquatic habitat.

GENERAL DESCRIPTION:

Turkey Creek is contained entirely within the Piedmont Province. It originates within the Eastern Slate Belt and flows over bands of felsic metavolcanic rocks, meta-argillites, and metamudstones. This entire area possesses a fairly low relief and below the Franklin/Nash county line the floodplain widens and the channel becomes meandering or even braided in some areas. All of the rare species of aquatic animals found in this stream occur in this reach, from just downstream of Murray's Millpond to the confluence with Moccasin Creek. Substrates within this section consist primarily of sand, gravel, and silt.

The population of the Endangered dwarf wedgemussel (Alasmidonta heterodon) alone makes this stream one of the most significant aquatic habitats in the state. In addition to the large size of this population, the presence of young as well as reproducing individuals indicates this is one of the healthiest populations still found in North Carolina, and second only to the upper Tar population in long-term viability (Alderman 1991b; Alderman 1992).

Along with the dwarf wedgemussel, ten additional species of freshwater mussels occur in this stream, including four state-listed species: the Atlantic pigtoe (Fusconaia masoni), squawfoot (Strophitus undulatus), triangle floater (Alasmidonta undulata), and eastern pondmussel (Ligumia nasuta) (Alderman 1991a, 1991b). One other state-listed animal that inhabits Turkey Creek is the Neuse River waterdog (Necturus lewisi).

Surprisingly, water quality in Turkey Creek has been rated as only Fair in terms of its diversity of aquatic insects (Water Quality Section 1985). One significant point source of pollution exists within the Turkey Creek watershed at Middlesex (emptying into Turkey Creek via Beaverdam Creek). Upstream from that point, where most of the rare mussels have been found, water quality is mainly affected by non-point runoff from clearcuts and agricultural fields.

OWNERSHIP: Waters of the State.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The most significant threat to this site, as well as to the Contentnea Creek and Moccasin Creek Aquatic Habitats, is the proposed expansion of the Buckhorn Reservoir. The city of Wilson should strongly consider other alternatives for increasing their municipal water supply.

Existing point sources (particularly the wastewater plants at Middlesex) also need to be maintained or modified to ensure the continued integrity of this aquatic habitat. In particular, chlorine and other toxic substances should be removed from all discharges and biological oxygen demand lowered to the minimum possible. Non-point sources of pollution and sedimentation also need to be controlled, including runoff from cultivated fields, clearcuts, and impervious surfaces. Official designation of the aquatic habitat as Critical Habitat and as High Quality Waters would afford the necessary level of protection.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point sources of pollution, such as toxic spills and discharges from wastewater plants, and non-point runoff occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

COMMENTS: This aquatic habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

- Alderman, J.M. 1991a. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- _____. 1991b. Survey for the dwarf wedge mussel (Alasmidonta heterodon) in Contentnea Creek. Nongame Project Report, Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission.
- _____. 1992. Station locations by species for proposed critical habitats. N.C. Wildlife Resources Report. Nongame and Endangered Wildlife Program, NC Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission. Water Quality Section. 1985. Assessment of surface water quality in North Carolina. North Carolina Division of Environmental Management, Raleigh, N.C.

TERRESTRIAL AND PALUSTRINE NATURAL AREAS

DURHAM COUNTY NATURAL AREAS

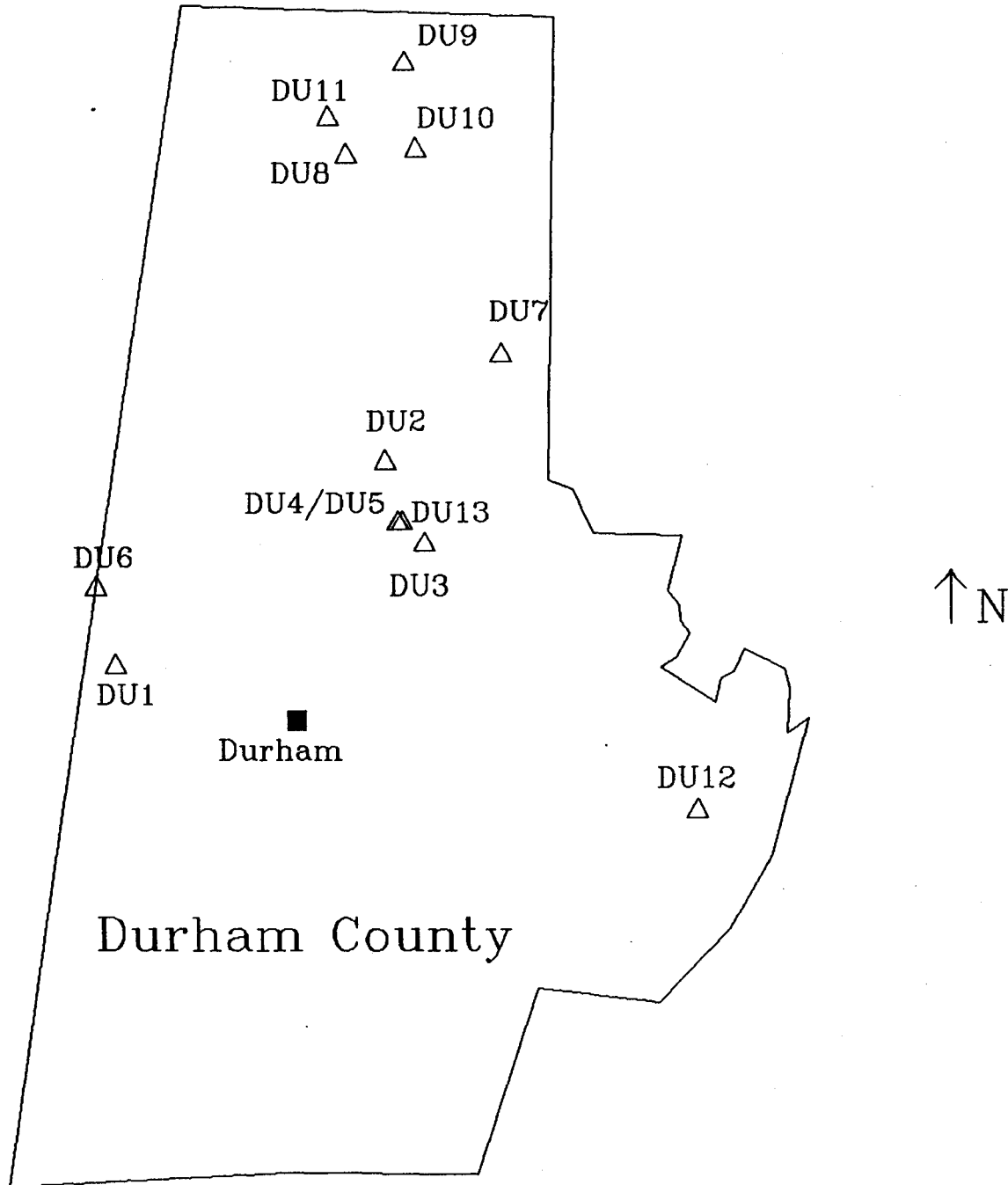
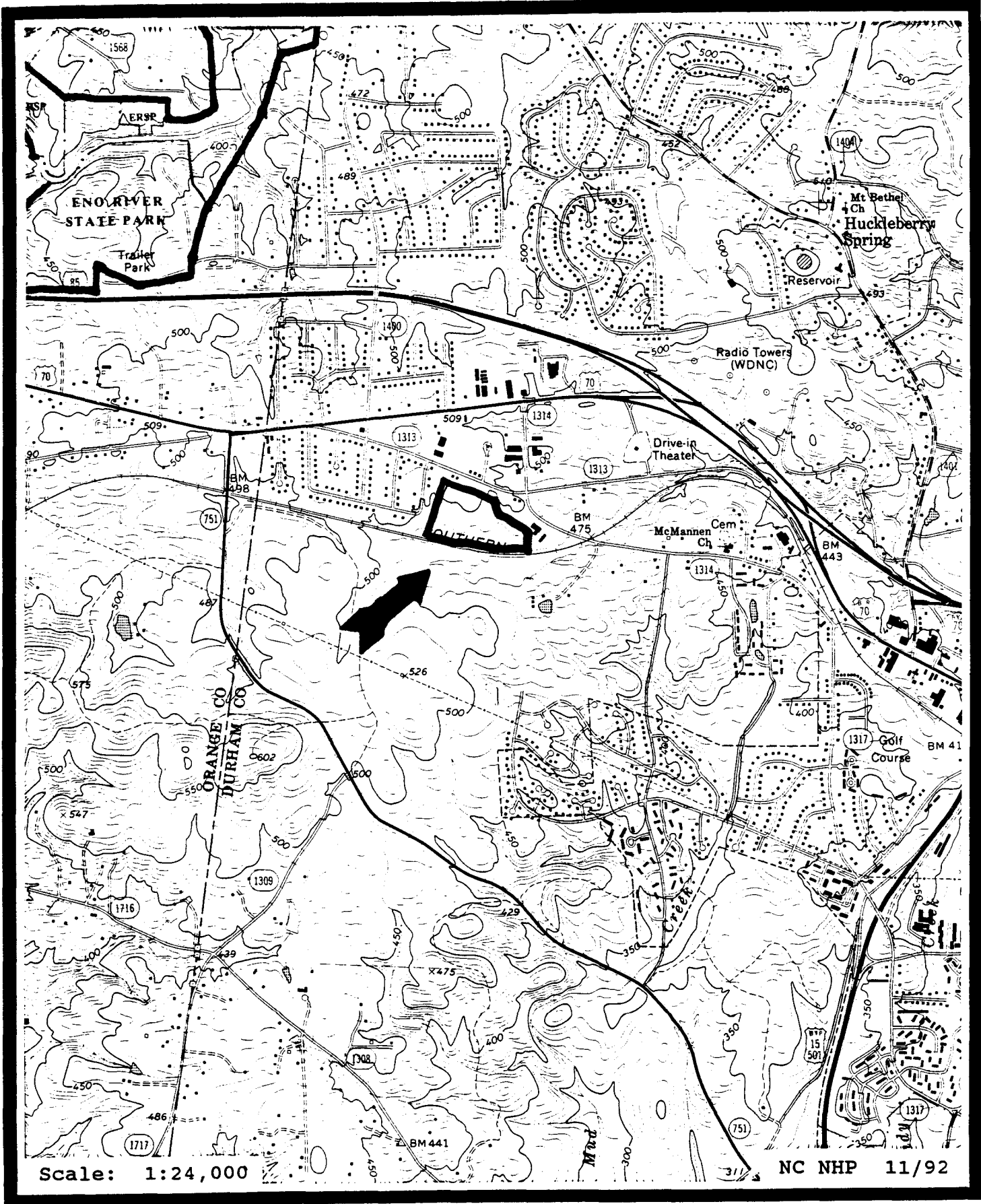


Figure 7. Significant natural areas in the A/P III study area portion of Durham County



Site Name: Bennett Place Forest
 Site Code: DU1
 Quadrangle: Northwest Durham

SITE NAME: Bennett Place Forest

SITE CODE: DU1

SIZE: 27 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Durham

QUADRANGLE: Northwest Durham

LOCATION: This site is in the Neuse River watershed in Durham County in the Piedmont Province of North Carolina. It is on Neal Road south of US 70; about 0.8 mile east of the Orange County line; northwest of Durham, N.C.

SIGNIFICANT FEATURES:

1. This natural area contains a population of Lewis's heartleaf (Hexastylis lewisii), a State Candidate species. This is one of the largest populations of this rare plant on public land in the state.

2. Two good quality natural communities are present at this site: Upland Depression Swamp Forest and Xeric Hardpan Forest.

GENERAL DESCRIPTION:

This natural area is part of a State Historic Site and is located behind and to the south of the visitor center. This specific site is wooded and gently sloping with some wet, low-lying areas. The soils at this site are clayey and sandy hardpan. The rock type is metamorphosed gabbro and diorite. The litter layer here is notably thinner than in other parts of nearby woods.

This site supports two good quality community types, Xeric Hardpan Forest and Upland Depression Swamp Forest. These forests have a great diversity of oaks and pines. In the Xeric Hardpan Forest blackjack oak (Quercus marilandica) and post oak (Q. stellata) are mixed with loblolly (Pinus taeda) and shortleaf pine (P. echinata). Other oak species present at this site include: white oak (Q. alba), black oak (Q. velutina), red oak (Q. rubra), willow oak (Q. phellos), southern red oak (Q. falcata), and water oak (Q. nigra). In the herb layer is a population of Lewis's heartleaf (Hexastylis lewisii), a State Candidate species, along with a few associated species such as bluestem (Andropogon sp.) and pipsissewa (Chimaphila maculata).

Most of the upland appears to be poorly drained, but particular spots are so impermeable that water is impounded and flows down the very gentle slope toward the railroad tracks. This situation creates small sites where willow oak dominates the canopy and peat moss (Sphagnum lescurii) forms mats over the hardpan substrates. These areas support examples of the Upland Depression Swamp Forest community type.

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Department of Cultural Resources, Division of Archives and History.

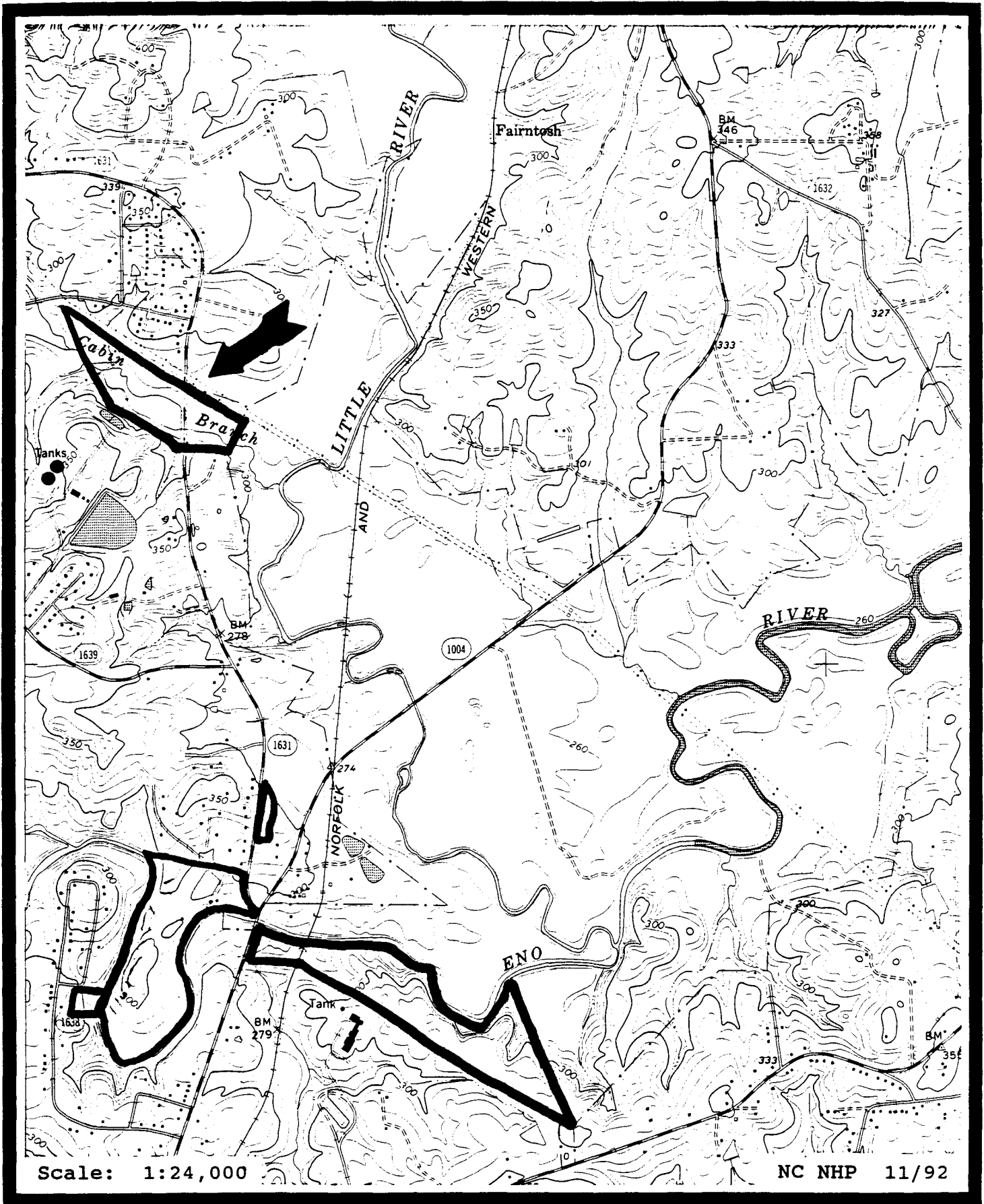
PROTECTION STATUS: This site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site should be managed with the goal of maintaining the heartleaf population and the two natural communities. The heartleaf population should be regularly monitored for signs of decline.

COMMENTS: Bennett Place State Historic Site as a whole is used for recreation and historic interpretation and reenactments. The wooded portion of this site, where the heartleaf population occurs, is infrequently used.

REFERENCES:

Mansberg, L. 1986. Bennett Place Lewis' Heartleaf. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
_____ and A.S. Weakley. 1986. Bennett Place Lewis's Heartleaf Habitat. Natural Area Summary. N.C. Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Cabin Branch Creek Bottomland-Swamp
 Site Code: DU2
 Quadrangle: Northeast Durham

SITE NAME: Cabin Branch Creek Bottomland-Swamp

SITE CODE: DU2

SIZE: 52 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Durham

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in eastern portion of Durham County in the Piedmont Province of North Carolina. It is a bottomland area on both sides of Cabin Branch Creek; site is bisected by SR 1631.

SIGNIFICANT FEATURES:

1. A large colony of Lewis' heartleaf (Hexastylis lewisii), a State Candidate species, grows in slightly drier zones and adjacent to the wettest areas at this site.

2. Scattered throughout the moister portions of the floodplain at this site is a population of Douglass' bittercress (Cardamine douglassii), a significantly rare species in the state.

GENERAL DESCRIPTION:

In general, the floodplain of Cabin Branch Creek lies within the Triassic Basin. The floodplain is quite wide for the current size of the creek. At this site water stands in pools and depressions during winter and into the spring.

A Piedmont/Low Mountain Alluvial Forest is located at this site and is dominated by hardwoods with a dbh of 8-10 inches. The canopy is dominated by oaks including white oak (Quercus alba), cherrybark oak (Q. pagoda), swamp chestnut oak (Q. michauxii), willow oak (Q. phellos), and overcup oak (Q. lyrata) in wetter depressions. Sweetgum (Liquidambar styraciflua), red maple (Acer rubrum), and American elm (Ulmus americana) are also common. American beech (Fagus grandifolia) grows on slightly elevated rises in the generally level topography. The subcanopy is sparse and is dominated by American hornbeam (Carpinus caroliniana) with an occasional redcedar (Juniperus virginiana). The shrub layer is open and has as common shrubs black haw (Viburnum prunifolium), elderberry (Sambucus canadensis), and strawberrybush (Evonymus americana).

Of particular interest at this site are the well-developed populations of two plants rare in the Piedmont region of North Carolina and adjoining states. One of these plants is the pink-flowered Douglass' bittercress (Cardamine douglassii), which occurs throughout the wetter portion of the floodplain. Several colonies of this attractive wetland herb were lost when the Falls Lake was impounded. Manipulation of the local hydrology is a potential threat to this species at sites where it still occurs. The rhizomatous Lewis' heartleaf (Hexastylis lewisii) grows in slightly better drained portions of the floodplain.

Other spring wildflowers growing in the floodplain include trout lily (Erythronium americanum), spring beauty (Claytonia virginica), windflower (Thalictrum thalictroides), various violets (Viola spp.), and atamasco lily (Zephyranthes atamasco).

OWNERSHIP: This site is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

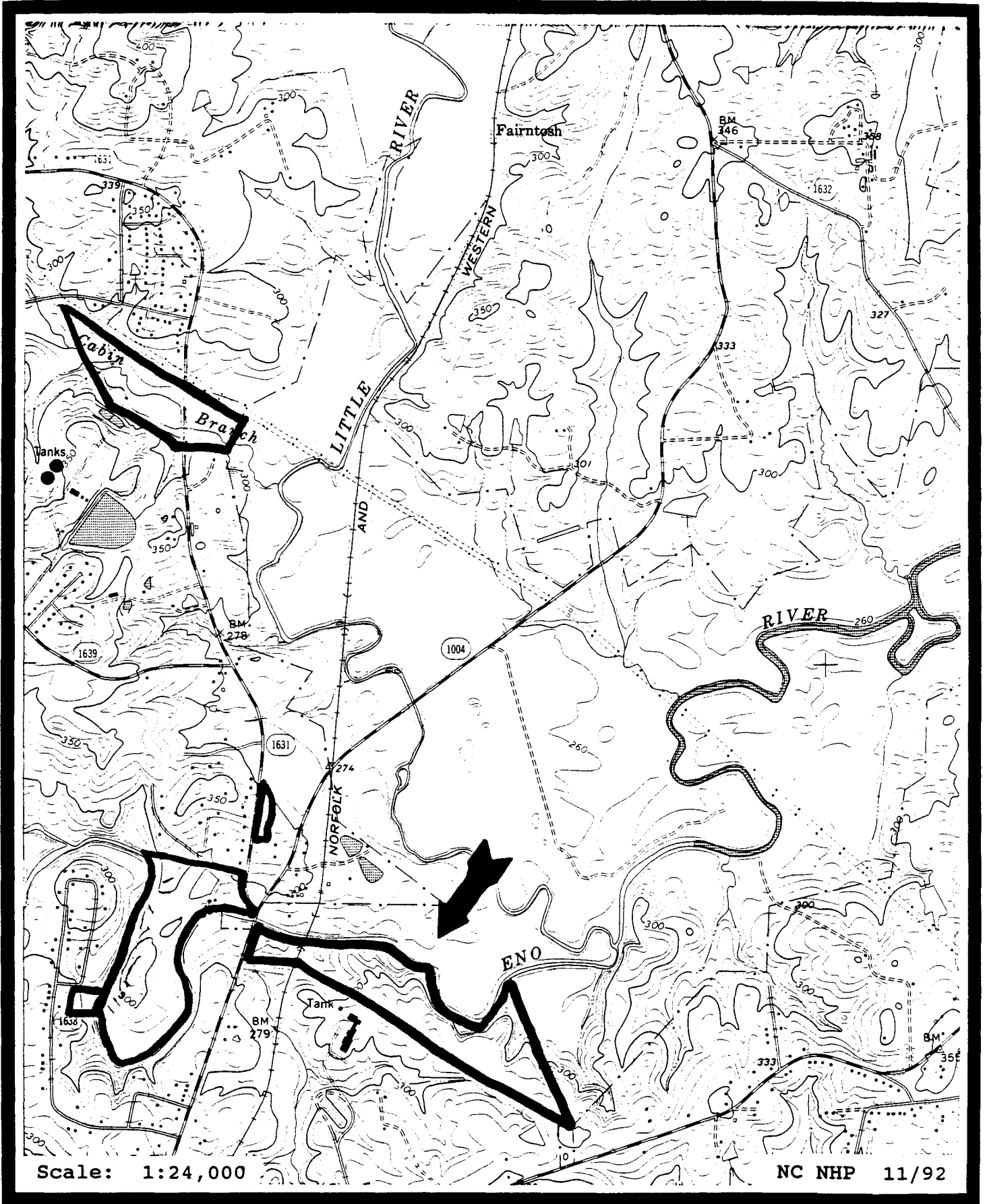
PROTECTION STATUS: Part of this site (the western portion) is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: No specific management is needed to perpetuate the rare plant populations that occur here. Manipulation of the existing flooding regime, such as raising the water levels of the lake (as proposed), could negatively impact these wetland species. Use of the area for hunting would not disturb the vegetation. This site is managed by the N.C. Wildlife Resources Commission.

COMMENTS: As indicated above, the Corps of Engineers has proposed to raise the water level of Falls Lake by at least one foot. This natural area might escape any major flooding at this elevated water level, but some negative effects to the natural area are expected along portions of the lake shoreline.

REFERENCES:

- Moore, J.H. and H.E. LeGrand, Jr. 1989. Falls Lake Natural Areas. N.C. Natural Heritage Program.
- Sutter, R.D., E. Harrison, and D. Rettig. 1987. Inventory of the natural areas and rare species of Durham County. Report to Durham County, Triangle Land Conservancy, Durham County Inventory, and N.C. Natural Heritage Program.



Site Name: Catsburg Natural Area
 Site Code: DU3
 Quadrangle: Northeast Durham

SITE NAME: Catsburg Natural Area

SITE CODE: DU3

SIZE: 84 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Durham

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in eastern Durham County in the Piedmont Province of North Carolina. It is along the south side of the Eno River; east and downstream from the SR 1004 bridge.

SIGNIFICANT FEATURES:

1. This site contains a good quality Basic Mesic Forest (Piedmont Subtype), which is rare in the A/P III study area.
2. Two rare plant species occur here: shale-barren skullcap (Scutellaria leonardii), a State Candidate species, and isopyrum (Enemion biternatum), a significantly rare species.

GENERAL DESCRIPTION:

This site contains north-facing bluffs along the south bank of the Eno River. These bluffs contain an unusual concentration of rare and showy herbaceous species and a good quality, old-growth Basic Mesic Forest. The steep, and in some places unvegetated, mudstone and sandstone bluffs adjacent to the river add distinctive features to this site.

The Basic Mesic Forest (Piedmont Subtype) at the site occurs on moist circumneutral soils over diabase rocks. It contains two rare species of plants: shale-barren skullcap (Scutellaria leonardii), a State Candidate species, and isopyrum (Enemion biternatum), a significantly rare species. Other uncommon plants found in this community include small-anthered buttercup (Ranunculus micranthus), James' sedge (Carex jamesii), glade fern (Athyrium pycnocarpon), walking fern (Asplenium rhizophyllum), spring coralroot (Corallorhiza wisteriana), and doll's eyes (Actaea pachypoda). An extensive population of the showy Dutchman's breeches (Dicentra cucullaria) covers a steep slope where the river makes a shallow curve.

Also present at this site is a Piedmont/Low Mountain Alluvial Forest. This forest is characterized by many large swamp chestnut oaks (Quercus michauxii) and shagbark hickories (Carya ovata).

OWNERSHIP: This site is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

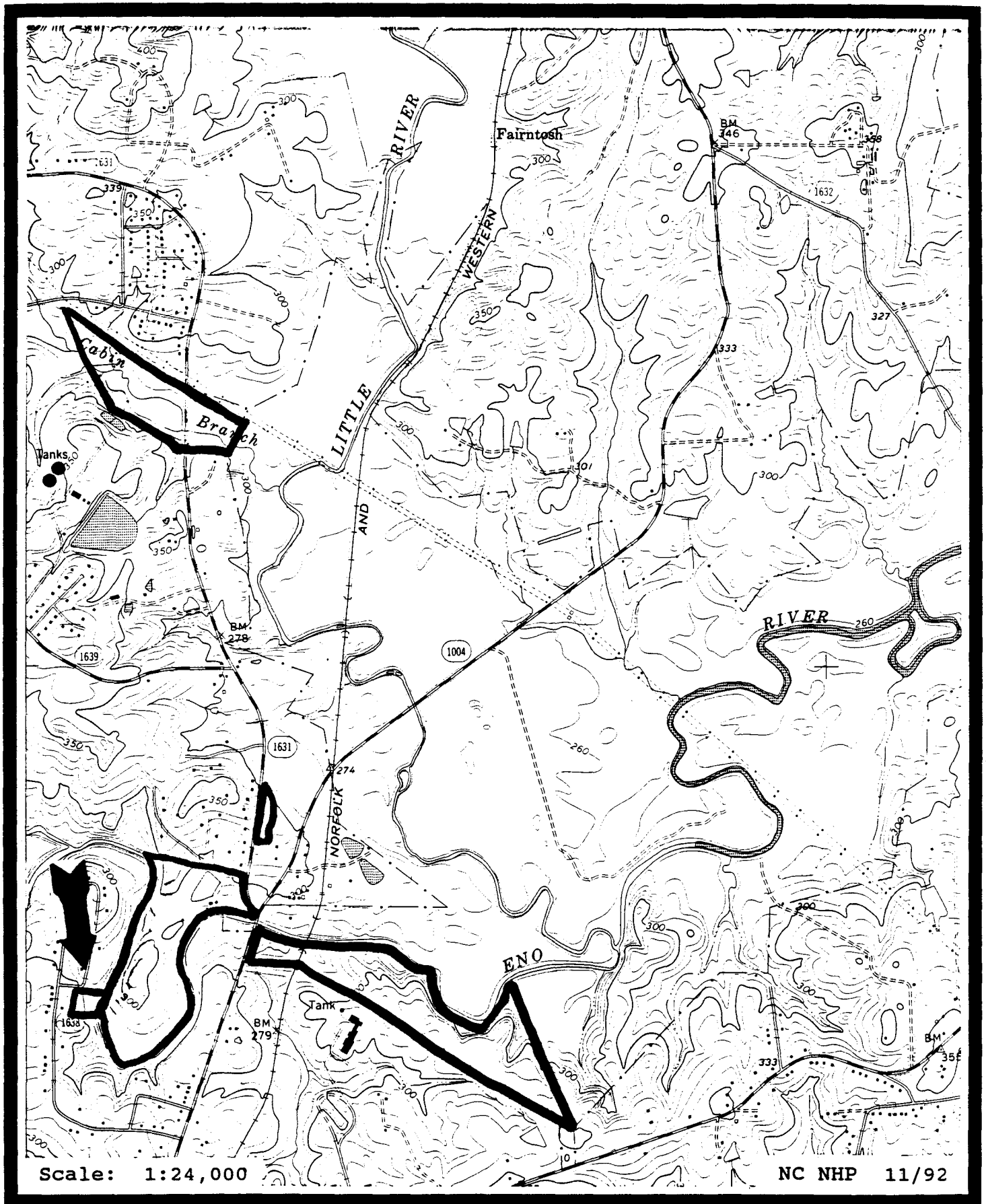
MANAGEMENT OR PROTECTION RECOMMENDATIONS: Urban and industrial development is taking place within 1,000 to 1,500 feet of the

bluffs. Efforts must continue to restrict access from off-road vehicles, to prevent reoccurrence of trash dumping, and to protect the bluff from erosion runoff and fires. The N.C. Wildlife Resources commission manages this site. The Corps of Engineers and Wildlife Resources Commission have attempted to create a vegetation barrier and to block access roads above the bluffs.

COMMENTS: The botanical significance and beauty of this site has long been recognized by university botanists and their students, by local wildflower enthusiasts, and by the Eno River Preservation Association. However, several of the species listed as uncommon have not been observed in the past decade.

REFERENCES:

- Moore, J.H. and M. Olwell. 1977. Botanical Survey and Evaluation, Falls Lake. Report to the U.S. Army Corps of Engineers, Wilmington, N.C. Wiggins-Rimer and Associates, Durham, N.C.
- _____ and H.E. LeGrand, Jr. 1989. Falls Lake Natural Areas. N.C. Natural Heritage Program.
- N.C. Natural Heritage Program. Date Unknown. Catsburg Sill and Penny's Bend. Natural Areas Report.
- Sutter, R.D., E. Harrison, and D. Rettig. 1987. Inventory of the natural areas and rare species of Durham County. Report to Durham County, Triangle Land Conservancy, Durham County Inventory, and North Carolina Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Eno River Blue Wild Indigo Slope
 Site Code: DU4
 Quadrangle: Northeast Durham

SITE NAME: Eno River Blue Wild Indigo Slope

SITE CODE: DU4

SIZE: 2 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Durham

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in Durham County in the Piedmont Province of North Carolina. It is off of the SR 1638 loop road; southwest side of the Eno River at Penny's Bend; west of SR 1004 (Old Oxford Road).

SIGNIFICANT FEATURES: This site contains five rare plant species: low wild-petunia (Ruellia humilis), a State Threatened species; prairie blue wild indigo (Baptisia australis var. minor), shale-barren skullcap (Scutellaria leonardii), and prairie dock (Silphium terebinthinaceum), State Candidate species; and hoary puccoon (Lithospermum canescens), significantly rare in the state.

GENERAL DESCRIPTION:

This natural area is a field in an early successional stage. It is located on a steep east-facing slope along the Eno River on the southwest margin of Penny's Bend, a horseshoe-shaped curve of the river. This site is located on the Braggtown diabase sill and contains Iredell soils (fine, montmorillonitic Typic Hapludalfs). These soils have a high pH relative to more acid soils common in the Piedmont. The upper soil horizon at this site is covered with pebbles and cobbles of diabase.

Four large populations of rare diabase endemics are present at this site. These rare endemics are prairie wild blue indigo (Baptisia australis var. minor), shale-barren skullcap (Scutellaria leonardii), and prairie dock (Silphium terebinthinaceum), all three State Candidate species, and hoary puccoon (Lithospermum canescens), which is significantly rare in the state. Also present at this site is low wild-petunia (Ruellia humilis), a State Threatened species. Several of these species are disjunct from the main part of their range west of the Appalachians. These plants are dependent not only upon high base soils but also on open prairie-like conditions which are often simulated in the Piedmont by grazing activities.

OWNERSHIP: This natural area is privately owned by the Eno River Preservation Association.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

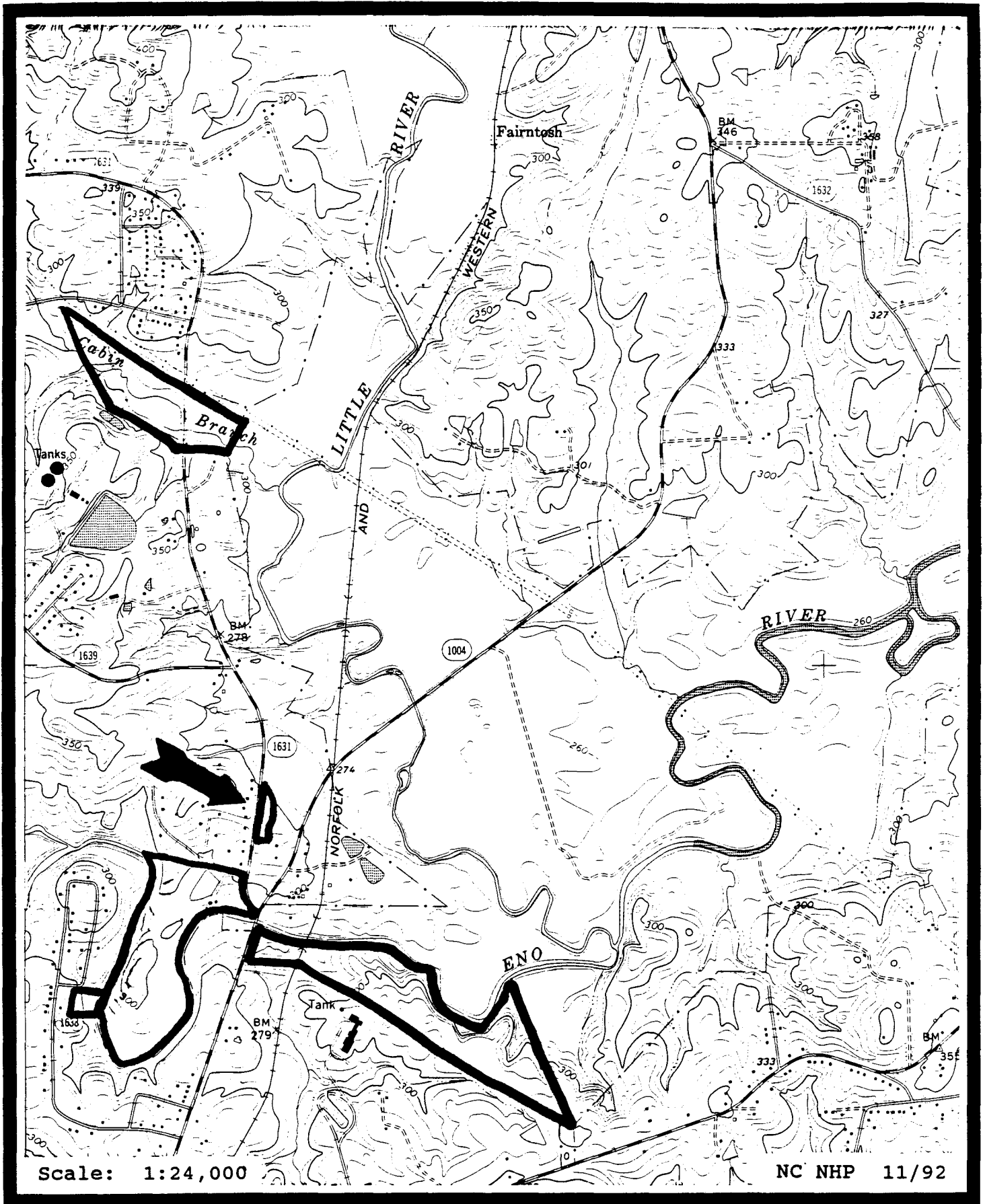
MANAGEMENT OR PROTECTION RECOMMENDATIONS: It is speculated that mixed trees and shrubs will eventually close the canopy and shade out the herb layer species if ongoing control of brush and tree

encroachment is not done. Encroachment can be controlled by hand cutting, dormant season bush-hogging, or prescribed burning.

COMMENTS: None

REFERENCES:

- Moore, J., L. Peacock, W. Sheftall, and M. Lynch. 1980. Wild Blue Indigo Slope. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- _____, M. Lynch, L. Peacock, and C. Roe. 1981. Eno River-Wild Blue Indigo Slope. Natural Area Summary. N.C. Natural Heritage Program.



Site Name: Eno River Diabase Sill
 Site Code: DU5
 Quadrangle: Northeast Durham

SITE NAME: Eno River Diabase Sill

SITE CODE: DU5

SIZE: 4 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Durham

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in Durham County in the Piedmont Province of North Carolina. It is on the east side of SR 1531; about 1300 feet north of the junction of SR 1531 and SR 1004.

SIGNIFICANT FEATURES:

1. This natural area contains two federally-listed rare plant species: smooth coneflower (Echinacea laevigata), Federally Endangered species, and tall larkspur (Delphinium exaltatum), a Federal Candidate and State Endangered species of Special Concern.

2. Nine other rare plant species are present at this site: low wild-petunia (Ruellia humilis), a State Threatened species; prairie blue wild indigo (Baptisia australis var. minor), glade wild quinine (Parthenium auriculatum), shale-barren skullcap (Scutellaria leonardii), and prairie dock (Silphium terebinthinaceum), State Candidate species; and Earle's blazing star (Liatris squarrulosa), American barberry (Berberis canadensis), hoary puccoon (Lithospermum canescens), and rufous bulrush (Scirpus pendulus), significantly rare in the state.

GENERAL DESCRIPTION:

This natural area contains a ridge crest and upper south-facing slope which occurs on a diabase sill, a mafic igneous rock intrusion in the Durham Triassic Basin. This site was at one time a pasture, but has not been grazed for at least 20 years. The soil at this site is Iredell Loam (fine, montmorillonite, thermic typic Hapludalf). The dark, mafic igneous intrusive rock is abundant in ferro-magnesium minerals.

This site supports an example of a Xeric Hardpan Forest community type. The canopy in this forest is composed of scattered loblolly pine (Pinus taeda) and shortleaf pine (P. echinata). Scattered through the site are transgressive persimmon (Diospyros virginiana), black oak (Quercus velutina), post oak (Q. stellata), mockernut hickory (Carya tomentosa), and other species.

This site contains ten rare basophilic plant species. This is one of the highest diversities of diabase endemic species known in the state. The rare species present here are: smooth coneflower (Echinacea laevigata), federally Endangered; tall larkspur (Delphinium exaltatum), a Federal Candidate and State Endangered species of Special Concern; prairie blue wild indigo (Baptisia australis var. minor), glade wild quinine (Parthenium auriculatum), shale-barren skullcap (Scutellaria leonardii), and

prairie dock (Silphium terebinthinaceum), State Candidate species; low wild-petunia (Ruellia humilis), a State Threatened species; and Earle's blazing star (Liatris squarrulosa), American barberry (Berberis canadensis), hoary puccoon (Lithospermum canescens), and rufous bulrush (Scirpus pendulus), significantly rare in the state. Other uncommon species present at this site include: tall thimbleweed (Anemone virginiana), curlyheads (Clematis ochroleuca), and fragrant sumac (Rhus aromatica).

OWNERSHIP: Multiple private ownership.

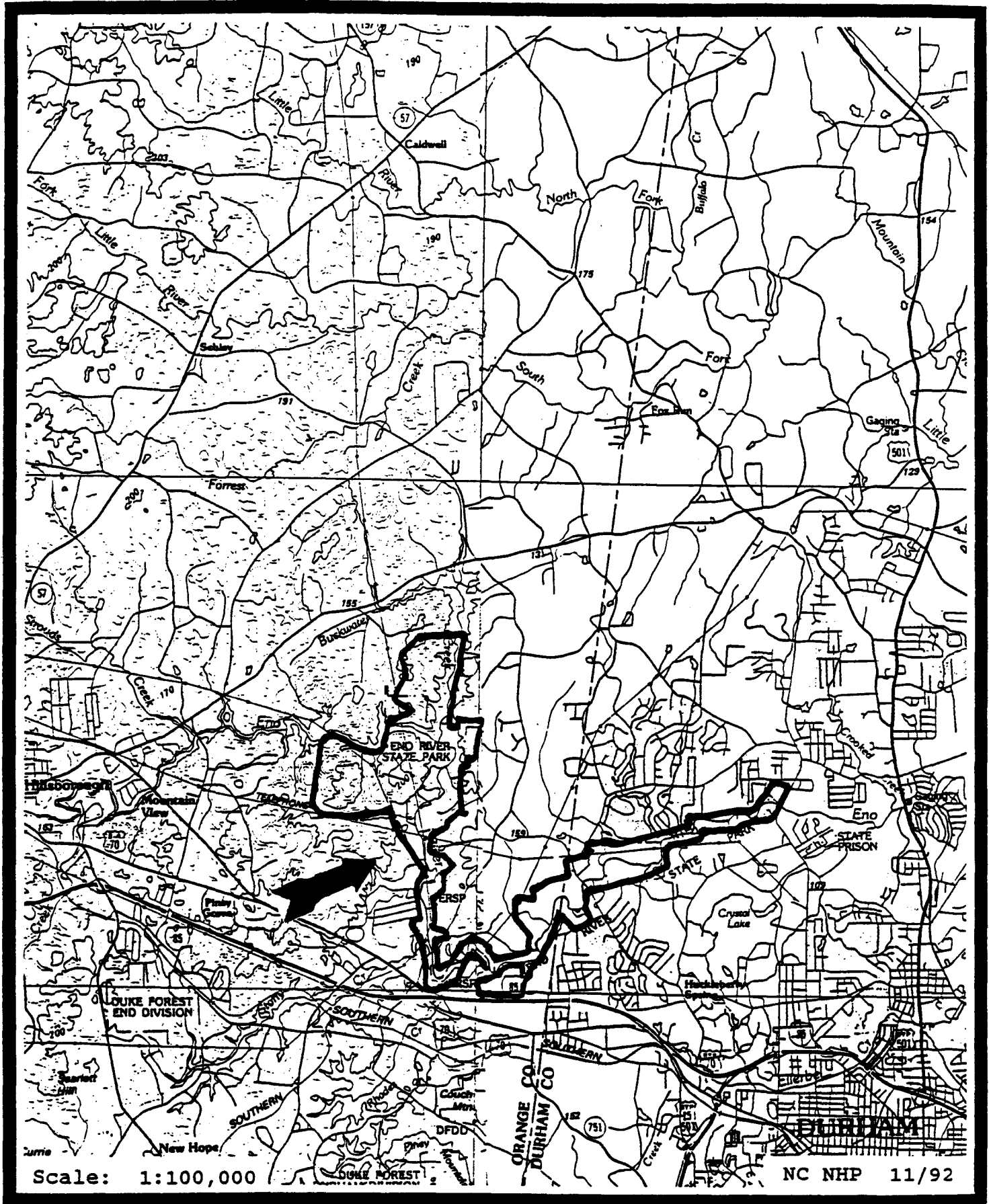
PROTECTION STATUS: A part of this site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The canopy of the forest should be kept open by burning or selective cutting. This site has not been grazed in the last 20+ years. Adjacent land is currently being grazed and has no rare species. Many new homes have been built in the vicinity of the site. Formal protection or perhaps acquisition by a conservation agency or group of the entire natural area is recommended.

COMMENTS: The N.C. Department of Transportation has plans to widen Hill Road (SR 1531) to four or five lanes. However, because of the presence of the Registered Natural Heritage Area and the federally-listed smooth coneflower, these plans may be abandoned.

REFERENCES:

Lynch, J.M., J.H. Moore, S.L. Peacock, and W. Sheftall. 1980.
Eno River Diabase Sill. Natural Area Inventory Form. N.C.
Natural Heritage Program.



Site Name: Eno River State Park and Vicinity
 Site Code: DU6
 Quadrangle: Henderson, Greensboro

SITE NAME: Eno River State Park and Vicinity

SITE CODE: DU6

SIZE: about 3100 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Orange, Durham

QUADRANGLE: Henderson, Greensboro (1:100,000 scale)

LOCATION: This site is in the Neuse River watershed in eastern Orange County and western Durham County in the Piedmont Province of North Carolina. It extends along the Eno River from about 2 miles east of Lawrence Road (SR 1561) near Hillsborough, downstream to Guess Road (SR 1003) in Durham. The site includes lands currently within the state park lands, lands within the planned acquisition boundary, and adjacent lands that are of natural significance.

SIGNIFICANT FEATURES:

1. Three rare aquatic vertebrate species are present at this site: the Carolina darter (*Etheostoma collis*) and the Neuse River waterdog (*Necturus lewisi*), state-listed as Special Concern, and the Roanoke bass (*Ambloplites cavifrons*), listed as significantly rare.

2. Five rare aquatic invertebrate species are present in this natural area: the yellow lampmussel (*Lampsilis cariosa*) and the green floater (*Lasmigona subviridis*), Federal Candidate and State Endangered species; the triangle floater (*Alasmidonta undulata*) and the squawfoot (*Strophitus undulatus*), state-listed as Threatened; and the panhandle pebblesnail (*Somatogyrus virginicus*), a globally rare snail.

3. A species of dragonfly significantly rare in North Carolina, Thorey's grayback dragonfly (*Tachopteryx thoreyi*), has been reported for this natural area.

4. This site supports high quality examples of eight different natural community types typical of the Piedmont: Piedmont/Coastal Plain Heath Bluff, Piedmont/Coastal Plain Acidic Cliff, Dry-Mesic Oak-Hickory Forest, Dry Oak-Hickory Forest, Mesic Mixed Hardwood Forest, Piedmont/Low Mountain Alluvial Forest, Rocky Bar and Shore, and Upland Depression Swamp.

GENERAL DESCRIPTION:

Eno River State Park and Vicinity encompasses about 2200 acres of land along the Eno River. The portion of the Eno River that flows through this site is a significant aquatic habitat (Aquatic Habitat AH4) and supports a large number of rare species. Aquatic invertebrates include the squawfoot (*Strophitus undulatus*), triangle floater (*Alasmidonta undulata*), green floater (*Lasmigona subviridis*), and yellow lampmussel (*Lampsilis cariosa*), all state listed as threatened. This aquatic habitat may be the only remaining location for the panhandle pebblesnail

(Somatogyrus virginicus) in the world. Aquatic vertebrate species include the Neuse River waterdog (Necturus lewisi), the Carolina darter (Etheostoma collis), and the Roanoke bass (Ambloplites cavifrons).

In addition to protecting the river, the park lands protect good examples of seven different natural community types, as well as several rare species. Five natural areas consisting of large units and a partial corridor along the river have been specifically identified within the park: Buckwater Branch Ridge and Slopes, Cox's Mountain, Cate's Ford, Mountain Spleenwort and Rhododendron Bluffs, and Cabelands and Rhododendron Slope. Situated adjacent to centers of extensive development, these natural areas retain some of the features which once were prevalent in the Piedmont. Good quality examples of seven natural community types are present in Eno River State Park: Piedmont/Coastal Plain Heath Bluff, Piedmont/Coastal Plain Acidic Cliff, Dry-Mesic Oak-Hickory Forest, Dry Oak-Hickory Forest, Mesic Mixed Hardwood Forest, Piedmont/Low Mountain Alluvial Forest, and Rocky Bar and Shore.

Buckwater Branch Ridge and Slopes is a north-south running ridge north of Eno River and west of Buckwater Creek. It supports outstanding xerophytic vegetation and is one of only two sites within the county where the regionally-rare pepper-and-salt skipper butterfly (Amblyscirtes hegon) is known to occur. On the ridgetop is a high quality post oak (Quercus stellata) dominated forest.

Cox's Mountain is an upland site with good examples of Mesic Mixed Hardwood Forest and Dry-Mesic Oak-Hickory Forest communities. The spring at this site is inhabited by Thorey's grayback dragonfly (Tachopteryx thoreyi). The regionally-rare doll's eyes (Actaea pachypoda) has also been reported for Cox's Mountain and is known from no other location in Orange County.

The Cate's Ford area contains acidic cliff upland forests and some of the best developed riparian communities within Orange County. Also of significance at Cate's Ford is one of the best natural exposures of Paleozoic metavolcanic rock and pyroclastic rock, which is widespread in the Piedmont.

The Mountain Spleenwort and Rhododendron Bluffs is the easternmost known location in the Carolinas for the mountain spleenwort (Asplenium montanum), a regionally-rare species disjunct from the mountains. This is one of only two known locations for this species in the eastern Piedmont. The steep north-facing bluff at this site is the location of a population of catawba rhododendron (Rhododendron catawbiense), a regionally-rare disjunct from the mountains. The red-backed salamander (Plethodon cinereus) is a regionally-rare, disjunct animal species that occurs in this natural area.

Cabelands and Rhododendron Slope contains several state-listed animal species. Regionally-rare species included in this section of the park are catawba rhododendron, maidenhair fern (Adiantum pedatum), galax (Galax urceolata), sumo mite

(Allothrombium sp.), and pileated woodpecker (Dryocopus pileatus).

In addition, the Eno River Uplands and Vernal Pools area lies southwest of the Cate's Ford area. The "vernal pools" are Upland Depression swamp communities dominated by willow oak (Quercus phellos) and overcup oak (Q. lyrata). These communities also contain wetland shrubs such as buttonbush (Cephalanthus occidentalis) and leucothoe (Leucothoe racemosa), as well as sphagnum moss (Sphagnum sp.). These pools are long-lasting, fish-free, and important breeding sites for salamanders. The surrounding forests are typical Dry-Mesic Oak-Hickory Forest and Dry Oak-Hickory Forest.

OWNERSHIP: The majority of this natural area is owned by the state. The smaller parcels are privately owned.

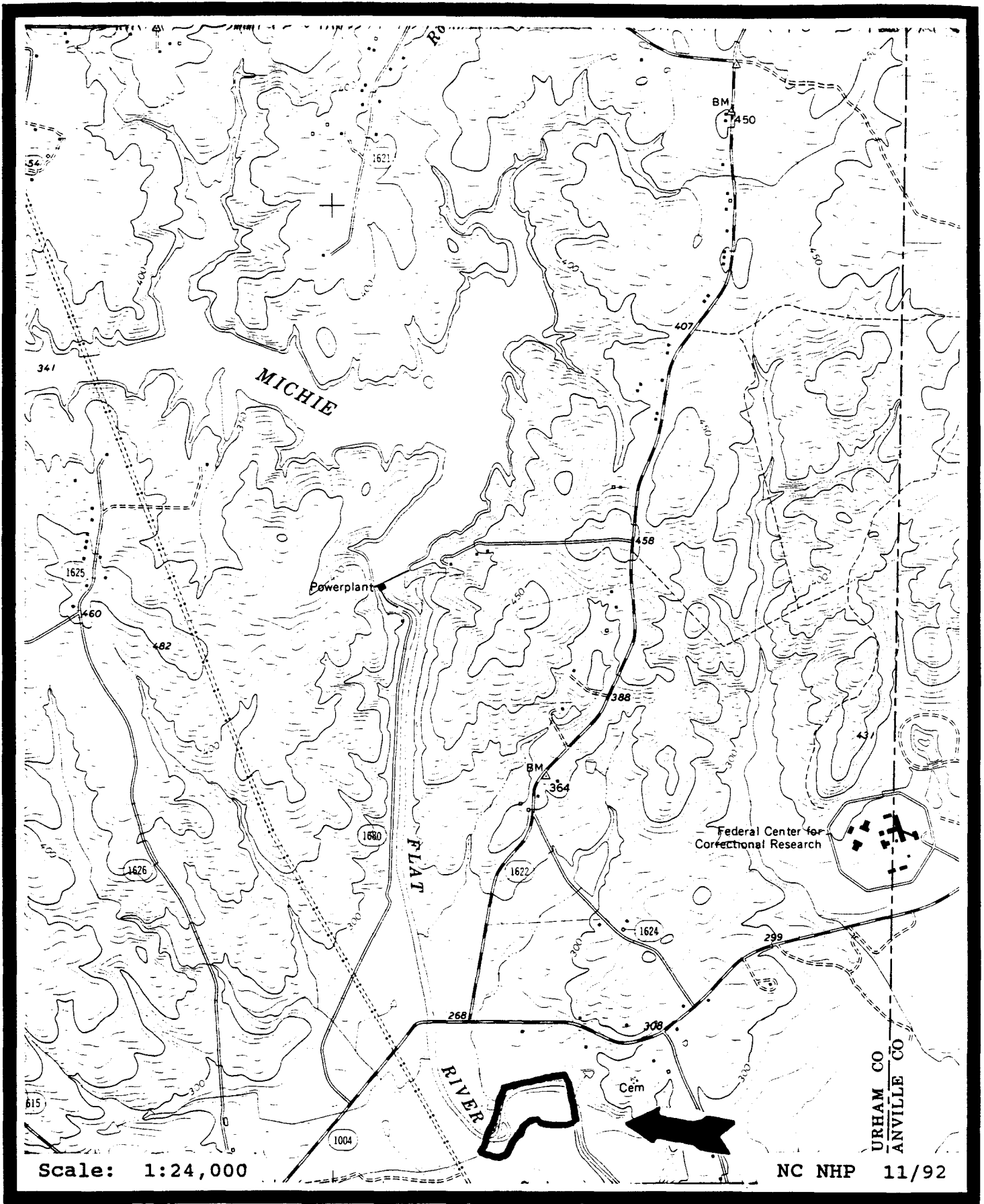
PROTECTION STATUS: Most of this site is a North Carolina State Park and portions of it are also a Registered Natural Heritage Area. The privately owned lands are not protected.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Much of the privately owned land adjacent to this natural area is already developed or is threatened by logging and development. Similar fates threaten the private lands within the natural area. The Eno River is subjected to pollution from upstream sources and from tributaries that feed it. Other threats include encroachment from Japanese honeysuckle (Lonicera japonica) and Japanese grass (Microstegium vimineum) in the floodplain and mesic slope communities. It is recommended that private inholdings be acquired by the State to further protect the integrity of the aquatic habitat as well as the natural communities.

COMMENTS: Annually, the Eno River Preservation Association, a non-profit organization, holds a 3-day festival to raise money to protect land along the Eno River. Land is purchased by the Eno River Preservation Association, which in turn gives the land to the state to be incorporated into the Eno River State Park. Presently, the park covers 2,186 acres. According to the park's master plan, it will eventually cover 3,126 acres.

REFERENCES:

Sather, D. and S. Hall. 1988. Inventory of the natural areas and wildlife habitats of Orange County, North Carolina. Report to Triangle Land Conservancy and N.C. Natural Heritage Program.



Site Name: Flat River Bend Forest
 Site Code: DU7
 Quadrangle: Lake Michie

SITE NAME: Flat River Bend Forest

SITE CODE: DU7

SIZE: 16 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Durham

QUADRANGLE: Lake Michie

LOCATION: This site is in the Neuse River watershed in northeastern Durham County in the Piedmont Province of North Carolina. It is south of SR 1004, along the Flat River; on the south side of a big turn in the river.

SIGNIFICANT FEATURES:

1. An outstanding example of a Piedmont/Mountain Levee Forest is present at this site.
2. A large population of isopyrum (Enemion biternatum), a significantly rare plant species, occurs at this site.
3. The site possesses a high diversity of spring ephemeral herbs and is the most "showy" wildflower site in the Falls Lake project area.

GENERAL DESCRIPTION:

This is a low-lying site located in an inverted "U" bend of the Flat River. It is underlain by diabase with circumneutral, sandy, clay loam soils. This site contains a low, natural levee with a level floodplain along the river. Some diabase rocks are exposed in the river and adjacent to the banks.

The mature to old forest present at this site is classified as a Piedmont/Mountain Levee Forest which is unusually rich even for this rich community type. Most trees are 12-18 inches in diameter, but a number of huge old trees are present. The canopy of this forest is dominated by sugar maple (Acer saccharum) and sugarberry (Celtis laevigata). The shrub layer is dominated by spicebush (Lindera benzoin) and pawpaw (Asimina triloba). The ground is covered by a great diversity of spring wildflowers including two species of special interest. The population of Dutchman's breeches (Dicentra cucullaria), which is almost 5 acres in extent, is one of the largest populations, if not the largest, known in the Piedmont. An extensive population of over 1,000 plants of isopyrum (Isopyrum biternatum), a significantly rare species, grows with the Dutchman's breeches. The herbs here are more typical of sheltered, north-facing slopes like those of the Catsburg Natural Area, but are found in much smaller populations at that site. There are distinct differences between the tree cover and herbaceous plants in the Flat River Bend and Catsburg natural areas.

OWNERSHIP: This site is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

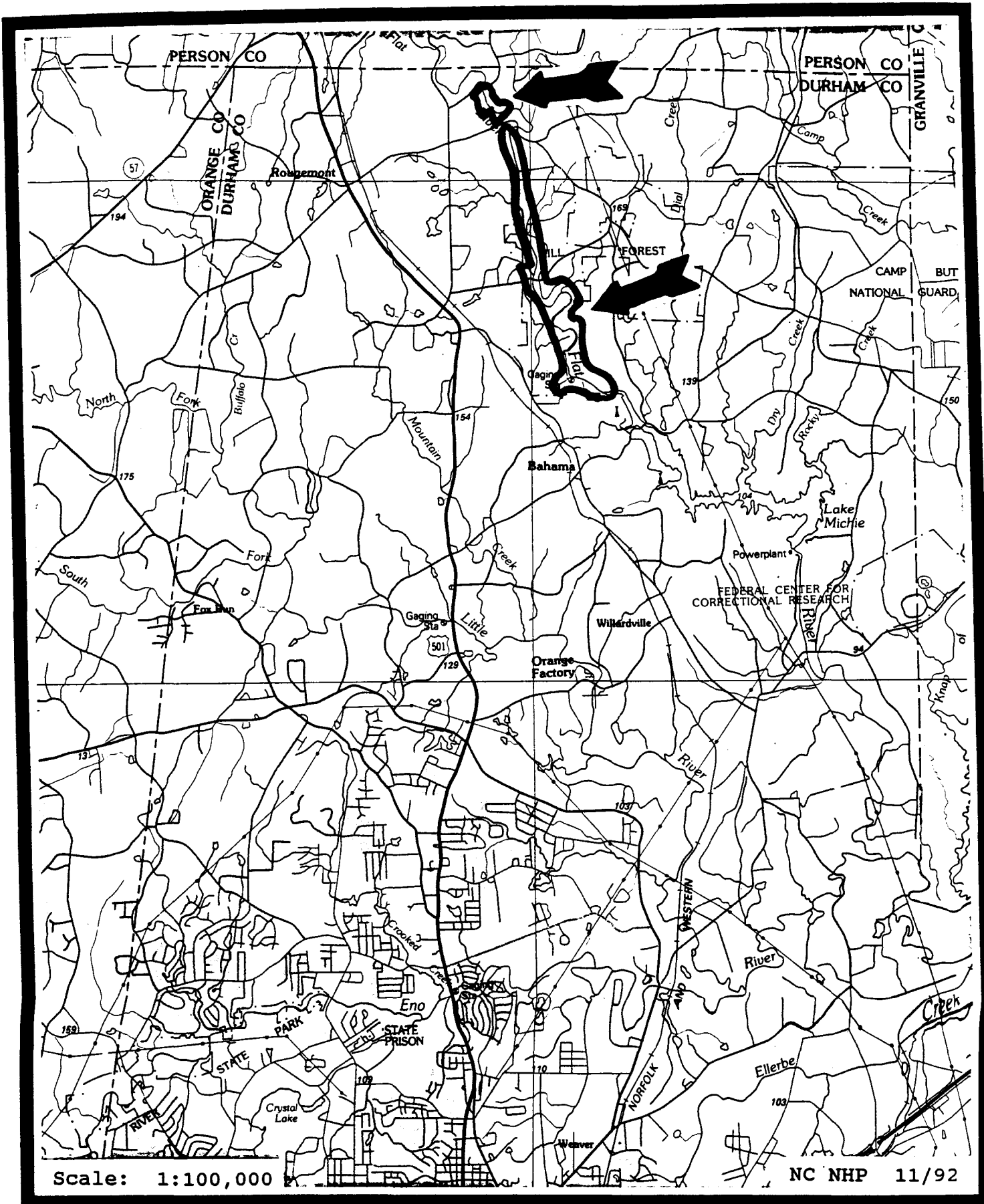
PROTECTION STATUS: This site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site is managed by the N.C. Wildlife Resources Commission. No timber harvesting is recommended within the exemplary hardwood forest communities of this natural area. The wildflower diversity makes this site the most "fragile" of the Falls Lake natural areas, and no active publicity and signage is recommended for this area in order to minimize impacts from public use. A diked waterfowl subimpoundment being constructed in the adjacent pasture area to the south of the designated natural area was relocated to avoid impacts to the natural area.

COMMENTS: None

REFERENCES:

- Moore, J., Sanders, D. Heron, M. Nygard, Needhams, D. Crouse, R. Jertle, and J. Lynch. 1981. Saunders' Flat River Bend Natural Areas. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- _____ and H.E. LeGrand, Jr. 1987. Falls Lake Natural Areas. N.C. Natural Heritage Program.
- Sutter, R.D., E. Harrison, and D. Rettig. 1987. Inventory of the natural areas and rare species of Durham County. Report to Durham County, Triangle Land Conservancy, Durham County Inventory, and North Carolina Natural Heritage Program.



Site Name: Flat River Slopes above Lake Michie
 Site Code: DU8
 Quadrangle: Henderson

SITE NAME: Flat River Slopes above Lake Michie

SITE CODE: DU8

SIZE: 255 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Durham

QUADRANGLE: Henderson (1:100,000 scale)

LOCATION: This site is in the Flat Neuse River watershed in Durham County in the Piedmont Province of North Carolina. It is on the west side of the Flat River; extending from the upper end of Lake Michie to SR 1602.

SIGNIFICANT FEATURES:

1. This site contains two rare plant species: glade milkvine (Matelea decipiens) and isopyrum (Enemion biternatum), both significantly rare in the state.

2. This natural area is located in a very scenic river corridor with a wide array of natural community types.

GENERAL DESCRIPTION:

The site is a complex of several sections of hardwood forests on the slopes west of the Flat River, bisected by roads which cross the river. The forests are mature and moist and have a rich herb layer, except on some of the steeper bluffs and rocky slopes which have a thick layer of mountain laurel (Kalmia latifolia). A few small waterfalls exist in the southernmost part of the site, where steep slopes converge on the river. The site overlooks the very rocky, scenic Flat River.

Rock types underlying the site include metamorphosed granitic rock, felsic metavolcanic rock and intermediate volcanic rock. Soils consist of Wedowee sandy loam, Tatum gravelly silt loam, Georgeville silt loam, Congaree silt loam, Nason silt loam, Goldston slaty silt loam, and soil of the Chewacla series. The predominant natural community is Mesic Mixed Hardwood Forest (Piedmont Subtype). Piedmont/Coastal Plain Acidic Cliff communities occupy small areas within the forest. The forest grades slightly toward Piedmont/Mountain Alluvial Forest or Dry-Mesic Oak-Hickory Forest in a few places.

The Mesic Mixed Hardwood Forest canopy is mature and dominated by American beech (Fagus grandifolia) and red oak (Quercus rubra). Also common are tuliptree (Liriodendron tulipifera) and sweetgum (Liquidambar styraciflua). Other species present include the uncommon Appalachian basswood (Tilia americana var. heterophylla) and Carolina basswood (T. floridana), swamp chestnut oak (Q. michauxii), white ash (Fraxinus americana), green ash (F. pennsylvanica), American sycamore (Platanus occidentalis), box elder (Acer negundo), American elm (Ulmus americana), and slippery elm (U. rubra). On the gentler slopes and narrow floodplain north of SR 1614, canopy

dominance shifts to sugarberry (Celtis laevigata) and river birch (Betula nigra) that have dbh's to 3 feet. Further northward, southern sugar maple (Acer floridanum) becomes abundant. The understory contains species such as hophornbeam (Ostrya virginiana), American holly (Ilex opaca), and American hornbeam (Carpinus caroliniana).

The site contains many species of shrubs. A dense layer of mountain laurel exists in many places. Uncommon species include Catawba rhododendron (Rhododendron catawbiense) and smooth azalea (R. arborescens). Other common shrubs are painted buckeye (Aesculus sylvatica), bladdernut (Staphylea trifolia), common pawpaw (Asimina triloba), storax (Styrax grandifolia), wild hydrangea (Hydrangea arborescens), and beaked hazelnut (Corylus cornuta). In most areas, a lush herb layer is present and may include glade milkvine (Matelea decipiens) and isopyrum (Enemion biternatum), both significantly rare in the state. Many species uncommon in the Piedmont are present: ginseng (Panax quinquefolius), goat's-beard (Aruncus dioicus), American spikenard (Aralia racemosa), Appalachian barren-strawberry (Waldsteinia fragarioides), rockcap fern (Polypodium virginianum), marginal shield fern (Dryopteris marginalis), puttyroot (Aplectrum hyemale), green violet (Hybanthus concolor), showy orchis (Galearis spectabilis), foxglove (Aureolaria flava), smooth peavine (Lathyrus venosus), and shining clubmoss (Lycopodium lucidulum).

A few Piedmont/Coastal Plain Acidic Cliff communities are present at this site. Plant species scattered throughout these communities include columbine (Aquilegia canadensis), fire pink (Silene virginica), early saxifrage (Saxifraga virginiana), and rockcap fern. The locally-rare mountain spleenwort (Asplenium montanum) is also present on vertical rock faces.

The site supports a diverse avifauna which includes the scarlet tanager (Piranga olivacea), prothonotary warbler (Protonotaria citrea), red-eyed vireo (Vireo olivaceus), northern parula (Parula americana), acadian flycatcher (Empidonax virescens), great crested flycatcher (Myiarchus crinitus), yellow-billed cuckoo (Coccyzus americanus), turkey vulture (Cathartes aura), and barred owl (Strix varia). Birds such as the Louisiana waterthrush (Seiurus motacilla) and hooded warbler (Wilsonia citrina) are known to nest at this site. Woodchucks (Marmota monax), cricket frogs (Acris sp.), and bullfrogs (Rana catesbeiana) also inhabit the area.

OWNERSHIP: The southern half of the site is owned in part by the state (administered by North Carolina State University), by the city of Durham, and by a private landholder. The northern half of the site is in multiple private ownership.

PROTECTION STATUS: The N.C. State University portion of this site is a Dedicated State Nature Preserve; the portion owned by the city of Durham receives some protection as part of Spruce

Pine Lodge and Lake Michie Buffer. The northern portion has received no protection.

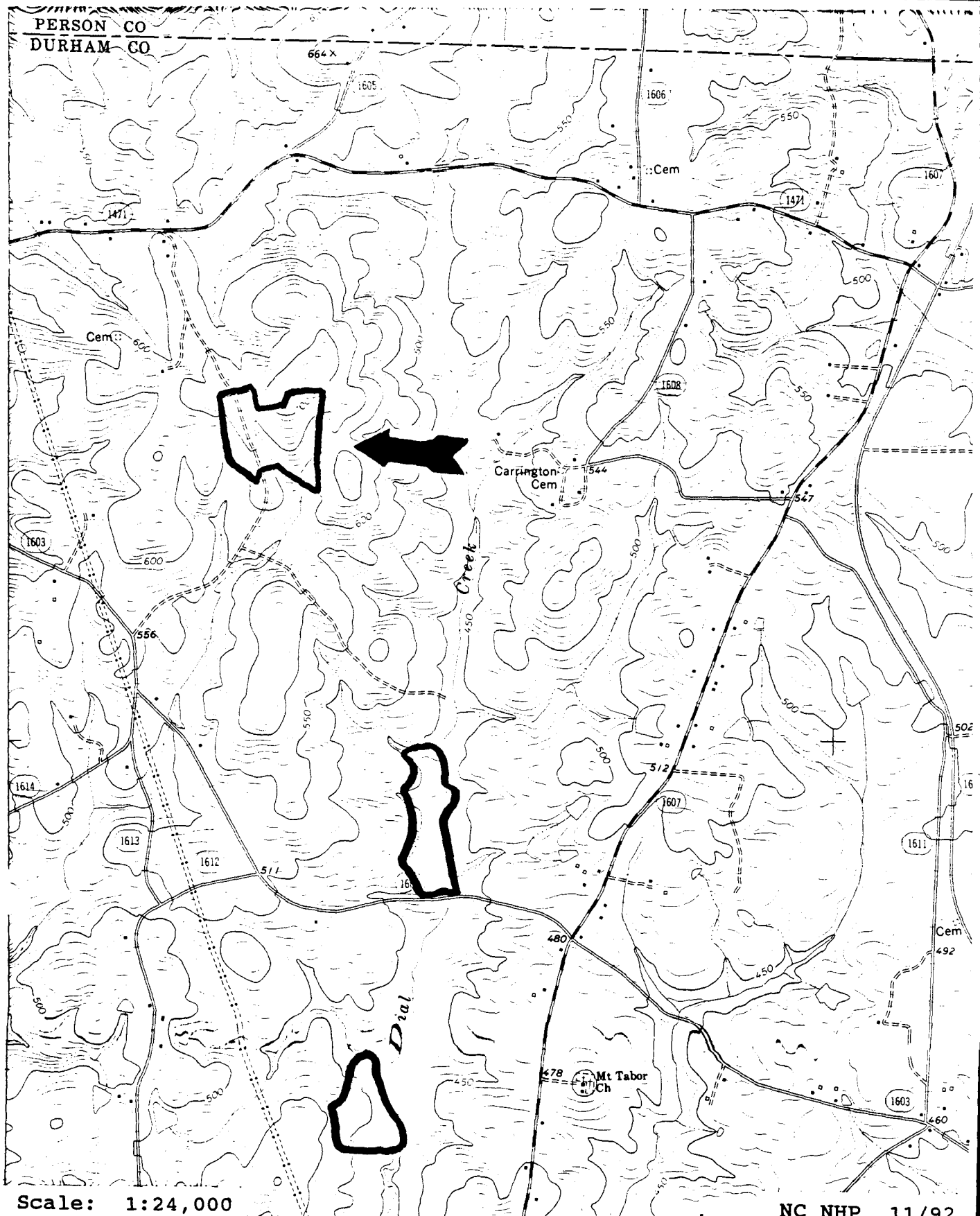
MANAGEMENT OR PROTECTION RECOMMENDATIONS: Clearcutting on uplands at the top of the slopes on North Carolina State University land (Hill Forest) should be discouraged. In general, the area has otherwise been well-protected from disturbance.

COMMENTS: Plant inventory especially on the slopes on the east side of the river is needed. Aquatic animal inventory is needed, especially for fishes. The city of Durham has planned to raise the water level of Lake Michie or to construct a new reservoir further north of the lake. This reservoir would flood part of the northern section of the natural area. Thus, the future of the natural area, at least the area north of N.C. State University's property, is in considerable jeopardy.

REFERENCES:

LeGrand, H.E., Jr. 1986. Flat River Slopes above Lake Michie. Natural Area Reconnaissance. N.C. Natural Heritage Program.

PERSON CO
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Scale: 1:24,000

NC NHP 11/92

Site Name: Hill Forest Chestnut Oak-Shortleaf Pine Forest
Site Code: DU9
Quadrangle: Lake Michie

SITE NAME: Hill Forest Chestnut Oak-Shortleaf Pine Forest

SITE CODE: DU9

SIZE: 15 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Durham

QUADRANGLE: Lake Michie

LOCATION: This site is in the Neuse River watershed in Durham County in the Piedmont Province of North Carolina. It is in the extreme northeastern corner of Hill Forest; about 1 mile north-northeast of the intersection of SR 1603 and SR 1613.

SIGNIFICANT FEATURES: This site contains a good quality Piedmont Monadnock Forest community.

GENERAL DESCRIPTION: Hill Forest is located in the Western Carolina Slate Belt Region of the state. In the extreme northeastern corner of Hill Forest is a small monadnock. Present on its upper slopes, at about 700 feet mean sea level, is a good quality Piedmont Monadnock Forest. This is a xeric forest characteristic of monadnocks and ridge crests in this region of the Piedmont. The canopy of this forest is dominated by chestnut oak (Quercus prinus). Also common in the canopy is shortleaf pine (Pinus echinata). The diversity of the shrub and herb layers is low. Most common in the shrub layer are blueberries (Vaccinium spp.); arrowwood (Viburnum rafinesquianum) is also common. The most conspicuous and frequent herbs are arrowleaf ginger (Hexastylis arifolia) and spotted wintergreen (Chimaphila maculata). Diversity of species, both woody and herbaceous, increases as moisture and soil conditions improve below the ridge crest.

OWNERSHIP: This natural area is owned by the state and is administered by the College of Forest Resources, North Carolina State University.

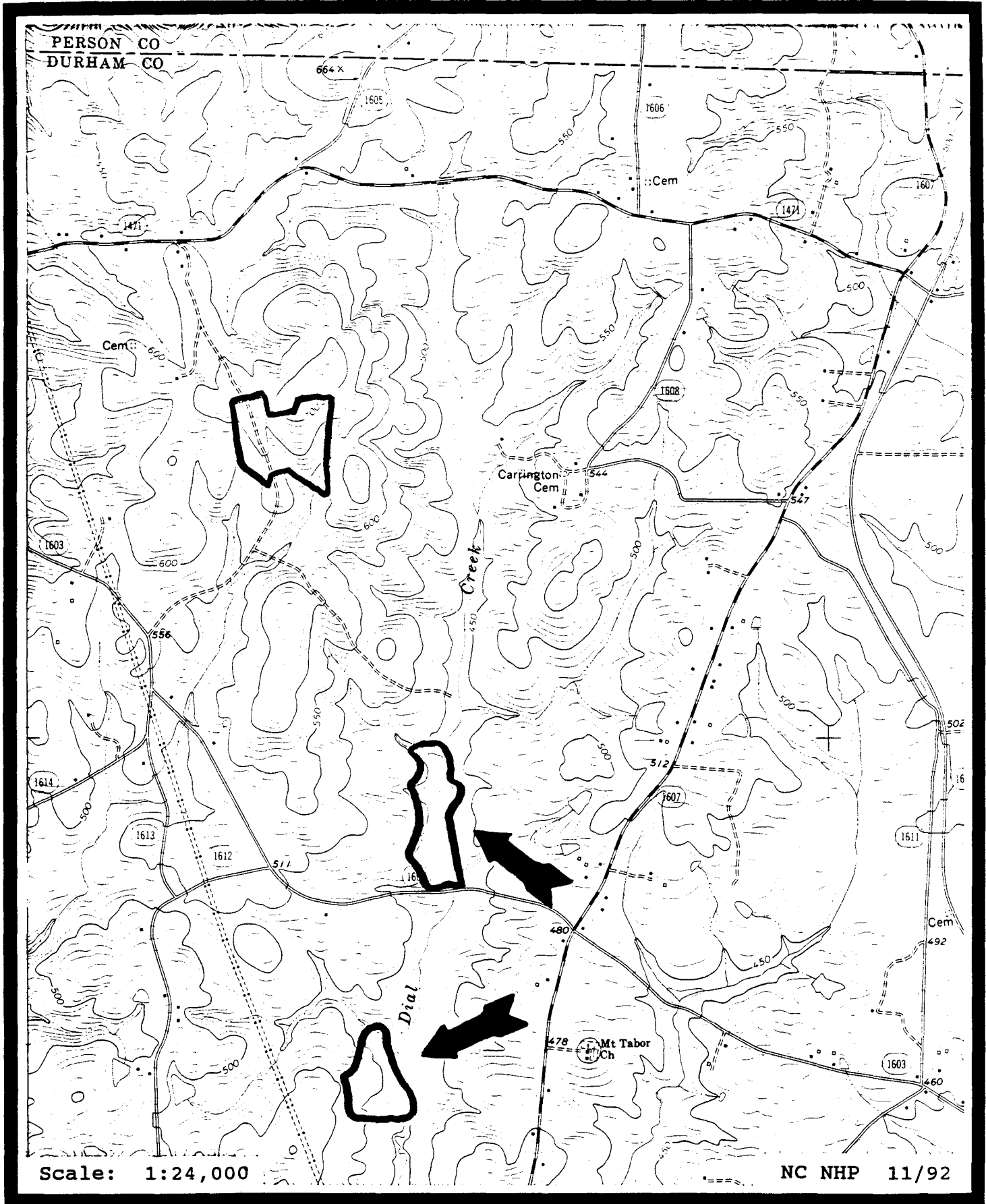
PROTECTION STATUS: It is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The immediate surrounding lands are in general timber management either by the College of Forest Resources as part of the Hill Demonstration Forest long-term management program or by private landowners. To the west and north of Hill Forest, rural residential neighborhoods are being replaced by subdivisions. The land to the east and south of Hill Forest is largely undeveloped woodland or is in agricultural use. Although the forest within the natural area has been selectively logged in the past, more intensive forest management could seriously degrade the site or alter the species composition of the natural communities.

COMMENTS: This natural area is used extensively by students and faculty for education and research as a part of the ongoing forestry program of Hill Demonstration Forest. Research conducted at this site includes studies on shortleaf pine.

REFERENCES:

Moore, J.H. and H.E. LeGrand, Jr. 1988. Hill Demonstration Forest Natural Areas. Natural Area Summary. N.C. Natural Heritage Program.



Site Name: Hill Forest Dial Creek Hardwood Forest
 Site Code: DU10
 Quadrangle: Lake Michie

SITE NAME: Hill Forest Dial Creek Hardwood Forest

SITE CODE: DU10

SIZE: 44 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Durham

QUADRANGLE: Lake Michie

LOCATION: This site is in the Neuse River watershed in Durham County in the Piedmont Province of North Carolina. It is along the western side of Dial Creek; extends from the northern boundary of Hill Forest about 0.75 mile north of SR 1603 southward to the southern boundary of Hill Forest.

SIGNIFICANT FEATURES:

1. This site contains four good quality natural community types: Piedmont/Mountain Semipermanent Impoundment, Piedmont/Low Mountain Alluvial Forest, Mesic Mixed Hardwood Forest, and Dry-Mesic Oak-Hickory Forest.

2. A State Candidate species, purple fringeless orchid (Platanthera permoena), occurs in this natural area.

GENERAL DESCRIPTION:

Hill Forest lies within the Western Carolina Slat Belt Region. On the gentle slopes on the west side of Dial Creek and on a rather narrow bottomland along the creek is a mature Piedmont/Low Mountain Alluvial Forest. The bottomland north of SR 1603, which previously was an old pasture or meadow, contains a high percentage of sweetgum (Liquidambar styraciflua). Also present are swamp chestnut oak (Quercus michauxii), American sycamore (Platanus occidentalis), and shagbark hickory (Carya ovata). The diameters of the canopy trees averages 9-12 inches, though scattered trees are over 2 feet in diameter, particularly on the slopes.

The floodplain at this site narrows toward the northern boundary of Hill Forest. Where the floodplain narrows is a distinct east-facing slope adjacent to Dial Creek. A Mesic Mixed Hardwood Forest occurs on these slopes. This forest contains some of the largest individuals of oaks, American beech (Fagus grandifolia), and hickories in Hill Forest with diameters of 2-3 feet.

Covering ridge areas at the site is a Dry-Mesic Oak-Hickory Forest. Common canopy trees include white oak (Quercus alba), southern red oak (Q. falcata), black oak (Q. velutina), mockernut hickory (Carya tomentosa), and pignut hickory (C. glabra). Mixed with the oaks and hickories are American beech, tuliptree (Liriodendron tulipifera), and northern red oak (Q. rubra), but these species are more numerous on the lower slopes. The best example of this forest type is located on an east-facing slope northeast of the terminus of a road and south of a creek draining east into Dial Creek. Notable plants of these upland forests include pipsissewa (Chimaphila umbellata), which is locally

common in Hill Forest but scarce elsewhere in the state; inkberry (Ilex glabra), widespread in the Coastal Plain but rare in the Piedmont; and puttyroot (Aplectrum hyemale), and orchid that is infrequently found in the eastern Piedmont. The rarest plant in the natural area is purple fringeless orchid (Platanthera permoena), a State Candidate species, first seen at this site in 1992.

Along Dial Creek at the southern boundary of Hill Forest are two recently created beaver ponds (Piedmont/Mountain Semipermanent Impoundments). The ponded water has killed scattered trees in the bottomland. Marshes are being created by the high water and the opening of the canopy as the trees die. These ponds provide habitat for amphibians and waterbirds, as well as for beavers and other wildlife.

OWNERSHIP: This natural area is owned by the state and is administered by the College of Forest Resources, North Carolina State University.

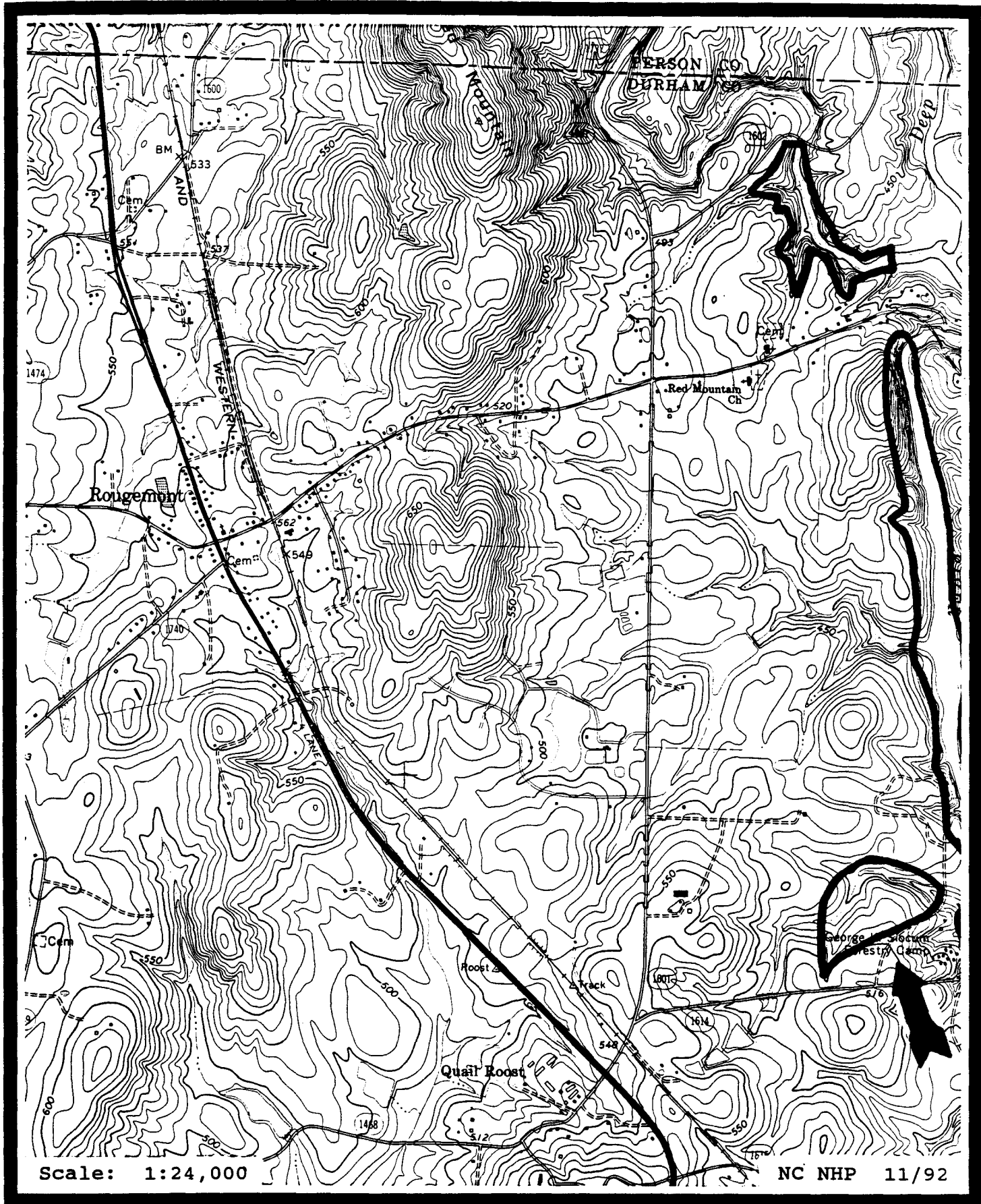
PROTECTION STATUS: It is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The immediate surrounding lands are in general timber management either by the College of Forest Resources as part of the Hill Demonstration Forest long-term management program or by private landowners. To the west and north of Hill Forest, rural residential neighborhoods are being replaced by subdivisions. The land to the east and south of Hill Forest is largely undeveloped woodland or is in agricultural use. Although the forest within the natural area has been selectively logged in the past, more intensive forest management could seriously degrade the site or alter the species composition of the natural communities.

COMMENTS: This natural area is used extensively by students and faculty for education and research as a part of the ongoing forestry program of Hill Demonstration Forest.

REFERENCES:

Moore, J.H. and H.E. LeGrand, Jr. 1988. Hill Demonstration Forest Natural Areas. Natural Area Summary. N.C. Natural Heritage Program.



Site Name: Hill Forest Slocum Camp Hardwood Forest
 Site Code: DU11
 Quadrangle: Rougemont

SITE NAME: Hill Forest Slocum Camp Hardwood Forest

SITE CODE: DU11

SIZE: 43 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Durham

QUADRANGLE: Rougemont

LOCATION: This site is in the Neuse River watershed in Durham County in the Piedmont Province of North Carolina. It is about 0.25 mile northwest of George K. Slocum Forestry Camp, on the west side of a forest road; north of SR 1614 and west of Flat River.

SIGNIFICANT FEATURES: This site contains an excellent example of a Mesic Mixed Hardwood Forest (Piedmont Subtype) natural community type.

GENERAL DESCRIPTION:

Hill Forest lies within the Western Carolina Slate Belt Region. Slocum Camp Hardwood Forest is located on the slopes of a small stream just northwest of the Slocum Forestry camp. An excellent example of a Mesic Mixed Hardwood Forest (Piedmont Subtype) is present at this site, especially on the north-facing slope. The canopy of this forest is mature and is dominated by tuliptree (Liriodendron tulipifera). Also common in the canopy are white oak (Quercus alba), northern red oak (Q. rubra), American beech (Fagus grandifolia), and several hickory species (Carya spp.). A few of the northern red oaks have diameters of about 3 feet. The herb layer in this forest is fairly rich, with a remarkable abundance of Catesby's trillium (Trillium catesbaei). Other herbs of note on the slopes are showy skullcap (Scutellaria serrata), southern wood violet (Viola hirsutula), crested dwarf iris (Iris cristata), and foamflower (Tiarella cordifolia).

On the north-facing slope is an unusual planted grove of American chestnut (Castanea dentata). These chestnut trees are at least 50-60 feet tall and have diameters of over 2 feet. They have not succumbed to the chestnut blight, as yet. Most chestnuts in its natural range exist today as saplings or root sprouts. Mature trees are rarely seen.

OWNERSHIP: This natural area is owned by the state and is administered by the College of Forest Resources, North Carolina State University.

PROTECTION STATUS: It is a Registered Natural Heritage Area.

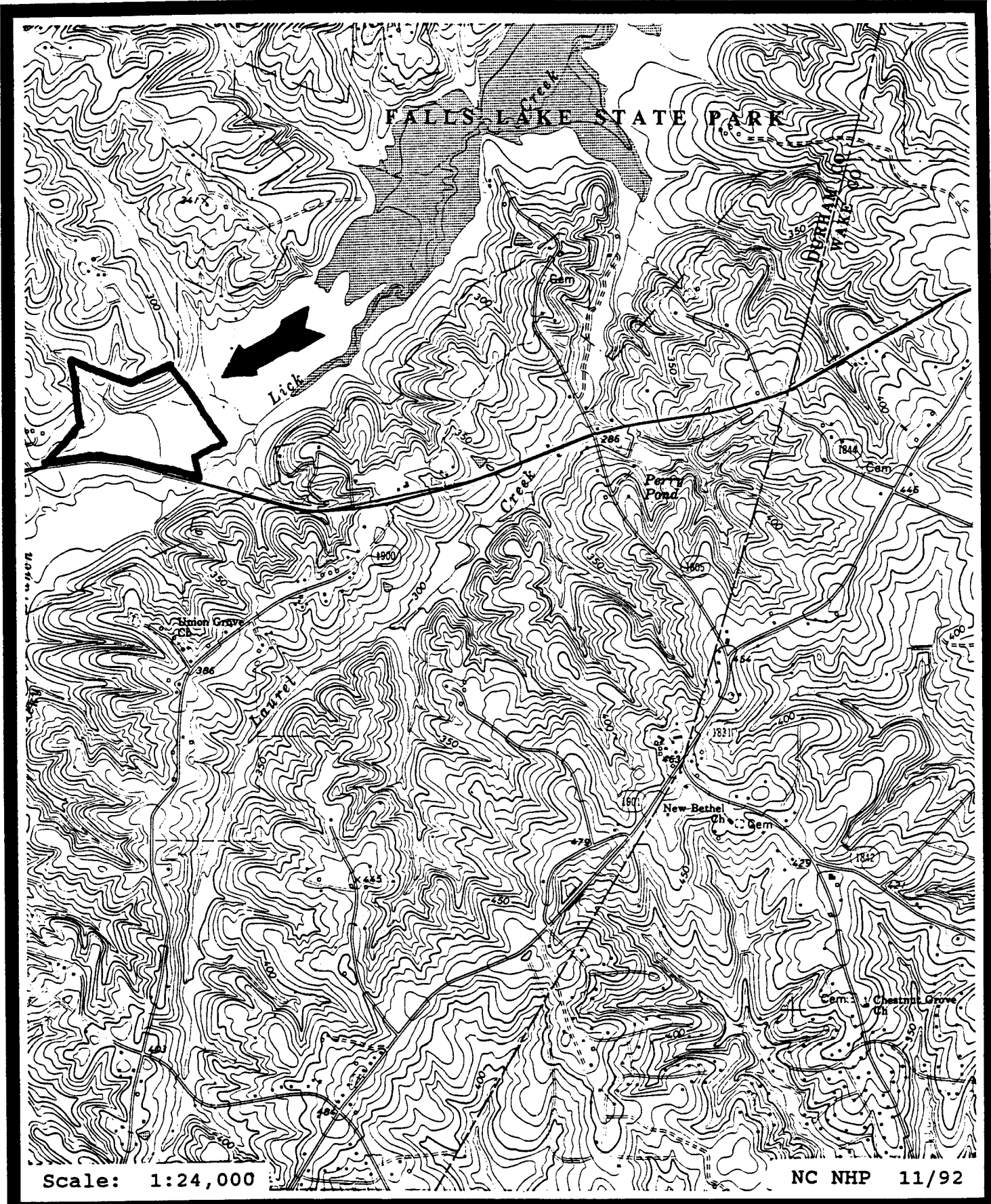
MANAGEMENT OR PROTECTION RECOMMENDATIONS: The immediate surrounding lands are in general timber management either by the College of Forest Resources as part of the Hill Demonstration Forest long-term management program or by private landowners. To

the west and north of Hill Forest, rural residential neighborhoods are being replaced by subdivisions. The land to the east and south of Hill Forest is largely undeveloped woodland or is in agricultural use. Although the forest within the natural area has been selectively logged in the past, more intensive forest management could seriously degrade the site or alter the species composition of the natural communities.

COMMENTS: This natural area is used extensively by students and faculty for education and research as a part of the ongoing forestry program of Hill Demonstration Forest.

REFERENCES:

Moore, J.H. and H.E. LeGrand, Jr. 1988. Hill Demonstration Forest Natural Areas. Natural Area Summary. N.C. Natural Heritage Program.



Site Name: Lick Creek Bottomland Forest
 Site Code: DU12
 Quadrangle: Bayleaf

SITE NAME: Lick Creek Bottomland Forest

SITE CODE: DU12

SIZE: 65 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Durham

QUADRANGLE: Bayleaf

LOCATION: This site is in the Neuse River watershed in southeastern Durham County in the Piedmont Province of North Carolina. It is located on the west side of Lick Creek; north of NC 98; between SR 1809 and SR 1900.

SIGNIFICANT FEATURES:

1. This site contains a very extensive population of Douglass's bittercress (Cardamine douglassii), a significantly rare species.
2. Also present at this site is a good quality Piedmont/Low Mountain Alluvial Forest.

GENERAL DESCRIPTION:

This site contains an extensive bottomland in the floodplain of Lick Creek. This floodplain is broad immediately north of NC 98, wider than might be anticipated for a creek of its size. This is a fairly common occurrence for low gradient streams which flow through the readily erodible soils of the Durham Triassic Basin. Southeast-facing slopes occur above the creek floodplain and support a mature mixed hardwood forest over a circumneutral or basic soil. Most hardwood forests in the Falls Lake area occur over acidic soils.

The periodically flooded bottomland at this site supports a Piedmont/Low Mountain Alluvial Forest with a diverse assemblage of hardwoods and loblolly pine (Pinus taeda). Common hardwoods include river birch (Betula nigra), red maple (Acer rubrum), sycamore (Platanus occidentalis), sweetgum (Liquidambar styraciflua), green ash (Fraxinus pennsylvanica), and American elm (Ulmus americana). Three oaks are also typical: cherrybark (Quercus pagoda), swamp chestnut (Q. michauxii), and white (Q. alba). On slightly elevated zones where the drainage is better grow American beech (Fagus grandifolia) and southern sugar maple (Acer floridanum). The subcanopy and shrub layers are sparse. American hornbeam (Carpinus caroliniana) and hop hornbeam (Ostrya virginiana) are present in the subcanopy. Typical shrubs include strawberrybush (Evonymus americana), deciduous holly (Ilex decidua), and black haw (Viburnum prunifolium).

In early spring Douglass' bittercress (Cardamine douglassii), significantly rare in North Carolina, grows in abundance throughout the floodplain. Many sites for this species were destroyed when the Falls Reservoir was created. An unusual combination of three species of clubmoss occurs at this site. Growing abundantly in a mixed population are groundpine (Lycopodium obscurum), which is rare in the Piedmont; shining

clubmoss (L. lucidulum), a somewhat restricted species; and the common running-pine (L. flabelliforme). More typical bottomland herbs include spring beauty (Claytonia virginica), bed straw (Galium spp.), and various violets (Viola spp.)

The narrow southeast-facing slope above the floodplain supports a marginal example of Basic Oak-Hickory Forest that is somewhat uncommon. Typical species are white oak, post oak (Quercus stellata), blackjack oak (Q. marilandica), and Florida maple. Several hickories are present, including mockernut hickory (Carya tomentosa). Large diameter eastern redcedars (Juniperus virginiana) are common and mature shortleaf pines (Pinus echinata) are scattered. Downy arrow-wood (Viburnum rafinesquianum) is the only common shrub; a few subcanopy-sized redbud (Cercis canadensis) are present. Coral honeysuckle (Lonicera sempervirens) is unusually abundant. This Basic Oak-Hickory Forest natural community apparently has developed over circumneutral or basic soils, which are not typical for this region.

OWNERSHIP: This site is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

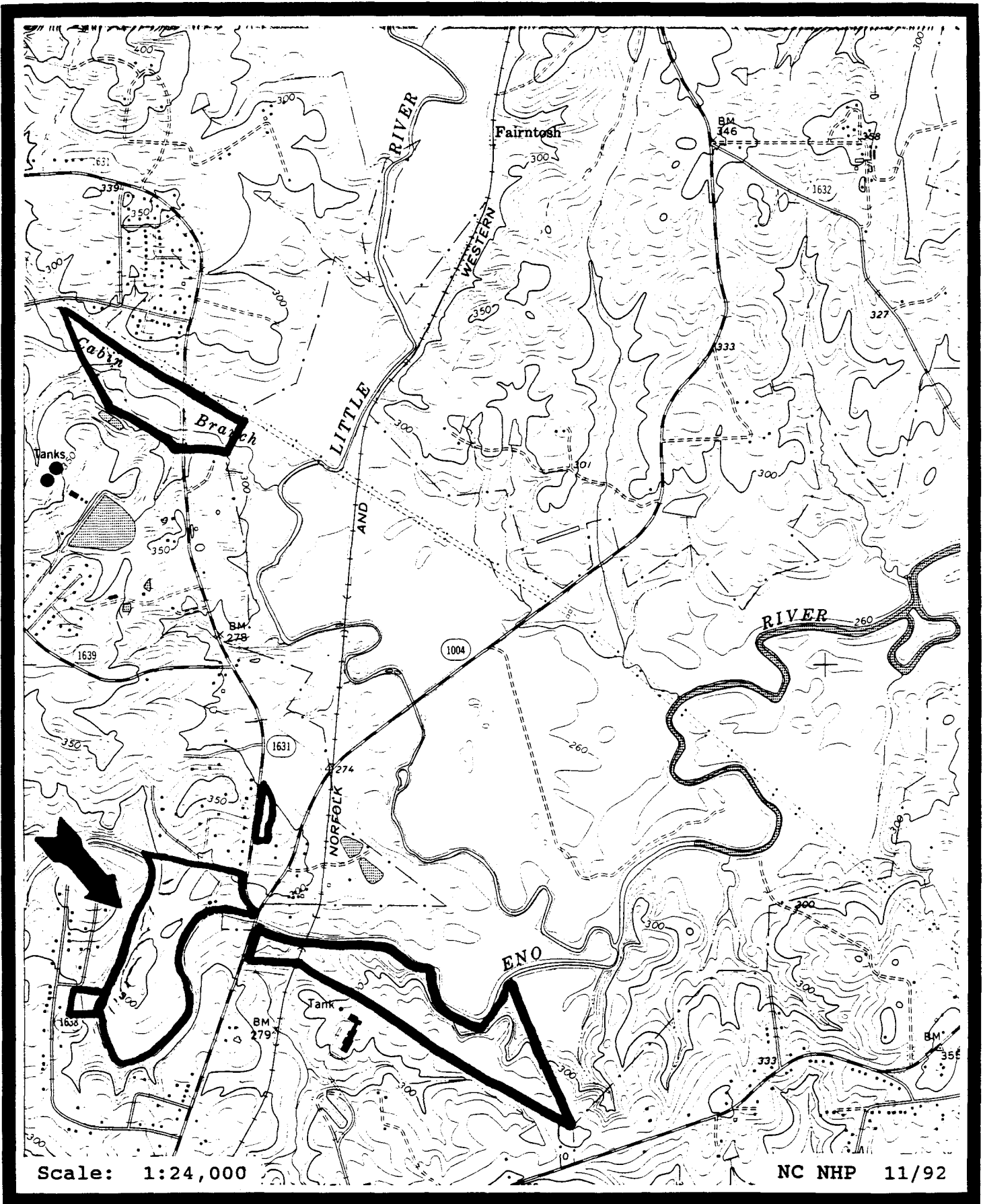
PROTECTION STATUS: This site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The N.C. Wildlife Resources Commission manages this site. Protection of the natural drainage patterns at this site is the primary management recommendation.

COMMENTS: This natural area would lie perilously close to the normal flood pool of Falls Lake if the lake levels were to be raised by at least a foot, as proposed by the Corps of Engineers.

REFERENCES:

- Moore, J.H. and H.E. LeGrand, Jr. 1989. Falls Lake Natural Areas. N.C. Natural Heritage Program.
- Sutter, R.D., E. Harrison, and D. Rettig. 1987. Inventory of the natural areas and rare species of Durham County. Report to Durham County, Triangle Land Conservancy, Durham County Inventory, and North Carolina Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Penny's Bend--Eno River Bluffs
 Site Code: DU13
 Quadrangle: Northeast Durham

SITE NAME: Penny's Bend--Eno River Bluffs

SITE CODE: DU13

SIZE: 73 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Durham

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in eastern Durham County in the Piedmont Province of North Carolina. It is on the north side of the Eno River in a large southward loop; 0.2 mile upstream (west) from SR 1004.

SIGNIFICANT FEATURES:

1. At this site are several rare plant species: low wild-petunia (Ruellia humilis), a State Threatened species; prairie dock (Silphium terebinthinaceum) and prairie blue wild indigo (Baptisia australis var. minor), both State Candidate species; and hoary puccoon (Lithospermum canescens) and glade milkvine (Matelea decipiens), both significantly rare species.

2. Also present at this site is a small, yet high quality, Basic Mesic Forest (Piedmont Subtype) with many large trees.

GENERAL DESCRIPTION:

This site, located inside a U-shaped "bend" of the Eno River, contains a distinctive flora. Both the river bend and the flora present are the result of the underlying geologic formation. An extensive, resistant diabase sill (part of the Braggtown Sill) causes the bending of the river course. This diabase rock weathers to a circumneutral Iredell soil which has a higher Ph (basic) compared to the typical acidic soils of the Piedmont.

Formerly part of the huge Cameron Plantation, Penny's Bend has a 200+ year history of agricultural and pastureland use. Located here is a 40 foot high, north-south trending ridge, the top of which was formerly pastureland. It remains open and dominated by a variety of grasses and herbaceous plants with occasional thickets of blackberries (Rubus spp.) and coralberries (Symphoricarpos orbiculatus) and young eastern redcedar trees (Juniperus virginiana). An old farm pond is also located on the ridge.

The combination of geology, soil, and open pasture conditions in the upland area has resulted in conditions suitable to the establishment of several rare plant species that are more typical of the Midwestern prairie region. Rare prairie plant species found here are prairie blue wild indigo (Baptisia australis var. minor), hoary puccoon (Lithospermum canescens), and prairie dock (Silphium terebinthinaceum). Located on adjacent property and possibly at this site is the Federally Endangered smooth coneflower (Echinacea laevigata). Other interesting species in the open fields and adjacent forest are

leather flower (Clematis ochroleuca) and fragrant sumac (Rhus aromatica).

The 40 foot high, mesic, river slopes present at this site contain exposed diabase boulders and support a small, yet high quality, Basic Mesic Forest (Piedmont Subtype). This community contains many large trees and a wide variety of spring wildflowers. Common tree species include red maple (Acer rubrum), several hickory species (Carya spp.), flowering dogwood (Cornus florida), tuliptree (Liriodendron tulipifera), and a few oak species (Quercus spp.). Some of the common herb species include dutchman's breeches (Dicentra cucullaria), and common bluets (Houstonia caerulea). These forested, rocky slopes provide attractive vistas over the river and lower pasture.

Along the rocky river channel and narrow floodplain are alluvial hardwood forests with large trees. Common trees of these forests include box elder (Acer negundo), American hornbeam (Carpinus caroliniana), persimmon (Diospyros virginiana), loblolly pine (Pinus taeda), American sycamore (Platanus occidentalis), and willow oak (Quercus phellos). Common herbs include yellow fumewort (Corydalis flavula), spring beauty (Claytonia virginica), and Japanese grass (Microstegium vimineum).

OWNERSHIP: This site is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The site is managed as an interpretive and research natural area by the North Carolina Botanical Garden Foundation through a lease with the state. Management actions already begun involve bushhogging and cutting of sections of the old pasture areas to remove successional tree and shrub growth, removing trash, and gating. The open character of the ridgetop will be maintained through use of prescribed fire and cutting.

COMMENTS: This natural area offers exceptional educational, interpretive, and research opportunities and will be maintained and used for those purposes by the North Carolina Botanical Garden.

REFERENCES:

Moore, J.H. and M. Olwell 1977. Botanical Survey and Evaluation, Falls Lake. Report to the U.S. Army Corps of Engineers, Wilmington, N.C. Wiggins-Rimer and Associates, Durham, N.C.
_____ and H.E. Legrand, Jr. 1989. Falls Lake Natural Areas. N.C. Natural Heritage Program.

Sutter, R.D., E. Harrison, and D. Rettig. 1987. Inventory of the natural areas and rare species of Durham County. Report to Durham County, Triangle Land Conservancy, Durham County Inventory, and North Carolina Natural Heritage Program.

EDGECOMBE COUNTY NATURAL AREAS

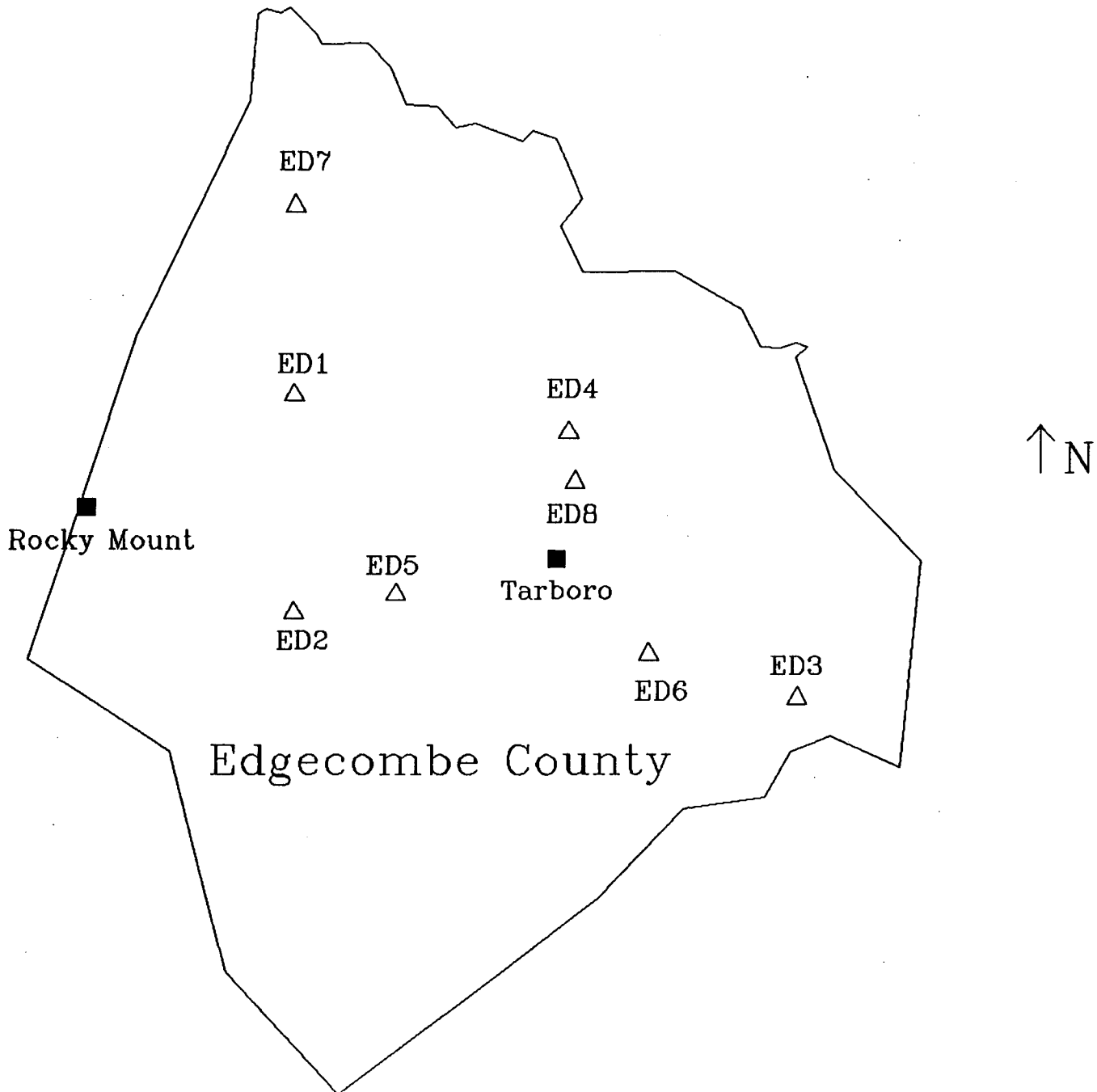


Figure 8. Significant natural areas in the A/P III study area portion of Edgemcombe County



Site Name: Beech Branch--Tar River Meander Loop
 Site Code: ED1
 Quadrangle: Hartsease

SITE NAME: Beech Branch--Tar River Meander Loop

SITE CODE: ED1

SIZE: 300 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Edgecombe

QUADRANGLE: Hartsease

LOCATION: This site is in the Tar River watershed in western Edgecombe County in the Coastal Plain Province of North Carolina. It is along Beech Branch extending about 2 miles north from NC 97, about 1.5 miles east of the Tar River.

SIGNIFICANT FEATURES: This site is a well-developed cut-off meander loop of the Tar River that serves as a channel for Beech Branch. It is a significant geomorphological feature and supports a young to mature forest.

GENERAL DESCRIPTION:

This site is a large, abandoned meander loop of the Tar River, which is now part of the Beech Branch stream system. The area upstream from NC 97 grades from swamp forest to drier bottomland forest as one moves upstream. The presence of swollen tree trunks, multiple channels, surface sediments, crayfish holes, and the absence of leaf litter all indicate the area remains very wet most of the year and probably has standing water for a significant part of the year. The area contains many pools, sluices, hummocks, mud flats, and tree falls. The soil is composed of depositional sediments and is of the Wehadkee Series.

Three natural community types are present at this site: Cypress-Gum Swamp (Brownwater Subtype), Coastal Plain Bottomland Hardwoods (Brownwater Subtype), and Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Upland Flats Variant). The forest types present at this site are variable in age, ranging from young to mature. Most trees have at least a 6 inch dbh and many have a dbh of 1-2 feet.

Upstream from NC 97 the forest changes from a Cypress-Gum Swamp (Brownwater Subtype) that is dominated by water tupelo (Nyssa aquatica), swamp tupelo (N. biflora), and swamp cottonwood (Populus heterophylla), to a wet mesic, possibly successional, Coastal Plain Bottomland Hardwoods (Brownwater Subtype) that is dominated by overcup oak (Quercus lyrata), red maple (Acer rubrum), river birch (Betula nigra), with numerous other species of lesser importance.

The high ground immediately adjacent to the swamp contains a Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Upland Flats Variant) that is dominated by American beech (Fagus grandifolia), white oak (Q. alba), and loblolly pine (Pinus taeda). The subcanopy includes American hornbeam (Carpinus caroliniana) and flowering dogwood (Cornus florida). Some common shrub species are American strawberrybush (Evonymus americana), sweet pepperbush (Clethra alnifolia), and Virginia sweetspire (Itea

virginica). Common herbs include giant cane (Arundinaria gigantea), lizard's-tail (Saururus cernuus), and false nettle (Boehmeria cylindrica).

OWNERSHIP: Multiple private ownership.

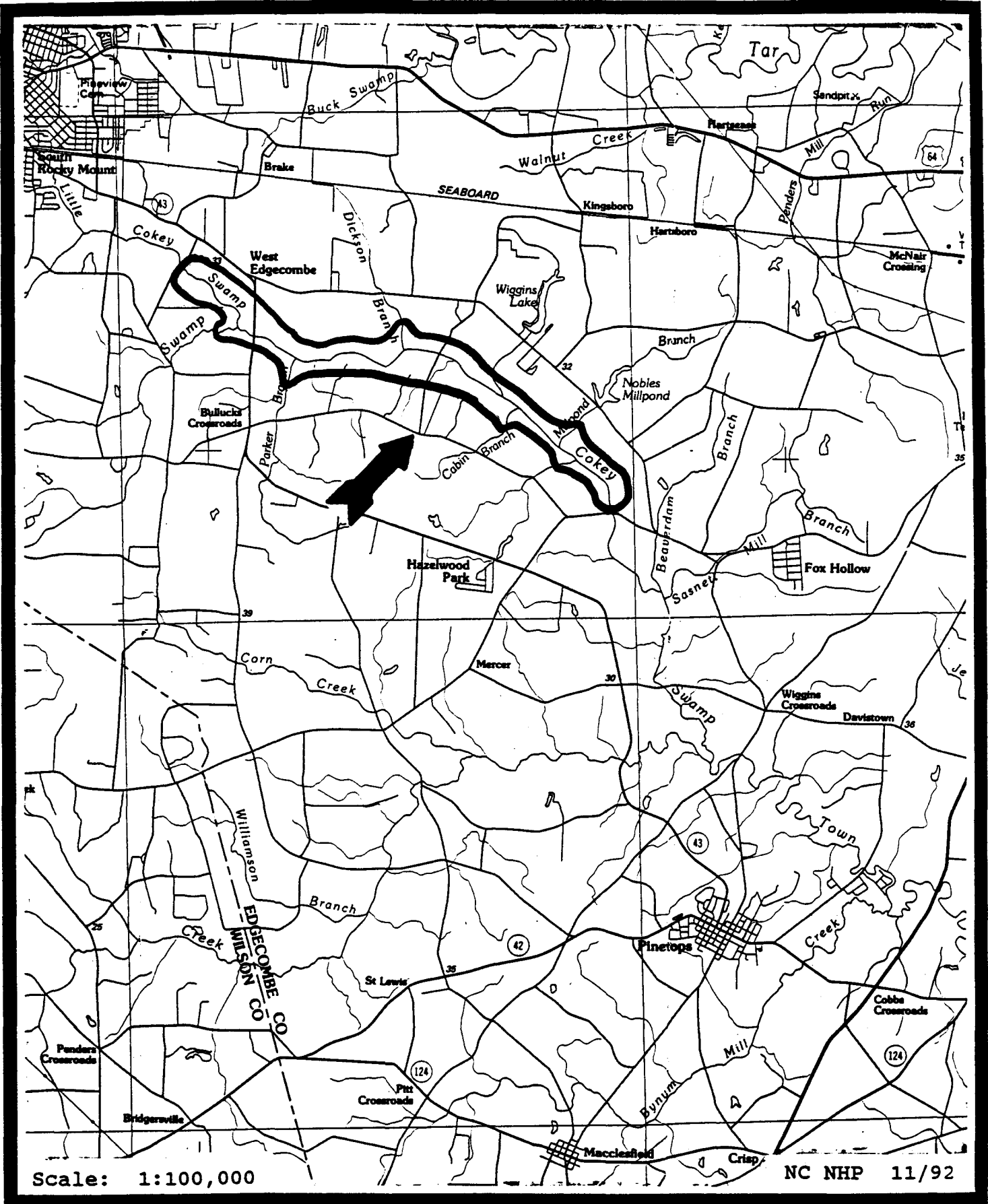
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The forest is, in most places, reaching early maturity, having recovered from cutting that took place possibly as long as 50 years ago. If this site were not disturbed, it would be an isolated swamp forest in about 50 years. Disturbance at this site also includes powerline cuts at two sites across the meander loop. The landowners should be contacted to discuss the significance of the site and the land protection options available.

COMMENTS: A more detailed study could be done at this site by visiting it in late summer to locate more herbaceous flora. This site has not been observed since 1985.

REFERENCES:

Otte L.J. and C. Saunders. 1985. Beech Branch--Tar River Meander Loop. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: Cokey Swamp
 Site Code: ED2
 Quadrangle: Rocky Mount

SITE NAME: Cokey Swamp

SITE CODE: ED2

SIZE: 1700 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Edgecombe

QUADRANGLE: Rocky Mount (1:100,000 scale)

LOCATION: This site is in the Tar River watershed in western Edgecombe County in the Coastal Plain Province of North Carolina. The least disturbed portion of the swamp is along the Cokey Swamp stream between SR 1006 and SR 1124; SR 1223 crosses the site.

SIGNIFICANT FEATURES: This site has occasional stands of very large overcup oak (Quercus lyrata) and swamp chestnut oak (Q. michauxii). One stand is several hundred feet east of SR 1223, containing at least 12 trees that have dbh's of 4-5 feet.

GENERAL DESCRIPTION:

This site is a forested floodplain up to 0.5 mile wide and 4 miles long. Some areas are dry, while others are seasonally inundated. The site is mostly flat with some abandoned channels and some areas which have been cut within the past 20-30 years. A large portion of the swamp contains a mixture of mature hardwoods with dbh's of 1-2 feet and some scattered larger trees. The vegetation changes from near the stream, across the floodplain, and up onto the terraces. The soil is composed of depositional floodplain sediments and belongs to the Bibb Series.

The natural community type present here is the Coastal Plain Small Stream Swamp (Blackwater Subtype). The dominant trees are oaks (Quercus sp.), red maple (Acer rubrum), river birch (Betula nigra), and sweetgum (Liquidambar styraciflua). Common herbs present are lizard's-tail (Saururus cernuus), giant cane (Arundinaria gigantea), and orange jewelweed (Impatiens capensis). Occasional stands of very large overcup oak (Q. lyrata), and swamp chestnut oak (Q. michauxii) occur at this site. Areas upstream from the highways that cross the floodplain are wetter and contain a higher percentage of wetland species than the downstream areas, suggesting some possible alteration of hydrology.

OWNERSHIP: Multiple private ownership.

PROTECTION STATUS: None

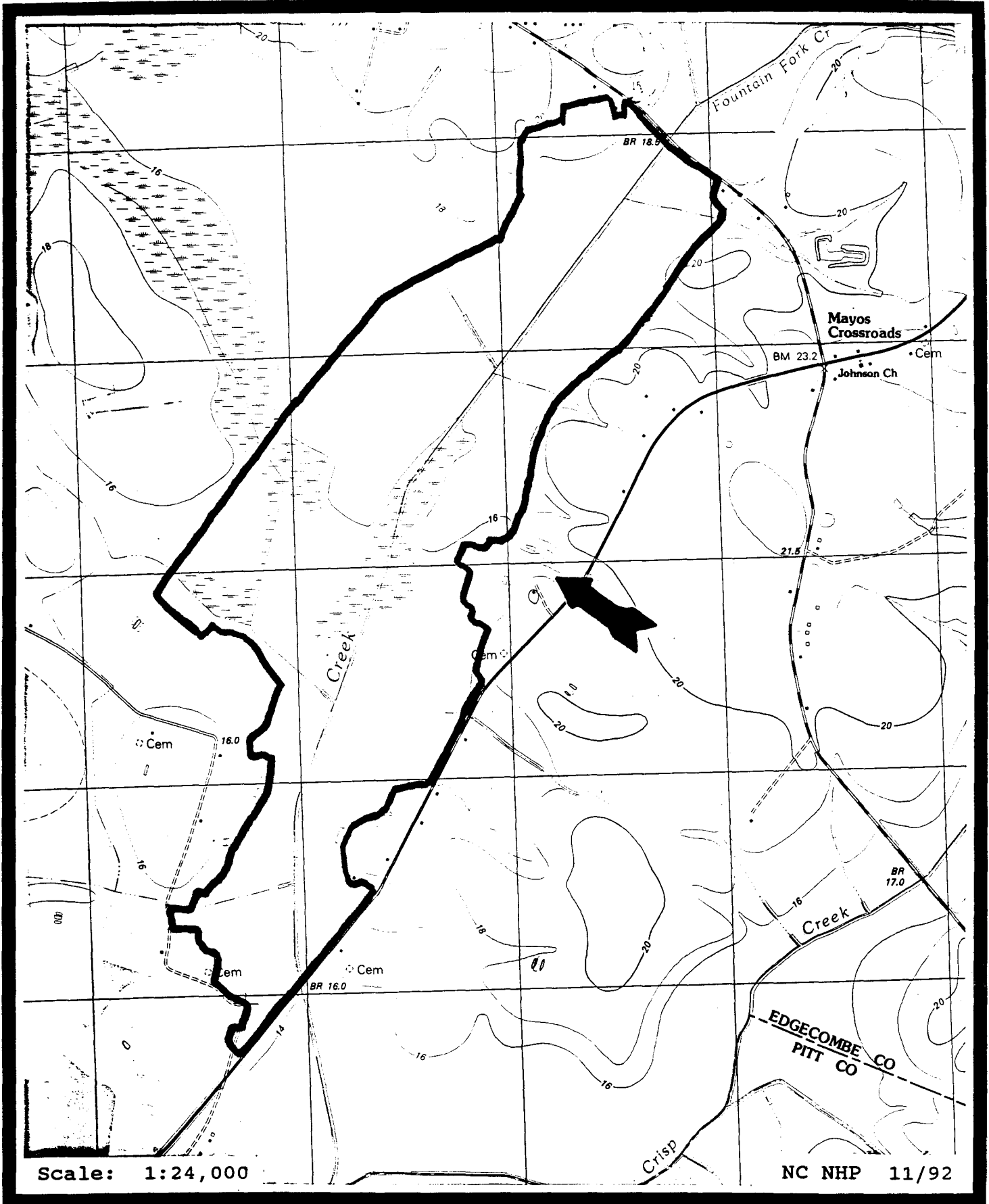
MANAGEMENT OR PROTECTION RECOMMENDATIONS: The vegetation at this site ranges from young hardwood forests 20-30 years old to trees with a dbh of over 4 feet. Evidence of logging is apparent at the site. If left undisturbed, this floodplain has the potential of becoming a mature bottomland forest. The portions of the site

which contain large oak trees should be protected and left undisturbed. The landowners should be informed of the significance of the site and of the land protection options available.

COMMENTS: This site was last visited in 1985. A more complete inventory of the site is needed.

REFERENCES:

Otte, L.J. 1985. Cokey Swamp. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: Conetoe Creek Bottomland Forest
 Site Code: ED3
 Quadrangle: Rocky Mount

SITE NAME: Conetoe Creek Bottomland Forest

SITE CODE: ED3

SIZE: 1000 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Edgecombe

QUADRANGLE: Rocky Mount (1:100,000 scale)

LOCATION: This site is in the Tar River watershed in eastern Edgecombe County in the Coastal Plain Province of North Carolina. It is located along Conetoe Creek; upstream from NC 42 to just upstream from where SR 1527 crosses Conetoe Creek.

SIGNIFICANT FEATURES: This site contains a fairly extensive, mature Coastal Plain Small Stream Swamp (Blackwater Subtype) on both sides of Conetoe Creek.

GENERAL DESCRIPTION:

The Conetoe Creek floodplain is flat with some dredge spoil sites. The soil is composed of depositional floodplain sediments and belongs to the Ballahack, Johnston, and Rains Series. Because Conetoe Creek has been channelized, the floodplain has few or no swampy spots and has experienced some drying out. The presence of thick leaf litter and trees lacking swollen bases indicates a minimal amount of seasonal flooding occurs at this site. There has been little recent disturbance or cutting at this site.

A fairly extensive Coastal Plain Small Stream Swamp (Blackwater Subtype) exists on both sides of the stream. [Because of siltation in the stream, this natural community could be described as having some Brownwater Subtype characteristics.] There are large stands of mature bottomland hardwoods and loblolly pine (*Pinus taeda*) mixed in with younger growth. The mature trees are up to 80-100 feet tall with a dbh of 2 feet. Baldcypress (*Taxodium distichum*) is present, but mainly oaks [swamp chestnut oak (*Quercus michauxii*), white oak (*Q. alba*), swamp laurel oak (*Q. laurifolia*), and water oak (*Q. nigra*)], sweetgum (*Liquidambar styraciflua*), and red maple (*Acer rubrum*) make up the canopy. The open, short subcanopy is dominated by American hornbeam (*Carpinus caroliniana*), sweetbay (*Magnolia virginiana*), and red bay (*Persea borbonia*). Common shrub species include sweet pepperbush (*Clethra alnifolia*), horsesugar (*Symplocos tinctoria*), and elderberry (*Sambucus canadensis*). The herb layer ranges from open to vine covered with occasional patches of dense herb growth. Common herbs include netted chainfern (*Woodwardia areolata*) and a small population of pink ladyslipper (*Cypripedium acaule*).

OWNERSHIP: Multiple private ownership.

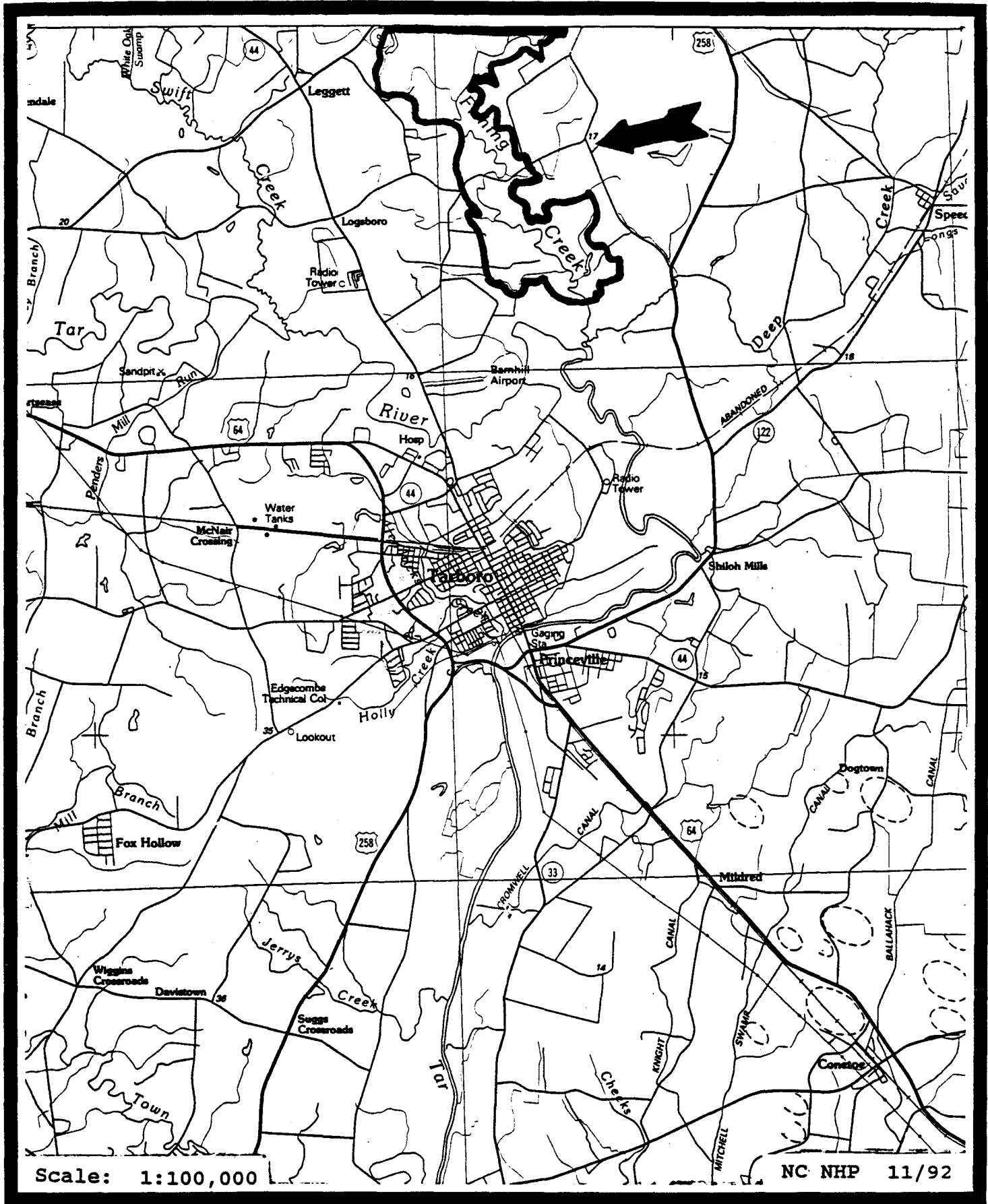
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The presence of very old, rotted, cut stumps scattered around the floodplain indicate that logging once occurred at this site. This area could be used as a study site to compare channelized vs. unchannelized stream systems. For long-term viability of the community, restoration of the natural hydrology disrupted by the channelization of Conetoe Creek is needed. The landowners should be informed of the significance of the site and of the land protection options available.

COMMENTS: This site should be revisited to conduct a more comprehensive site survey. This site was last visited in 1985.

REFERENCES:

Otte, L.J. 1985. Conetoe Creek Bottomland Forest. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.

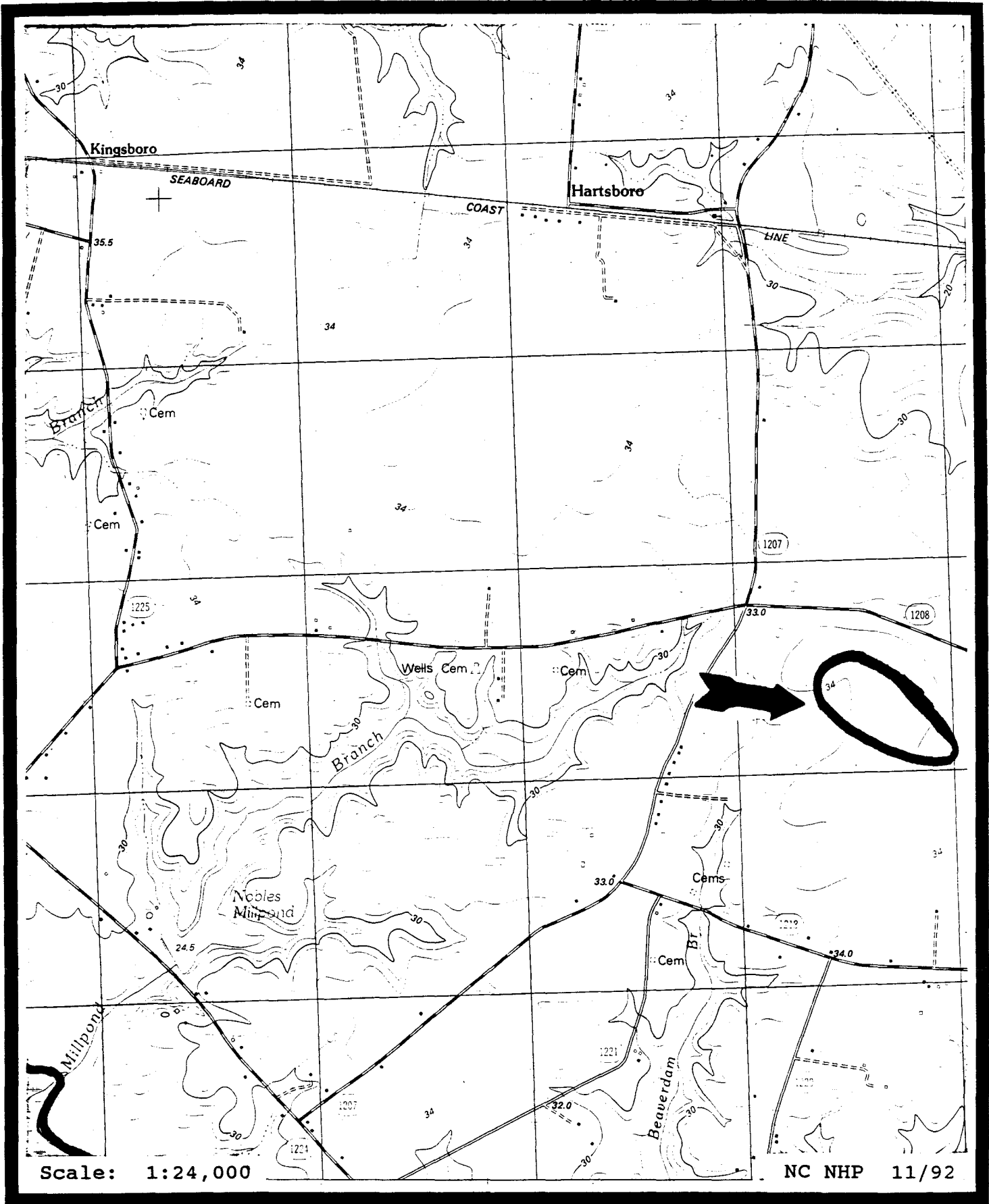


Site Name: Fishing Creek Floodplain Forest
 Site Code: ED4
 Quadrangle: Tarboro

COMMENTS: For a more comprehensive species list, additional survey work is needed.

REFERENCES:

Otte, L.J. 1985. Fishing Creek Floodplain. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: Hartsboro Flatwoods
 Site Code: ED5
 Quadrangle: Hartsease

SITE NAME: Hartsboro Flatwoods

SITE CODE: ED5

SIZE: 42 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Edgecombe

QUADRANGLE: Hartsease

LOCATION: This site is in the Tar River watershed in Edgecombe County in the Coastal Plain Province of North Carolina. It is on both sides of US 64, about 5 miles west of Tarboro, between SR 1218 and SR 1207.

SIGNIFICANT FEATURES: This site contains the only remnant Wet Pine Flatwoods in this part of the Coastal Plain and is one of very few anywhere north of the Neuse River. While not in excellent condition no other site known is similar to this site. This area may lie northwest of the original range of wiregrass, and may actually represent an undescribed community type.

GENERAL DESCRIPTION:

This site contains poorly-drained upland flats with a remnant pond-loblolly-longleaf pine woodland. The soils at this site belong to the Exum and Grantham series. The soils are fine-silty, siliceous, and thermic Aquic Paleudult and Typic Paleaquult. This site was presumably once maintained by fire in an herb-dominated or mixed herb-shrub savanna structure. Recently, hardwoods have invaded the site.

This natural area supports a Wet Pine Flatwoods natural community that has a somewhat open pine canopy with dense hardwood saplings and shrubs. The canopy is dominated primarily by loblolly (*Pinus taeda*) and pond pine (*P. serotina*) with some longleaf pine (*P. palustris*). Invading red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) form a moderate subcanopy as well as contributing to the dense shrub layer. Sweet pepperbush (*Clethra alnifolia*) dominates the shrub layer, with cane (*Arundinaria tecta*) abundant in patches. The herb layer is absent or sparse. Wiregrass (*Aristida stricta*), usually common in Pine Flatwoods, was not seen during the site visit. It is unclear if wiregrass was ever present at this site.

OWNERSHIP: Unknown

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The area has undergone a prescribed burn in the last 2-3 years, but probably had not been burned for many years before that. The community has clearly deteriorated badly in the absence of regular prescribed burns. The site north of US 64 was burned in the last few years, reducing the density of the

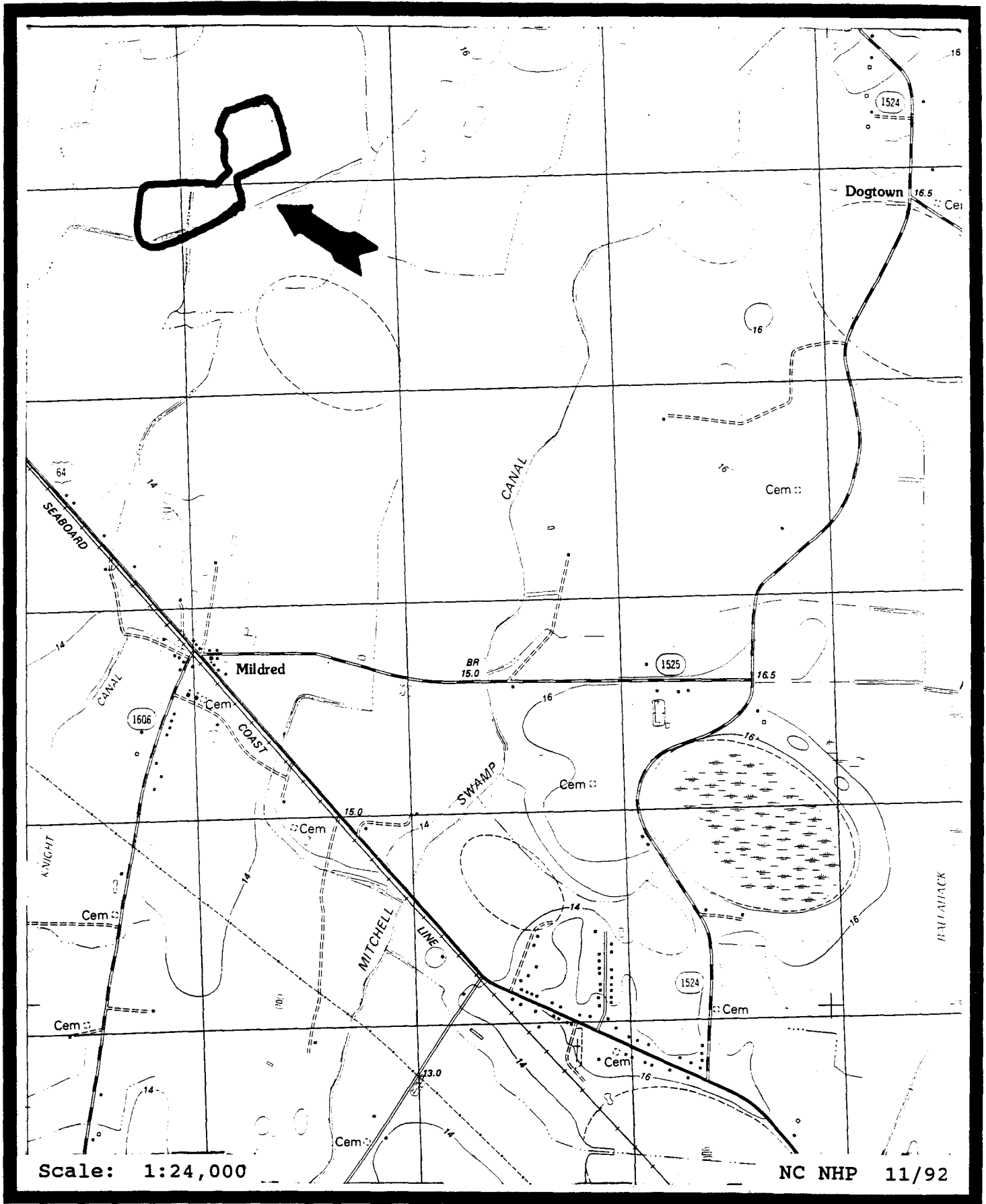
hardwoods. Regular prescribed burning should continue at this site.

Cutting of the larger hardwoods may also be necessary to restore community structure. The canopy trees are fairly large, with no sign of recent cutting, except for a few cut trees on the highway right-of-way. The landowner should be contacted to discuss the significance of the site and of the land protection options available.

COMMENTS: This site was not surveyed thoroughly; therefore, additional survey work is recommended.

REFERENCES:

Schafale, M., M. Lynch, and B. Sandler. 1992. Hartsboro Flatwoods. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Mildred Wet Hardwood Forest
 Site Code: ED6
 Quadrangle: Conetoe

SITE NAME: Mildred Wet Hardwood Forest

SITE CODE: ED6

SIZE: 46 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Edgecombe

QUADRANGLE: Conetoe

LOCATION: This site is in the Tar River watershed in eastern Edgecombe County in the Coastal Plain Province of North Carolina. It is about 1.5 miles north of Mildred, N.C.; about 1 mile east of SR 1523.

SIGNIFICANT FEATURES: This site, though small and somewhat fragmented, offers a rare opportunity to see an old growth example of a once common, now rare, community type, the Nonriverine Wet Hardwood Forest. This site supports the farthest inland known occurrence of this community type.

GENERAL DESCRIPTION:

This site is a flat, poorly-drained upland area. Shallow depressions present at the site hold standing water part of the year. Because several ditches exist in the southern and western portions of the site, the western end is better drained than the northern and eastern ends. The northern part was recently heavily cut, leaving only a small forest remnant. The land surface at this site rises gradually and contains Carolina bays. The soil is mapped as the Roanoke Series.

A small high quality Nonriverine Wet Hardwood Forest exists in the wetter northern part of the site. The canopy is uneven-aged with large, old trees dominating. Canopy dominants are swamp laurel oak (Quercus laurifolia), sweet gum (Liquidambar styraciflua), swamp chestnut oak (Q. michauxii), and loblolly pine (Pinus taeda) with a few tuliptree (Liriodendron tulipifera), red maple (Acer rubrum), and white oak (Q. alba) trees. The understory includes American holly (Ilex opaca), persimmon (Diospyros virginiana), and horsesugar (Symplocos tinctoria). There is a dense shrub layer of giant cane (Arundinaria gigantea) tangled with abundant glaucous greenbrier (Smilax glauca). Herbs are few except in a standing pool where sedges (Carex spp.) are abundant.

The southwestern part of the area appears to be better drained. The community type there seems most similar to a wet Mesic Mixed Hardwood Forest. The old uneven-aged canopy is dominated by tuliptree, swamp chestnut oak, white oak, sweet gum, and American beech (Fagus grandifolia). The understory is sparse with horsesugar, American holly (Ilex opaca), and sweetbay (Magnolia virginiana) as common species. Giant cane (Arundinaria gigantea) forms a moderately dense shrub layer in most of the area, but parts are free of it. Japanese honeysuckle (Lonicera japonica) has taken over much of the herb layer. Several patches of younger forest are interspersed among the old growth. They

are dominated by tuliptree, white oak, and red maple. Japanese honeysuckle is abundant here as well.

OWNERSHIP: Single private ownership.

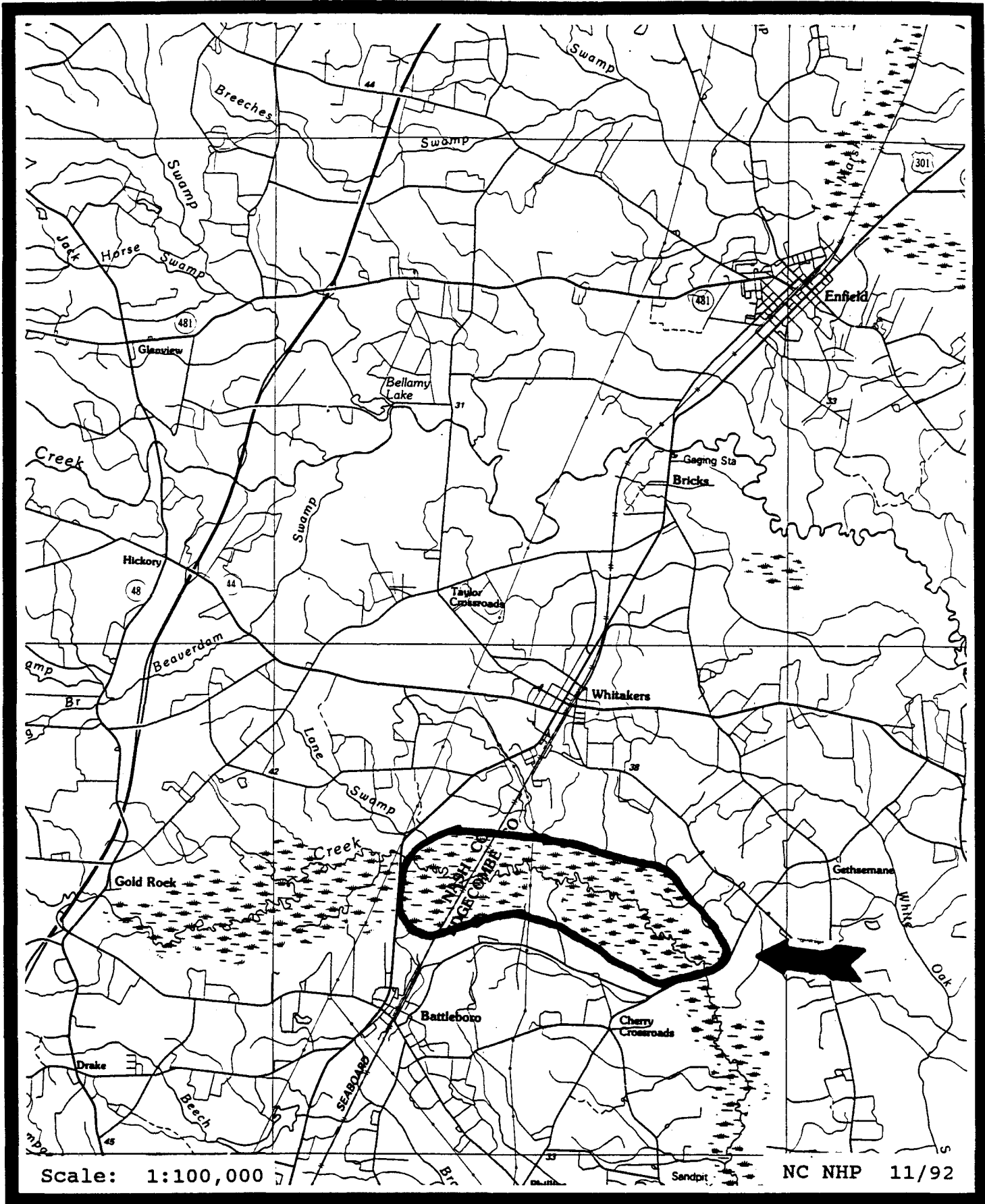
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The forest is surrounded by fields. Honeysuckle control may be needed. This site is in or near the path of a new route for US 64. It is also potentially threatened by logging. An appropriate strategy might be to purchase the site for protection as mitigation for necessary wetland loss along the highway.

COMMENTS: All of the high quality areas were examined in early spring; therefore, further growing season survey work is not a high priority.

REFERENCES:

Schafale, M. and M. Baranski. 1989. Mildred Wet Hardwood Forest. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Swift Creek Swamp Forest
 Site Code: ED7
 Quadrangle: Roanoke Rapids

SITE NAME: Swift Creek Swamp Forest

SITE CODE: ED7

SIZE: 2000 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Edgecombe

QUADRANGLE: Roanoke Rapids (1:100,000 scale)

LOCATION: This site is in the Tar River watershed in northern Edgecombe County in the Coastal Plain Province of North Carolina. It is about 3 miles east-northeast of Battleboro, N.C. and 11 miles northeast of Rocky Mount, N.C.; along SR 1404 0.5 miles east of its junction with SR 1411. It is the section of floodplain encircled by Seaboard System RR, SR 1410, SR 1404, and SR 1411.

SIGNIFICANT FEATURES:

1. This site supports three good quality natural communities: Cypress-Gum Swamp (Brownwater Subtype), Coastal Plain Levee Forest (Brownwater Subtype), and Coastal Plain Bottomland Hardwoods (Brownwater Subtype).

2. This site has a high diversity of canopy species (45 species) and bird species (29 species).

3. Two rare species of plants are present: yellow water crowfoot (Ranunculus flabellaris), a State Candidate species found at only two sites in North Carolina, and crowfoot sedge (Carex crus-corvi), a significantly rare species.

4. The Swift Creek (Vance/Warren/Franklin/Nash/Edgecombe) Aquatic Habitat (AH15) flows through this site. The Neuse River waterdog (Necturus lewisi), a species of Special Concern in the state, has been reported from this portion of the Swift Creek habitat.

GENERAL DESCRIPTION:

This site contains an old-growth swamp forest located along a low-gradient, meandering, brown-water stream. The swamp forest is in a broad, essentially flat basin averaging about 0.5 mile wide. The stream (Swift Creek) has a braided channel effect across the wide basin which indicates the stream has an underlying hard impermeable marl layer, perhaps of the Castle Hayne formation. The entire swamp is underlain by alluvial deposits overlying the Yorktown formation. High soil pH, nutrient availability, and adequate moisture provide excellent plant growth conditions and may explain the high plant diversity at the site.

The canopy of the Cypress-Gum Swamp (Brownwater Subtype) has as its common species water tupelo (Nyssa aquatica), baldcypress (Taxodium distichum), swamp cottonwood (Populus heterophylla), and red maple (Acer rubrum). Other canopy species include sweetgum (Liquidambar styraciflua), green ash (Fraxinus

pennsylvanica), and several oak species: overcup oak (Quercus lyrata), diamondleaf oak (Q. laurifolia), and cherrybark oak (Q. pagoda). The subcanopy is made up mostly of water ash (F. caroliniana). Some of the herb species present in this forest are clearweed (Pilea pumila), false nettle (Boehmeria cylindrica), lizard's tail (Saururus cernuus), and resurrection fern (Polypodium polypodioides), on tree branches and tree trunks.

The Coastal Plain Levee Forest (Brownwater Subtype) occurs in a narrow band along the creek. The canopy is very diverse with twenty species present. Typical species of the creek bank include river birch (Betula nigra), water hickory (Carya aquatica), mockernut hickory (Carpinus caroliniana), and overcup oak. In low seepagees are baldcypress, swamp cottonwood (Populus heterophylla), water tupelo, and Carolina ash. The common true levee species are laurel oak, red maple, American elm (Ulmus americana), water hickory, sweetgum, shagbark hickory (Carya ovata), willow oak (Q. phellos), pin oak (Q. palustris), and swamp chestnut oak (Q. michauxii). The subcanopy contains individuals of the canopy species and smaller species such as possum haw (Ilex decidua) and switch cane (Arundinaria tecta). The herbs present include lizard's tail and two violets (Viola papilionacea) and (V. palmata var. triloba).

The canopy of the Coastal Plain Bottomland Hardwoods (Brownwater Subtype) is very diverse. The most common canopy species are red maple, green ash, and loblolly pine (Pinus taeda). Other canopy species include sweetgum, cherrybark oak, laurel oak, pin oak, overcup oak, water oak (Q. nigra), willow oak, and swamp red oak (Q. shumardii). The subcanopy in this forest is open and is made up of Carolina ash, white ash, ironwood (Carpinus caroliniana), winged elm (Ulmus alata), and hawthorn (Crataegus viridis). The shrub layer is composed of possum haw (Ilex decidua), burning bush (Evonymus americanus), Virginia willow (Itea virginica), viburnum (Viburnum dentatum), and cane. The herb layer in general is sparse, however, in certain areas lizard's tail is a local dominant.

Two rare species of plants are present in this natural area: yellow water crowfoot (Ranunculus flabellaris), a State Candidate species found only at two sites in North Carolina, and crowfoot sedge (Carex crus-corvi), a significantly rare species.

Twenty-nine species of birds have been observed in this natural area. These include swamp sparrow (Melospiza georgiana), white-throated sparrow (Zonotrichia albicollis), pine siskin (Carduelis pinus), wood duck (Aix sponsa), and pileated woodpecker (Dryocopus pileatus). The Swift Creek (Vance/Warren/Franklin/Nash/Edgecombe) Aquatic Habitat flows through this site and contains the Neuse River waterdog (Necturus lewisi), a species of Special Concern in the state.

OWNERSHIP: This site has multiple private owners, including local agricultural companies.

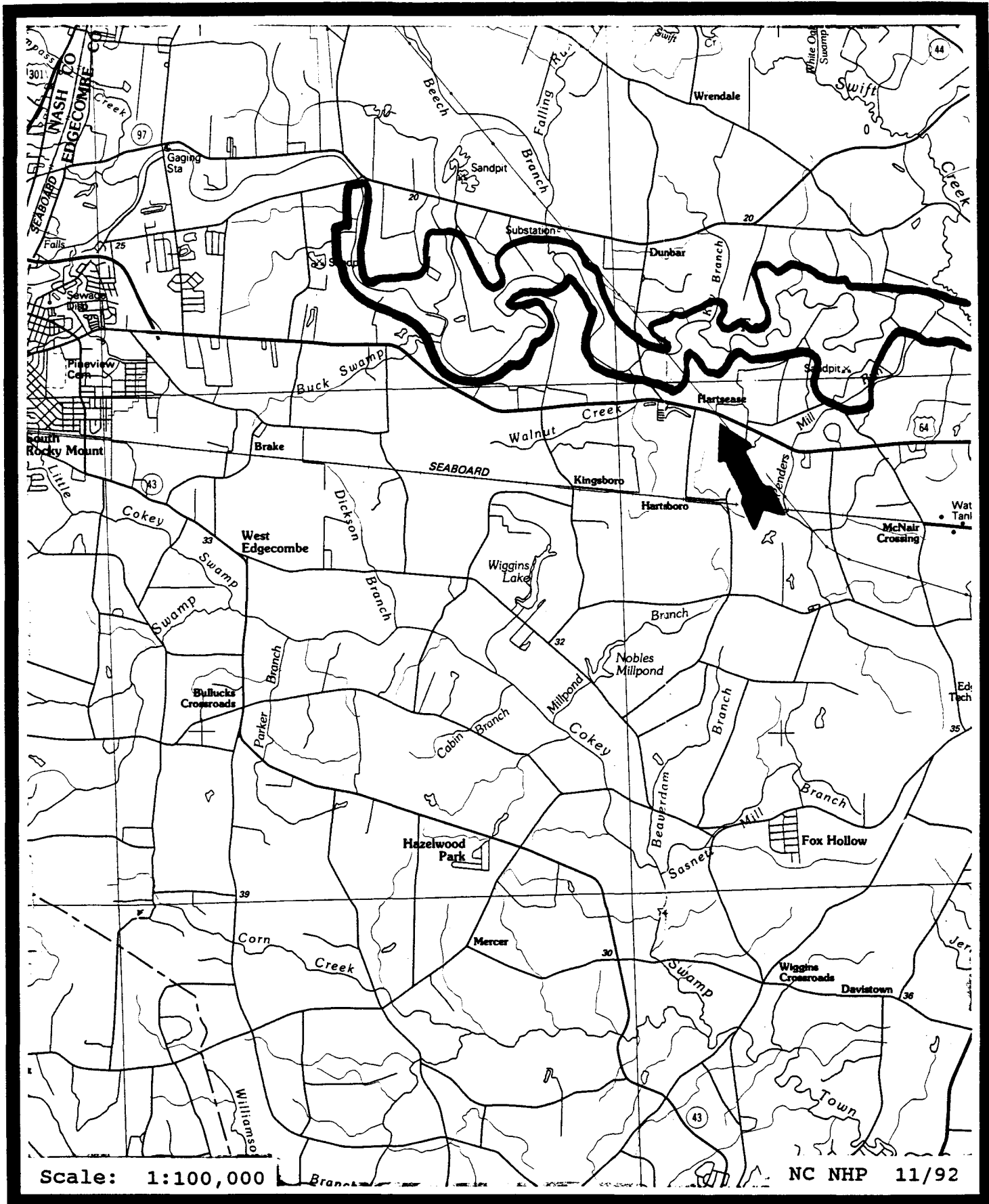
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This land has high aesthetic value and has great potential for educational and scientific purposes. Threats include clearing for agricultural purposes and clear-cutting. Cutting is most evident along SR 1404, however the actual extent of the logging is uncertain. Portions of the natural area could be preserved as a wilderness area. Other parts need to be managed by the landowners.

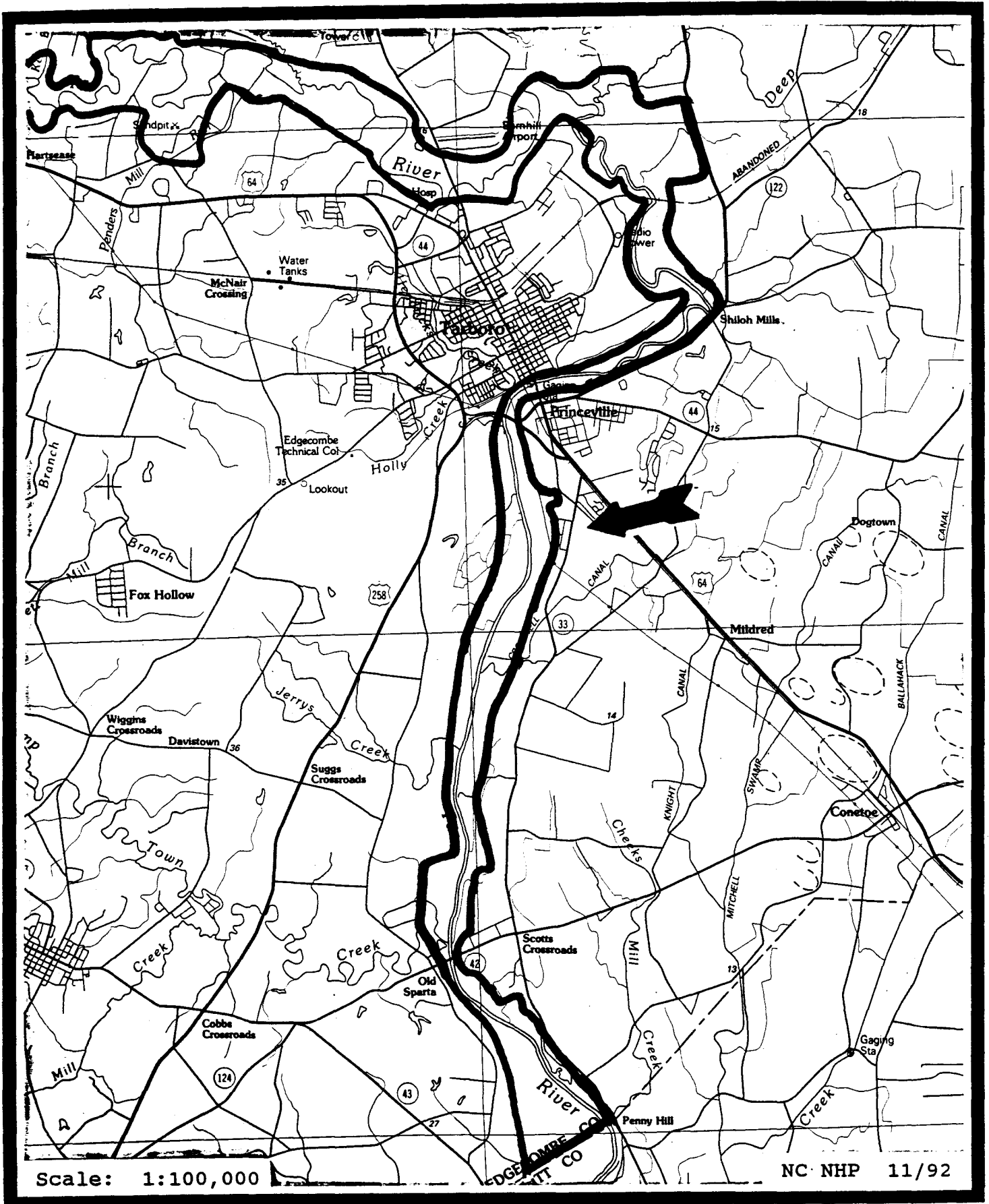
COMMENTS: In 1978, this swamp forest was in excellent second-growth condition with much of the site appearing not to have been logged for over 80 years. A more recent report from 1985 indicated, however, that logging had begun along SR 1404. This site has the potential for supporting shadow-witch (Ponthieva racemosa), a significantly rare plant species.

REFERENCES:

- Lynch, J.M. and J.H. Moore. 1981. Swift Creek Swamp. Site Survey Report. N.C. Natural Heritage Program.
- Otte, L.J. 1985. Swift Creek Swamp Forest. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- Radford, A.E., D.K. Otte, L.J. Otte, J.R. Massey, and P.D. Whitson. 1981. Natural Heritage: Classification, inventory, and information. The University of North Carolina Press, Chapel Hill, N.C.
- Weakley, A.S. 1978. The vegetation of Swift Creek Swamp Forest, Edgecombe County, North Carolina. Honors Thesis, Department of Botany, University of North Carolina.



Site Name: Tar River Floodplain
 Site Code: ED8
 Quadrangle: Rocky Mount



Site Name: Tar River Floodplain
 Site Code: ED8
 Quadrangle: Rocky Mount

SITE NAME: Tar River Floodplain

SITE CODE: ED8

SIZE: 9900 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Edgecombe

QUADRANGLE: Rocky Mount (1:100,000 scale)

LOCATION: This site is in the Tar River watershed in central Edgecombe County in the Coastal Plain Province of North Carolina. It is along both sides of the Tar River which flows west to east through the center of Edgecombe County.

SIGNIFICANT FEATURES:

1. The Tar River floodplain supports a variety of vegetation types, bottomland communities, soils, hydrological regimes, and degrees of disturbance.

2. The significantly rare fox squirrel (Sciurus niger) is located in or near this floodplain.

GENERAL DESCRIPTION: This site is essentially defined as the Tar River's floodplain in Edgecombe County. The floodplain is a complex mixture of bottomland and terrace habitats. Large portions of the higher terraces are now in farmland. Numerous small to large tracts of land are still forested. Many of these forests are young, second growth stands of pine. Some forests contain mature hardwoods. This site has the potential for high quality communities extending from below Rocky Mount down into Pitt County. The significantly rare fox squirrel (Sciurus niger) has been reported in this area. The Tar River--Lower Aquatic Habitat (AH16) flows through this site and contains numerous rare aquatic animal species.

OWNERSHIP: Multiple private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Clearcutting, agricultural practices, drainage, and channelizing are all disturbances that are evident at this site. The best areas within this system need to be identified in order for proper management practices to be developed and implemented.

COMMENTS: This site was last surveyed in 1985 and has reported to contain some significant areas. However, a detailed survey of the land was beyond the scope of that study. It is recommended that a comprehensive survey be done of this site in the future.

REFERENCES:

Otte, L.J. 1985. Tar River Floodplain. Preliminary Site
Reconnaissance Survey. N.C. Natural Heritage Program.

FRANKLIN COUNTY NATURAL AREAS

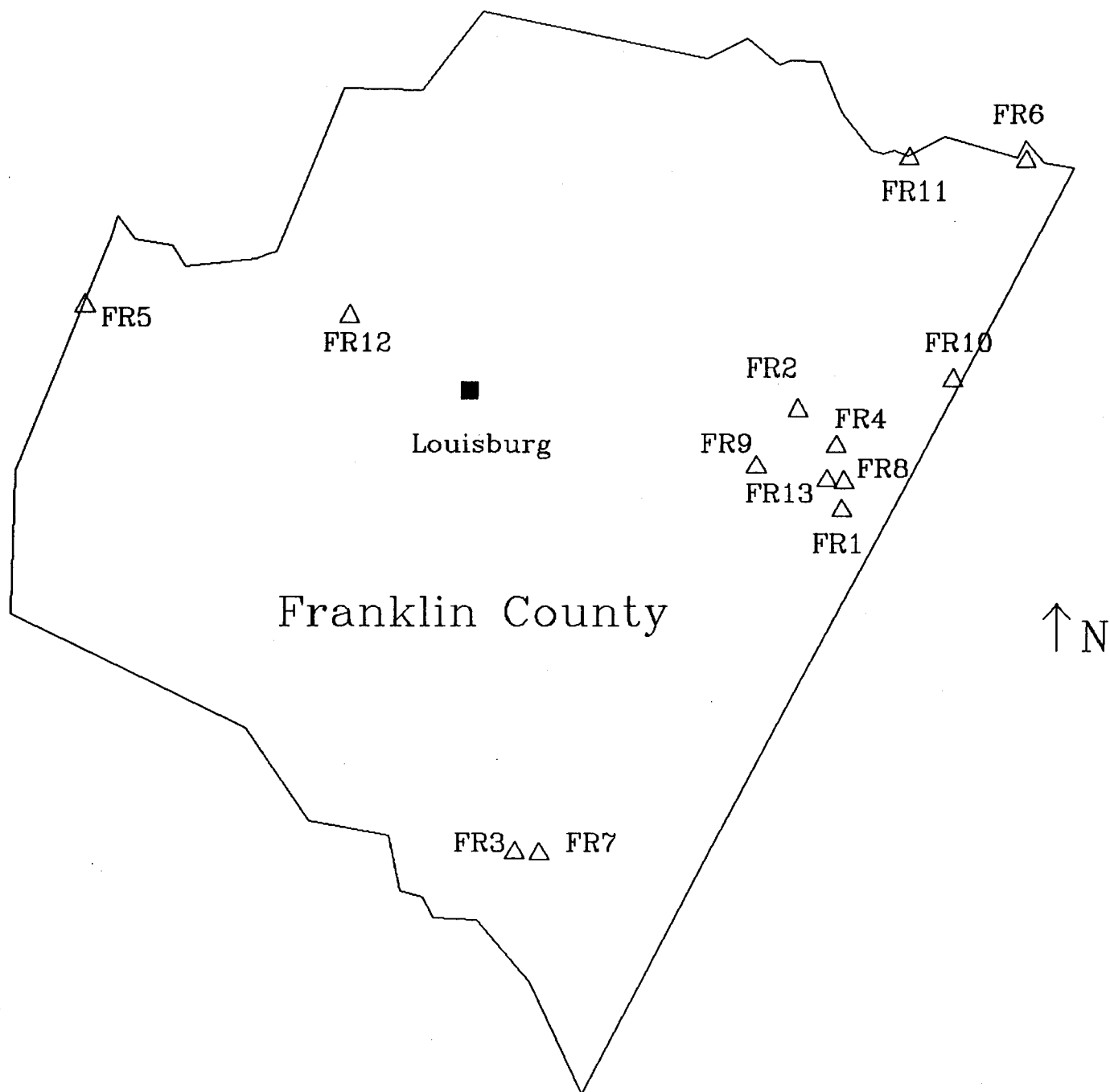
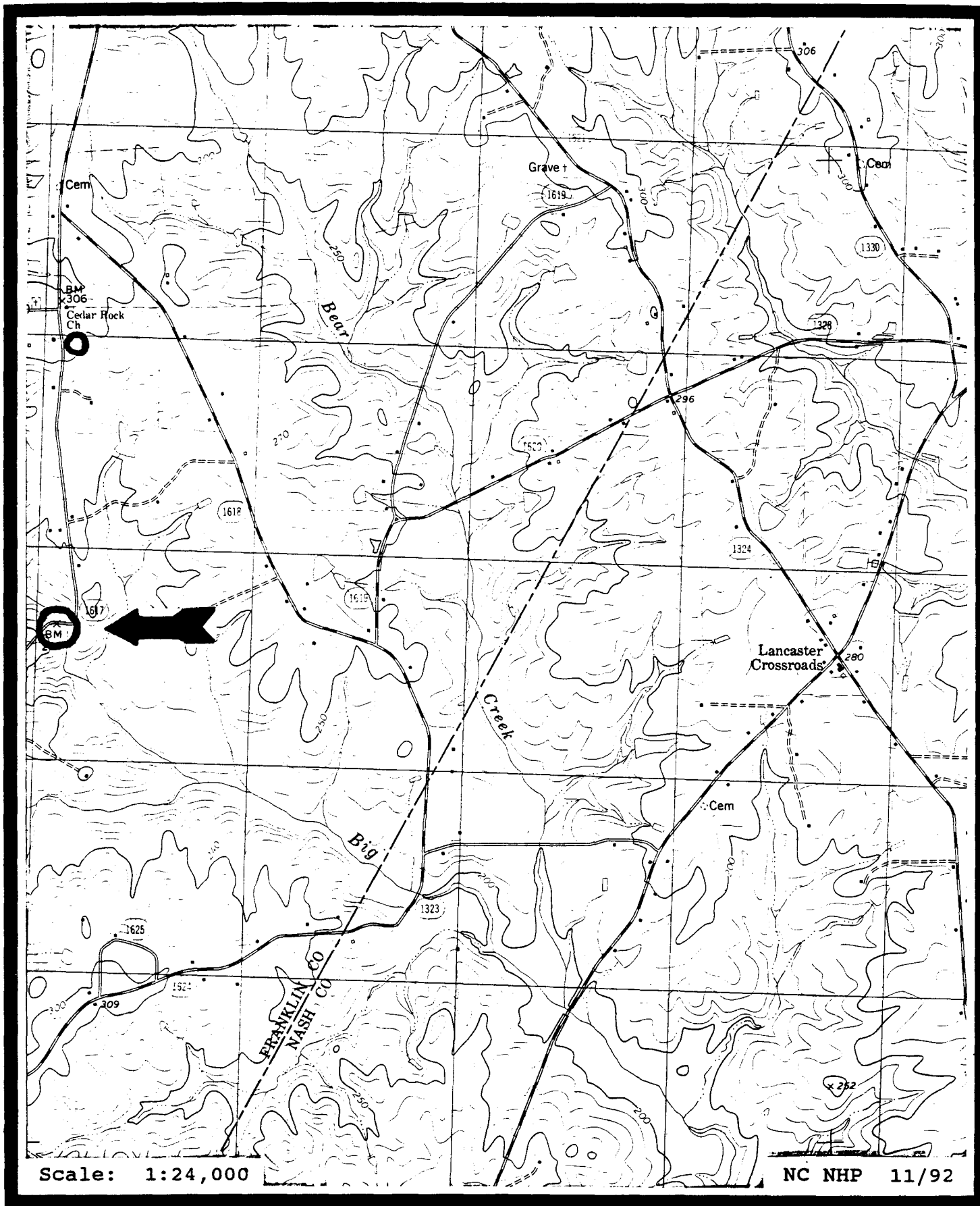


Figure 9. Significant natural areas in the A/P III study area portion of Franklin County



Site Name: Big Peachtree Creek Flatrock
 Site Code: FR1
 Quadrangle: Castalia

SITE NAME: Big Peachtree Creek Flatrock

SITE CODE: FR1

SIZE: 4 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Franklin

QUADRANGLE: Castalia

LOCATION: This site is in the Tar River watershed in eastern Franklin County in the Piedmont Province of North Carolina. It is located on the north side of SR 1617, just west of its crossing of Big Peachtree Creek.

SIGNIFICANT FEATURES: This site contains a large population of Small's portulaca (Portulaca smallii), a State Threatened species.

GENERAL DESCRIPTION:

This site is a smooth outcrop of granite occurring on a gentle slope above a creek. The opening is approximately 1/4 acre in size. The surrounding area is a cut-over pine-oak-hickory forest.

A small Granitic Flatrock community occurs on the outcrop. The community is not of high quality, but does contain some typical species, such as lichens (Cladonia spp.), moss (Grimmia sp.), Adam's needle (Yucca filimentosa), and eastern redcedar (Juniperus virginiana).

The flatrock contains a large population of Small's portulaca (Portulaca smallii), as species confined to Granitic Flatrock communities and is Threatened in the state. More than 1000 individuals of this species occur here. This is one of seven known populations of Small's portulaca in the state.

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

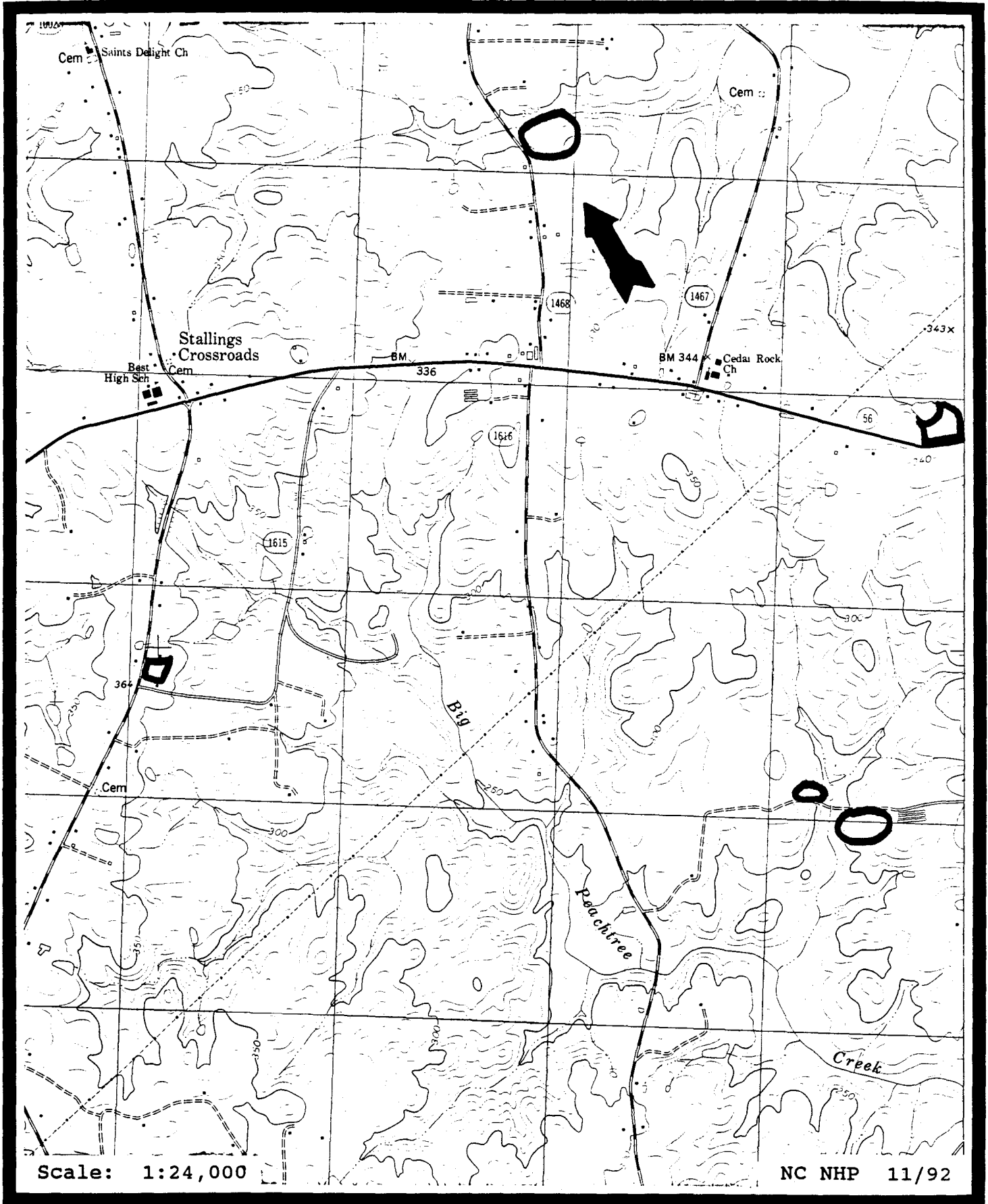
MANAGEMENT OR PROTECTION RECOMMENDATIONS: The owner should be contacted to encourage protection of the site. Vehicle traffic, mining, and trash dumping on the outcrop should be prohibited. A wooded buffer around the outcrop should be left undisturbed. This buffer will serve to minimize weedy invasion and to limit access to the flatrock.

COMMENTS: This site has not been visited since 1985.

REFERENCES:

Lynch, J.M. 1985. Big Peachtree Creek Flatrock. N.C. Natural Heritage Program rare plant survey form.

Prince, A. 1992. Big Peachtree Creek Flatrock. Natural Area Summary. N.C. Natural Heritage Program.



Site Name: Bog Flatrock
 Site Code: FR2
 Quadrangle: Justice

SITE NAME: Bog Flatrock

SITE CODE: FR2

SIZE: 7 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Franklin

QUADRANGLE: Justice

LOCATION: This site is in the Tar River watershed in eastern Franklin County in the Piedmont Province of North Carolina. It is an outcrop about 0.6 mile north of highway 56 on SR 1468; on the east side of the road, just south of a tributary of Red Bud Creek.

SIGNIFICANT FEATURES:

1. Present in this natural area is a high quality example of a Granitic Flatrock natural community. This Flatrock is unusual for the extensive seepage and boggy vegetation present.

2. This site supports two State Threatened species: Small's portulaca (Portulaca smallii) and Piedmont quillwort (Isoetes piedmontana).

3. Granite flatsedge (Cyperus granitophilus), a significantly rare species, is also present at this site.

GENERAL DESCRIPTION:

This site is on a gently sloping hillside with five outcrops in close proximity to each other, each being 20-30 feet wide and 20-50 feet long. The site is bordered by a field to the south and a Dry-Mesic Oak-Hickory Forest to the north.

A very good quality and unusual Granitic Flatrock natural community is located in this natural area. No other flatrock in the state has so much seepage and extensive wetland vegetation. It covers an area of about 3-5 acres and is mostly very wet with seepage. The area is largely covered with boggy vegetation mats of sphagnum moss (Sphagnum sp.), rushes and the State Threatened Piedmont quillwort (Isoetes piedmontana). In the adjacent areas the canopy and subcanopy are dominated by eastern redcedar (Juniperus virginiana), winged elm (Ulmus alata), loblolly pine (Pinus taeda), and American hornbeam (Carpinus caroliniana) that have an estimated average dbh of 6 inches, with a maximum dbh of about 1 foot. The shrub layer is dominated by winged sumac (Rhus copallina). Small's portulaca (Portulaca smallii), granite flatsedge (Cyperus granitophilus), white nodding ladies-tresses (Spiranthes cernua), smooth sandwort (Minuartia glabra), prickly-pear cactus (Opuntia compressa), and Adam's-needle (Yucca filamentosa) are common in the herb layer.

OWNERSHIP: Private ownership.

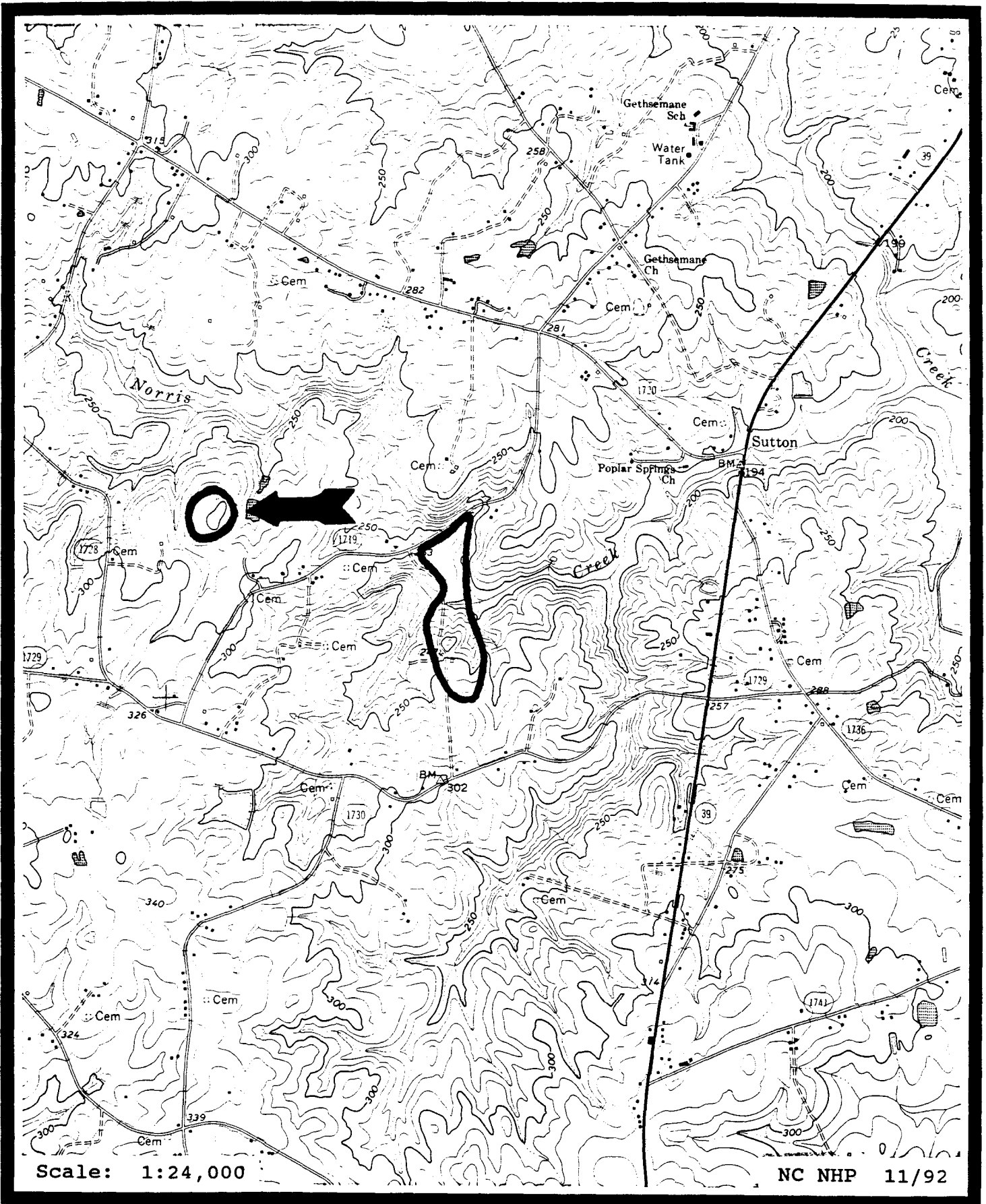
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This unusual flatrock should be protected before ORV use or trash dumping deteriorates the flatrock community. The landowner needs to be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: More information should be collected on species present at the site. A spring survey may be required to locate more herbaceous species.

REFERENCES:

Murrell, Z.E. 1991. Bog Flatrock. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Bunn Flatrock
Site Code: FR3
Quadrangle: Bunn West

SITE NAME: Bunn Flatrock

SITE CODE: FR3

SIZE: 4 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Bunn West

LOCATION: This site is in the Tar River watershed in extreme southern Franklin County in the Piedmont Province of North Carolina. It is northwest of SR 1719, about 0.25 mile north of its junction with SR 1729.

SIGNIFICANT FEATURES:

1. A high quality Granitic Flatrock community of typical composition is present on the site.
2. A moderate sized population of Small's portulaca (Portulaca smallii), a State Threatened species, is present on the site.

GENERAL DESCRIPTION:

The site is a nearly flat exfoliated outcrop of granite on a broad upland ridgetop. This flatrock is a bald exposure of the Rolesville Granite Batholith. Many fault zone cracks cross the flatrock. The surrounding area includes successional woodlands and cultivated fields.

The outcrop supports a typical Granitic Flatrock natural community. Herbaceous vegetation occurs in zones on mats of developing soil on the bedrock surface. Major plants include lichens (Cladonia spp.), moss (Grimmia sp.), fame flower (Talinum teretifolium), elf orpine (Diamorpha smallii), smooth sandwort (Minuartia glabra), Adam's needle (Yucca filamentosa), and prickly pear cactus (Opuntia compressa). Deeper soils in depressions and at the edges support blueberries (Vaccinium spp.), eastern redcedar (Juniperus virginiana), and Virginia pine (Pinus virginiana). Small's portulaca (Portulaca smallii), Threatened in the state, occurs here in a population of several hundred individuals.

The community, when last observed, was in excellent condition, with little damage by trash dumping or vehicle traffic. The site is well away from roads.

OWNERSHIP: Private ownership.

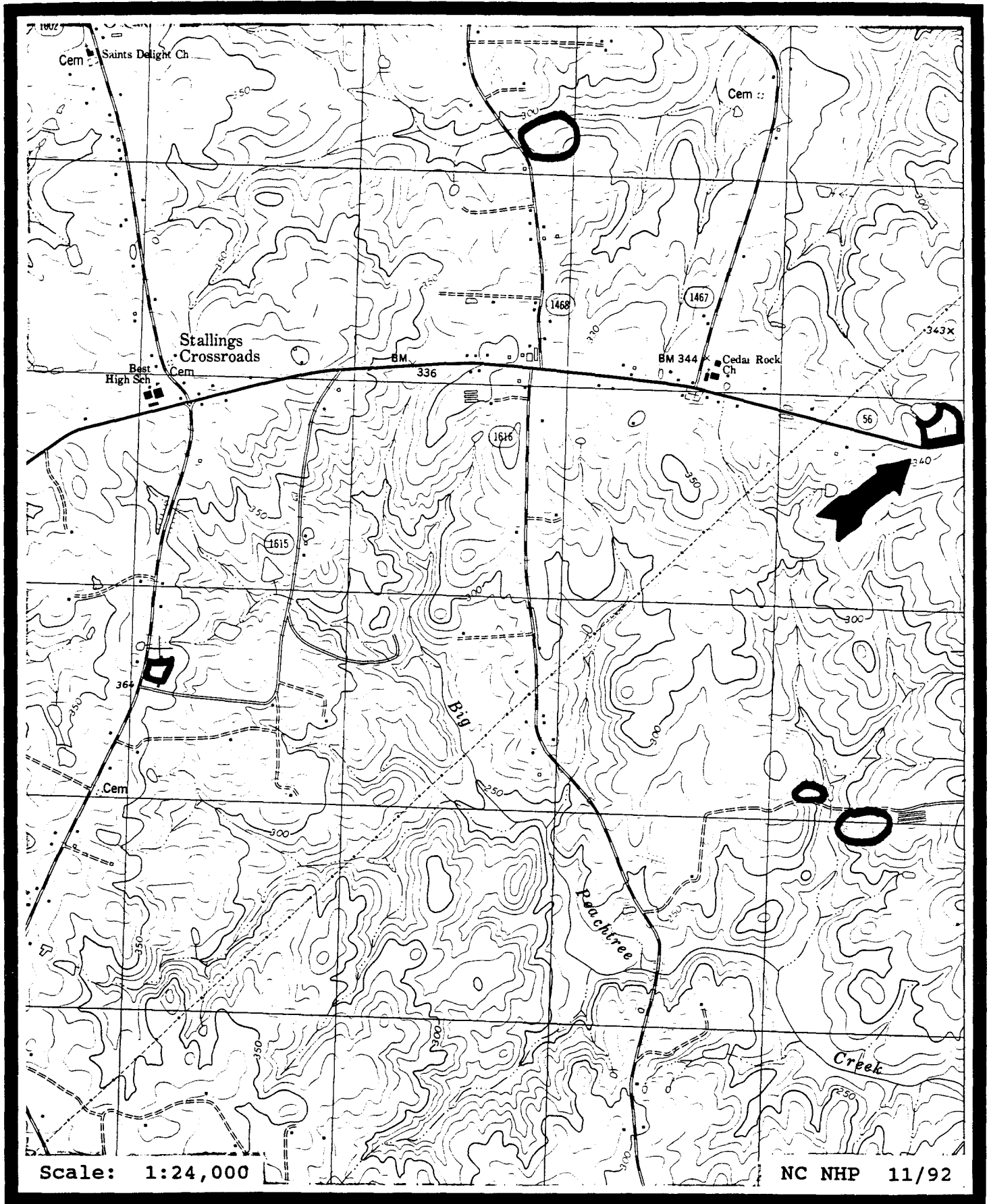
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The owner should be contacted to discuss the significance of the site and the various protection options available. Vehicle traffic, mining, and trash dumping should be prohibited. A wooded buffer should be protected around the outcrops.

COMMENTS: This site has not been visited since 1980. Its current condition is not known, though its location well away from the road may have protected it from damage. The site could be surveyed for other flatrock endemics.

REFERENCES:

Lynch, J.M. and J.H. Moore. 1980. Bunn Flatrock. Natural Area Reconnaissance Survey. N.C. Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Cedar Rock Church Flatrock
 Site Code: FR4
 Quadrangle: Justice

SITE NAME: Cedar Rock Church Flatrock

SITE CODE: FR4

SIZE: 6 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Justice

LOCATION: This site is in the Tar River watershed in eastern Franklin County in the Piedmont Province of North Carolina. It is on the north side of NC 56, about 0.7 mile east of SR 1467; about 1.5 miles east of Stallings Crossroads.

SIGNIFICANT FEATURES:

1. Two State Threatened species are present in this natural area: Small's portulaca (Portulaca smallii) and Piedmont quillwort (Isoetes piedmontana).

2. Also present here is a population of the significantly rare granite flatsedge (Cyperus granitophilus).

GENERAL DESCRIPTION:

Generally described, this site is a granitic flatrock that borders NC 56. Although a large portion of the flatrock has been mined, the vegetation in the remainder was not disturbed. Recently, heavy ORV use and trash dumping have significantly degraded the site. The site is bordered by a highway on the south, fields and development on the east, and by the abandoned mine operation to the north and west. Portions of the flatrock are seasonally saturated to inundated by seepage water and in pools.

This site supports a Granitic Flatrock community that covers about 6 acres. The flatrock is open with a diverse herbaceous layer. The dominant herbs are Small's portulaca (Portulaca smallii)- a State Threatened species, farnesflower (Talinum teretifolium), prickly-pear cactus (Opuntia compressa), smooth sandwort (Minuartia glabra), and elf orpine (Diamorpha smallii). Piedmont quillwort (Isoetes piedmontana), a State Threatened species, is present in the saturated and inundated pools at the site. The significantly rare granite flatsedge (Cyperus granitophilus) is another herbaceous species found in this natural area. Shrubs and trees located about the margins include eastern redcedar (Juniperus virginiana), black cherry (Prunus serotina), and loblolly pine (Pinus taeda). The community is surrounded by secondary growth forest and hedgerows.

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

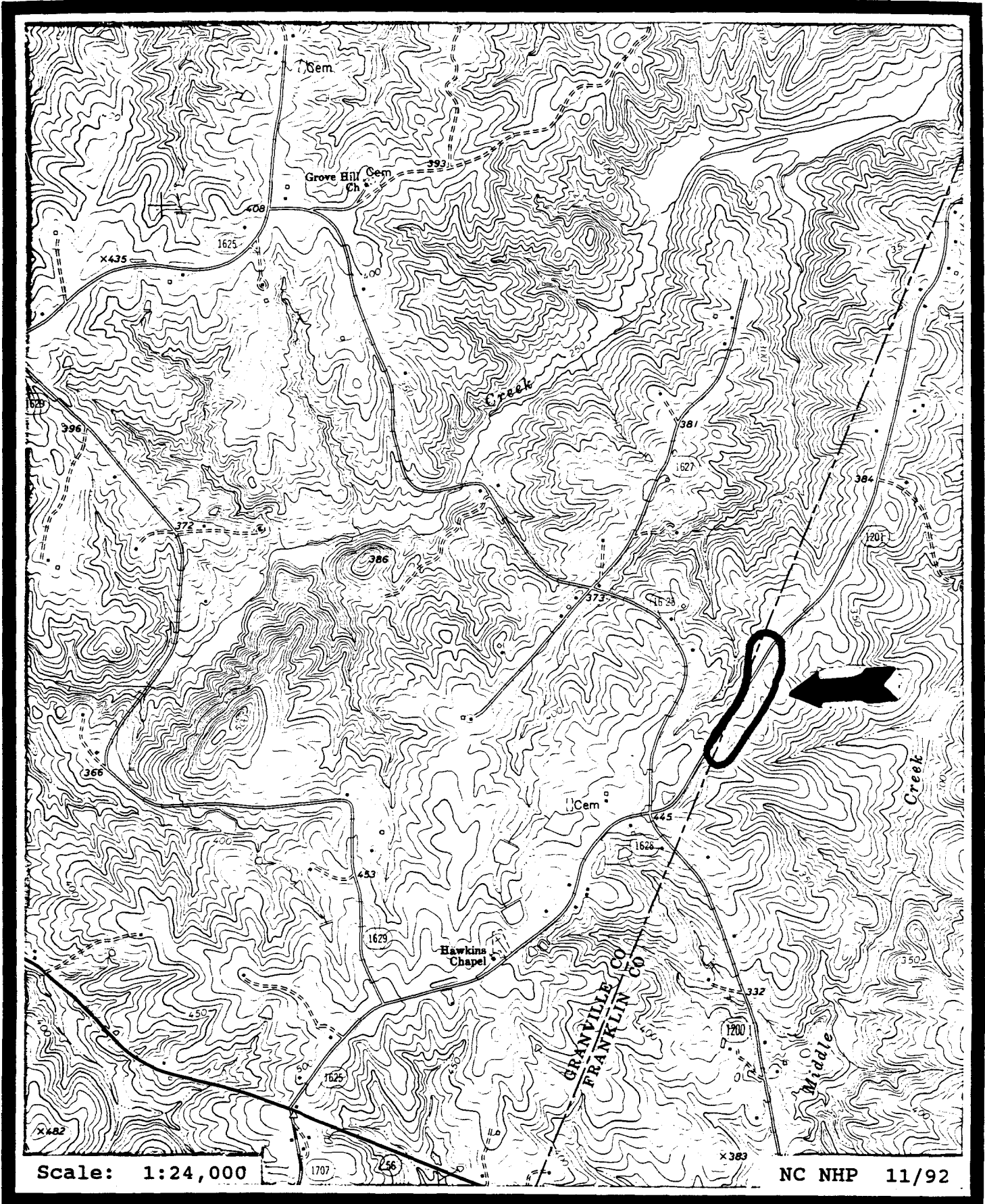
MANAGEMENT OR PROTECTION RECOMMENDATIONS: Fencing is imperative for this site because it is beside a major highway and is a popular place for ORV's and dumping. Tree limbs, for example,

have been dumped over a large portion of the outcrop. If this site is not protected soon, it will very likely be destroyed. The landowner should be informed of the significance of the site and of the land protection options available.

COMMENTS: Because this site was visited in late fall, a spring survey would be merited.

REFERENCES:

Murrell, Z.E. 1991. Cedar Rock Church Flatrock. Site Survey Report. N.C. Natural Heritage Program.



Site Name: County Line Flatrocks
 Site Code: FR5
 Quadrangle: Wilton

SITE NAME: County Line Flatrocks

SITE CODE: FR5

SIZE: 17 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Franklin

QUADRANGLE: Wilton

LOCATION: This site is in the Tar River watershed in Franklin County in the Piedmont Province of North Carolina. It is just east of the Granville County border, along SR 1201, approximately 0.3 mile north of SR 1200.

SIGNIFICANT FEATURES:

1. This natural area contains an extensive series of exfoliated granitic outcrops on a level upland ridge.
2. A cluster of Granitic Flatrock communities with typical vegetation is present at this site. These communities are in good condition and are relatively free from disturbance.
3. This site also contains a large population of Small's portulaca (Portulaca smallii), a State Threatened species.

GENERAL DESCRIPTION:

County Line Flatrocks is a series of granitic outcrops covering several acres along a broad upland ridge. The bare rock contains patchy soil mats in different stages of development. These granite flatrocks are formed from sedimentary rocks of the Triassic Period. This site has been little disturbance by vehicles or trash dumping.

The outcrop communities present at this site are extensive and in good condition. The vegetation on these flatrocks is characteristically zoned in response to soil depth and moisture. Typical flatrock species include elf orpine (Diamorpha smallii), smooth sandwort (Arenaria glabra), flatrock pimpernel (Lindernia monticola), mosses (Grimmia sp.) and lichens (Cladonia spp.). A large population of Small's portulaca (Portulaca smallii) occurs at this site. The margins of the flatrocks support a diverse shrubby zone, with unusual species including fragrant sumac (Rhus aromatica).

OWNERSHIP: Private ownership.

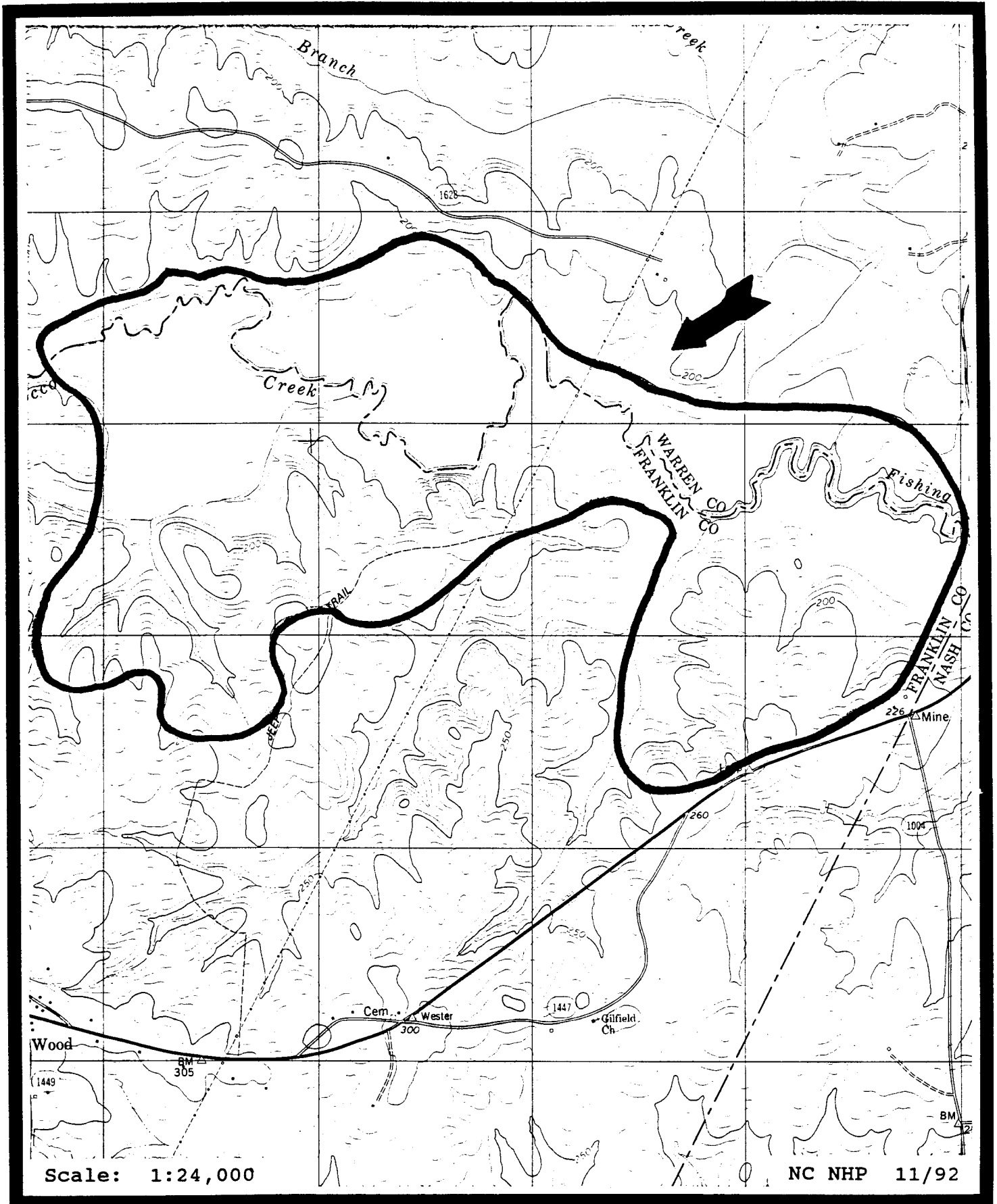
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The landowner should be contacted to discuss the significance of the site and the various protection options available. Vehicle traffic, mining, and trash dumping should be prevented. A wooded buffer should be left between and around the outcrops to minimize weedy invasion and to limit access to the site.

COMMENTS: This site has not been visited since 1985.

REFERENCES:

- LeGrand, H.E., Jr. 1985. County Line Flatrocks. Natural Area Reconnaissance Survey. N.C. Natural Heritage Program.
- Prince, A. 1992. County Line Flatrocks. Natural Area Summary. N.C. Natural Heritage Program.



Site Name: Lower Shocco Creek Bluffs
 Site Code: FR6
 Quadrangle: Centerville

SITE NAME: Lower Shocco Creek Bluffs

SITE CODE: FR6

SIZE: 1500 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Centerville

LOCATION: This site is in the Tar River watershed in the northeastern portion of Franklin County in the Piedmont Province of North Carolina. It is north-northeast of Wood, N.C.; west of a powerline cut; about 1.3 miles west of the Nash County line.

SIGNIFICANT FEATURES: This site is significant because of its high quality Mesic Mixed Hardwood Forest (Piedmont Subtype) and good quality Piedmont/Low Mountain Alluvial Forest.

GENERAL DESCRIPTION:

In general, the site is a fairly extensive north-facing bluff along Shocco Creek. An alluvial floodplain borders the creek. The geology is characterized by biotite gneiss and schist rocks. Two community types are found at this site: Mesic Mixed Hardwood Forest (Piedmont Subtype) and Piedmont/Low Mountain Alluvial Forest.

The Mesic Mixed Hardwood Forest, found along the bluff and in the ravines south of the creek, has well-developed canopy and herb layers and covers about 100 acres. The canopy is dominated by American beech (Fagus grandifolia), white oak (Quercus alba), tuliptree (Liriodendron tulipifera), and mockernut (Carya alba). The subcanopy contains as dominants sourwood (Oxydendrum arboreum), flowering dogwood (Cornus florida), and umbrella magnolia (Magnolia tripetala). The shrub layer is dominated by fringetree (Chionanthus virginicus) and common pawpaw (Asimina triloba). The herb layer contains yellow ladyslipper (Cypripedium pubescens), maidenhair fern (Adiantum pedatum), and showy orchis (Orchis spectabilis).

The Piedmont/Mountain Alluvial Forest is on the creek floodplain. It is of good condition and covers about 50 acres. The canopy is mature and is dominated by green ash (Fraxinus pennsylvanica), sweetgum (Liquidambar styraciflua), tuliptree and swamp chestnut oak (Quercus michauxii). The subcanopy is characterized by red maple (Acer rubrum) and American hornbeam (Carpinus caroliniana). The dominant shrub is common spicebush (Lindera benzoin). The herb layer is dominated by Japanese grass (Microstegium vimineum), jack-in-the-pulpit (Arisaema triphyllum), and Canada sanicle (Sanicula canadensis).

Faunal observations were made during the site survey. It was found that beaver (Castor canadensis) and white-tailed deer (Odocoileus virginianus) inhabit this site.

OWNERSHIP: Private; timber company ownership.

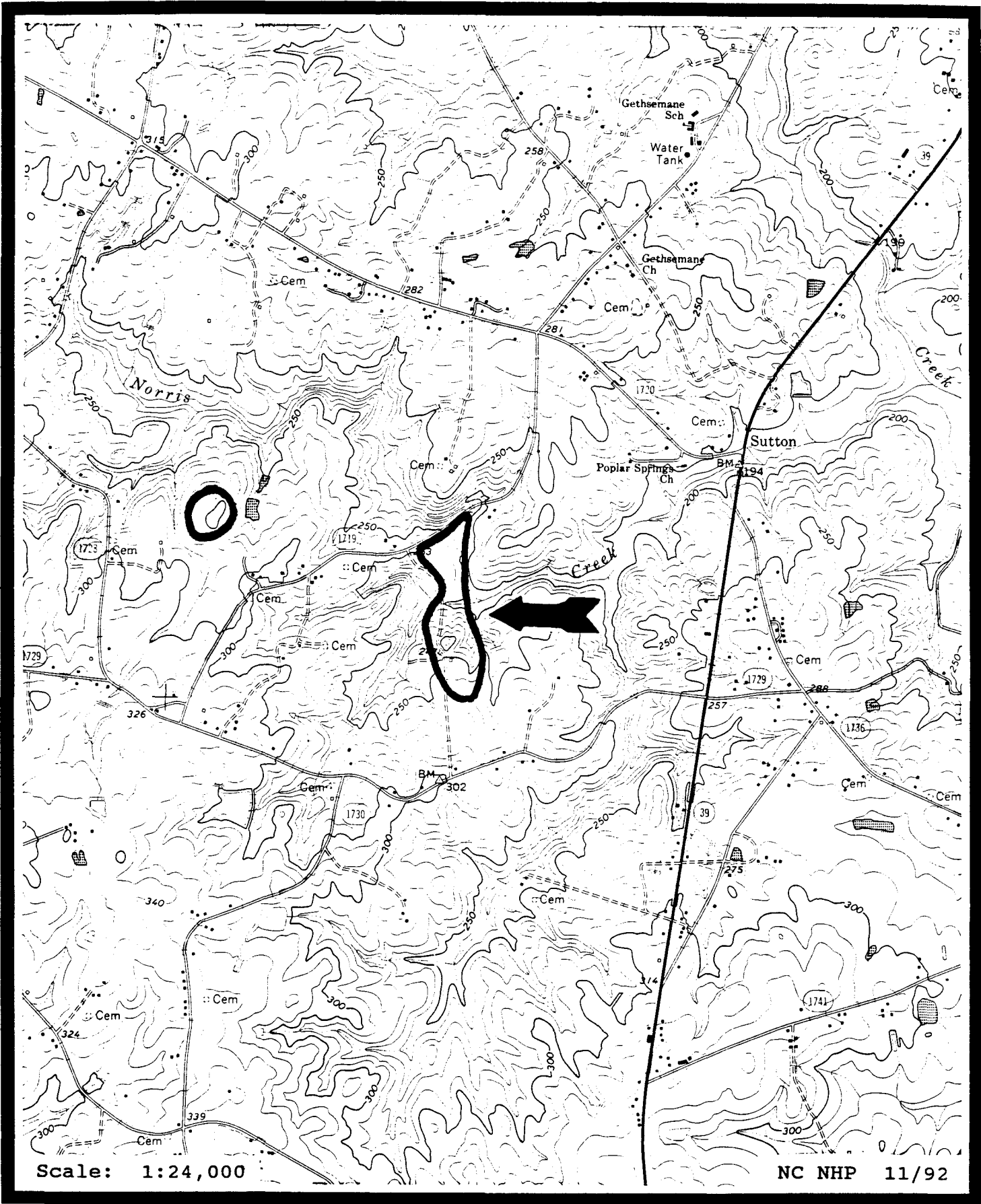
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Clearcutting has occurred in many nearby areas. This site needs to be protected from clearcutting. The landowner should be contacted to discuss the significance of the site and the land protection options available.

COMMENTS: Because this site was surveyed in the late summer, an early spring visit is recommended.

REFERENCES:

Murrell, Z.E. 1991. Shocco Creek Bluffs upstream from confluence with Fishing Creek. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Norris Creek Plant Site
 Site Code: FR7
 Quadrangle: Bunn West

SITE NAME: Norris Creek Plant Site

SITE CODE: FR7

SIZE: 32 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Franklin

QUADRANGLE: Bunn West

LOCATION: This site is in the Tar River watershed in the southern portion of Franklin County in the Piedmont Province of North Carolina. It is about 2.5 miles southwest of Bunn; about 0.5 miles southwest of SR 1720; just off SR 1719; about 0.2 miles south of bridge crossing at Norris Creek along SR 1719.

SIGNIFICANT FEATURES:

1. This site contains one of the largest known populations in the Piedmont of Michaux's sumac (Rhus michauxii), a Federally Endangered plant species.

2. A population of Small's portulaca (Portulaca smallii), a State Threatened species, is also present at this site.

GENERAL DESCRIPTION:

The general landscape along the gentle slopes at Norris Creek is composed of woods, fields, and roadsides. The geology is characterized by granitic rocks. The Norris Creek Plant Site contains a fairly good quality, yet somewhat dissected, Dry Oak-Hickory Forest logged perhaps 50-75 years ago. The forest is spread over a 50-acre area. The canopy is composed of white oak (Quercus alba) and mockernut (Carya alba) with estimated average dbh's of 1 foot. The subcanopy is dominated by flowering dogwood (Cornus florida), American holly (Ilex opaca), and red maple (Acer rubrum). The shrub layer consists of Michaux's sumac (Rhus michauxii) and sparkleberry (Vaccinium arboreum). Some Michaux's sumac individuals grow in the vicinity of very small outcrops and many grow in a phone line clearing. Trailing phlox (Phlox nivalis) and pipsissewa (Chimaphila maculata) dominate the herb layer. Small's portulaca (Portulaca smallii) has been found at granitic outcrops on the northwest side of SR 1719.

OWNERSHIP: Private ownership.

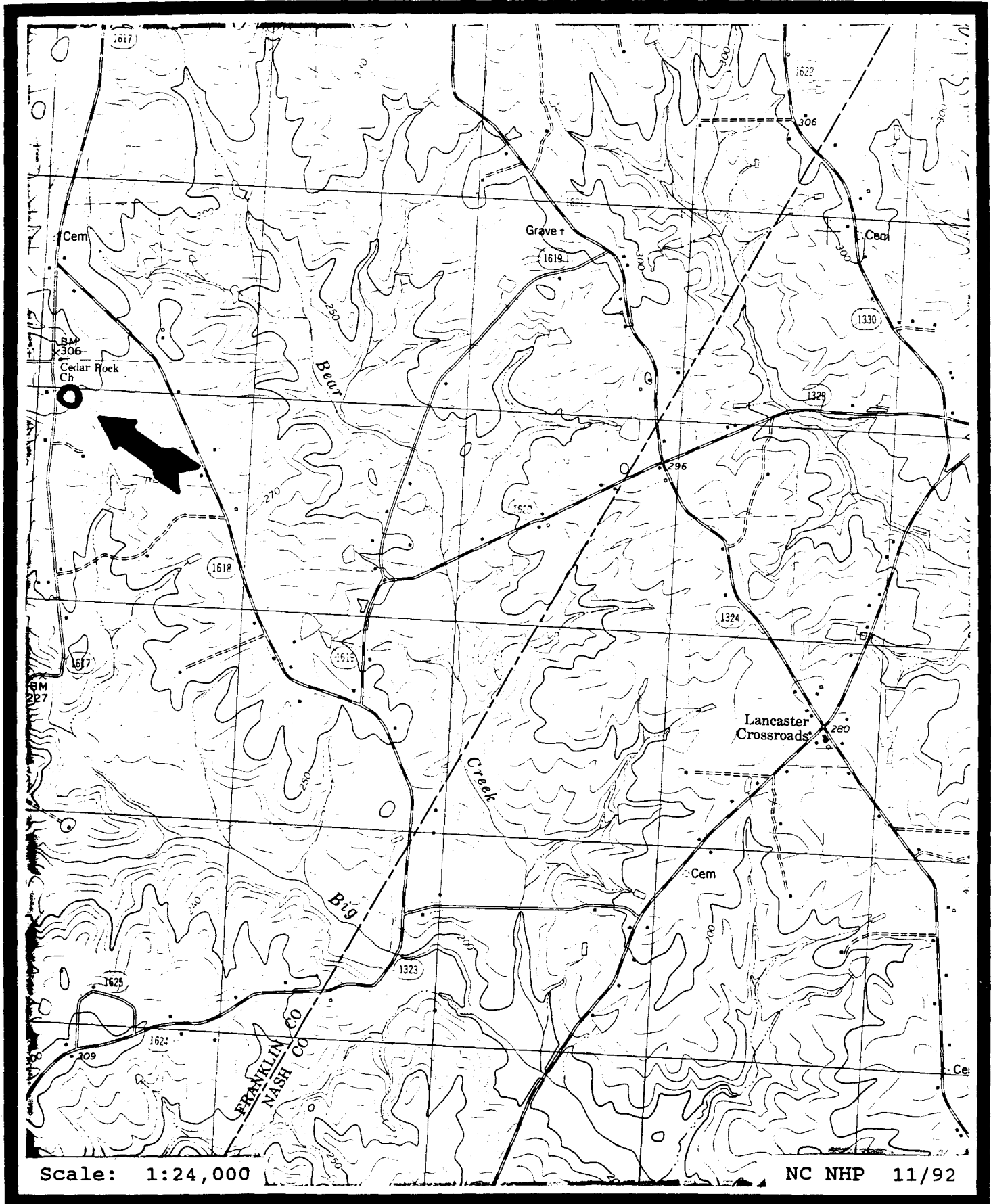
PROTECTION STATUS: There is an unofficial agreement between the state and the landowner to modify mowing and agricultural practices.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The population of Michaux's sumac may need some type of controlled disturbance because the plant seems to grow well along edges and in open forested areas. Mowing and agricultural practices should be avoided in the Michaux's sumac sites. Herbicides should not be used in nearby sites along SR 1719.

COMMENTS: Studies being conducted at Duke University on the population ecology of Michaux's sumac may give insight into the proper management of this species. This particular population has both male and female plants, which is necessary for maintaining a viable population. Also at this site are scattered hybrids of Michaux's sumac and smooth sumac (Rhus glabra). This site is perfect for population level studies of this hybridization. Because this site was most recently visited in the fall, a spring survey is recommended.

REFERENCES:

Murrell, Z.E. 1991. Norris Creek Rhus michauxii Site. Site Survey Report. N.C. Natural Heritage Program.



Site Name: North Big Peachtree Creek Flatrock
 Site Code: FR8
 Quadrangle: Castalia

SITE NAME: North Big Peachtree Creek Flatrock

SITE CODE: FR8

SIZE: 0.6 acre

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Castalia

LOCATION: This site is in the Tar River watershed in eastern Franklin County in the Piedmont Province of North Carolina. It includes three main flatrocks on SR 1617 about 1 mile south of NC 56; about 400 meters south of Cedar Rock Church.

SIGNIFICANT FEATURES: This site has a large population of Small's portulaca (Portulaca smallii), a State Threatened species.

GENERAL DESCRIPTION:

The general landscape is a small granitic flatrock area along a roadside, surrounded by agricultural fields. Because this area had been mined in the 1950's, the flatrocks have been much reduced and several slabs of granite have been piled on the flatrocks. The soil is in very thin layers in rock depressions and along the margins.

The flatrocks support a small but fairly high quality Granitic Flatrock natural community that is 50 X 50 feet in size and is surrounded by soybean fields. The vegetation is dominated by herbaceous species, but some trees are scattered along the margins. The dominant woody species are winged elm (Ulmus alata), Virginia pine (Pinus virginiana), and willow oak (Quercus phellos). The herb layer is dominated by common broomsedge (Andropogon virginicus), Small's portulaca (Portulaca smallii), and prickly-pear cactus (Opuntia compressa). Over 1500 individuals of Small's portulaca were observed in fall (Murrell 1991). The large population of Small's portulaca is actually spreading into the edge of the nearby cultivated fields.

OWNERSHIP: Private ownership.

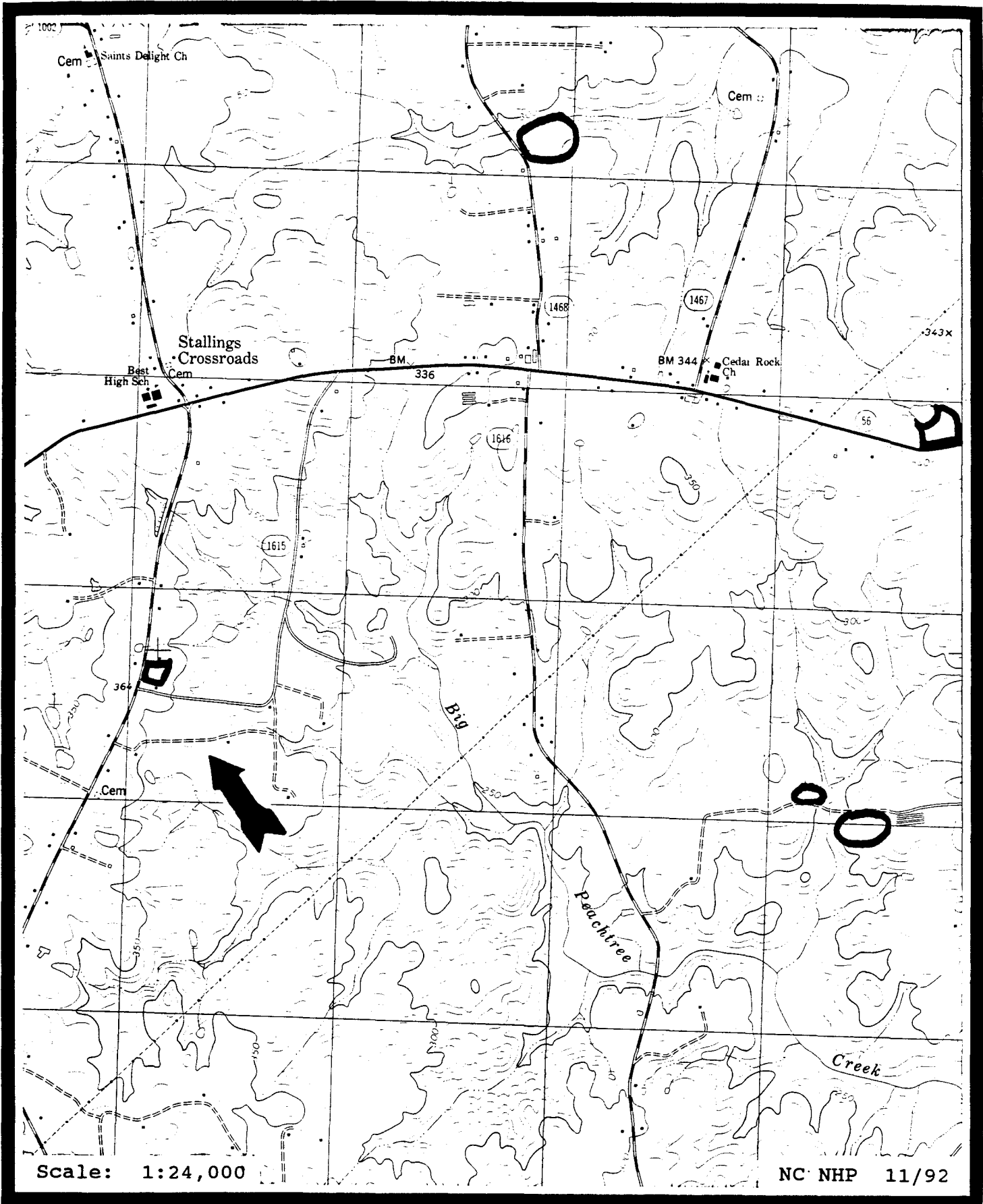
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Use of herbicides may be very harmful to the population of Small's portulaca. There may be a need to restrict farming within at least 10 feet of the flatrock. Other threats to these plants include damage by tractors. Non-native or weedy species such as Japanese honeysuckle (Lonicera japonica) may pose a threat to native species in the plant community. The landowner should be contacted to discuss the significance of the site and the protection options available.

COMMENTS: Because the site was visited in the late fall, a spring survey is recommended for finding more herbaceous species.

REFERENCES:

Murrell, Z.E. 1991. Cedar Rock Church Outcrop. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Overton Rock
 Site Code: FR9
 Quadrangle: Justice

SITE NAME: Overton Rock

SITE CODE: FR9

SIZE: 5 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Franklin

QUADRANGLE: Justice

LOCATION: This site is in the Tar River watershed in eastern Franklin County in the Piedmont Province of North Carolina. It is at the junction of SR 1002 and SR 1615, approximately 0.8 mile south of Stallings Crossroads.

SIGNIFICANT FEATURES:

1. This site contains one of the best Granitic Flatrock communities in North Carolina. The community is in excellent condition and displays typical vegetation zones.

2. Three rare species of plants are present at this site: wavyleaf wild quinine (Parthenium radfordii), a Federal Candidate species; Small's portulaca (Portulaca smallii), Threatened in the state; and granite flatsedge (Cyperus granitophilus), significantly rare in the state.

GENERAL DESCRIPTION:

Overton Rock is a level outcrop produced by exfoliation of the granitic bedrock. The outcrop is on a broad upland ridgetop and is level with the surrounding soil surface. The rock surface has a series of shallow depressions and mats of developing soil.

The site contains one of the best examples in the state of a Granitic Flatrock community. The vegetation consists of zones of herbs, controlled by soil depth and moisture. Dominants in patches include mosses and lichens (Grimmia sp. and Cladonia spp.), broomsedge (Andropogon virginicus), ragwort (Senecio tomentosus), haircap moss (Polytrichum sp.), and elf oprine (Diamorpha smallii). Many other species largely confined to flatrock communities occur here, including fame flower (Talinum tertifolium), smooth sandwort (Arenaria glabra), flatrock pimpernel (Lindernia monticola), eggleaf rushfoil (Crotonopsis elliptica), and flatsedge (Cyperus aristatus). A large population of Small's portulaca (Portulaca smallii), a species confined to Granitic Flatrock communities, is present. A smaller population of wavyleaf wild quinine (Parthenium radfordii) is also present.

OWNERSHIP: Single private ownership.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

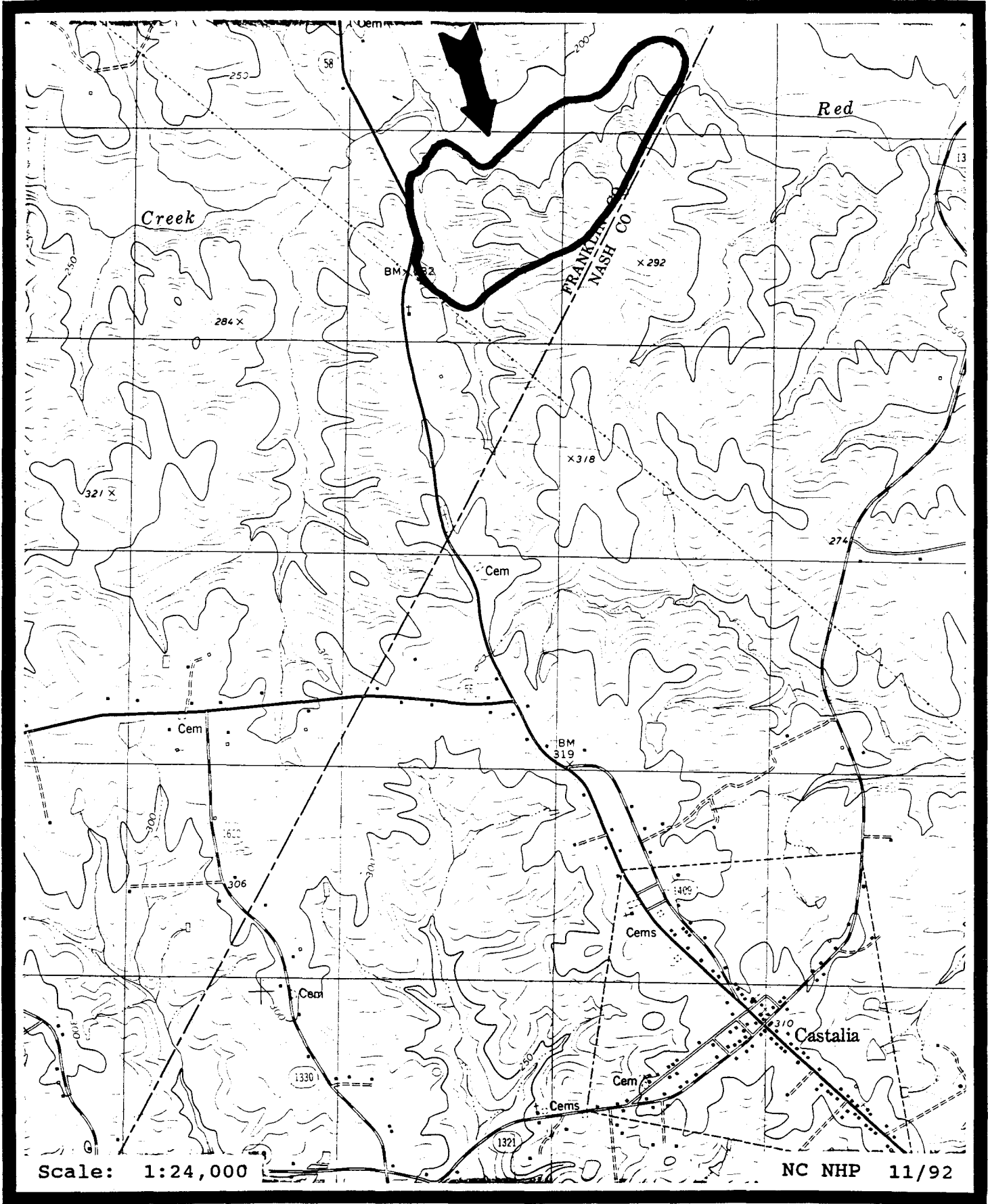
MANAGEMENT OR PROTECTION RECOMMENDATIONS: The site is registered. Disturbance has been limited, but continued

monitoring is needed to prevent trash dumping and vehicle traffic. A wooded buffer should be left around the outcrop.

COMMENTS: This site is one of the best known flatrocks in the eastern Piedmont cluster.

REFERENCES:

- Lynch, J.M. and J.H. Moore. 1980. Overton Rock Outcrop. Natural Area Summary. N.C. Natural Heritage Program.
- Palmer, P.G. 1970. The Vegetation of Overton Rock Outcrop, Franklin County, N.C. Journal of the Elisha Mitchell Scientific Society 86: 80-87.



Site Name: Red Bud Creek Slopes
Site Code: FR10
Quadrangle: Castalia

294

SITE NAME: Red Bud Creek Slopes

SITE CODE: FR10

SIZE: 167 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Castalia

LOCATION: This site is in the Tar River watershed in eastern Franklin County in the Piedmont Province of North Carolina. It is north-northwest of Castalia on NC 58; east of NC 58, northeast of a powerline cut, and east to the Franklin-Nash county line.

SIGNIFICANT FEATURES: This site contains a ravine and bluff area that supports a good quality, well-developed Mesic Mixed Hardwood Forest (Piedmont Subtype) and a good quality Piedmont/Low Mountain Alluvial Forest.

GENERAL DESCRIPTION:

The area in general is a steep ravine near NC 58 with steep northwest-facing bluffs on the south side of Red Bud Creek. The ravine, from the small church to the creek near the highway, is in good condition. The bluff east of the ravine is of high quality. This site is at the interface of gneiss and slate rocks. The soil is deep, well drained, and probably acidic.

Two community types are found at this site: Mesic Mixed Hardwood Forest (Piedmont Subtype) and Piedmont/Low Mountain Alluvial Forest. The Mesic Mixed Hardwood Forest is surrounded by clearcut areas and agricultural fields and covers 50-100 acres. This community is an old forest with a thick canopy layer of large trees and a well-developed herb layer. The canopy is dominated by American beech (Fagus grandifolia), red oak (Quercus rubra), and tuliptree (Liriodendron tulipifera). The subcanopy contains as dominants sourwood (Oxydendrum arboreum), flowering dogwood (Cornus florida), and redbud (Cercis canadensis). The shrub layer is of pawpaw (Asimina) and American strawberrybush (Evonymus americana). The herb layer contains beechdrops (Epifagus virginiana), Christmas fern (Polystichum acrostichoides), downy rattlesnake orchid (Goodyera pubescens), and rattlesnake fern (Botrychium virginianum).

The Piedmont/Mountain Alluvial Forest is on a narrow floodplain on the south side of Red Bud Creek. It is a good quality forest that covers 10-20 acres. The canopy is mature and is dominated by loblolly pine (Pinus taeda), tuliptree, and red oak. The subcanopy is dominated by flowering dogwood and American hornbeam (Carpinus caroliniana). Common spicebush (Lindera benzoin) is the dominant shrub species. The herb layer is dominated by Japanese grass (Microstegium vimineum), lopseed (Phryma leptostachya), and Christmas fern.

Faunal observations were made during the site survey. The following species are present at this site: barred owl (Strix varia) and red fox (Vulpes).

OWNERSHIP: Private ownership.

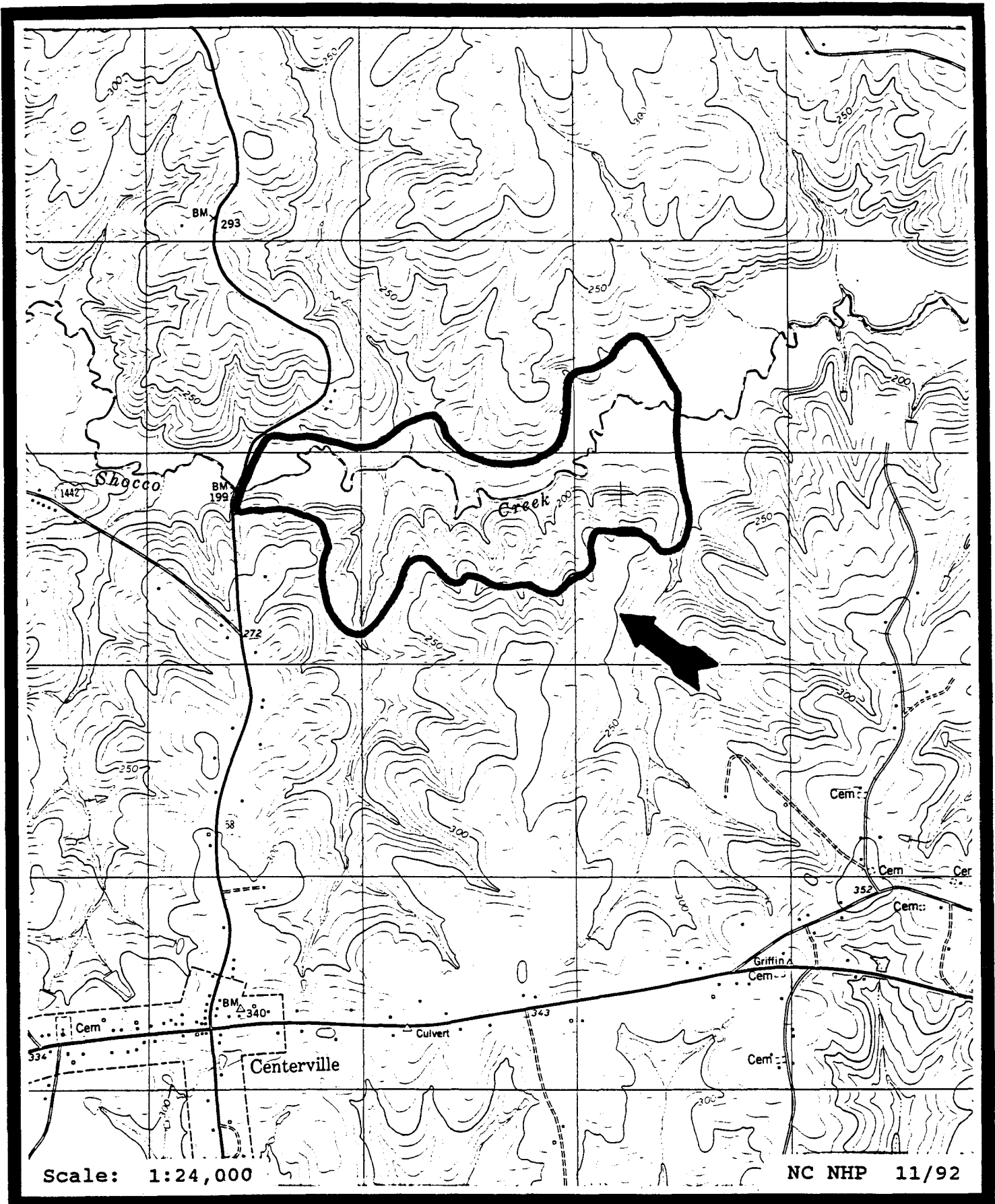
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The Mesic Mixed Hardwood Forest at this site is mature and in good condition. Clearcutting should be avoided. Farming and recent clear-cutting have occurred all around this site, leaving it isolated. Regrowth of the hardwood forest in cut areas and connection of the site to a forested corridor along the creek would reduce the long-term effect of isolation. The landowner should be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: A spring survey is recommended because the site was visited in the fall. An additional survey could locate rare species of herbs.

REFERENCES:

Murrell, Z.E. 1991. Red Bud Creek. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Shocco Creek--Centerville Bluffs
 Site Code: FR11
 Quadrangle: Centerville

SITE NAME: Shocco Creek--Centerville Bluffs

SITE CODE: FR11

SIZE: 330 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Centerville

LOCATION: This site is in the Tar River watershed in northeastern Franklin County in the Piedmont Province of North Carolina. It is about 1 mile north of Centerville on NC 58, east of the road along Shocco Creek.

SIGNIFICANT FEATURES:

1. This site has intact examples of Mesic Mixed Hardwood Forest (Piedmont Subtype) and Piedmont/Low Mountain Alluvial Forest community types with well-developed herbaceous layers.
2. The amphibolite intrusion at this site is a significant geologic feature.

GENERAL DESCRIPTION:

The general area is a north-facing bluff along Shocco Creek and its adjacent floodplain. The geology is characterized by biotite gneiss and schist with an intrusion of amphibolite. Two community types are found at this site: Mesic Mixed Hardwood Forest (Piedmont Subtype) and Piedmont/Low Mountain Alluvial Forest.

The Mesic Mixed Hardwood Forest, found along the bluff, is in good condition and has well-developed canopy and herb layers. This forest covers an area of about 60 acres. The canopy is dominated by American beech (Fagus grandifolia), southern red oak (Quercus falcata), white oak (Q. alba), tuliptree (Liriodendron tulipifera), and pignut hickory (Carya glabra). The subcanopy contains as dominants sourwood (Oxydendrum arboreum), flowering dogwood (Cornus florida), and redbud (Cercis canadensis). The shrub layer is dominated by American strawberrybush (Evonymus americana) and downy arrowwood (Viburnum rafinesquianum). The herb layer contains lopseed (Phryma leptostachya), agrimony (Agrimonia rostellata), perfoliate bellwort (Uvularia perfoliata), and the uncommon showy orchis (Orchis spectabilis). Some of the species present indicate this community is transitional to Basic Mesic Forest, as would be expected, given the presence of amphibolite.

The Piedmont/Low Mountain Alluvial Forest is at the base of the bluff and in the floodplain. It is in good condition and covers about 40 acres. The canopy is mature and is dominated by tuliptree, green ash (Fraxinus pennsylvanica), and river birch (Betula nigra). The subcanopy is characterized by red maple (Acer rubrum) and American hornbeam (Carpinus caroliniana). The dominant shrub species are common spicebush (Lindera benzoin), American strawberrybush, and elderberry (Sambucus canadensis).

The herb layer is dominated by false nettle (Boehmeria cylindrica) and jack-in-the-pulpit (Arisaema triphyllum).

Faunal observations were made during the site inventory. The following species are present at this site: raccoon (Procyon lotor), beaver (Castor canadensis), and white-tailed Deer (Odocoileus virginianus).

OWNERSHIP: Private ownership.

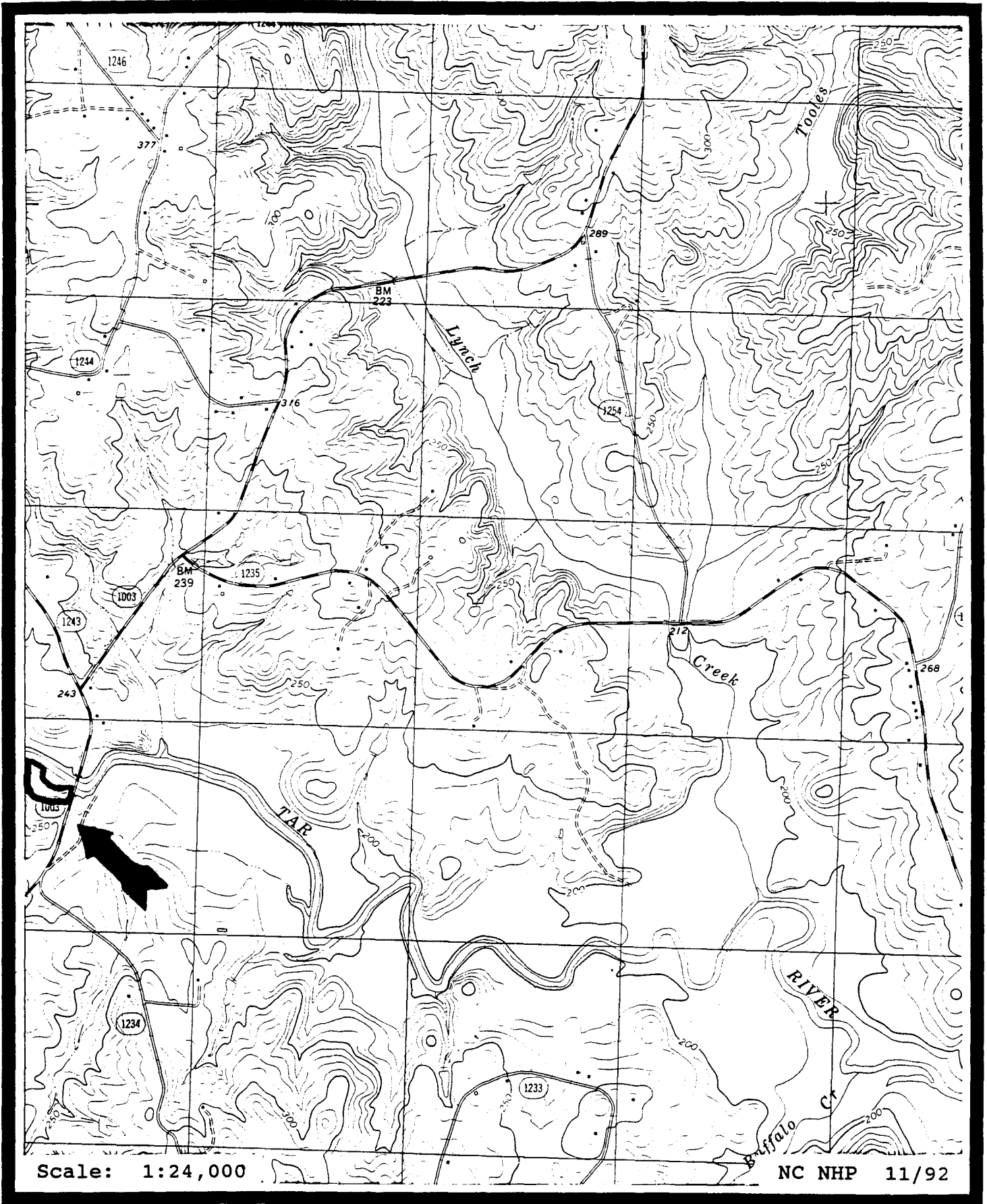
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: To the south and west of the site are clearcuts and to the east and north is second growth forest. A portion of the site to the east has a diminished herbaceous layer due to cattle grazing and may merit protection from such disturbances. This site should be protected from clearcutting. The landowner should be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: The amphibolite area deserves a visit in the spring to get a better understanding of the herbaceous layer.

REFERENCES:

Murrell, Z.E. 1991. Shocco Creek Bluffs at highway 58. Site Survey Report. N.C. Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Tar River Levee
Site Code: FR12
Quadrangle: Ingleside

SITE NAME: Tar River Levee

SITE CODE: FR12

SIZE: 6 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Ingleside

LOCATION: This site is in the Tar River watershed in northwestern Franklin County in the Piedmont Province of North Carolina. It is on the south side of the Tar River, just west of SR 1003.

SIGNIFICANT FEATURES:

1. This site contains high quality examples of Piedmont/Mountain Levee Forest and Floodplain Pool natural communities.
2. A population of the significantly rare isopyrum (Enemion biternatum) occurs on the site.
3. The Tar River--Middle Aquatic Habitat (AH16) flows through this site and contains rare aquatic species including three Federal Candidate species: the yellow lance (Elliptio lanceolata), the Atlantic pigtoe (Fusconaia masoni), and the yellow lampmussel (Lampsilis cariosa), all are also state-listed as State Threatened.

GENERAL DESCRIPTION:

This site is a segment of the Tar River floodplain. It includes a well-developed natural levee along the river bank. Behind it is a Floodplain Pool community, occurring a depression blocked by the levee.

The levee forest is unusually rich and contains species suggestive of a soil pH higher than usual for this community type. The canopy is dominated by sugar maple (Acer saccharum var. barbatum), with swamp chestnut oak (Quercus michauxii), river birch (Betula nigra), and sycamore (Platanus occidentalis) also present. The shrub layer is dominated by painted buckeye (Aesculus sylvatica). The lush herb layer includes wild ginger (Asarum canadense), isopyrum (Enemion biternatum), yellow fumewort (Corydalis flavula), and wood-nettle (Laportea canadensis). Isopyrum is listed as significantly rare and occurs here in a large population.

The Floodplain Pool community is not well known. It is dominated by aquatic plant species and appears to be permanently flooded. If fish are not present in the pool, it may be an important breeding site for amphibians.

The Tar River--Middle Aquatic Habitat (AH16) flows through this site and contains several rare mussel species. At this site are three Federal Candidate species: the yellow lance (Elliptio lanceolata), the Atlantic pigtoe (Fusconaia masoni), and the yellow lampmussel (Lampsilis cariosa), all of which are also state-listed as State Threatened.

OWNERSHIP: Private ownership.

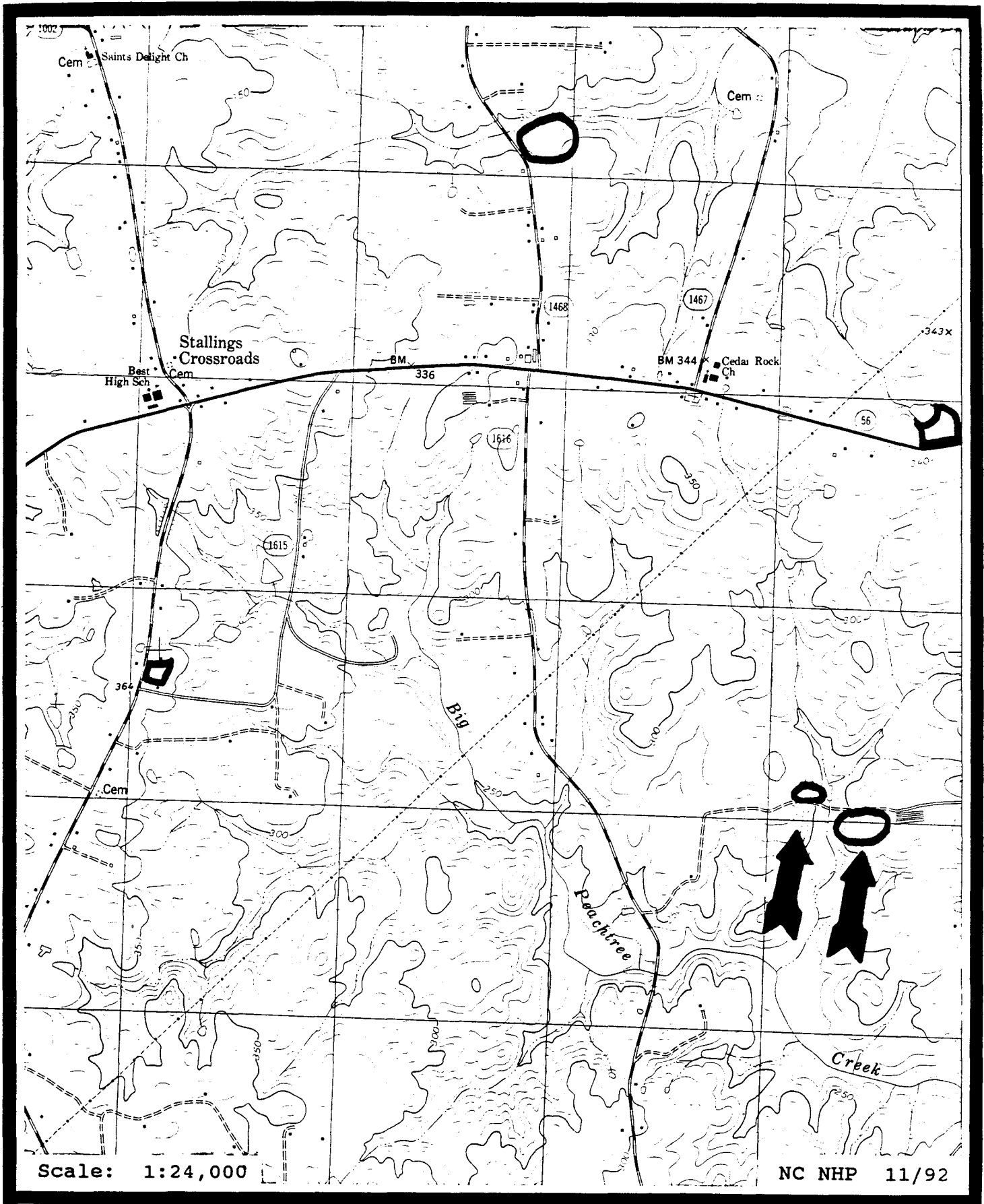
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The owner should be contacted to discuss the significance of the site and the various protection options available. Forests should not be cut on the rich floodplain, slope base, and in the immediate watershed of the pool.

COMMENTS: This site has not been visited in several years.

REFERENCES:

LeGrand, H.E., Jr. and L. Mansberg. 1985. Tar River Levee. Natural Area Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: West Big Peachtree Creek Flatrock
 Site Code: FR13
 Quadrangle: Justice

SITE NAME: West Big Peachtree Creek Flatrock

SITE CODE: FR13

SIZE: 7 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Franklin

QUADRANGLE: Justice

LOCATION: This site is in the Tar River watershed in eastern Franklin County in the Piedmont Province of North Carolina. It is between SR 1617 and SR 1616, about 1 mile south of NC 56; 0.3 mile west of SR 1617 on the south side of a dirt road downslope from several greenhouses.

SIGNIFICANT FEATURES: This is a very high Granitic Flatrock with a very large population of Small's portulaca (Portulaca smallii), a State Threatened species.

GENERAL DESCRIPTION:

This site includes three granitic outcrops on a slightly sloping hillside above a tributary of Peachtree Creek. Bordering the site are farm fields and greenhouses. Peachtree Creek is dammed on the north side of the road.

This site supports a high quality Granitic Flatrock natural community with a well-developed herbaceous layer. The dominant plants on the open rock outcrops are Small's portulaca (Portulaca smallii), smooth sandwort (Minuartia glabra), eggleaf rushfoil (Crotonopsis elliptica), and fameflower (Talinum teretifolium). The primary shrub on the rock outcrops is sparkleberry (Vaccinium arboreum). The outcrop is bordered by a dense tangle of brambles of greenbrier (Smilax spp.) and blackberry (Rubus spp.) surrounded by cultivated land.

OWNERSHIP: Single private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Recent disturbances to the site include some trash dumping on the flatrock and logging along the margin of the flatrock. To avoid future trash dumping and ORV use, fencing may be needed. The landowner needs to be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: This site should be surveyed further for Piedmont quillwort (Isoetes piedmontana), a state threatened species.

REFERENCES:

Murrell, Z.E. 1991. Gardner Greenhouse Flatrock. Site Survey Report. N.C. Natural Heritage Program.

GRANVILLE COUNTY NATURAL AREAS

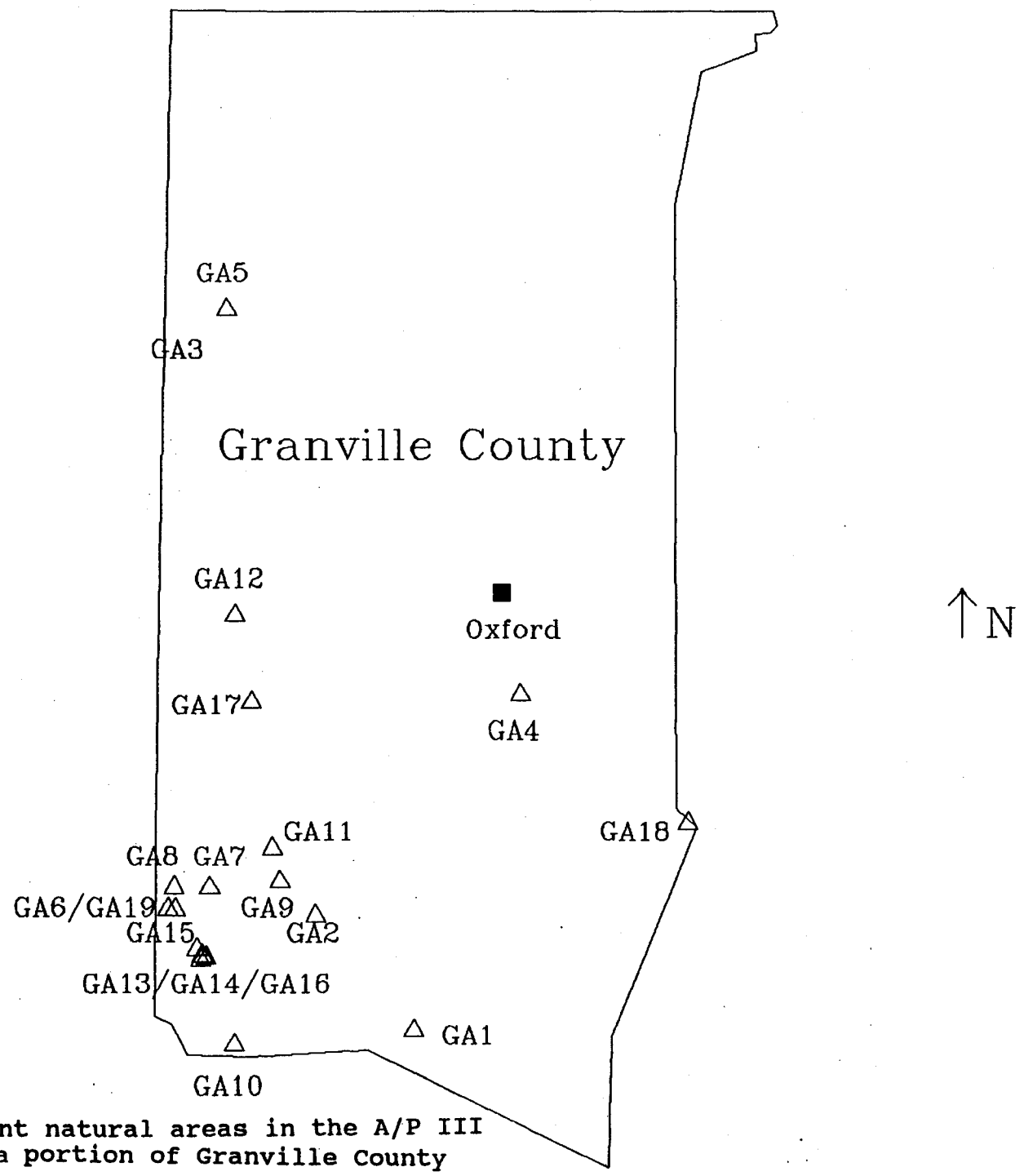
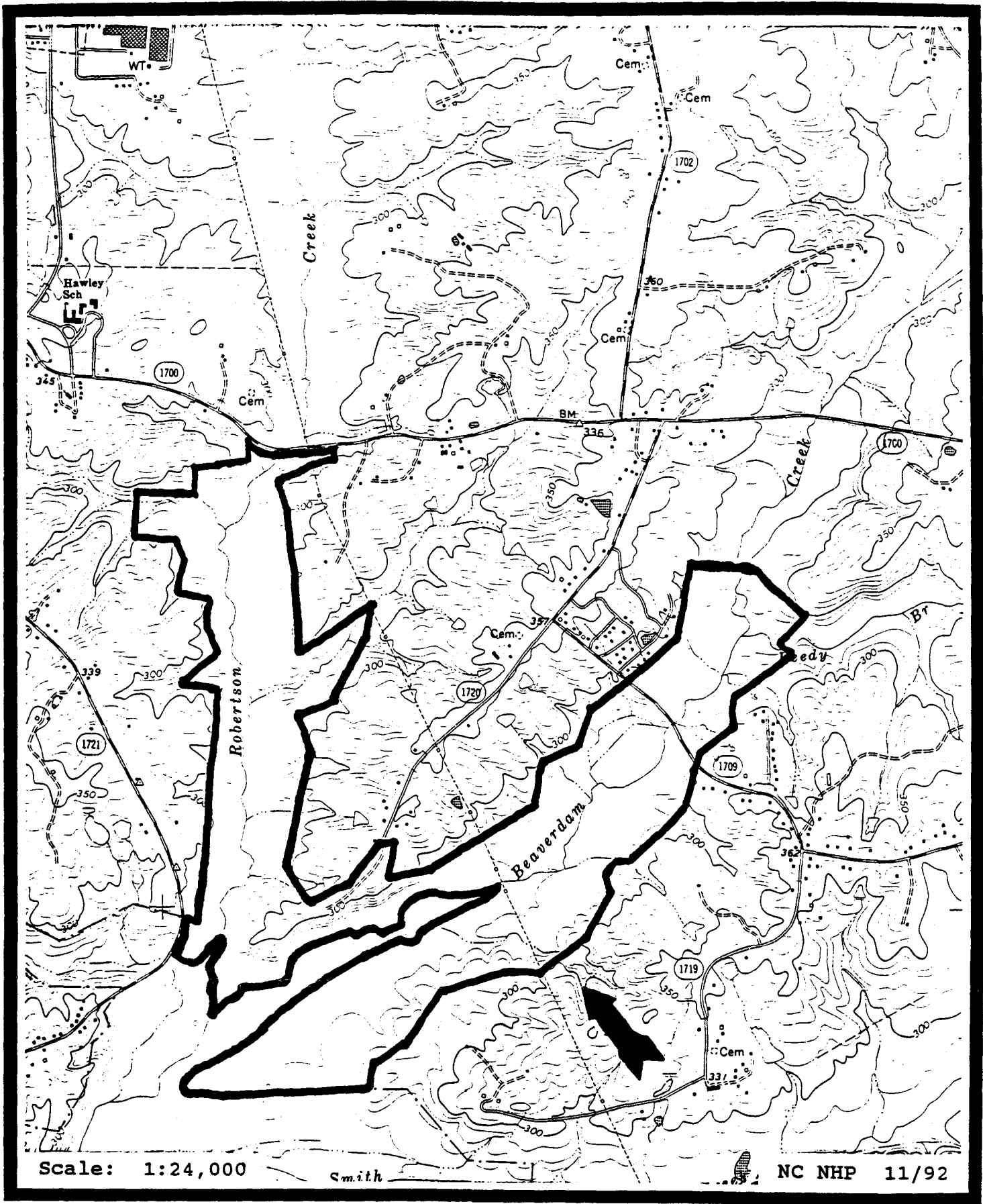


Figure 10. Significant natural areas in the A/P III study area portion of Granville County



Site Name: Beaverdam Lake Swamps and Arkose Outcrops
 Site Code: GA1
 Quadrangle: Creedmoor

SITE NAME: Beaverdam Lake Swamps and Arkose Outcrops

SITE CODE: GA1

SIZE: 700 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Creedmoor

LOCATION: This site is in the Neuse River watershed in Granville County in the Piedmont Province of North Carolina. It is south of SR 1700 and 1709; both east and west of the termination of SR 1720.

SIGNIFICANT FEATURES:

1. This site contains three good quality natural communities: Piedmont/Mountain Swamp Forest, Piedmont/Mountain Semipermanent Impoundment, and Granitic Flatrock.
2. This site contains one of the best developed outcroppings of arkose in the Durham Triassic Basin.

GENERAL DESCRIPTION:

This site contains a mature swamp forest along Beaverdam and Robertson Creeks. This is one of the most extensive swamps remaining in the Research Triangle area. The creation of Falls and Beaverdam Reservoirs inundated hundreds of acres of high quality wetlands along Beaverdam Creek.

This site also contains at least seven arkose outcrops immediately northwest of the Beaverdam Creek floodplain. This series of outcrops is one of the best developed outcroppings of arkose in the Durham Triassic Basin. These outcrops occur in a linear fashion for nearly one-half mile on the slope overlooking the swamp. The land slopes southeast at a 20-30° angle, thus the outcrops are not called "flatrocks" even though their surfaces are rather flat. They have the initial appearance of granite outcrops, which are fairly frequent in Franklin County and in eastern Wake County; however, arkose is a sandstone, composed of grains weathered from rocks such as granite and transported only a short distance from their origin. Arkose is thus somewhat similar to granite, an igneous rock, in chemical composition, but arkose is a sedimentary rock that is somewhat crumbly as compared to the solid nature of granite.

Present at this site are three good quality natural communities: Piedmont/Mountain Swamp Forest, Piedmont/Mountain Semipermanent Impoundment, and Granitic Flatrock. The Piedmont/Mountain Swamp Forest at this site is dominated by a variety of mast producing, flood tolerant oaks. Swamp chestnut oak (Quercus michauxii) is particularly abundant and cherrybark oak (Q. pagoda), overcup oak (Q. lyrata), and willow oak (Q. phellos) are common. Also present are red maple (Acer rubrum), green ash (Fraxinus pennsylvanica), and American elm (Ulmus americana) are also present in this forest. The subcanopy and shrub layers are

open with scattered juveniles of the canopy species, plus American hornbeam (Carpinus caroliniana), deciduous holly (Ilex decidua), black haw (Viburnum prunifolium), and hawthorn (Crataegus marshallii). The herb layer is sparse due to prolonged periods of standing water. Various grasses and sedges appear in clumps, and lizard's-tail (Saururus cernuus) dominates depressions where water pools.

The Granitic Flatrocks at this site are all less than 50 X 50 feet in size and tend to be quite dry. After heavy rainfall, however, there is some ground water seepage over several outcrops. Some rocks are nearly devoid of vegetation, but mats of lichens and mosses are common on them. Rather than developing a flora characteristic of granite flatrocks, the arkose outcrops are vegetated by a scattering of rock outcrops species mixed with species of xeric woodlands and weedy places. Rock inhabiting species present in good numbers include fameflower (Talinum teretifolium), slender dayflower (Commelina erecta), and early saxifrage (Saxifraga virginensis). The uncommon hairy lipfern (Cheilanthes lanosa) occurs in several places on the rocks. Columbine (Aquilegia canadensis) grows commonly in the soil at the base of many outcrops and beargrass (Yucca filamentosa) grows on the periphery. The vegetation surrounding the outcrops is a xeric and scrubby woodland of pines and hardwoods, typical of that growing on the margins of most outcrops in the Piedmont.

Several ponds, or Piedmont/Mountain Semipermanent Impoundments, have been created at this site by the ever increasing populations of beavers (Castor canadensis). The beaver dams have effectively impounded shallow ponds which have stressed trees resulting in an opening of the canopy. A variety of aquatic shrubs, including button-bush (Cephalanthus occidentalis) and marsh mallow (Hibiscus moscheutos), and herbs like lizard's tail and arrow arum (Peltandra virginica) thrive in the sunny, wet habitat.

The diversity of bird species utilizing the mature hardwood forest is high. Several species of woodpeckers, wild turkey (Meleagris gallopavo), red-shouldered hawk (Buteo lineatus), barred owl (Strix varia), and wood duck (Aix sponsa) breed in this wetland habitat.

OWNERSHIP: This natural area is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

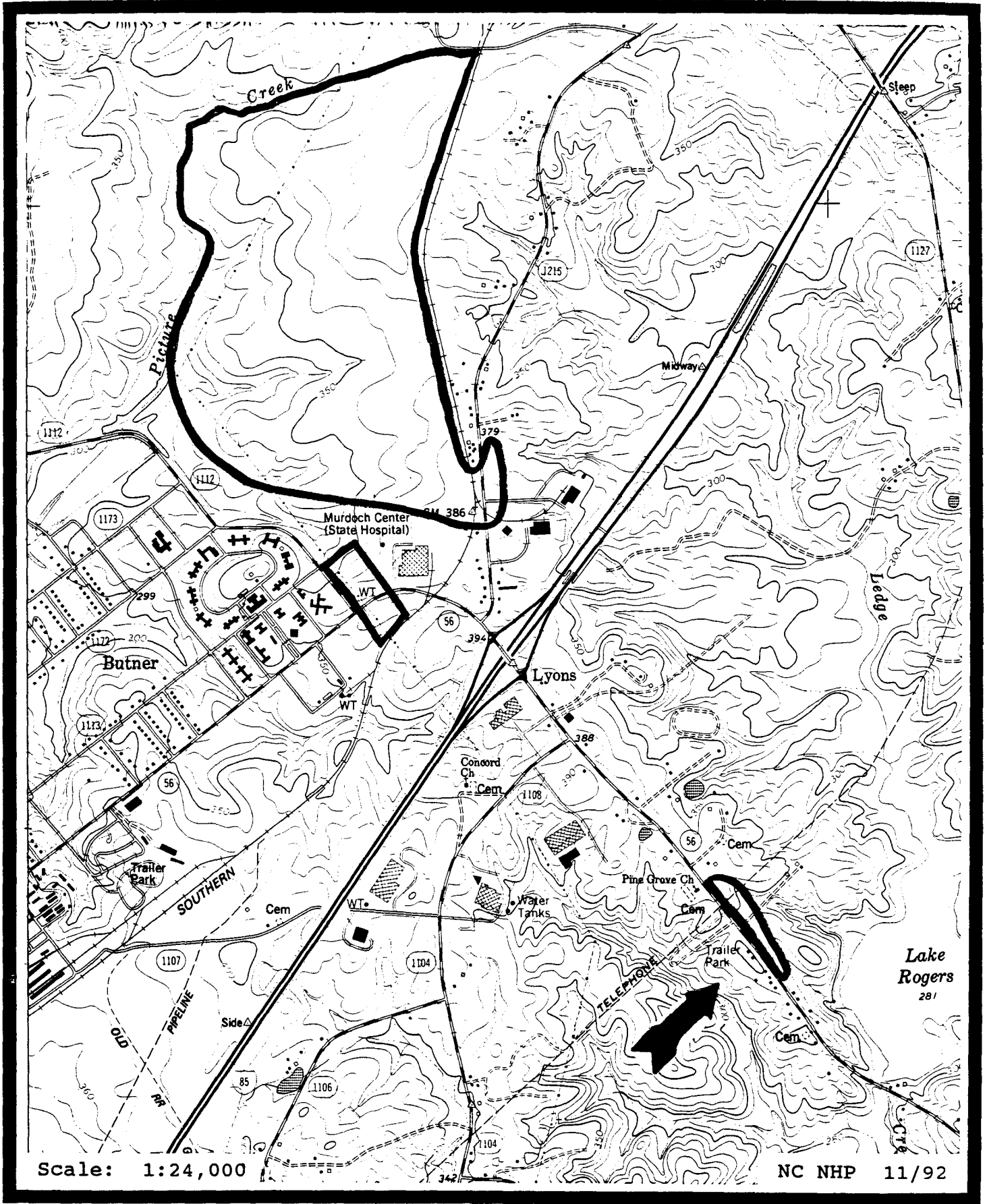
MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site is managed by the N.C. Wildlife Resources Commission. No management is necessary to enhance the natural features of the swamp forest. Man-made subimpoundments would alter the wetland communities. Efforts to manage the beaver population may be desirable if population levels increase dramatically. In fact, these animals appear to be killing many trees in the forest due an excessive

number of dams. Some dams may need to be removed. Because rock outcrops contain fragile communities, mats of mosses and other plants are easily dislodged by foot traffic. Visitor usage should be kept to a minimum. Japanese honeysuckle (Lonicera japonica) grows around the edges of the outcrops and is beginning to invade some areas; some of these should be removed every few years.

COMMENTS: Even though no threatened or endangered plant species have been found on the rocks, the area has the potential of supporting rare species.

REFERENCES:

- LeGrand, H.E., Jr. 1985. Beaverdam Creek Arkose Flatrocks. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- _____. 1986. Beaverdam Creek Swamp. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- Moore, J.H. and H.E. LeGrand, Jr. 1989. Falls Lake Natural Areas. N.C. Natural Heritage Program.



Site Name: Creedmoor Lake Diabase Area
Site Code: GA2
Quadrangle: Stem

SITE NAME: Creedmoor Lake Diabase Area

SITE CODE: GA2

SIZE: 10 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Granville

QUADRANGLE: Stem

LOCATION: This site is in the Neuse River watershed in southern Granville County in the Piedmont Province of North Carolina. It is along the northeast side of NC 56; between Butner and Lake Rogers (Creedmoor Lake); extending from Pine Grove Church southeast for about 0.3 mile.

SIGNIFICANT FEATURES:

1. This natural area contains two Federal Candidate species: serpentine aster (Aster depauperatus), also State Endangered, and Carolina birdfoot-trefoil (Lotus helleri).
2. One State Candidate species occurs at this site, prairie dock (Silphium terebinthinaceum).
3. Three plants significantly rare in the state occur at this site: Piedmont gerardia (Agalinis decemloba), hoary puccoon (Lithospermum canescens), and southeastern bold goldenrod (Solidago rigida ssp. glabrata).

GENERAL DESCRIPTION:

This site lies over a diabase sill. The area has been mostly clear-cut and is growing back in eastern redcedar (Juniperus virginiana), hardwoods, and pines (Pinus sp.). A telephone line clearing cuts through the site, plus there is a wide clearing under telephone lines along NC 56.

Many rare herbaceous plants occur in this natural area. These plants grow in the right-of-ways, in old logging road beds, and in other disturbed areas at the site. Rare plant species at this site include: serpentine aster (Aster depauperatus), Carolina birdfoot-trefoil (Lotus helleri), prairie dock (Silphium terebinthinaceum), piedmont gerardia (Agalinis decemloba), hoary puccoon (Lithospermum canescens), and southeastern bold goldenrod (Solidago rigida ssp. glabrata).

OWNERSHIP: Private ownership.

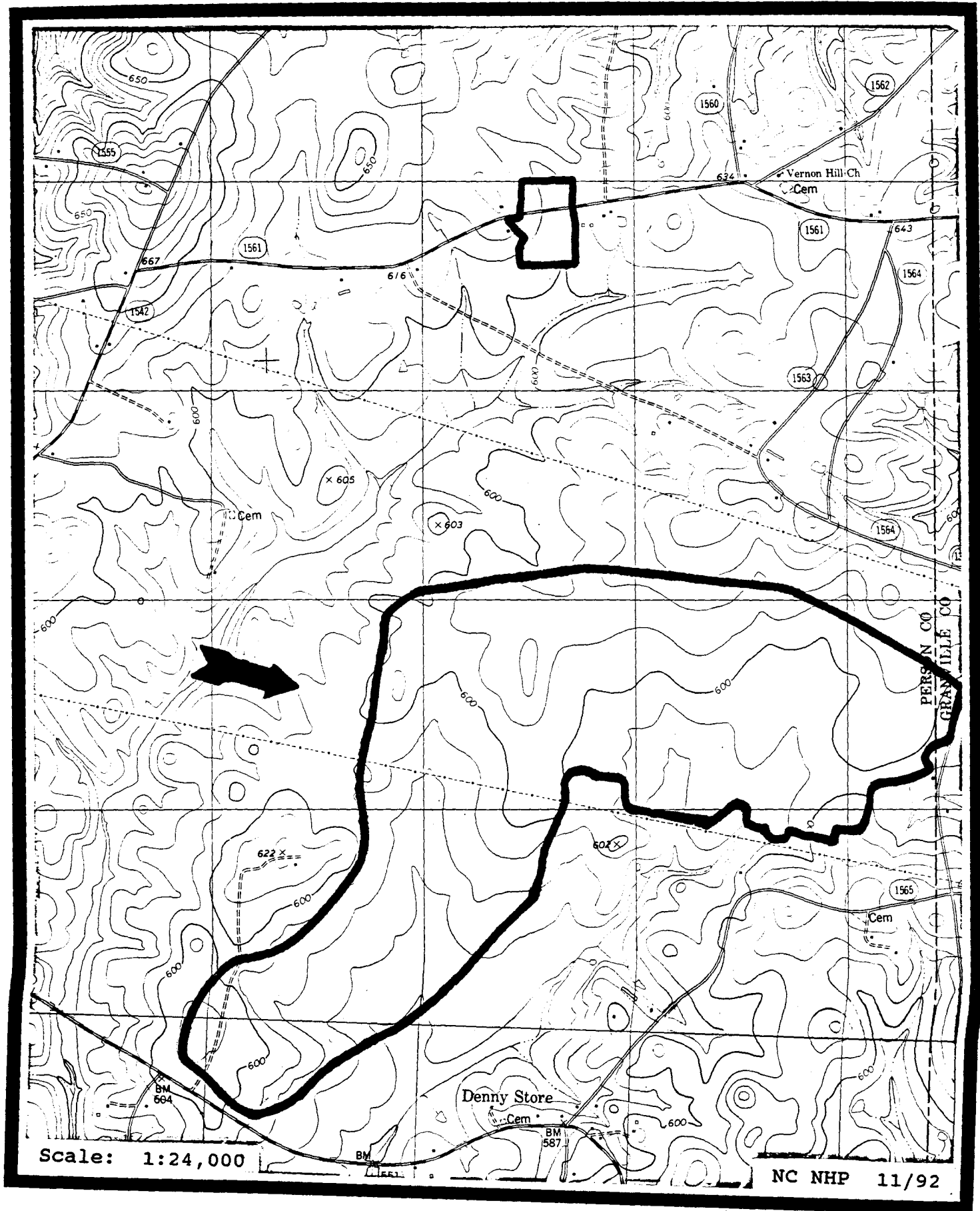
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Little threat is known to exist at the site; however, there is some potential for development, as the town of Butner is rapidly expanding toward the site. The rare plants need clearings and other openings. Burning would be best, but this is not likely to occur. The clearing along the road needs mowing every few years.

COMMENTS: The site has been poorly surveyed back from the road.

REFERENCES:

Element occurrence records. N.C. Natural Heritage Program.



Site Name: Denny Store Gabbro Forest
 Site Code: GA3
 Quadrangle: Triple Springs

SITE NAME: Dennys Store Gabbro Forest

SITE CODE: GA3

SIZE: 925 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Person, Granville

QUADRANGLE: Triple Springs

LOCATION: This site is in the Tar River watershed in eastern Person County and western Granville County in the Piedmont Province of North Carolina. It is along the Person/Granville county line, extending from SR 1313 (Granville) southwestward to SR 1536 (Person); about 1 mile north of the community of Dennys Store, N.C.

SIGNIFICANT FEATURES:

1. This natural area contains one of the more extensive areas of gabbro rock in the state.
2. A population of Lewis's heartleaf (Hexastylis lewisii), a State Candidate species, is present at this site.
3. This site supports a mature Basic Oak-Hickory Forest and several other natural communities.

GENERAL DESCRIPTION:

The topography at this site is quite flat and the underlying rock is a gabbro pluton. The site contains a mature Basic Oak-Hickory Forest. The surrounding areas are forested or are being used for agriculture and home sites. This site is somewhat of a continuation of the Goshen Gabbro Forest just to the east. Both of these natural areas lie over the same gabbro pluton.

The Basic Oak-Hickory Forest present at this site is mature and extensive and has an excellent variety of tree species. Common canopy species include: tuliptree (Liriodendron tulipifera), sweetgum (Liquidambar styraciflua), many oak species [such as white oak (Quercus alba), willow oak (Q. phellos), southern red oak (Q. falcata), and black oak (Q. velutina)], and several hickory species [such as shagbark hickory (Carya ovata), pignut hickory (C. glabra), and red hickory (C. ovalis)]. The subcanopy contains flowering dogwood (Cornus florida), redbud (Cercis canadensis), and red mulberry (Morus rubra), among other species. The shrub layer contains lowbush blueberry (Vaccinium tenellum) and fringetree (Chionanthus virginicus). The herb layer at this site contains species such as: curlyheads (Clematis ochroleuca), partridgeberry (Mitchella repens), and perfoliate bellwort (Uvularia perfoliata). Lewis's heartleaf (Hexastylis lewisii), a State Candidate species, is also present at this site.

OWNERSHIP: Private ownership.

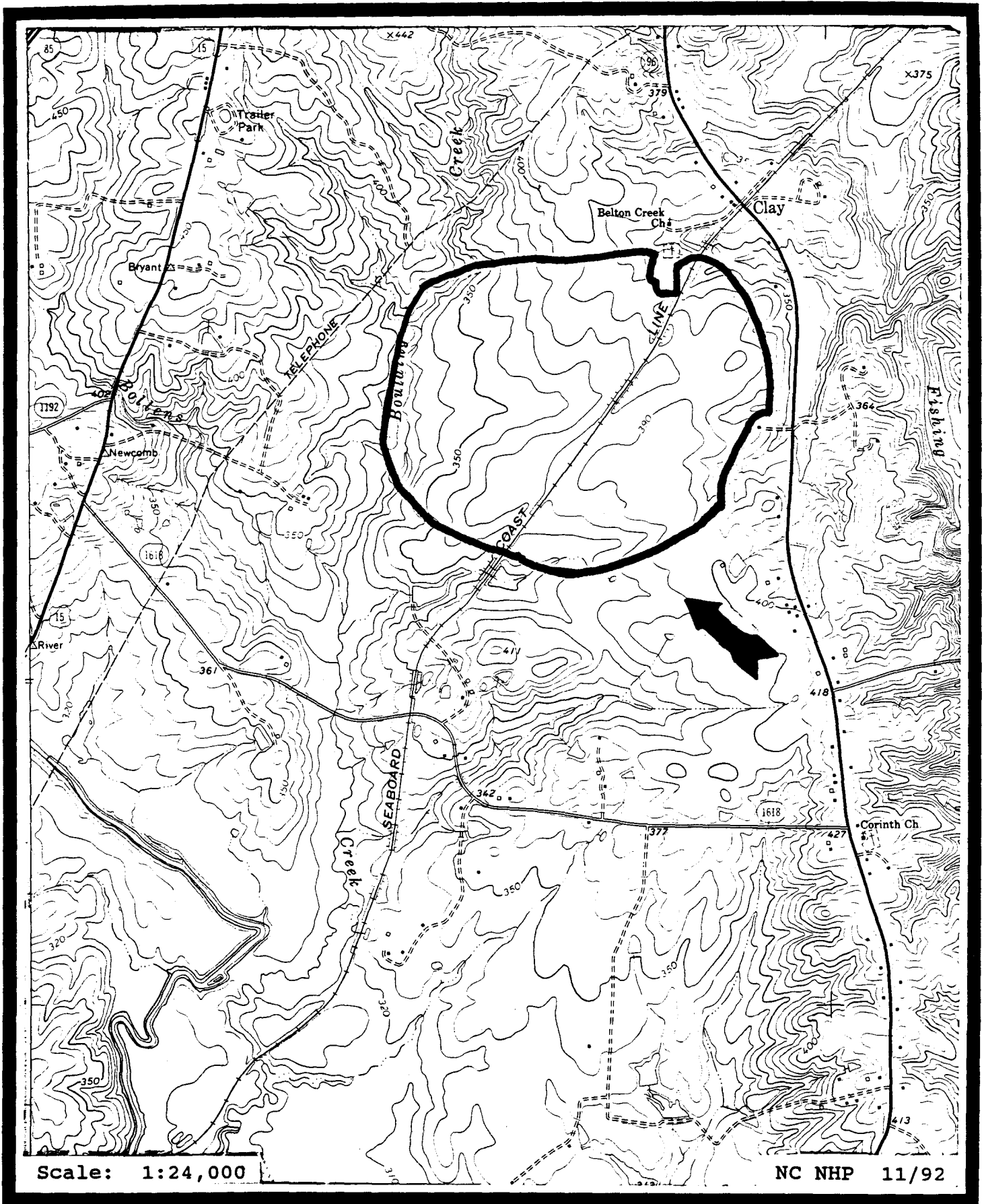
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site is likely to be logged, perhaps within the next few years. There is relatively little pressure from development in this area. Little management is required at this site. The landowner should be informed of the significance of the site and of the various protection options available.

COMMENTS: This site has the potential to support Indian physic (Porteranthus stipulata), a significantly rare species. The northern portions of this site need further survey work.

REFERENCES:

LeGrand, H.E., Jr. 1986. Dennys Store Gabbro Forest. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: Diabase Sill near Clay
 Site Code: GA4
 Quadrangle: Wilton

SITE NAME: Diabase Sill near Clay

SITE CODE: GA4

SIZE: 500 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Wilton

LOCATION: This site is in the Tar River watershed in southern Granville County in the Piedmont Province of North Carolina. It is west of NC 96; north of SR 1618; just south of community of Clay, N.C.

SIGNIFICANT FEATURES:

1. Three State Candidate species occur in this natural area: prairie blue wild indigo (Baptisia australis var. minor), prairie dock (Silphium terebinthinaceum), and shale-barren skullcap (Scutellaria leonardii).

2. Four plant species listed as significantly rare in the state occur at this site: Earle's blazing star (Liatris squarrulosa), glade milkvine (Matelea decipiens), rufous bulrush (Scirpus pendulus), and southeastern bold goldenrod (Solidago rigida ssp. glabrata).

GENERAL DESCRIPTION:

This site is a moderately-sized diabase sill which lies on both sides of an abandoned railroad track. The soils at this site belong to the Iredell and Enon Series. Most of the site has been clearcut in the last 10 years. Some of the clearing has provided bare ground and removed shrubs and saplings. These clearings have provided habitat for several rare "prairie" plants. Some pinewoods and mixed hardwoods also occur at this site.

Some of the common herbs present at this site include: rattlebox (Crotalaria sagittalis), coppery St. John's-wort (Hypericum denticulatum), and Earle's blazing star (Liatris squarrulosa). Species present at this site typical of circumneutral/basic soils include prairie blue wild indigo (Baptisia australis var. minor), shale-barren skullcap (Scutellaria leonardii), prairie dock (Silphium terebinthinaceum), and southeastern bold goldenrod (Solidago rigida ssp. glabrata). Another rare plant species present at this site is rufous bulrush (Scirpus pendulus). Most of these rare plants are present in surprisingly large numbers (several hundred individuals).

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Clearcutting of the woods in the last 10 years has provided habitat for rare plant species at this site. The landowner should be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: This site has the potential to support other rare plant species, such as smooth coneflower (Echinacea laevigata) and hoary puccoon (Lithospermum canescens). It is therefore recommended that this area may need another site survey, particularly away from the railroad right-of-way.

REFERENCES:

LeGrand, H.E., Jr. 1988. Diabase Sill near Clay. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.

SITE NAME: Goshen Gabbro Forest

SITE CODE: GA5

SIZE: 1900 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Granville

QUADRANGLE: Triple Springs

LOCATION: This site is between the Tar River and Roanoke River watersheds in northwestern Granville County in the Piedmont Province of North Carolina. It is just west of the community of Goshen, N.C.; south of SR 1317; west of SR 1316; north of a powerline clearing; east of SR 1313 and SR 1564.

SIGNIFICANT FEATURES:

1. This site contains the best and most extensive forest over gabbro in the state. This is probably one of the most extensive forests over gabbro in the country.
2. Several significant plant communities occur at this site: Upland Depression Swamp Forest, Xeric Hardpan Forest, and Basic Mesic Forest (Piedmont Subtype).
3. Nine rare plant species are present in this natural area: smooth coneflower (Echinacea laevigata), Federally Endangered; nestronia (Nestronia umbellula), a Federal Candidate; prairie dock (Silphium terebinthinaceum), a State Candidate; and six significantly rare plant species: American barberry (Berberis canadensis), Earle's blazing star (Liatris squarrulosa), hoary puccoon (Lithospermum canescens), Indian physic (Porteranthus stipulatus), balsam ragwort (Senecio pauperculus), and southeastern bold goldenrod (Solidago rigida ssp. glabrata).

GENERAL DESCRIPTION:

This site is very scenic although the topography at this site is remarkably flat for the Piedmont. The site is poorly drained in many areas where water is ponded for much of the year. Along the southern boundary of the site is a powerline with a clearing perhaps 100 feet wide. A jeep trail traverses the site from east to west. Most significant at this site are the high quality examples of rare natural communities such as Upland Depression Swamp Forest, Xeric Hardpan Forest, and Basic Mesic Forest (Piedmont Subtype). Also present at this site is a ridge containing rare "prairie" plants. This site is part of the extensive gabbro pluton along the Granville-Person county line.

About 90% of the natural area is covered by a Basic Oak-Hickory Forest natural community. The canopy has an excellent diversity of xeric and hydric species and contains trees at least 70 feet tall. Common to the canopy are numerous oak species (Quercus spp.), several hickory species (Carya spp.), and other hardwoods such as maples (Acer spp.) and elms (Ulmus spp.). The canopy is likely one of the most diverse of any comparable site in the Piedmont of North Carolina. The shrub layer is not well

defined; however, the herb layer is rich. Rare species present in this community are Indian physic (Porteranthus stipulatus) and nestronia (Nestronia umbellula).

Located within the hardwood forest are several small swampy depressions, less than 1-2 acres, which contain good quality examples of the rare Upland Depression Swamp Forest community type. Species diversity is rather low in these areas. The dominant and characteristic tree of these depressions is willow oak (Quercus phellos). Other trees present include red maple (Acer rubrum), sweetgum (Liquidambar styraciflua), and swamp white oak (Q. bicolor). Two shrub species common in at least one of these areas are swamp doghobble (Leucothoe racemosa) and common winterberry (Ilex verticillata). In general, shrubs and herbs are few in these depressions.

The Xeric Hardpan Forest present at this site is located within the hardwood forest at the crest of a gentle ridge which is quite xeric. This Hardpan Forest is an excellent and undisturbed example of this rather rare natural community. The canopy of this forest is rather open and few shrubs or herbs are present. The common canopy species is post oak (Q. stellata) with some blackjack oak (Q. marilandica), loblolly pine (Pinus taeda), shortleaf pine (P. echinata), Virginia pine (P. virginiana), and eastern redcedar (Juniperus virginiana).

An unusual xeric ridge is present in the center of this site. This ridge contains a hardwood forest with a rather closed canopy and much shade. The common canopy species present are post oak, shortleaf pine, and eastern redcedar. This ridge contains a wide array of "prairie plants" that are rare in North Carolina. Most of these plants grow in the partial sun along the jeep trail that traverses the site. The rare plant species present in this area include: smooth coneflower (Echinacea laevigata), prairie dock (Silphium terebinthinaceum), American barberry (Berberis canadensis), Earle's blazing star (Liatris squarrulosa), hoary puccoon (Lithospermum canescens), balsam ragwort (Senecio pauperculus), and southeastern bold goldenrod (Solidago rigida ssp. glabrata).

The natural communities at this site are adjacent to each other in a 3-square-mile continuous block of forest. Thus, the site should provide important breeding and feeding habitat for amphibians that utilize the pools and the wooded areas. A large variety of birds that require extensive forests use this site.

OWNERSHIP: Private ownership, primarily a single owner.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Overall, little management of the site is needed. Japanese honeysuckle (Lonicera japonica) is a problem in a portion of the site. The jeep trail that traverses the site should be left open and not allowed to grow over because it provides habitat for most of the rare plant species present at the site. Some mechanical

thinning of shrubs and saplings along the edge of the jeep trail may be needed to enhance the rare plant species. Fire management may be necessary for maintaining rare plant species populations on the ridge. It appears that the smooth coneflower population is dying out at the site because of over-shading. Water levels in the pools should be monitored.

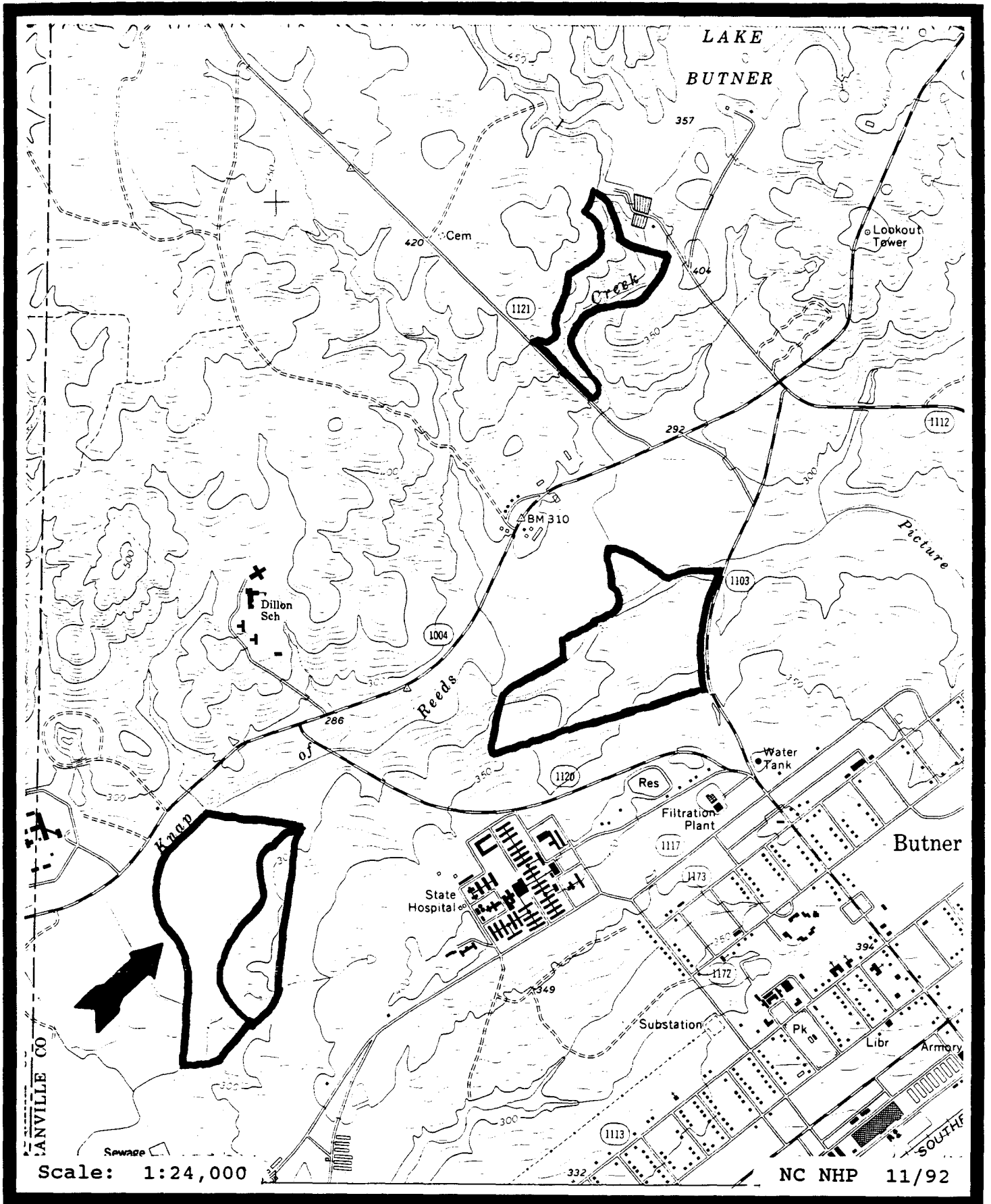
The major landowner is considering logging a portion of the site. The entire site may be too large to protect by acquisition. However, the southern end of the site featuring the rare plant "prairie ridge" and the portion of the site containing the large upland pond could be purchased as a preserve. At least one of the two known xeric forests in the natural area should be protected if the entire site can not be protected.

The major landowner has been informed of the significance of the site and of the various protection options available. If not acquired, the land should at least be protected through land registry. This, however, is not a good long-term option. The site is suitable to be a TNC preserve, a State Natural Area, or a N.C. Wildlife Resources Commission Game Land or Conservation Area.

COMMENTS: This site could use additional survey work, especially further away from the jeep trail. The locations of all of the relatively permanent ponds need to be more clearly determined. There is a great need for a herpetologist to survey the pools in the natural area for frogs, toads, and salamanders, as there is a potential for rare amphibians.

REFERENCES:

- LeGrand, H.E., Jr. 1986. Goshen Gabbro Forest. Natural Area Reconnaissance. N.C. Natural Heritage Program.
_____. 1990. Goshen Gabbro Forest. Preserve Design. North Carolina Nature Conservancy.



Site Name: Knap of Reeds Creek Diabase--Clearings and Levee
 Site Code: GA6
 Quadrangle: Lake Michie

SITE NAME: Knap of Reeds Creek Diabase--Clearings and Levee

SITE CODE: GA6

SIZE: 80 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Granville

QUADRANGLE: Lake Michie

LOCATION: This site is in the Neuse River watershed in southwestern Granville County in the Piedmont Province of North Carolina. It is east of Knap of Reeds Creek; 0.8 mile west of Umstead Hospital in Butner, N.C.

SIGNIFICANT FEATURES:

1. This site contains two good quality natural communities: Piedmont/Mountain Levee Forest and Piedmont/Mountain Semipermanent Impoundment.

2. Three Federally listed rare plant species are present at this site: smooth coneflower (Echinacea laevigata), Federally Endangered; tall larkspur (Delphinium exaltatum), a Federal Candidate species and a State Threatened species of Special Concern; and nestronia (Nestronia umbellula), a Federal Candidate species.

3. Eight other rare plant species are also present at this site: Carolina thistle (Cirsium carolinianum) and prairie dock (Silphium terebinthinaceum), both State Candidate species; and Douglass's bittercress (Cardamine douglassii), Earle's blazing star (Liatris squarrulosa), hoary puccoon (Lithospermum canescens), glade milkvine (Matelea decipiens), Indian physic (Porteranthus stipulatus), and Pursh's wild-petunia (Ruellia purshiana), all significantly rare in the state.

GENERAL DESCRIPTION:

This natural area is part of the large diabase sill that extends for several miles in the Butner area. This site contains a complex of habitats over diabase including beaver ponds, a natural levee along Knap of Reeds Creek, and sewerline and telephone line clearings. An excellent variety of plant species is associated with basic soil growing in the clearings and upland woodlands on the slopes.

At the upper edge of the floodplain is a sewerline clearing that is perhaps 30 feet wide. This clearing is beginning to become overgrown with herbaceous plants, but shrubs and saplings have not yet invaded. A large number of uncommon or rare plant species grow along the edge of this clearing. Near the southeastern corner of the site is a telephone line clearing. This clearing is only about 15 feet wide and extends from the sewerline clearing in an easterly direction toward Umstead Hospital. The telephone line clearing crosses a dry diabase area that teems with rare plants. Several rare plant species and numerous uncommon plant species grow within 100 yards of the junction of these clearings. These rare plants include:

Carolina thistle (Cirsium carolinianum), tall larkspur (Delphinium exaltatum), smooth coneflower (Echinacea laevigata), Indian physic (Porteranthus stipulatus), hoary puccoon (Lithospermum canescens), nestronia (Nestronia umbellula), prairie dock (Silphium terebinthinaceum), Pursh's wild-petunia (Ruellia purshiana), and Earle's blazing star (Liatris squarrulosa).

Two beaver ponds, nearly flooding the entire bottomland in this area, support a Piedmont/Mountain Semipermanent Impoundment. A scattering of dead trees are present in the water, and some of the cleared area in the floodplain not occupied by the ponds is covered in various grasses and sedges. A moderate population of Douglass's bittercress (Cardamine douglassii) grows in the bottomland. The beaver ponds provide habitat for waterfowl, woodpeckers, and other bird species.

Bordering the ponds on the west is a natural levee which contains a good quality Piedmont/Mountain Levee Forest with a variety of alluvial forest plant species. This forest is mature and contains very rich understory and shrub layers. One notable plant species present in this levee forest is Dutchman's breeches (Dicentra cucullaria).

OWNERSHIP: This natural area is owned by the U.S. Army Corps of Engineers.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The N.C. Wildlife Resources Commission manages this site. There appears to be few immediate threats to this natural area. The creation of a sewerline clearing and a telephone line clearing may actually have enhanced the site by creating openings for rare plant species. However, these utility corridors need to be mowed every few years, preferably in the non-growing seasons, in order to maintain the proper conditions for the rare herbaceous species. There are a number of weedy spots near the levee, caused by logging, where blackberry (Rubus sp.), honeysuckle (Lonicera sp.), and other weedy plants are taking over.

COMMENTS: This site has the potential to support prairie blue wild indigo (Baptisia australis var. minor). Aquatic plants and animals should be inventoried in and around the beaver ponds. Of particular interest would be amphibian and reptile surveys.

REFERENCES:

LeGrand, H.E., Jr. 1986. Knap of Reeds Creek Diabase Area -- Sewerline and Levee. Natural Area Reconnaissance. N.C. Natural Heritage Program.

SITE NAME: Knap of Reeds Creek Diabase--Forest and Glades

SITE CODE: GA7

SIZE: 110 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Granville

QUADRANGLE: Lake Michie

LOCATION: This site is in the Neuse River watershed in western Granville County in the Piedmont Province of North Carolina. It is just north of Butner, NC; south side of Picture Creek; between SR 1103, SR 1104, and SR 1120.

SIGNIFICANT FEATURES:

1. A large, good quality Basic Oak-Hickory Forest, uncommon in North Carolina, and a small, but very rare, Diabase Glade are present at the site.

2. Glade bluecurls (Trichostema brachiatum), a State Candidate plant species, occurs at this site. Two significantly rare plant species are also known from this site: glade milkvine (Matelea decipiens) and Pursh's wild-petunia (Ruellia purshiana).

GENERAL DESCRIPTION:

This site is mostly gentle upland terrain, with smaller areas of moderate to steep slopes and bottomland, all overlying an uncommon geologic structure known as a diabase sill. Diabase rock weathers to produce soils less acidic than those usually found in the Piedmont. Soils on uplands and slopes at this site are probably of the Iredell series; in bottomland areas they are possibly of the Congaree series. The site contains Basic Oak-Hickory Forest, Diabase Glade and Piedmont/Mountain Bottomland Forest.

The Basic Oak-Hickory Forest, occurring on upland flat areas and slopes at the site, covers about 90 acres. Its mature, closed canopy is strongly dominated by black oak (Quercus velutina). Other oaks such as southern red oak (Q. falcata), post oak (Q. stellata), and white oak (Q. alba) dominate to a lesser degree. Shagbark hickory (Carya ovata), bitternut hickory (C. cordiformis), and mockernut hickory (C. tomentosa) are also present, but not dominant. The understory contains trees such as redbud (Cercis canadensis), eastern redcedar (Juniperus virginiana), hophornbeam (Ostrya virginiana), and flowering dogwood (Cornus florida). The shrub layer contains mostly saplings of canopy species, as well as painted buckeye (Aesculus sylvatica), common pawpaw (Asimina triloba), and coralberry (Symphoricarpos orbiculatus). Notable herbs in this forest are heartleaf skullcap (Scutellaria ovata), Canadian wild ginger (Asarum canadense), and puttyroot (Aplectrum hyemale).

The small Diabase Glade at this site is especially significant as one of only two known in the state. It occupies a flat area on a hilltop in the southwest corner of the site. It is extremely dry and its soils are thin and pebbly. In places,

the underlying diabase rock is visible at the surface. It is a mosaic of stunted trees, shrubs, and herbs. It is composed of a mixture of base-loving species and those typical of Granitic Flatrock communities. Eastern redcedar, by far the dominant tree, occurs in large patches where soils are deeper. Other trees present are white ash (Fraxinus americana), Georgia hackberry (Celtis tenuifolia), winged elm (Ulmus alata), hophornbeam, and Virginia pine (Pinus virginiana). The largest trees are only 25-30 feet tall. The patches of trees are interspersed by small (to 15 feet wide) grassy or barren openings. The bare, pebbly areas commonly have patches of common prickly-pear cactus (Opuntia compressa), fragrant sumac (Rhus aromatica), and fameflower (Talinum teretifolium). The herb layer is quite diverse and contains uncommon species such as the State Candidate glade bluecurls (Trichostema brachiatum) and the significantly rare glade milkvine (Matelea decipiens) and Pursh's wild-petunia (Ruellia purshiana). Other herb species include false garlic (Allium bivalve), glade knotweed (Polygonum tenue), and leatherflower (Clematis viorna).

A small, mature, fair to good quality Piedmont/Mountain Bottomland Forest is located on an alluvial flat near Picture Creek. Canopy trees in this forest have dbh's up to two feet. However, the presence of weedy species in the herb layer indicates that a disturbance, such as grazing, occurred in the past. The canopy and understory contain sugarberry (Celtis laevigata), American sycamore (Platanus occidentalis), river birch (Betula nigra), southern sugar maple (Acer floridanum), box elder (A. negundo), American elm (Ulmus americana), swamp chestnut oak (Quercus michauxii), cherrybark oak (Q. pagoda) and tuliptree (Liriodendron tulipifera). The shrub layer contains painted buckeye and common spicebush (Lindera benzoin). The dense herb layer is quite diverse and contains large numbers of uncommon plant species such as dutchman's breeches (Dicentra cucullaria), Canadian wild ginger, and puttyroot (Aplectrum hyemale), as well as many spring ephemeral herbs common to the Piedmont.

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Department of Human Resources.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The integrity of the site is good. The main disturbance to the site is a sewer right-of way which follows the northern edge of the Basic Oak-Hickory Forest and has destroyed vegetation on the steepest and potentially richest slope. Weedy plant species now grow beneath it. Any disturbance, such as logging, should be avoided as it would result in the weedy species becoming more widespread. The landowner has been informed of the significance of this site.

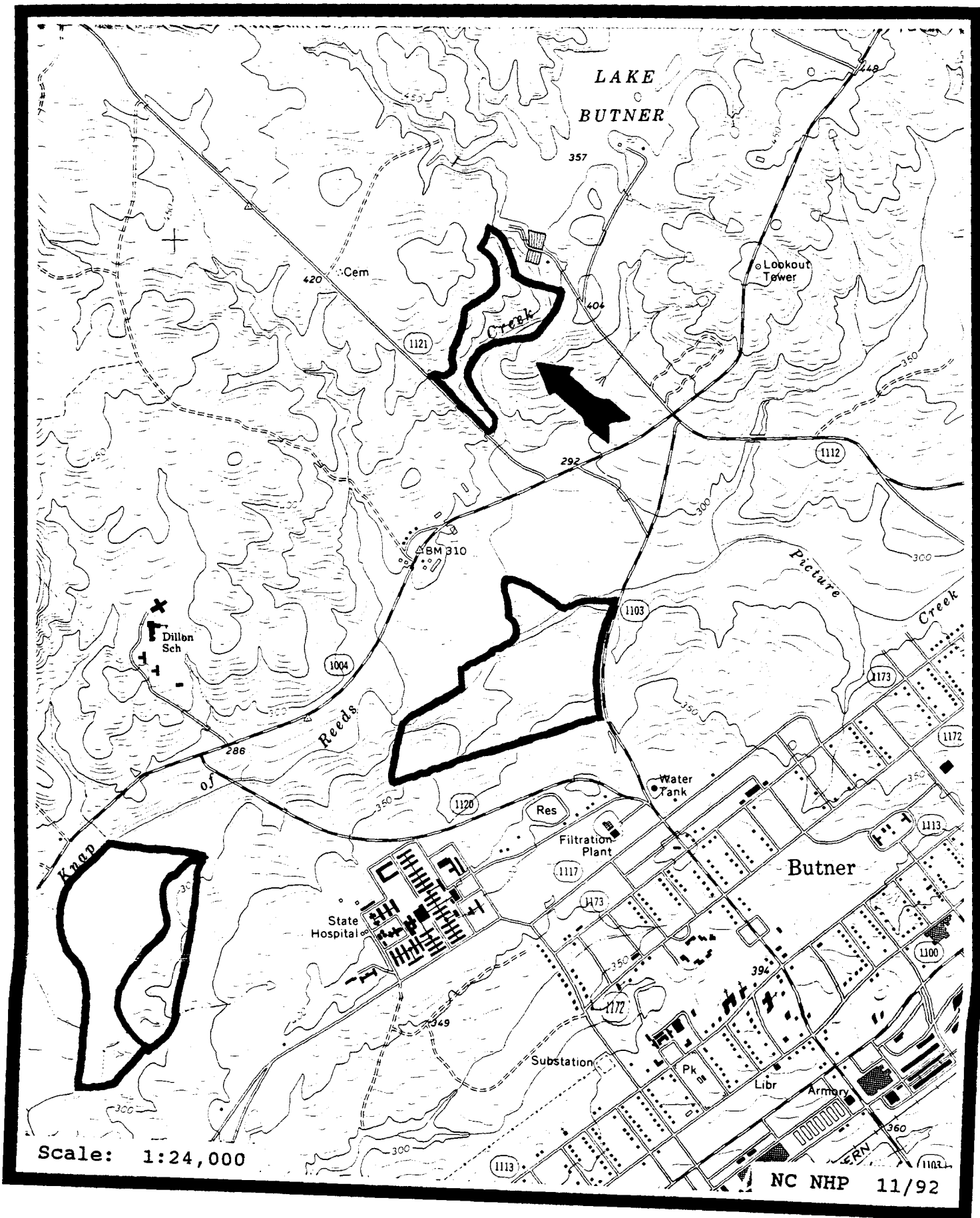
COMMENTS:

Very good potential exists for additional rare plant species growing in the Diabase Glade. Further summer and fall inventories should be conducted, with particular attention being given to grasses. Inventory for animal species is also warranted. The rare shrub nestronia (Nestronia umbellula) may exist in the Basic Oak-Hickory Forest, as it is known from similar sites within a mile of this natural area. The Piedmont/Mountain Bottomland Forest appears to contain suitable habitat for veined skullcap (Scutellaria nervosa) or isopyrum (Enemion biternatum).

A potential major conflict exists at this and other state-owned sites in the Butner vicinity. Protection of these natural areas might hinder population growth of Butner in northward and westward directions. However, it is important that such high priority sites over diabase, especially those of National or State significance, be protected.

REFERENCES:

LeGrand, H.E., Jr. 1986. Knap of Reeds Creek Diabase Area -- Forest and Glades. Natural Area Reconnaissance. N.C. Natural Heritage Program.



Site Name: Knap of Reeds Creek Ravine
 Site Code: GA8
 Quadrangle: Lake Michie

SITE NAME: Knap of Reeds Creek Ravine

SITE CODE: GA8

SIZE: 46 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Granville

QUADRANGLE: Lake Michie

LOCATION: This site is in the Neuse River watershed in western Granville County in the Piedmont Province of North Carolina. It is along Knap of Reeds Creek south of Holt Reservoir; from dam south to SR 1004 and SR 1121.

SIGNIFICANT FEATURES: This site contains scenic steep bluffs and stream, several plant communities, and a variety of showy wildflowers.

GENERAL DESCRIPTION:

This natural area is rugged in certain areas and contains a very steep bluff just east of Knap of Reeds Creek. The eastern slopes and the creek are quite rocky. The geology is described as Felsic Metavolcanic Rock. The southern portions of this site are quite xeric. The site contains flora of both mesic and xeric forests.

The very steep slopes and bluffs at this site support a Piedmont/Coastal Plain Heath Bluff community with a dense stand of mountain laurel (Kalmia latifolia). The moderate slopes of the west bank are more mesic and contain a fairly good variety of wildflowers. These slopes support a fairly mature Mesic Mixed Hardwood Forest that contains as its common canopy species American beech (Fagus grandifolia), tuliptree (Liriodendron tulipifera), and northern red oak (Quercus rubra). On the higher slopes above the Mesic Mixed Hardwood Forest is a Dry-Mesic Oak-Hickory Forest. Species such as sparkleberry (Vaccinium arboreum) and fragrant sumac (Rhus aromatica) grow on these slopes. Notable wildflowers at the natural area include eastern columbine (Aquilegia canadensis), barren strawberry (Waldsteinia fragarioides), and doll's-eyes (Actaea pachypoda).

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Department of Agriculture.

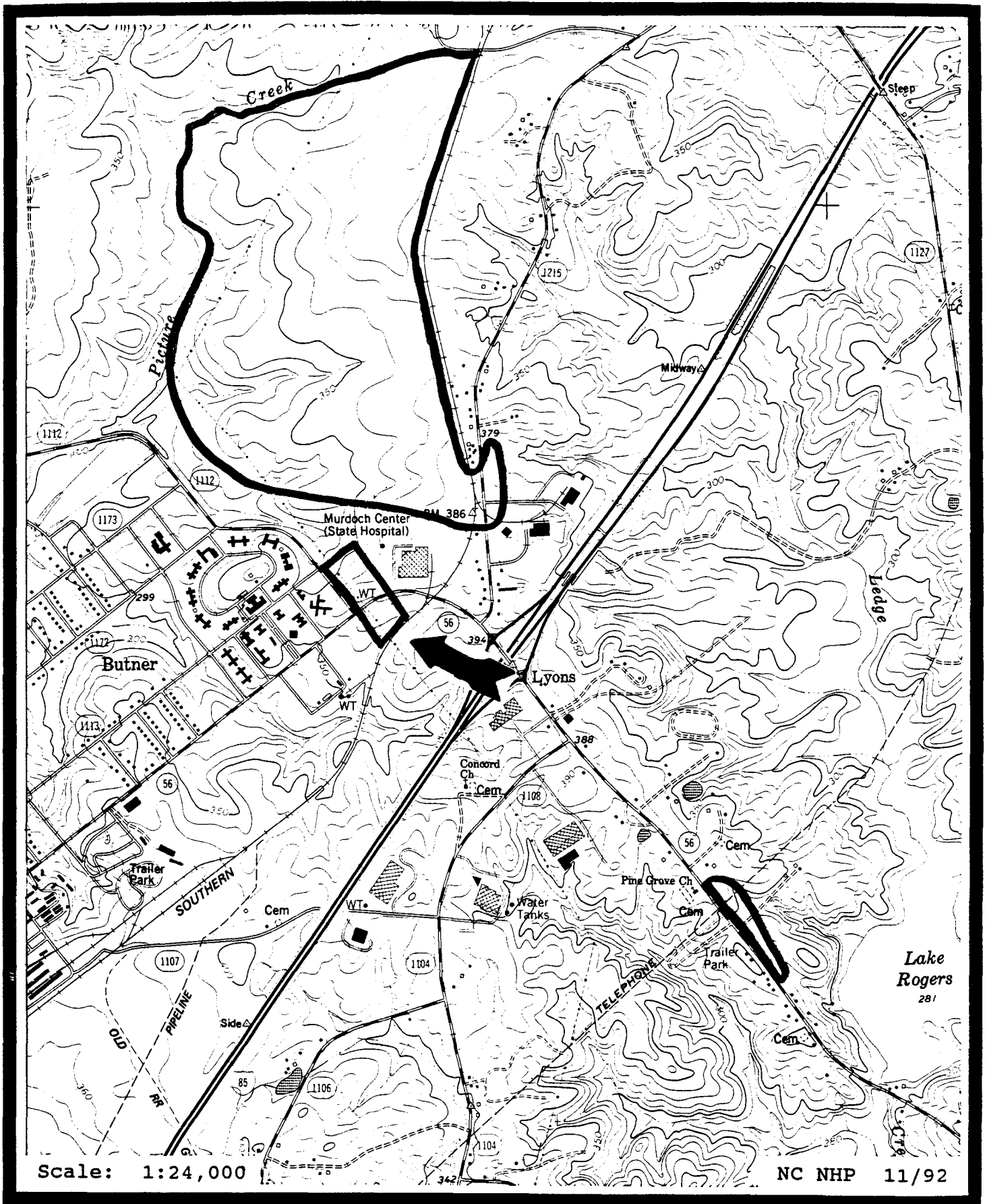
PROTECTION STATUS: No official status; however, the site is reserved from timber removal and is administered as a natural area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The site should be left undisturbed so that the forests can mature.

COMMENTS: No additional site surveys are needed; however, the site has not been visited in several years. This site is a good area for nature study and hiking.

REFERENCES:

LeGrand, H.E., Jr. 1986. Knap of Reeds Creek Ravine. Natural Area Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: Murdoch Center Diabase Sill
 Site Code: GA9
 Quadrangle: Stem

SITE NAME: Murdoch Center Diabase Sill

SITE CODE: GA9

SIZE: 14 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Granville

QUADRANGLE: Stem

LOCATION: This site is in the Neuse River watershed in southern Granville County in the Piedmont Province of North Carolina. It is north of SR 1111; west of SR 1215; just northeast of the Murdoch Center in Butner, N.C.

SIGNIFICANT FEATURES:

1. Carolina birdfoot-trefoil (Lotus helleri), a Federal Candidate species is present at this site.
2. One State Threatened species is present at this site, low wild-petunia (Ruellia humilis).
3. Two State Candidate species, prairie blue wild indigo (Baptisia australis var. minor) and prairie dock (Silphium terebinthinaceum), occur at this site.
4. Two plants species considered significantly rare in the state are also present at this site, Earle's blazing star (Liatris squarrulosa) and hoary puccoon (Lithospermum canescens).

GENERAL DESCRIPTION: This site is underlain by diabase rock. Most of the site is along and within a Carolina Power and Light powerline clearing. This site supports populations of several rare plant species. Rare species at this site include: Carolina birdfoot-trefoil (Lotus helleri), a Federal Candidate; prairie blue wild indigo (Baptisia australis var. minor) and prairie dock (Silphium terebinthinaceum), State Candidate species; and Earle's blazing star (Liatris squarrulosa), hoary puccoon (Lithospermum canescens), and low wild-petunia (Ruellia humilis), significantly rare in the state. Other uncommon herb species present in this natural area are: narrowleaf bluet (Houstonia tenuifolia), vervain (Verbena simplex), and skullcap (Scutellaria integrifolia).

OWNERSHIP: This natural area is partly privately owned and partly owned by the state and administered by the N.C. Department of Human Resources.

PROTECTION STATUS: No official status; however, the Carolina Power and Light Company has an unofficial agreement with the N.C. Natural Heritage Program to maintain the powerline without impacting the rare plants.

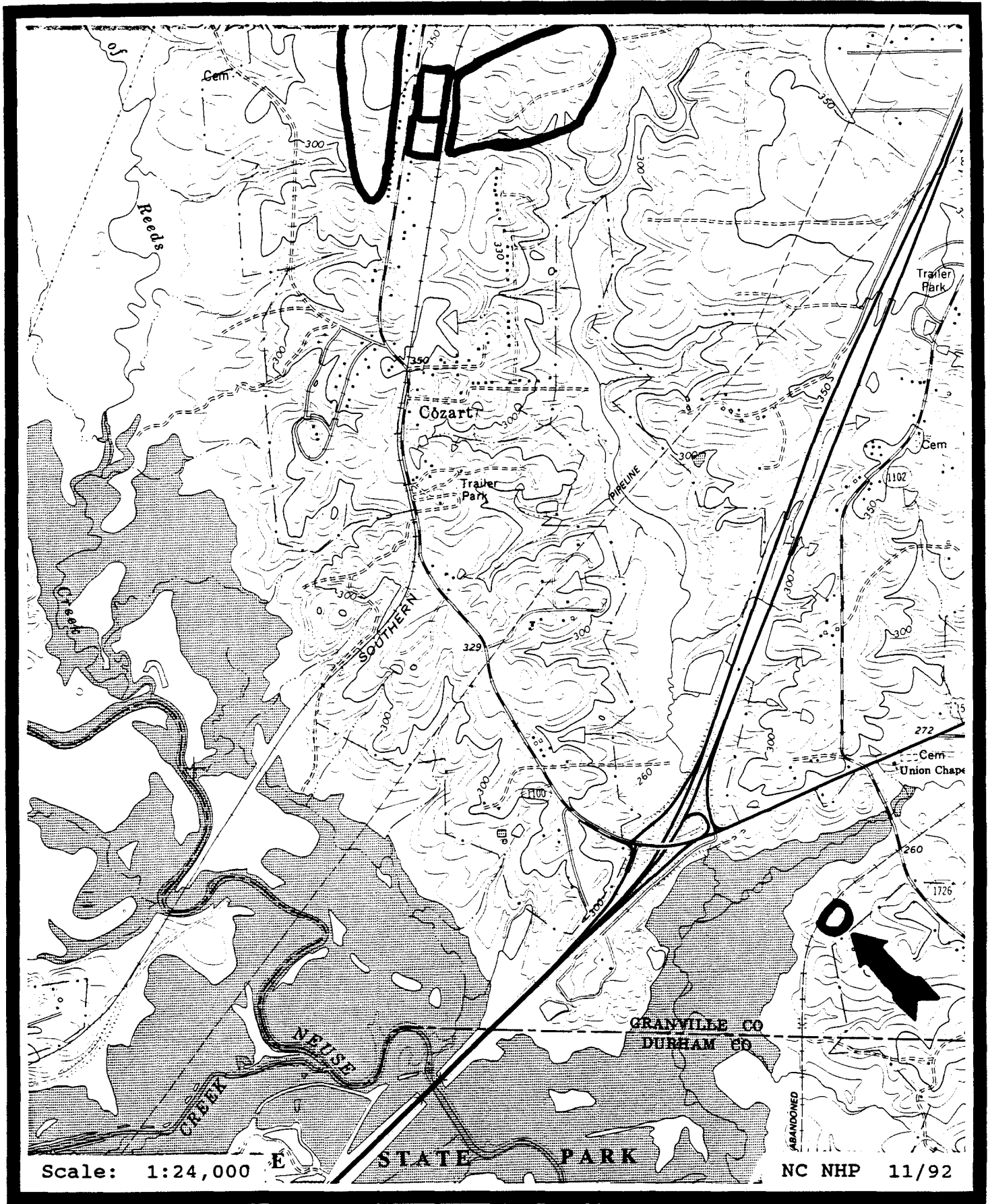
MANAGEMENT OR PROTECTION RECOMMENDATIONS: Mowing has occurred at the site and needs to continue on a 2-3 year cycle. It appears the clearing is becoming too overgrown and that some of the "prairie plants" are getting crowded out by blackberry (Rubus

sp.) and other weedy invaders. Kudzu (Pueraria lobata) is spreading in the woods along SR 1112 and is shading out some of the prairie dock.

COMMENTS: This site has the potential to contain smooth coneflower (Echinacea laevigata), a Federal Endangered species.

REFERENCES:

LeGrand, H.E., Jr. 1986. Butner Powerline Diabase Area--Murdoch Center. Natural Area Reconnaissance. N.C. Natural Heritage Program.



Site Name: Northside Diabase Area
 Site Code: GA10
 Quadrangle: Northeast Durham

SITE NAME: Northside Diabase Area

SITE CODE: GA10

SIZE: 2 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in extreme southwestern Granville County in the Piedmont Province of North Carolina. It is located on the southeastern side of an abandoned Seaboard Coastline Railroad line about 0.2 mile from where SR 1726 crosses the tracks.

SIGNIFICANT FEATURES: A well established population of smooth coneflower (Echinacea laevigata), a Federal Endangered plant, grows here.

GENERAL DESCRIPTION: This site contains a mixed shrub community near an old railroad embankment adjacent to Falls Lake. The area is underlain by diabase. A population of smooth coneflower (Echinacea laevigata), a Federal Endangered plant, is located here on the shrubby embankment adjacent to the abandoned Seaboard Coastline Railroad bed. The high base soils at the site also support other less rare plant species characteristic of the plant associations which are closely correlated with diabase formations in this region.

OWNERSHIP: This site is owned by the U.S. Army Corps of Engineers and is a part of the Falls Lake Project.

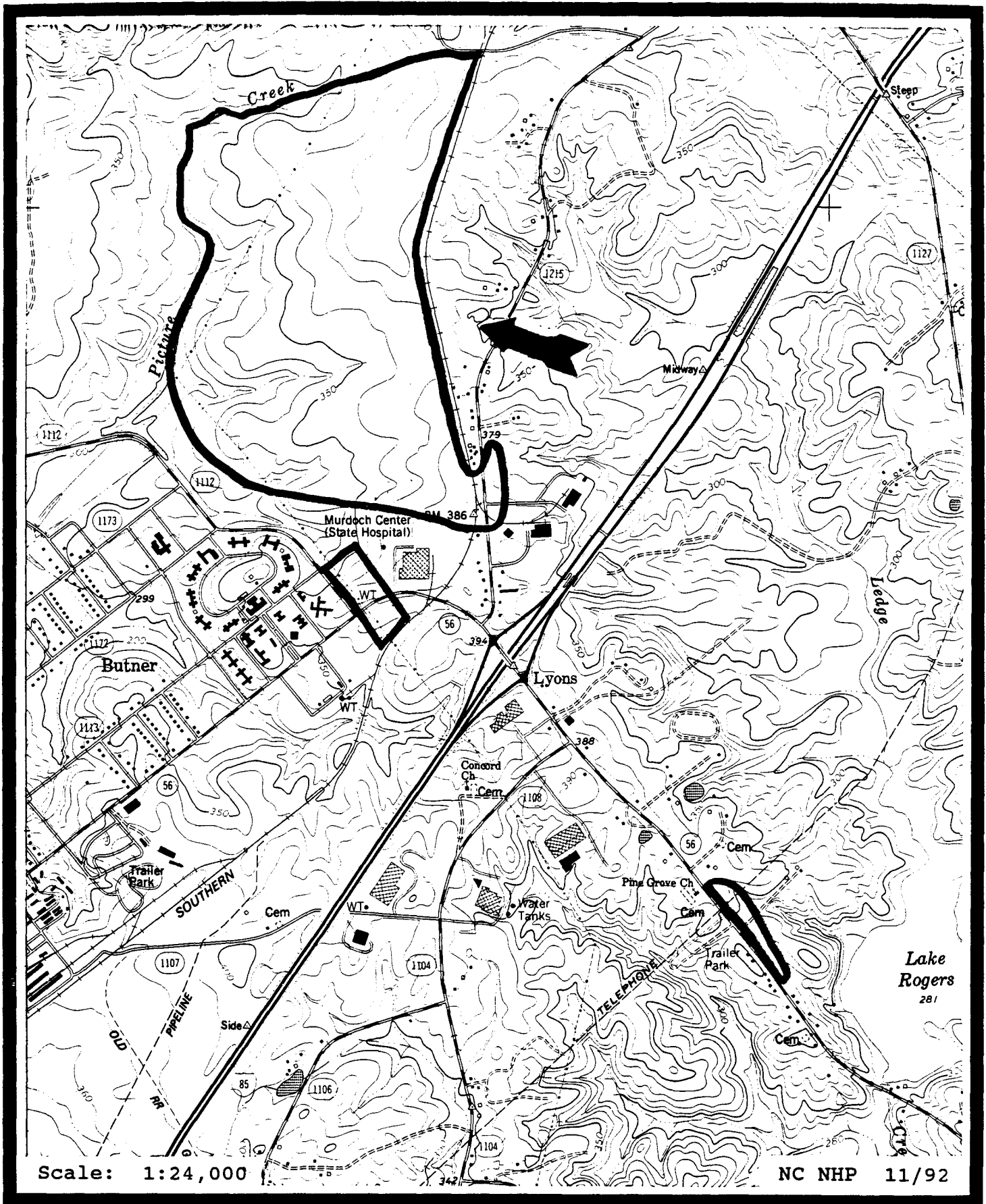
PROTECTION STATUS: This site is a Registered Natural Heritage Area and is managed by the N.C. Wildlife Resources Commission.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Periodic monitoring of this coneflower population by the N.C. Natural Heritage Program and Department of Agriculture's Plant Conservation Program, in coordination with the U.S. Army Corps of Engineers is recommended. This is needed to assure that shrubs and saplings do not encroach and cause shading, and that other activities do not disturb the coneflower population.

COMMENTS: Corps of Engineer biologists cut saplings and shrubs from this site in the late 1980's. The coneflower population, perhaps only 25 plants at the time, increased in the next 1-2 years to well over 100 plants. This strongly points out the positive value of occasional removal of woody vegetation.

REFERENCES:

Moore, J.H. and H.E. LeGrand, Jr. 1989. Falls Lake Natural Area. N.C. Natural Heritage Program.



Site Name: Picture Creek Diabase Barrens
 Site Code: GA11
 Quadrangle: Stem

SITE NAME: Picture Creek Diabase Barrens

SITE CODE: GA11

SIZE: 540 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Granville

QUADRANGLE: Stem

LOCATION: This site is in the Neuse River watershed in southern Granville County in the Piedmont Province of North Carolina. It is located mainly on the west side of SR 1215, beginning just north of the Murdoch Center State Hospital and extending northward for about 1.0 mile. A very small part of the site is on the east side of SR 1215, 0.3 mile north of its intersection with NC 56.

SIGNIFICANT FEATURES:

1. Several rare plant species with federal status are present: smooth coneflower (Echinacea laevigata), Federally Endangered; serpentine aster (Aster depauperatus), a Federal Candidate and State Endangered species, and Carolina birdfoot-trefoil (Lotus helleri), a Federal Candidate species.

2. Many rare plant species with State status are present: prairie goldenrod (Solidago ptarmicoides), State Endangered; low wild-petunia (Ruellia humilis), State Threatened; and prairie blue wild indigo (Baptisia australis var. minor), prairie dock (Silphium terebinthinaceum), smooth blue aster (Aster laevis var. concinus), glade Barbara's buttons (Marshallia sp. 1), and glade wild quinine (Parthenium auriculatum), State Candidate species.

3. Several species significantly rare in the state are present. These include: Earle's blazing star (Liatris squarrulosa), southeastern bold goldenrod (Solidago rigida ssp. glabrata), hoary puccoon (Lithospermum canescens), Douglass's bittercress (Cardamine douglassii), balsam ragwort (Senecio pauperculus), glade milkvine (Matelea decipiens), and Heller's rabbit tobacco (Gnaphalium helleri var. helleri).

GENERAL DESCRIPTION:

The majority of the site is a dry, upland pine-cedar forest of fair quality. A number of small, mostly man-made openings, such as old logging roads, are scattered throughout the forest. A powerline clearing is included in this area. The site is located over diabase, a rock type which weathers to produce soils which are more basic than those normally found in the Piedmont. The soils at the site are of the Iredell series.

The majority of the site supports a fair quality Xeric Hardpan Forest community type. Its canopy is fairly open and dominated by shortleaf pine (Pinus echinata), loblolly pine (P. taeda), and eastern redcedar (Juniperus virginiana), most of which are 50-60 feet tall. The subcanopy is mostly eastern redcedar. Fragrant sumac (Rhus aromatica) is common in the shrub layer. Other shrubs such as American plum (Prunus americana),

Carolina rose (Rosa carolina), and New Jersey tea (Ceanothus americanus) are also present.

In the small openings scattered throughout the Xeric Hardpan Forest and in the powerline clearing, the herb layer is extremely diverse. These areas are composed of grasses and a wide variety of other herbaceous plants, many of which are rare and have prairie affinities. Rare species include: smooth coneflower (Echinacea laevigata), serpentine aster (Aster depauperatus), prairie goldenrod (Solidago ptarmicoides), low wild-petunia (Ruellia humilis), prairie blue wild indigo (Baptisia australis var. minor), prairie dock (Silphium terebinthinaceum), smooth blue aster (Aster laevis var. concinus), glade milkvine (Matelea decipiens), hoary puccoon (Lithospermum canescens), Earle's blazing star (Liatris squarrulosa), balsam ragwort (Senecio pauperculus), Carolina birdfoot-trefoil (Lotus helleri), glade wild quinine (Parthenium auriculatum), southeastern bold goldenrod (Solidago rigida ssp. glabrata), Douglass's bittercress (Cardamine douglassii), Heller's rabbit tobacco (Gnaphalium helleri var. helleri), and glade Barbara's buttons (Marshallia sp. 1). Many other herb species usually restricted to basic soils also grow in these open areas.

Portions of the site along Picture Creek support a fair quality Basic Oak-Hickory Forest, and the creek itself contains an abundance of diabase boulders. The canopy of this forest contains species such as post oak (Quercus stellata), black oak (Q. velutina), pignut hickory (Carya glabra), southern sugar maple (Acer floridanum), and white ash (Fraxinus americana). Shrubs include common wild azalea (Rhododendron periclymenoides), fragrant sumac, silky dogwood (Cornus amomum), downy arrowwood (Viburnum rafinesquianum), and ninebark (Physocarpus opulifolius), which is uncommon in the eastern Piedmont. This forest's herb layer is fairly diverse and contains a few uncommon species such as narrowleaf tinker's-weed (Triosteum angustifolium), monkshood (Aconitum uncinatum), smooth phlox (Phlox glaberrima), and in a small tributary stream, seaside brookweed (Samolus valerandi).

Animal species seen in the natural area include white-tailed deer (Odocoileus virginiana), solitary vireo (Vireo solitarius), wild turkey (Meleagris gallopavo), and pickerel frog (Rana palustris).

OWNERSHIP: The majority of the natural area is owned by the state and is administered by the N.C. Department of Agriculture. A small area on the east side of SR 1215 is privately owned.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The Department of Agriculture has been informed of the significance of the site and of the various protection options available. An effort to place the site on the Registry of Natural Heritage Areas has been placed on hold. However, this is

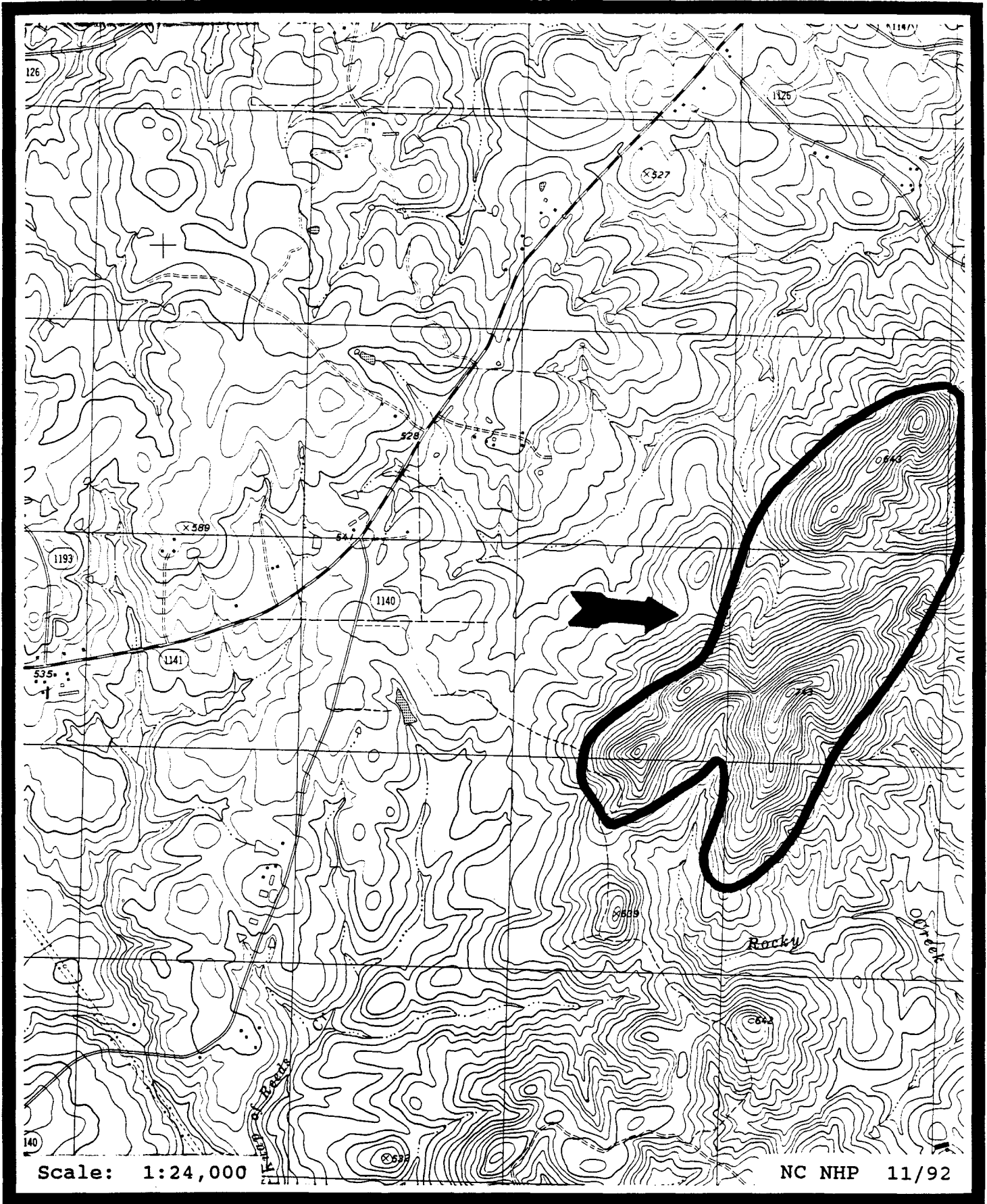
one of the most significant natural areas in the state and efforts at Dedication should be made.

To maintain an open habitat for the rare plant species present at this site, encroaching trees and shrubs should be eliminated by hand cutting or by selective logging. Portions of the site would probably benefit from controlled burns. The powerline clearing should be mowed or bush-hogged every 3-5 years (at the most), with the work done in the winter months to avoid impact to the rare herbaceous plants. Carolina Power and Light does maintain the powerline right-of-way clearing at the site.

COMMENTS: Additional plant surveys, especially for grasses, sedges, and for composites in late summer, are recommended. Surveys for fishes and herpetofauna in Picture Creek are recommended.

REFERENCES:

LeGrand, H.E., Jr. 1986. Butner Powerline Diabase Area--Smooth Coneflower Glades. Natural Area Reconnaissance. N.C. Natural Heritage Program.



Site Name: Pyrophyllite Ridge Monadnocks
Site Code: GA12
Quadrangle: Moriah

SITE NAME: Pyrophyllite Ridge Monadnocks

SITE CODE: GA12

SIZE: 425 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Granville

QUADRANGLE: Moriah

LOCATION: This site is in the Tar River watershed in western Granville County in the Piedmont Province of North Carolina. It is encircled by SR 1126, SR 1140, SR 1141, and SR 1139; 2 miles west-northwest of Culbreth, N.C.

SIGNIFICANT FEATURES: This site contains several monadnocks with good examples of the Piedmont Monadnock Forest community type.

GENERAL DESCRIPTION:

This natural area contains a cluster of several monadnocks. These monadnocks are characterized by resistant rock and acidic soils. This site is in the Carolina Slate Belt and is composed of felsic Metavolcanic Rock. This is a relatively undisturbed site with boulder outcrops at least 12 feet across.

The majority of the site contains very extensive, rather mature Piedmont Monadnock Forests. The canopy of these forests have few or no openings and chestnut oak (Quercus montana) is the canopy dominant. The remainder of the canopy species are mostly other oaks such as white oak (Q. alba), blackjack oak (Q. marilandica), post oak (Q. stellata), and southern red oak (Q. falcata). The subcanopy is composed mostly of sourwood (Oxydendrum arboreum), persimmon (Diospyros virginiana), sassafras (Sassafras albidum), and downy serviceberry (Amelanchier arborea). The shrub layer is dense in places and is composed mostly of knee-high ericads, especially black huckleberry (Gaylussacia baccata) and deerberry (Vaccinium stamineum). Herbs present in this community include rattlesnake hawkweed (Hieracium venosum), pipsissewa (Chimaphila maculata), and goat's rue (Tephrosia virginiana).

Several streams reach into the area and divide the monadnocks. The margins of these streams are boggy and provide habitat for plants not normally found in upland woods. These species include tag alder (Alnus serrulata), Indian cucumber-root (Medeola virginiana), and cinnamon fern (Osmunda cinnamomea).

OWNERSHIP: Multiple private ownership.

PROTECTION STATUS: None

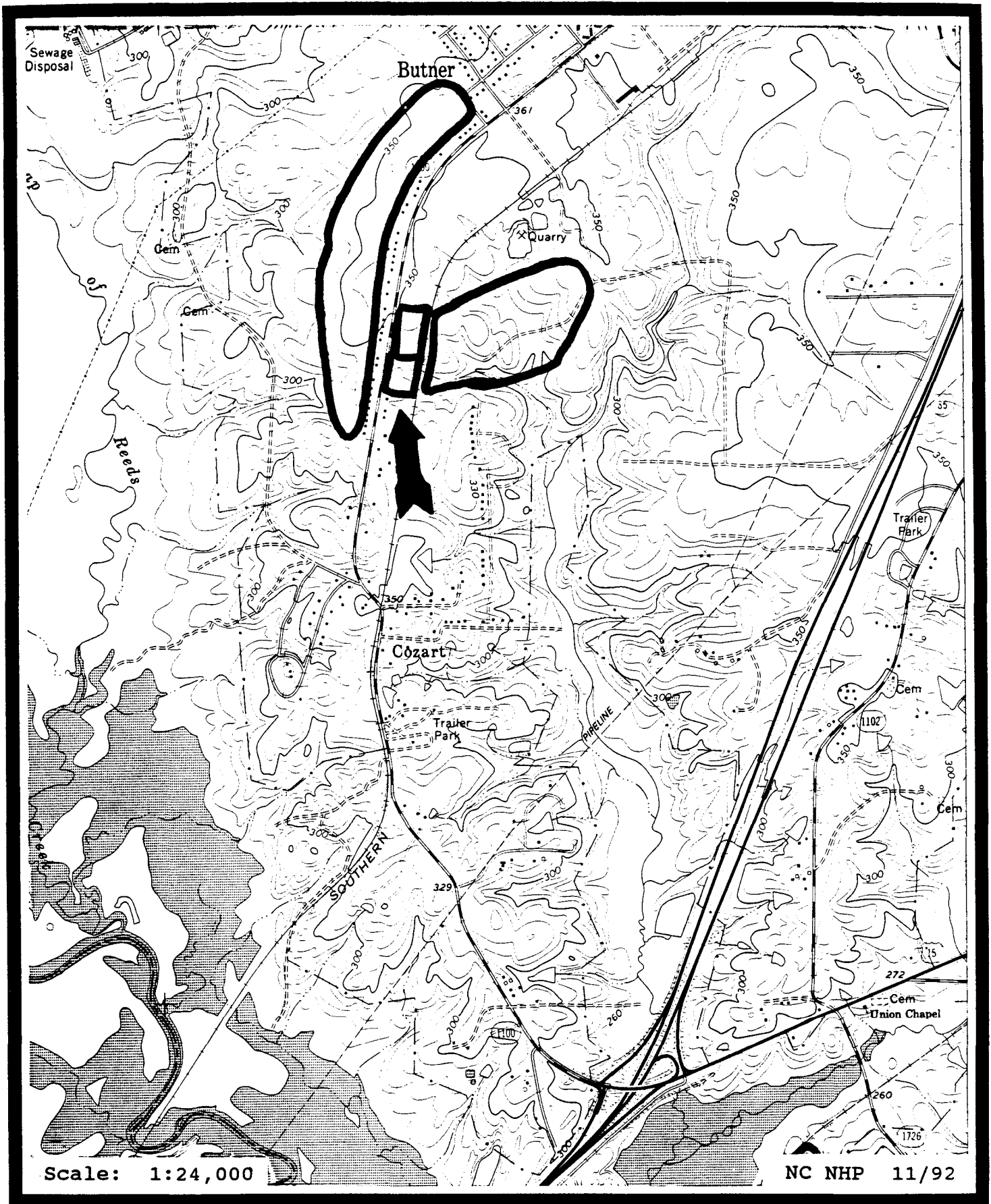
MANAGEMENT OR PROTECTION RECOMMENDATIONS: A few areas on the monadnocks were mined in past years. There are several abandoned dirt roads leading to the hilltops where small areas of disturbed ground (less than 1 acre) are present. These areas are where rock mining had occurred. At present, there appears to be no

disturbance at this site and no mining in recent years. The landowners need to be informed of the significance of the natural area and of the various protection options available.

COMMENTS: Further survey work is probably not needed; however, the site has not been visited in a few years.

REFERENCES:

LeGrand, H.E., Jr. 1986. Pyrophyllite Ridge Monadnocks. Natural Area Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: South Butner Cedar Glades
 Site Code: GA13
 Quadrangle: Northeast Durham

SITE NAME: South Butner Cedar Glades

SITE CODE: GA13

SIZE: 6 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Granville

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in southwestern Granville County in the Piedmont Province of North Carolina. It is in the southern portion of Butner, N.C.; east of SR 1100 (B Street) railroad track; about 0.7 mile north of the railroad crossing.

SIGNIFICANT FEATURES:

1. This natural area contains the best high quality example of a Diabase Glade natural community in North Carolina. It is one of the two best known sites globally.

2. This site contains a good quality example of a Xeric Hardpan Forest community.

3. Nine rare species are present at this small site. These include: serpentine aster (Aster depauperatus), a Federal Candidate species also state-listed as Endangered; low wild-petunia (Ruellia humilis) and Small's portulaca (Portulaca smallii), State Threatened; glade bluecurls (Trichostema brachiatum) and prairie blue wild indigo (Baptisia australis var. minor), State Candidate species; and hoary puccoon (Lithospermum canescens), Earle's blazing star (Liatris squarrulosa), glade milkvine (Matelea decipiens), and American barberry (Berberis canadensis), all significantly rare in the state.

GENERAL DESCRIPTION:

This natural area was first identified in 1986. It contains a very dry Diabase Glade which is an extremely rare natural community in the state. The site is surrounded by a Xeric Hardpan Forest community with somewhat stunted trees. Numerous openings of weathered diabase are present among the small trees and are vegetated only with herbaceous plants, many of which are uncommon in North Carolina. The initial appearance of these glade areas is of a granitic flatrock. The surface, however, is not of solid rock, but of pebbles perhaps 1/16 to 1/4 inch in size. The soil is basic or circumneutral and is very thin, with a few small outcroppings of diabase rock.

The open, pebbly areas at this site support the best high quality example of a Diabase Glade natural community in North Carolina. Common to these areas are plants such as rough buttonweed (Diodia teres) and glade knotweed (Polygonum tenue). Several species typical of flatrocks are also present in these areas. These include fameflower (Talinum teretifolium) and dune dayflower (Commelina erecta). Other plant species which grow in the sterile, open areas include: false aloe (Agave virginica), low wild-petunia (Ruellia humilis), which is very rare in the

state, and Small's portulaca (Portulaca smallii), Threatened in the state.

Surrounding the open, glade areas at this site is a good quality example of a Xeric Hardpan Forest natural community. The canopy of this forest is composed of rather small trees (40-50 feet tall) that apparently grow very slowly. Post oak (Quercus stellata), eastern redcedar (Juniperus virginiana), and redbud (Cercis canadensis) are the abundant canopy species. Other canopy and subcanopy tree species include blackjack oak (Q. marilandica), winged elm (Ulmus alata), mockernut hickory (Carya tomentosa), and Georgia hackberry (Celtis tenuifolia). Around the edges of the glade openings grow shrubs, most of which are characteristic of dry, basic soils (Iredell series). Abundant along the edges are fragrant sumac (Rhus aromatica), coralberry (Symphoricarpos orbiculatus), and downy arrowwood (Viburnum rafinesquianum). American barberry (Berberis canadensis), rare in the state, is rather common along the edges of the openings. The largest number of herbaceous species also occur along the edges, especially under the eastern redcedar. Hoary puccoon (Lithospermum canescens) is common in a few spots, mostly under the redcedar. A few individuals of prairie blue wild indigo (Baptisia australis var. minor), a State Candidate species, were seen at this site in 1986. Both of these species are rare in the state and are restricted to Iredell-type soils.

Other rare species present in this natural area include: serpentine aster (Aster depauperatus), a Federal Candidate and State Endangered species; glade bluecurls (Trichostema brachiatum), a State Candidate species; and Earle's blazing star (Liatris squarrulosa) and glade milkvine (Matelea decipiens), significantly rare in the state.

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Department of Human Resources.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

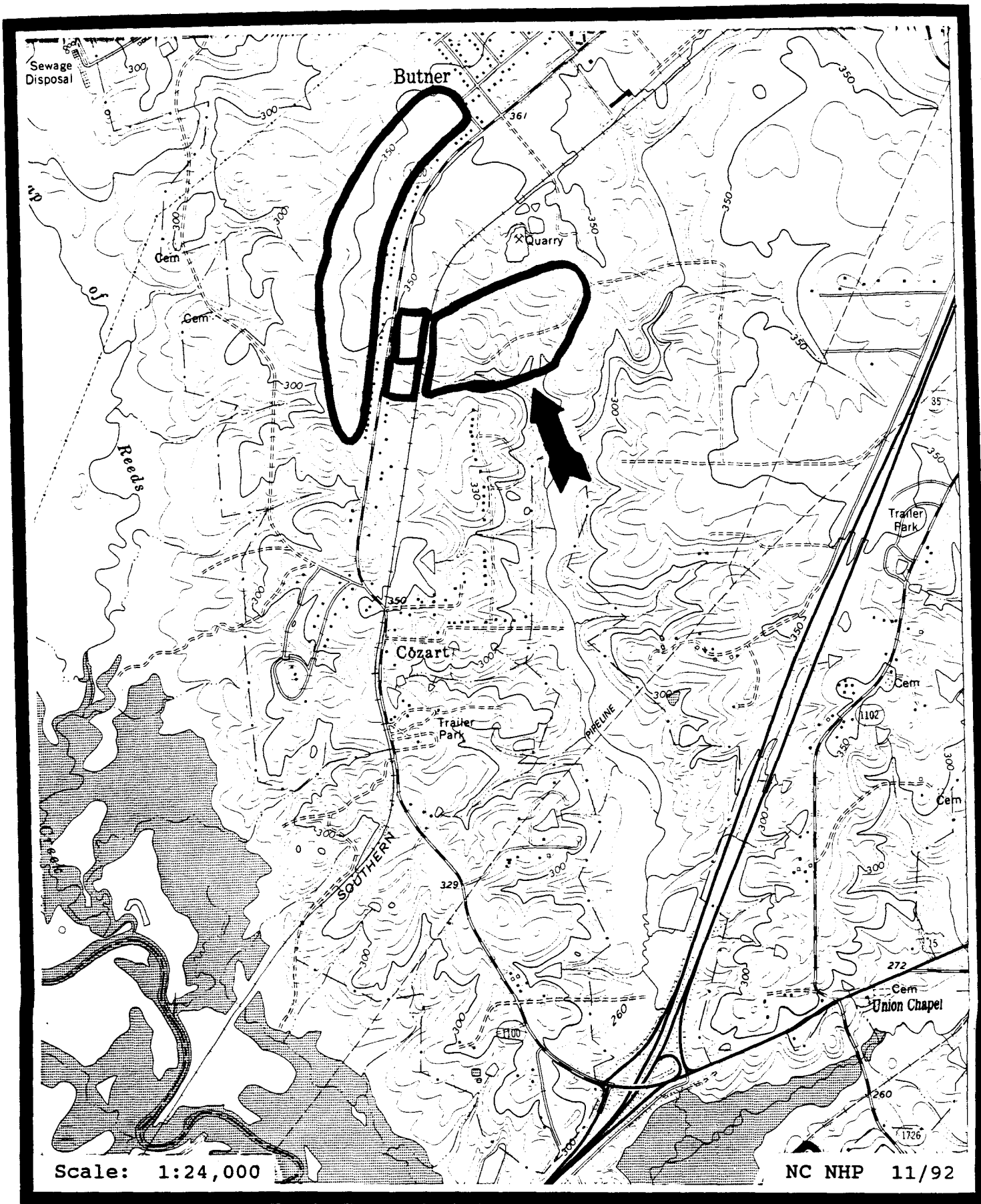
MANAGEMENT OR PROTECTION RECOMMENDATIONS: A motorbike trail runs through the site and ongoing ORV control is needed. Trash dumping at the site was once a problem. Much of the trash has been cleared from the site by the Department of Human Resources, which has also posted several signs along B street indicating that the site is a Registered Natural Heritage Area.

COMMENTS: This site may contain rare moss and grass species. Additional survey work could be done for such species. Several rare species typical of Iredell soils were not found at this site, for example prairie dock (Silphium terebinthinaceum) and smooth coneflower (Echinacea laevigata). The soil at this site may be too thin and pebbly for such species. The fact that fameflower is common, along with prickly-pear cactus (Opuntia compressa), seems to indicate the barren nature of the openings.

REFERENCES:

LeGrand, H.E., Jr. 1986. South Butner Diabase Area--Cedar Glades. Natural Area Reconnaissance. N.C. Natural Heritage Program.

_____. 1988. Cedar glades on diabase outcrops: A newly described community type. *Castanea* 53:168-172.



Site Name: South Butner Diabase--Pine Forest
 Site Code: GA14
 Quadrangle: Northeast Durham

SITE NAME: South Butner Diabase--Pine Forest

SITE CODE: GA14

SIZE: 78 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in southwestern Granville County in the Piedmont Province of North Carolina. It is about one mile north-northeast of Cozart, NC; about 0.1 mile east of SR 1100 and just east of a railroad track.

SIGNIFICANT FEATURES:

1. Present at this site is the low wild-petunia (Ruellia humilis), Threatened in North Carolina.
2. Two State Candidate species, prairie blue wild indigo (Baptisia australis var. minor) and shale-barren skullcap (Scutellaria leonardii) are present at this site.
3. Five significantly rare plants are also present at this site: Pursh's wild-petunia (Ruellia purshiana), hoary puccoon (Lithospermum canescens), veined skullcap (Scutellaria nervosa), Earle's blazing star (Liatris squarrulosa), and American barberry (Berberis canadensis).

GENERAL DESCRIPTION:

This site occurs over an uncommon geologic structure known as a diabase sill. Soils throughout the site are probably of the Iredell series. The majority of the site is a fairly young, xeric, pine-cedar forest, traversed from west to east by a small, intermittent stream with a bed of diabase rocks. A small area (ca. 5 acres) in the northeastern portion of the site, situated on a dry upland ridgetop, has small diabase flatrocks surrounded by very xeric forest.

The site is transitional between Xeric Hardpan Forest and the very rare Diabase Glade natural community. It contains numerous, small, gladelike openings and several small (20 x 25 feet) flatrocks. Another uncommon feature is a small stream with a rocky diabase bed which crosses the site. A wide variety of plants usually restricted to circumneutral/basic soils are present.

The forest canopy, which has numerous openings and a maximum height of about 40 feet, is dominated by loblolly pine (Pinus taeda) and shortleaf pine (P. echinata) with eastern redcedar (Juniperus virginiana) and post oak (Quercus stellata) being quite common. The understory contains redbud (Cercis canadensis) and eastern redcedar. Throughout the forest, and especially in gladelike areas that exist in canopy openings, the shrub coralberry (Symphoricarpos orbiculatus) is abundant. The shrubs downy arrowwood (Viburnum rafinesquianum) and fragrant sumac (Rhus aromatica) are also quite common. The rare shrub American barberry (Berberis canadensis) is scattered throughout. The herb

layer contains many grasses in addition to several rare plant species. Rare species include prairie blue wild indigo (Baptisia australis var. minor), shale-barren skullcap (Scutellaria leonardii), Pursh's wild-petunia (Ruellia purshiana), hoary puccoon (Lithospermum canescens), and Earle's blazing star (Liatris squarrulosa). Other uncommon species present are narrowleaf tinker's-weed (Triosteum angustifolium), feverwort (T. perfoliatum), and columbine (Aquilegia canadensis). Many plant species normally associated only with basic soils are present. The rare veined skullcap (Scutellaria nervosa) and the uncommon seaside brookweed (Samolus valerandi) grow along the banks of the stream which crosses the site.

A small dry ridgetop in the northeastern portion of the site contains dry pine-cedar forest over thin soils with several small, very uncommon diabase flatrocks, the largest of which is 20 x 25 feet. The forest on this ridge is similar in composition and structure to that previously described. Rare plant species include prairie blue wild indigo, hoary puccoon, and American barberry. The flatrocks are devoid of vegetation, except where the rock has been weathered to produce pebbly accumulations. These support the rare low wild-petunia, fameflower (Talinum teretifolium), and common prickly-pear cactus (Opuntia compressa), as well as plants normally found in moister areas such as parsley hawthorn (Crataegus marshallii) and water oak (Quercus nigra).

OWNERSHIP: Private ownership.

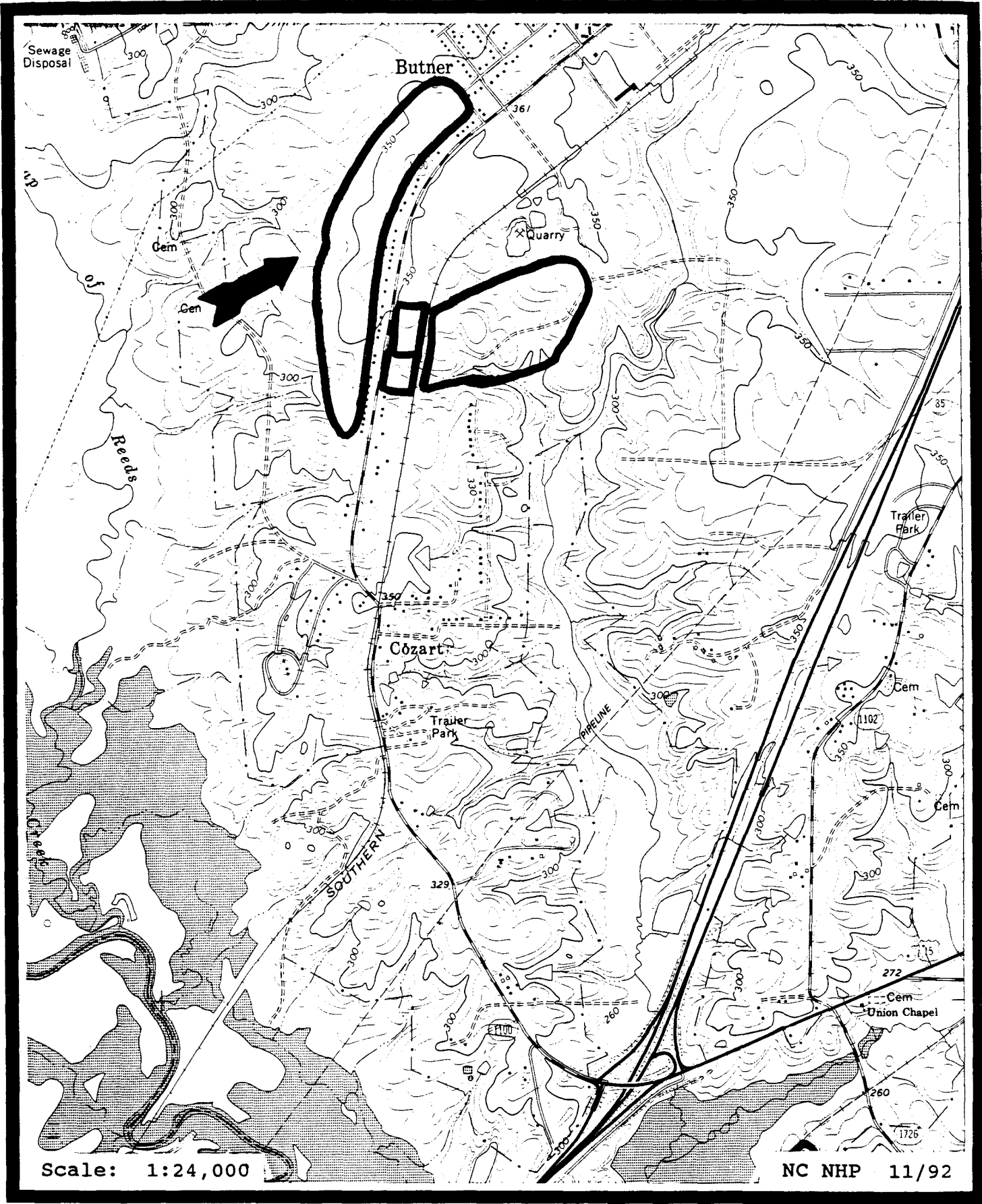
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: A quarry situated just north of the site would pose a serious threat to site integrity if it were expanded southward. Since clearcutting has occurred just east of the site, it is at risk from further cutting. Natural succession may eventually have an adverse affect on shade-intolerant species growing in the glade-like openings. The landowner should be informed of the significance of this site and of the various protection options available.

COMMENTS: Further inventory in summer and fall, with particular attention to the east and northeast portions of the site, is recommended. After this site was initially described, about 5% of the natural area along the railroad track was cleared of vegetation for construction of a side track.

REFERENCES:

LeGrand, H.E., Jr. 1986. South Butner Diabase Area--Pine and Cedar Glades near Quarry. Natural Area Reconnaissance. N.C. Natural Heritage Program.



Site Name: South Butner Diabase Swamp
 Site Code: GA15
 Quadrangle: Northeast Durham

SITE NAME: South Butner Diabase Swamp

SITE CODE: GA15

SIZE: 90 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in southwestern Granville County in the Piedmont Province of North Carolina. It is in the southern portion of Butner; west of SR 1100 behind a row of houses; north of Cozart, N.C.

SIGNIFICANT FEATURES:

1. This site contains an excellent example of an Upland Depression Swamp Forest natural community, which is rare in the state. This community type is generally limited to Piedmont areas over basic rocks such as gabbro. This is the first known instance in the state of this natural community occurring over diabase rock.

2. This natural area supports a good quality example of a Basic Oak-Hickory Forest. Mature upland hardwood forests over diabase rock, such as this one, are rare in the state.

3. Present at this site is a population of the rare shrub *Nestronia* (*Nestronia umbellula*), a State and Federal Candidate species.

GENERAL DESCRIPTION:

This natural area is located on an extensive diabase sill which underlies much of the southern half of Butner, N.C. The diabase sill is flat and contains rocky soils of the Iredell series. At the north end of the site is a small, elongate depression that holds water seasonally. The depression is shallow and is about three feet lower than its surroundings and holds about 1-2 feet of water for much of the year. Scattered on the margins of this swamp are diabase boulders. These rocks weather to a very dark brown, sticky circumneutral to basic soil that drains rather poorly.

The depression at this site supports an excellent example of an Upland Depression Swamp Forest community type. The canopy of this forest is quite mature with many trees over 70 feet tall. About 90% of the canopy is composed of overcup oak (*Quercus lyrata*), a rather uncommon tree in the Piedmont that is typical of the larger wetter bottomlands of the Coastal Plain. The remainder of the canopy is composed of willow oak (*Q. phellos*), which is common in the Piedmont bottomlands. The plant diversity in the understory, shrub, and herb layers is low. Highbush blueberry (*Vaccinium corymbosum*) is the only common shrub species. Several species of grasses and sedges grow in the damp soil along the edges of the swamp. Also along the margins of the swamp are extensive patches of sphagnum moss. It is likely that

a number of amphibian species lay their eggs in the pool because fish that might prey on the eggs are absent from the site.

Present at this site is an upland forest that is mature in many places. Some trees in this forest have diameters of 12 inches or more. Less mature portions of the forest have much pine mixed with the hardwoods. This forest is a good quality example of a Basic Oak-Hickory Forest. This community type is more commonly found over gabbro and other basic rock types in the central and western Piedmont. The canopy of this forest is composed mostly of oaks -- white oak (Quercus alba), post oak (Q. stellata), black oak (Q. velutina), and southern red oak (Q. falcata). Also common in the canopy are white ash (Fraxinus americana) and shortleaf pine (Pinus echinata). Common in the subcanopy are flowering dogwood (Cornus florida), redbud (Cercis canadensis), American beech (Fagus grandifolia), and hophornbeam (Ostrya virginiana). The shrub layer has as its common species fragrant sumac (Rhus aromatica), deciduous holly (Ilex decidua), downy arrowwood (Viburnum rafinesquianum), and dwarf pawpaw (Asimina parviflora). A population of the rare shrub nestronia (Nestronia umbellula) is present in this shrub layer. Herbs common to this forest are turpentine root (Aristolochia serpentaria), spotted wintergreen (Chimaphila maculata), ragwort (Senecio sp.), and spurge nettle (Tragia urticifolia).

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Department of Human Resources.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Surrounding areas are undergoing development or clearcutting. Few such upland swamps are in public ownership and only one, in Uwharrie National Forest, is protected. The forest at the South Butner Diabase Swamp might undergo selective cutting or clearcutting in the near future or development in the distant future. The natural area's integrity varies widely over its length. All of the area shows evidence of past selective cutting and grazing. A formal protection agreement should be sought to protect this site.

COMMENTS: Despite being on public, state-owned property, protection of this natural area (other than the upland depression) and others in the Butner area will likely be difficult because of the potential to hinder growth of the town in a westerly direction. Presently, Butner is growing in an easterly direction, along I-85, and growth in this direction is encouraged, as opposed to growth westward and northward toward such significant natural areas as described in this report. Nonetheless, it is important to pursue permanent protection of all highly significant sites, no matter their locations.

REFERENCES:

Schafale, M. and H.E. LeGrand, Jr. 1987. South Butner Diabase Swamp. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.

SITE NAME: South Butner Hardwood Forest

SITE CODE: GA16

SIZE: 11 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Northeast Durham

LOCATION: This site is in the Neuse River watershed in southwestern Granville County in the Piedmont Province of North Carolina. It is in the southern portion of Butner; east of SR 1100; west of railroad track; about 1 mile north of Cozart, N.C.

SIGNIFICANT FEATURES: This site contains a good quality example of a Basic Oak-Hickory Forest, a rather rare community type in the state.

GENERAL DESCRIPTION:

This natural area is a nearly flat upland with a small shallow drainage. It is a rather poorly drained site, but is not swampy. This site is part of the diabase sill located in the Butner area. The soils are generally very dark with some clay and fine gravel. A few outcrops of boulders are located in the natural area.

The site supports a mature, relatively undisturbed deciduous forest over diabase. This forest is a Basic Oak-Hickory Forest which is a rather rare community type in the state. The canopy of this forest varies from closed to fairly open and is dominated by post oak (Quercus stellata). Also common in the canopy are mockernut hickory (Carya tomentosa) and white ash (Fraxinus americana). Many of the canopy trees have diameters over 12 inches; some are over 24 inches dbh. The subcanopy is composed of plants such as flowering dogwood (Cornus florida), redbud (Cercis canadensis), eastern redcedar (Juniperus virginiana), persimmon (Diospyros virginiana), and black cherry (Prunus serotina). Common in the shrub layer is fringetree (Chionanthus virginicus). The herb layer is rather sparse. More detailed information on herbaceous flora is needed.

The integrity of the site is excellent, with little signs of disturbance. There is some Japanese honeysuckle (Lonicera japonica) and pines (Quercus spp.) indicating some disturbance occurred at the site; however, it appears the disturbance occurred more than several decades ago.

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Department of Human Resources, but the entire area has been subdivided for residential development.

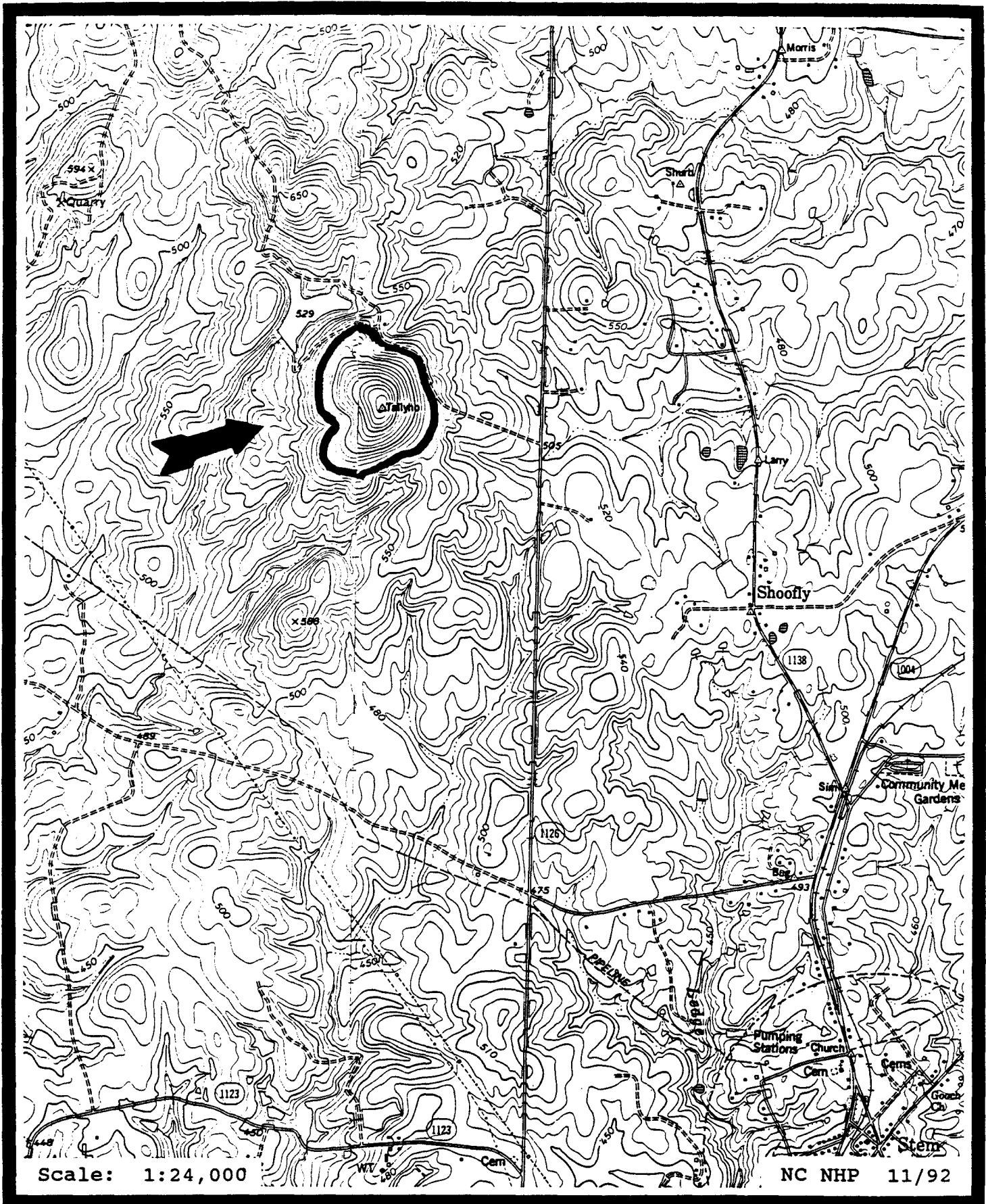
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Development is an imminent threat to this natural area. The whole area has been platted, with a road planned to bisect the site. Half acre lots are proposed for the site.

COMMENTS: Protection of the natural area now seems to be futile. Nonetheless, as of late 1992, the natural area was still intact and therefore is included in this report.

REFERENCES:

- LeGrand, H.E., Jr. 1986. Report on the special-interest natural areas and endangered species habitats in the general vicinity of the proposed superconducting super collider in North Carolina (portions of Durham, Granville, Person, and Orange Counties). N.C. Natural Heritage Program.
- _____ and M.P. Schafale. 1986. South Butner Diabase Area--Oak-Hickory Forest. Natural Area Reconnaissance. N.C. Natural Heritage Program.



Site Name: Tallyho Monadnock
 Site Code: GA17
 Quadrangle: Stem, Lake Michie

SITE NAME: Tallyho Monadnock

SITE CODE: GA17

SIZE: 63 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Granville

QUADRANGLE: Stem, Lake Michie

LOCATION: This site is in the Neuse River watershed in western Granville County in the Piedmont Province of North Carolina. It is northwest of Stem, N.C.; about 1.7 miles north of SR 1004 on SR 1126; west of SR 1126.

SIGNIFICANT FEATURES: This natural area contains a good quality Piedmont Monadnock Forest, which is uncommon in the A/P III study area.

GENERAL DESCRIPTION:

This natural area contains a monadnock which protrudes nearly 200 feet above the surrounding area due to its more resistant rocks. Rock outcrops and small boulders are present on top of the monadnock. A dirt road crosses the monadnock. The surrounding area, which is level to gently sloping, has been recently cleared. The geology at this site is of felsic Metavolcanic Rock in the Carolina Slate Belt. The soils are apparently part of the Stony Land Association.

The northeastern portion of the monadnock crest at this site supports a good quality Piedmont Monadnock Forest. The canopy of this forest is open and is dominated by chestnut oak (Quercus prinus). The subcanopy is dominated by sourwood (Oxydendrum arboreum), red maple (Acer rubrum), and black gum (Nyssa sylvatica). The shrub layer is sparse, with hillside blueberry (Vaccinium pallidum) and small black blueberry (V. tenellum) forming dense patches in some areas. Scattered herbs include pipsissewa (Chimaphila maculata), Indian pipe (Monotropa uniflora), and goat's rue (Tephrosia virginiana). The ground of this forest is littered with outcrops, small boulders, and large stones, usually covered with heavy lichen growth.

On the southeastern side of the monadnock's crest is a loblolly pine (Pinus taeda) plantation. On the slopes of the monadnock is an immature forest (about 20-30 years old) which is dominated by sourwood and red maple.

OWNERSHIP: Unknown; however, the site is leased to a hunt club.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Because monadnocks are good places to build houses and towers, the Piedmont Monadnock Forest is prone to disturbance. Even though portions of the site have been planted in loblolly pine, the crest areas of the monadnock are probably too steep to be converted to a pine

plantation. The dirt road at the site should not be widened. The landowners should be informed of the significance of the site and of the various protection options available.

COMMENTS: None

REFERENCES:

Kelly, A. and Z. Murrell. 1992. Tallyho Monadnock. Site Survey Report. N.C. Natural Heritage Program.

SITE NAME: Tar River--Wilton Slopes

SITE CODE: GA18

SIZE: 1400 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Henderson (1:100,000 scale)

LOCATION: This site is in the Tar River watershed in eastern Granville County in the Piedmont Province of North Carolina. This site stretches along the Tar River from just east of NC 96 to just west of the Granville/Vance county line.

SIGNIFICANT FEATURES:

1. Present in this natural area are isopyrum (Enemion biternatum) and Indian physic (Porteranthus stipulatus), both significantly rare plant species.
2. This site supports a number of good quality natural community types; it also has an extremely high scenic value.

GENERAL DESCRIPTION:

This natural area is a mosaic of bluffs, slopes, floodplains, and levees. The slopes are dissected by ravines and small tributaries. This site occurs along a sometimes rocky stretch of the Tar River and two tributaries, Fishing and Ford creeks. The river has rocky bars and small islands. The geology at this site is of metavolcanic-epiclastic rocks and metamorphosed quartz diorite, with intrusions of meta-ultramafic rock and diabase.

This natural area supports several natural community types: Mesic Mixed Hardwood Forest, Basic Mesic Forest, Piedmont/Coastal Plain Heath Bluff, Piedmont/Mountain Levee Forest, and Rocky Bar and Shore. The Mesic Mixed Hardwood Forest community present in this natural area is located in certain areas along the slopes and is in fairly good condition. In some areas the canopy is dominated by American beech (Fagus grandifolia), mockernut hickory (Carya tomentosa), and various oak species such as white oak (Quercus alba) and swamp chestnut oak (Q. michauxii). Common understory species are red maple (Acer rubrum) and arrowwood (Viburnum dentatum). In certain areas mountain laurel (Kalmia latifolia) is common. The herb layer is rich and contains species such as partridgeberry (Mitchella repens), royal fern (Osmunda regalis), and round-lobed hepatica (Hepatica americana). Associated with this Mesic Mixed Hardwoods community is a Piedmont/Coastal Plain Heath Bluff. This community is dominated by mountain laurel and is located on north and east-facing slopes.

The Basic Mesic Forest at this site is located close to the Granville/Vance county line. Located upslope from a Piedmont/Mountain Levee Forest, this rare community contains a

diverse assemblage of basic-mesic herbs and ferns. The canopy is dominated by bitternut hickory (Carya cordiformis), sugarberry (Celtis laevigata), and various oak species (Quercus spp.). A distinct shrub layer of painted buckeye (Aesculus sylvatica) is present. Common herb species include dutchman's breeches (Dicentra cucullaria), trout lily (Erythronium umbilicatum), and isopyrum (Enemion biternatum), a plant significantly rare in the state.

Located on a small terrace at the base of a bluff along the river just west of SR 1622 is a Piedmont/Mountain Levee Forest community. The canopy of this forest is dominated by American hornbeam (Carpinus caroliniana), tuliptree, American sycamore (Platanus occidentalis), water oak (Q. nigra), and sweet gum (Liquidambar styraciflua). The understory has as its common species eastern redcedar (Juniperus virginiana), witch hazel (Hamamelis virginiana), black cherry (Prunus serotina), and common pawpaw (Asimina triloba).

Another area that contains a Piedmont Levee Forest is located on the south bank of the river about 1 mile upstream from the SR 1201 bridge. This forest has a canopy of swamp chestnut oak, sugarberry, and bitternut hickory. Common understory species are box elder (Acer negundo), painted buckeye, common pawpaw, spicebush (Lindera benzoin), and American hornbeam. The ground cover is composed of mixed herbs such as bedstraw (Galium sp.), violets (Viola sp.), yellow fumewort (Corydalis flavula), and speedwell (Veronica sp.).

Located along the river is a Rocky Bar and Shore community. This community was not inventoried. These areas are probably dominated by common waterwillow (Justicia americana). Also present at this site is the Tar River--Upper Aquatic Habitat which flows through the site. It is a Nationally significant aquatic habitat and contains numerous rare aquatic animals.

OWNERSHIP: Multiple private ownership; part of the site is owned or is leased by a hunt club.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

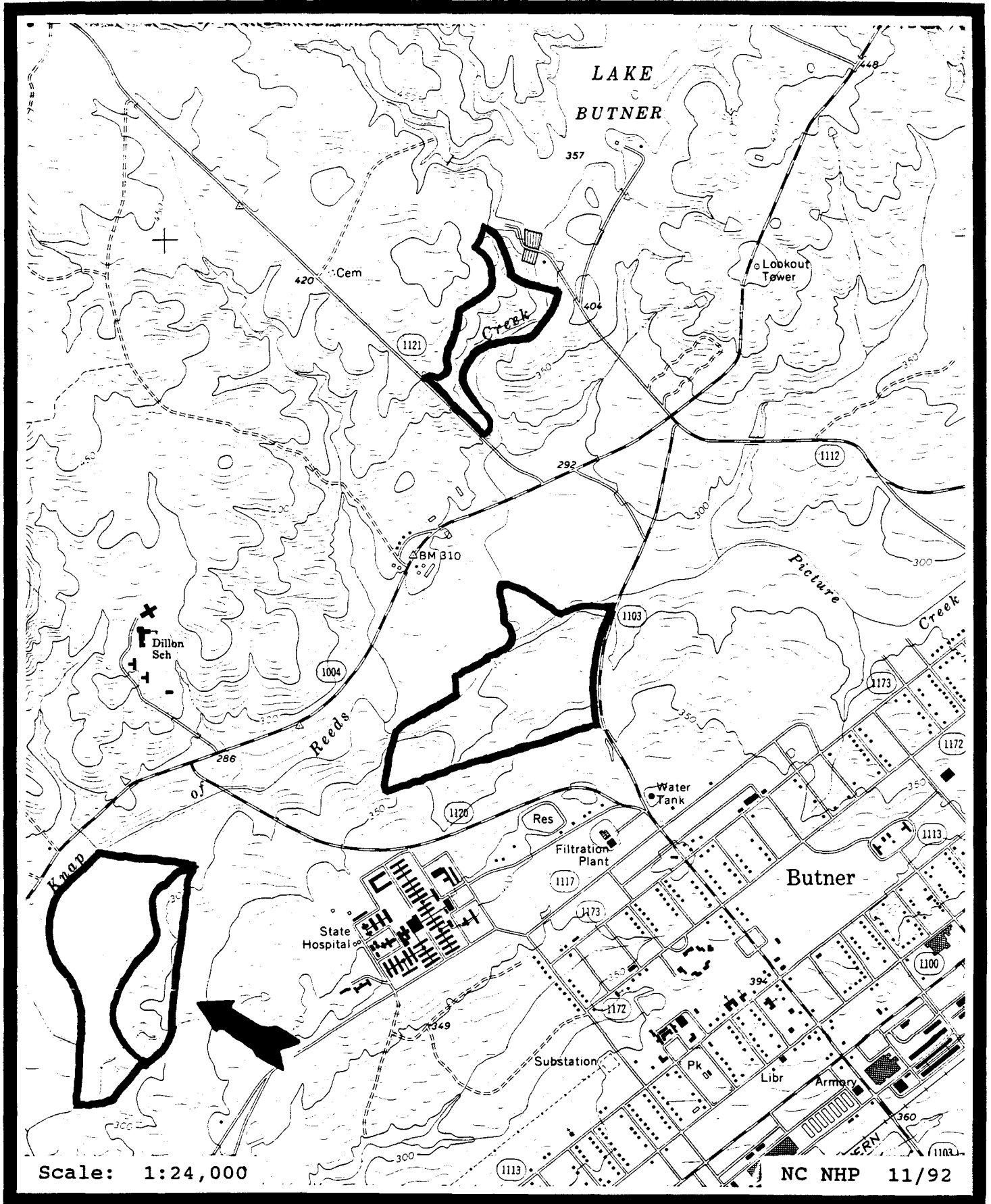
Scattered old stumps indicate selective logging has occurred in certain portions of the site in the past. There is no evidence of grazing or other types of disturbance. The site is far enough from roads and houses that it is probably not visited often. Hunting club signs do indicate that the site is visited on occasion by hunters.

This natural area needs to be protected. Many of the surrounding areas are in agriculture or have been clear-cut or selectively logged. The landowners need to be informed of the significance of the site and of the various protection options available.

COMMENTS: This natural area is large and has the potential for more rare plant species; therefore, additional site surveys are recommended. This area has state park potential because of its scenic beauty, whitewater canoeing, and high quality natural areas.

REFERENCES:

- Kelly, A. and Z. Murrell. 1992. Tar River Bluffs and Slopes. Site Survey Report. N.C. Natural Heritage Program.
- Lynch, J.M. and K.M. Lynch. 1987a. Tar River Floodplain. Site Survey Summary. N.C. Natural Heritage Program.
- _____. 1987b. Tar River Slope. Site Survey Summary. N.C. Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Umstead Hospital Pine-Oak Forest
 Site Code: GA19
 Quadrangle: Lake Michie

SITE NAME: Umstead Hospital Pine-Oak Forest

SITE CODE: GA19

SIZE: 40 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Granville

QUADRANGLE: Lake Michie

LOCATION: This site is in the Tar River watershed in southwestern Granville County in the Piedmont Province of North Carolina. It is east of Knap of Reeds Creek; 0.8 mile west of Umstead Hospital in Butner, N.C.; just east of Knap of Reeds Creek Diabase--Clearings and Levee.

SIGNIFICANT FEATURES: This site contains three rare plant species: nestronia (Nestronia umbellula), a Federal Candidate species; and hoary puccoon (Lithospermum canescens) and American barberry (Berberis canadensis), both significantly rare in the state.

GENERAL DESCRIPTION:

This natural area is part of the large diabase sill that extends for several miles in the Butner area. This site is generally along the lower 30-50% of the gentle west-facing slopes that extend from the Knap of Reeds Creek floodplain upward to Umstead Hospital. A few small streams, dry much of the year, flow from east to west through the forest at this site.

The slope at this site is xeric to mesic and supports a middle-aged mixed hardwood-pine-cedar forest which is a seral stage of the Xeric Hardpan Forest and Basic Oak-Hickory Forest community types. The canopy of this forest is composed mainly of loblolly pine (Pinus taeda), white oak (Quercus alba), and post oak (Q. stellata). Subcanopy species include eastern redcedar (Juniperus virginiana), redbud (Cercis canadensis), and hop hornbeam (Ostrya virginiana). Shrub species include fragrant sumac (Rhus aromatica), winged sumac (R. copallina), coralberry (Symphoricarpos orbiculatus), American barberry (Berberis canadensis), and 2-3 colonies of nestronia (Nestronia umbellula), a Federal Candidate species. Herb species include hoary puccoon (Lithospermum canescens), narrowleaf bluet (Houstonia tenuifolia), lowland loosestrife (Lysimachia hybrida), and spurge-nettle (Tragia urticifolia).

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Department of Human Resources.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This natural area was proposed for Registry in the late 1980's. However, this and several other Butner sites were deferred from Registry, because of future potential development of these lands by the town of

Butner. Protection of the site should still be pursued. Little management is necessary; the site should be allowed to mature.

COMMENTS: Additional survey is needed for rare plants at this site, especially along the eastern portion near Umstead Hospital.

REFERENCES:

LeGrand, H.E., Jr. 1986. Knap of Reeds Creek Diabase Area -- Sewerline and Levee. Natural Area Reconnaissance. N.C. Natural Heritage Program.

GREENE COUNTY NATURAL AREAS

GREENE COUNTY

Greene County has no known natural areas of National, State, or Regional significance. At least one known site in Greene County might contain high quality habitat and significant natural communities. This site is the floodplain located along Contentnea Creek on the Stantonsburg quadrangle map. This site was not surveyed for this study due to inaccessibility. It is recommended that this site be inventoried at a later date if access can be gained.

HALIFAX COUNTY NATURAL AREAS

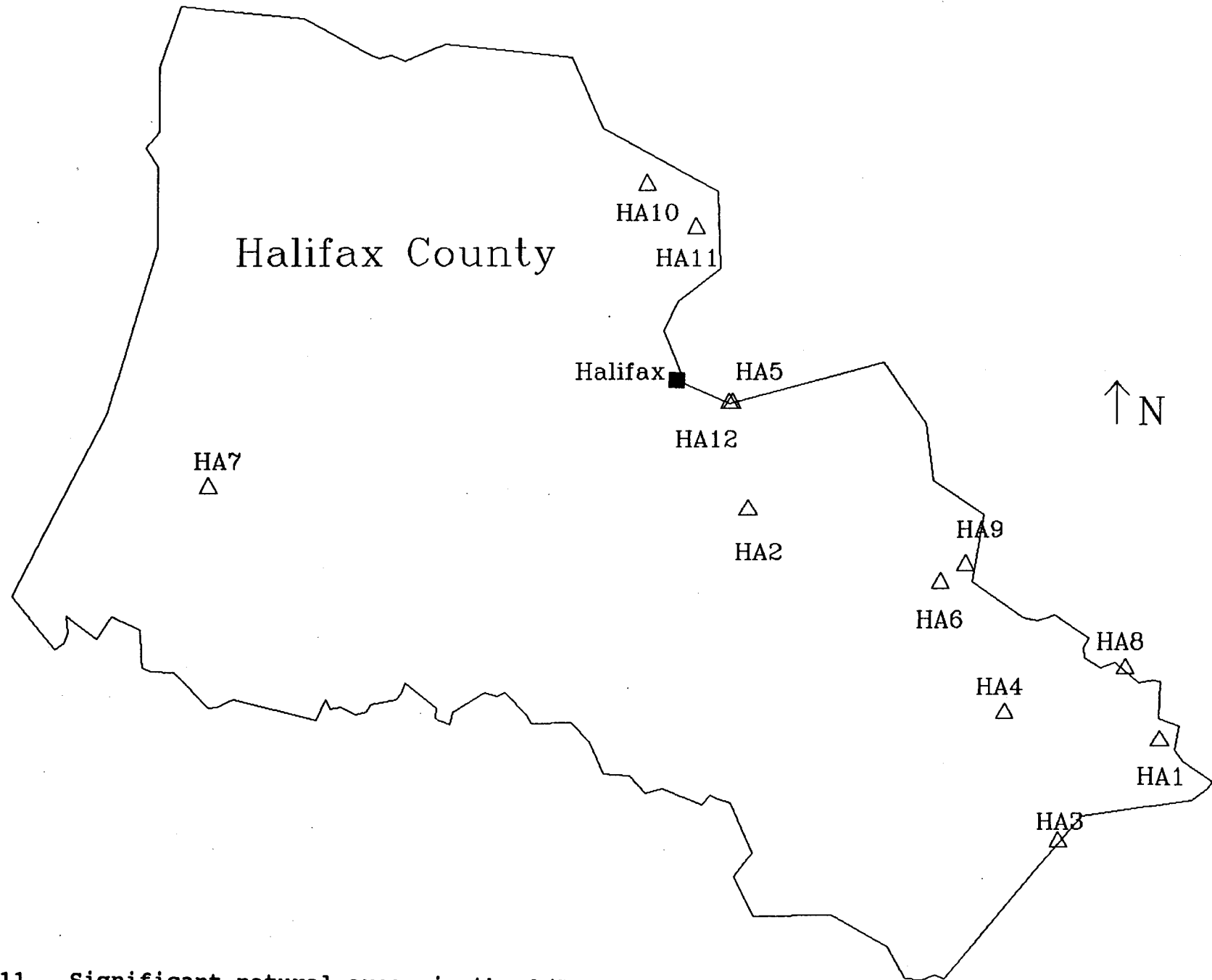
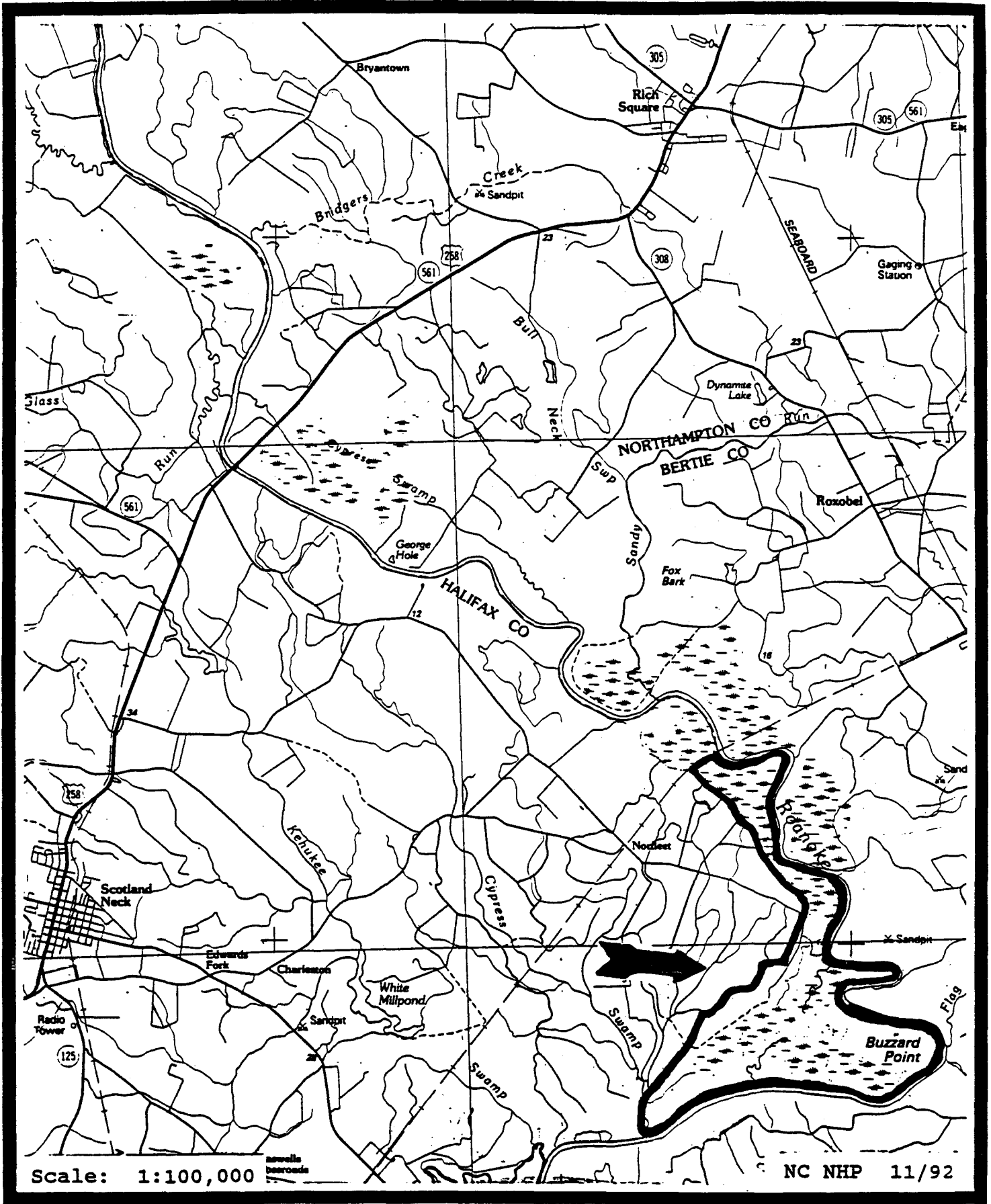


Figure 11. Significant natural areas in the A/P III study area portion of Halifax County



Site Name: Buzzard Point/Ventosa Plantation
 Site Code: HA1
 Quadrangle: Roanoke Rapids

SITE NAME: Buzzard Point/Ventosa Plantation

SITE CODE: HA1

SIZE: 3700 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Halifax

QUADRANGLE: Roanoke Rapids (1:100,000 scale)

LOCATION: This site is in the Roanoke River watershed in southeastern Halifax County in the Coastal Plain Province of North Carolina. It is on the west side of the Roanoke River; about 1 mile southeast of Norfleet, N.C.; about 7.5 miles east-southeast of Scotland Neck, N.C.

SIGNIFICANT FEATURES:

1. This natural area contains a large expanse of river floodplain with some of the best examples of the typical bottomland and swamp communities in the Roanoke system.

2. Four good quality natural communities are present: Coastal Plain Levee Forest (Brownwater Subtype), Cypress-Gum Swamp (Brownwater Subtype), Coastal Plain Bottomland Hardwoods (Brownwater Subtype), and Coastal Plain Semipermanent Impoundment.

3. Two rare species of plants are found here: big shellbark hickory (*Carya laciniosa*), a State Candidate species, and dwarf stinging nettle (*Urtica chamidryoides*), a significantly rare species.

4. Three rare species of birds are found here: cerulean warbler (*Dendroica cerulea*), a Federal Candidate species, black vulture (*Coragyps atratus*), a species of Special Concern, and Mississippi kite (*Ictinia mississippiensis*), a significantly rare species.

5. This natural area contains a wading bird rookery, a special wildlife habitat.

GENERAL DESCRIPTION:

This site contains two natural areas: Buzzard Point and Ventosa Plantation. The surface substrates in these areas are composed of flood-deposited alluvial sediments ranging from fine sand to silt to clay. The underlying surficial sediments are interbedded clays and sands of the Cretaceous age Tuscaloosa Formation.

The Buzzard Point natural area consists of about 75% backswamp and 25% natural levee. The levee supports a Coastal Plain Levee Forest (Brownwater Subtype) and the backswamp supports a Cypress-Gum Swamp (Brownwater Subtype). The natural levee within Buzzard Point ranges from a width of about 2800 feet along the north side of the point to about 400 feet along the south side. The Coastal Plain Levee Forest (Brownwater Subtype) at this site is a good quality, mature, second growth forest with

a canopy composed mainly of green ash (Fraxinus pennsylvanica), American sycamore (Platanus occidentalis), sugarberry (Celtis laevigata), and American elm (Ulmus americana). The dominant subcanopy tree is boxelder (Acer negundo). The shrub layer is characterized by buckeye (Aesculus sylvatica) and pawpaw (Asimina triloba). The ground cover is dominated in some places by dense colonies of giant cane (Arundinaria gigantea) and in other places by mixed grasses and sedges.

The Cypress-Gum Swamp (Brownwater Subtype) at Buzzard Point has a canopy composed mostly of water tupelo (Nyssa aquatica) with scattered baldcypress (Taxodium distichum) and swamp cottonwood (Populus heterophylla). A sparse shrub layer of Carolina water ash (Fraxinus caroliniana) occurs over most of the area. Essentially no herb layer is present. In this swamp is a heronry containing nesting pairs of great egrets (Casmerodius albus) and great blue herons (Ardea herodias). The birds nest in the crowns of both water tupelo and bald cypress. This heronry is one of seven known heronries in the Roanoke River floodplain.

The Ventosa Plantation natural area is located along the inner portion of a large bend or "neck" of the Roanoke River, just west of the Buzzard Point site. Both the northern and southern ends of the area border the river channel. The northern third of this natural area is bordered along its western side by an old man-made levee about 10 feet high. Along the eastern side of this natural area are natural levees and backswamps. The middle portion of the natural area is dominated by a series of alternating low, flat-topped ridges (relic point bars and natural levees) and long, narrow swamp sloughs or meander scars (old river channels). This section also contains several beaverponds which lie along the narrow sloughs.

The natural levees along the river channels support a Coastal Plain Levee Forest (Brownwater Subtype) community type with a canopy dominated by American sycamore, sugarberry, and green ash. The subcanopy is dominated by boxelder and the shrub layer is dominated by pawpaw, buckeye, and spicebush (Lindera benzoin). The herb layer is dominated by various assemblages of species such as giant cane, sedges, bottlebrush grass (Hystrix patula), and chickweed (Stellaria media). Woody vines are conspicuous throughout.

The backswamps and sloughs located at Ventosa Plantation support a Cypress-Gum Swamp (Brownwater Subtype) community type. The canopy is dominated by one or both of the following species: baldcypress and water tupelo. Less frequent trees include overcup oak (Quercus lyrata), swamp cottonwood, water hickory (Carya aquatica), American elm, sweetgum, and green ash. The shrub layer is dominated by Carolina water ash or American hornbeam (Carpinus caroliniana). There is no subcanopy. In some areas there is no herb layer; in other areas aquatic herbs and graminoids dominate.

In several areas the sloughs have been dammed by beaver colonies creating open, ponded areas which typically have very

diverse aquatic plant communities. These dammed areas are considered to be Coastal Plain Semipermanent Impoundments.

The low ridges at Ventosa Plantation support a Coastal Plain Bottomland Hardwoods (Brownwater Subtype) community type. The common canopy trees include sweetgum, swamp chestnut oak (Quercus michauxii), cherrybark oak (Q. pagoda), Shumard oak (Q. shumardii), laurel oak (Q. laurifolia), willow oak (Q. phellos), shagbark hickory (Carya ovata), bitternut hickory (C. cordiformis), black walnut (Juglans nigra), American elm, and green ash. The subcanopy is dominated by American hornbeam, hawthorns (Crataegus spp.), and possum haw (Ilex decidua). The herb layer is sparse, but locally dominated by patches of giant cane, spikegrass (Uniola spp.), and other grasses and sedges.

At least 68 species of breeding birds are present at Ventosa Plantation. This represents over 70% of the total number of breeding birds in the inner Coastal Plain region of the state. There is also a high diversity of game and non-game mammals at this site. These include: eastern gray squirrel (Sciurus carolinensis), marsh rabbit (Sylvilagus palustris), eastern cottontail (S. floridanus), raccoon (Procyon lotor), mink (Mustela vison), muskrat (Ondatra zibethicus), river otter (Lutra canadensis), gray fox (Urocyon cinereoargenteus), bobcat (Felis rufus), beaver (Castor canadensis), and opossum (Didelphis virginiana).

OWNERSHIP: Buzzard Point is owned by the state and is administered by the N.C. Wildlife Resources Commission, whereas Ventosa Plantation is privately owned.

PROTECTION STATUS: Ventosa Plantation is a Registered Natural Heritage Area and Buzzard Point is a state Game Land. Buzzard Point had been designated as a Dedicated State Nature Preserve several years ago. However, this designation was rescinded when the plan for the Roanoke River National Wildlife Refuge indicated that Buzzard Point was to be transferred from state to federal ownership.

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

Land adjacent to the Buzzard Point natural area is used for timber. The Buzzard Point natural area itself receives little use except from occasional deer and turkey hunters. To preserve the continued existence of the heronry, no timber cutting should be allowed within the buffer zone surrounding this area. It is recommended that during the nesting season (March 1 to June 30) timber operations within a one-half mile radius of the colony not be conducted.

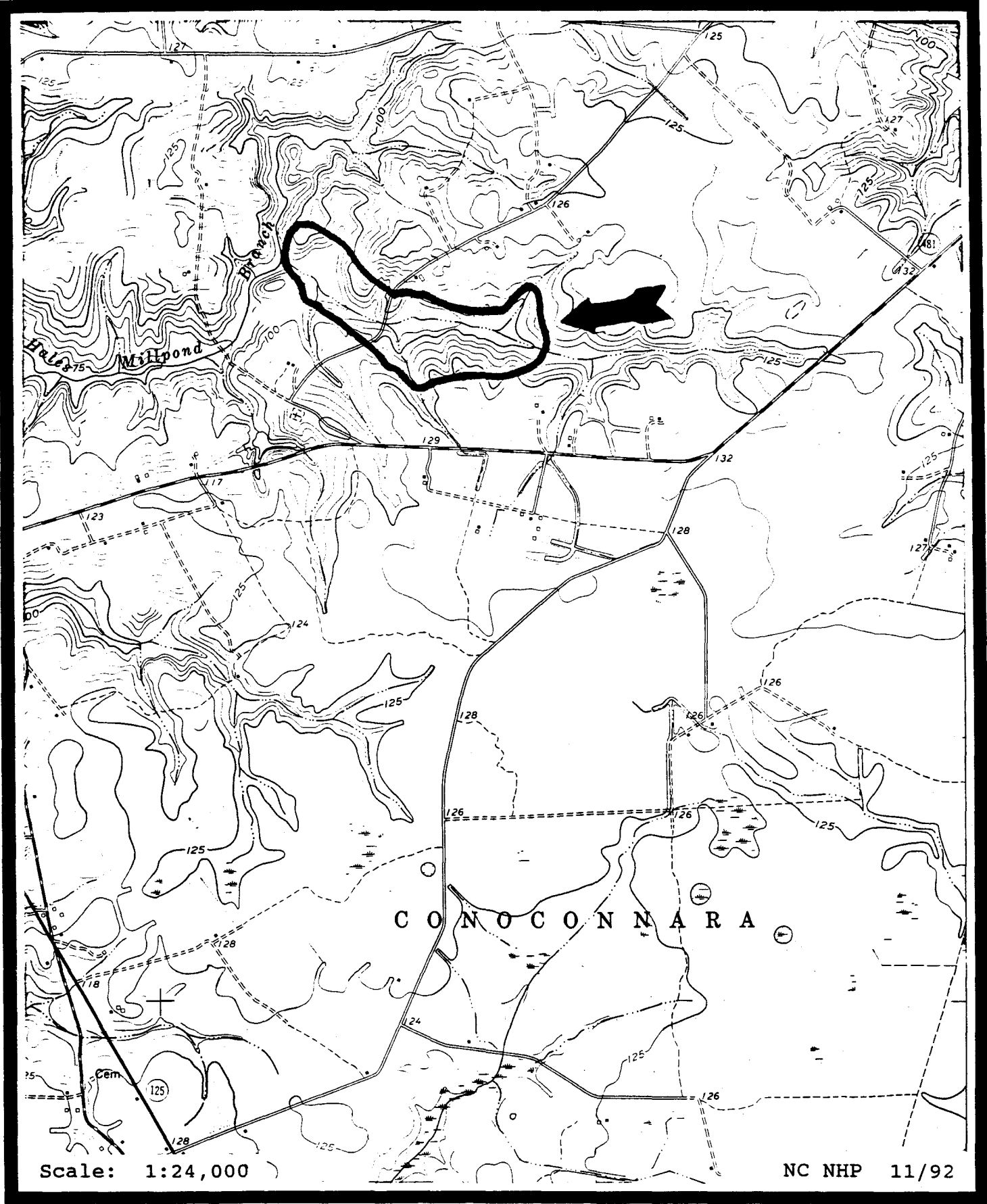
Deer hunting is the primary land use of the Ventosa Plantation natural area. The landowner manages the area as a turkey refuge and has a "no-cut" policy. Clearing for agriculture and timber is therefore unlikely in this portion of the site. Illegal hunting of deer, turkeys, and other wildlife does, however, occur along the Roanoke River by hunters using

boats. Management of this area should be designed to preserve and maintain the bottomland hardwood and swamp forest wetlands and their native plant and animal populations. Management should provide equal emphasis on non-game mammals and birds. The no timber cutting policy should continue to allow the forest communities to develop into mature forests which will enhance most wildlife populations. It is recommended that no additional roads be built within the designated natural areas.

COMMENTS: Buzzard Point is proposed for inclusion in the Roanoke River National Wildlife Refuge. It will be transferred to U.S. Fish and Wildlife Service ownership once lands in the Martin County portion of the Roanoke floodplain are acquired by the Service and transferred to the Commission.

REFERENCES:

- Lynch, J.M. 1981a. Roanoke River Preserve Design Project. Submitted to N.C. Natural Heritage Program and The North Carolina Nature Conservancy.
- _____. 1981b. Buzzard Point Heronry Natural Area. N.C. Natural Heritage Program.
- _____. 1981c. Ventosa Plantation Alluvial Floodplain. N.C. Natural Heritage Program.



Site Name: Conoconnara Swamp Forest
Site Code: HA2
Quadrangle: Dawson Crossroads

SITE NAME: Conoconnara Swamp Forest

SITE CODE: HA2

SIZE: 95 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Halifax

QUADRANGLE: Dawson Crossroads

LOCATION: This site is in the Tar River watershed in eastern Halifax County in the Coastal Plain Province of North Carolina. It lies along a tributary of Hales Millpond Branch, on a dirt road north of NC 481; about 1 mile northeast of Crowell's Crossroad, N.C.

SIGNIFICANT FEATURES:

1. This site supports large populations of two rare species of plants: Carolina least trillium (Trillium pusillum var. pusillum), a Federal Candidate and State Endangered species, and southern twayblade (Listera australis), a significantly rare species.

2. A dominate species at this site is skunk cabbage (Symplocarpus foetidum), rare in the N.C. Coastal Plain.

GENERAL DESCRIPTION:

This palustrine site contains an old beaver pond or mill pond with very little stream flow and permanently flooded seeps along its margins. The geology of this site is of the Coastal Plain Yorktown and Duplin formations.

This site supports a Coastal Plain Semipermanent Impoundment that is succeeding back to a Coastal Plain Small Stream Swamp. The canopy in this community is well-developed and the herb layer is very dense. The canopy is composed of trees with 1-2 foot dbh's and is dominated by red maple (Acer rubrum), white ash (Fraxinus americana), willow oak (Quercus phellos), and swamp tupelo (Nyssa biflora). Common to the subcanopy are sweetbay (Magnolia virginiana), red chokeberry (Sorbus arbutifolia), and possum-haw (Ilex decidua). Skunk cabbage (Symplocarpus foetidum), Carolina least trillium (Trillium pusillum var. pusillum), and sensitive fern (Onoclea sensibilis) dominate the herb layer. Also present in the herb layer is southern twayblade (Listera australis). Along the margins are relicts of white oak (Quercus alba), loblolly pine (Pinus taeda), and flowering dogwood (Cornus florida). Beyond the margin one can see evidence of trees having been logged or cleared for farming.

Faunal observations were made during the site survey. Inhabiting this site is the eastern cottonmouth (Agkistrodon piscivorus).

OWNERSHIP: Private ownership.

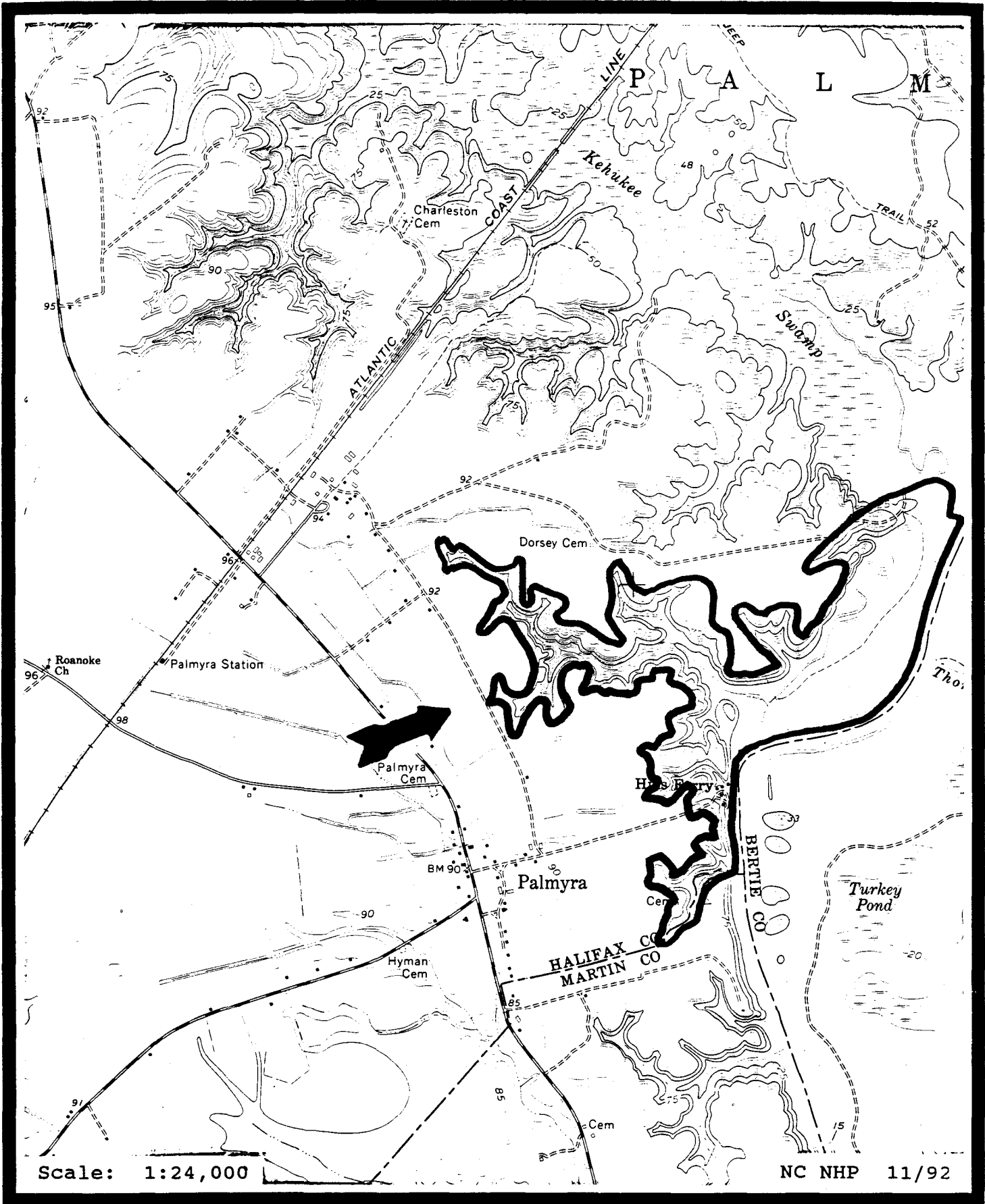
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Because this site is surrounded by clearcuts and agricultural fields, clearcutting and timber harvesting are major threats. This site should be protected from clearcutting and drainage. The landowner should be contacted to discuss the significance of the site and protection options.

COMMENTS: An additional survey may be needed to better describe the community type present at this site. Summer and fall surveys are also needed, especially to inventory animals.

REFERENCES:

Murrell, Z.E., S. Hall, and H.E. LeGrand, Jr. 1991. Steve Leonard Trillium Pusillum Site. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Hills Ferry Bluffs
 Site Code: HA3
 Quadrangle: Palmyra

SITE NAME: Hills Ferry Bluffs

SITE CODE: HA3

SIZE: 200 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Halifax

QUADRANGLE: Palmyra

LOCATION: This site is in the Roanoke River watershed in southeastern Halifax County in the Coastal Plain Province of North Carolina. It is on the west side of the Roanoke River, about 1 mile northeast of Palmyra, N.C.

SIGNIFICANT FEATURES:

1. This site contains at least five natural community types: Piedmont/Coastal Plain Heath Bluff, Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant), Basic Mesic Forest (Coastal Plain Subtype), Coastal Plain Small Stream Swamp (Brownwater Subtype), and Coastal Plain Bottomland Hardwoods (Brownwater Subtype).

2. A vertical bluff with a fossil (shell) deposit is present at this site.

GENERAL DESCRIPTION:

Hills Ferry Bluffs natural area contains a remarkable number of distinct and very different natural communities lying in close proximity to each other. The site also contains various landforms such as: rich, south-facing slopes containing a variety of herbaceous plants; a spectacular vertical bluff that contains a fossil (shell) deposit at its base; ravines 70 feet deep, some containing montane-like vegetation; a former alluvial pasture that is now a large pond; and a highly dissected and steeply eroded "plateau" (Wicomico Terrace).

At least five natural community types are present at this site. Steep, xeric bluffs and slopes at the site support a Piedmont/Coastal Plain Heath Bluff community dominated by American beech (Fagus grandifolia), mountain laurel (Kalmia latifolia), and galax (Galax aphylla). Mixed mesophytic hardwood slopes at this site support a Basic Mesic Forest (Coastal Plain Subtype) dominated by painted buckeye (Aesculus sylvatica). The subcanopy, shrub, and herbaceous layers of this community have a high species diversity. Other slopes at the site support a Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) dominated by American beech. The subcanopy and shrub layers in this community are not well-developed.

Along streams and in a pond in this natural area is a Coastal Plain Small Stream Swamp (Brownwater Subtype). Along the streams baldcypress (Taxodium distichum) dominates and in the pond silver maple (Acer saccharinum) dominates. An alluvial floodplain and levee area at this site supports a Coastal Plain Bottomland Hardwoods (Brownwater Subtype) community dominated by eastern cottonwood (Populus deltoides).

OWNERSHIP: Single private ownership.

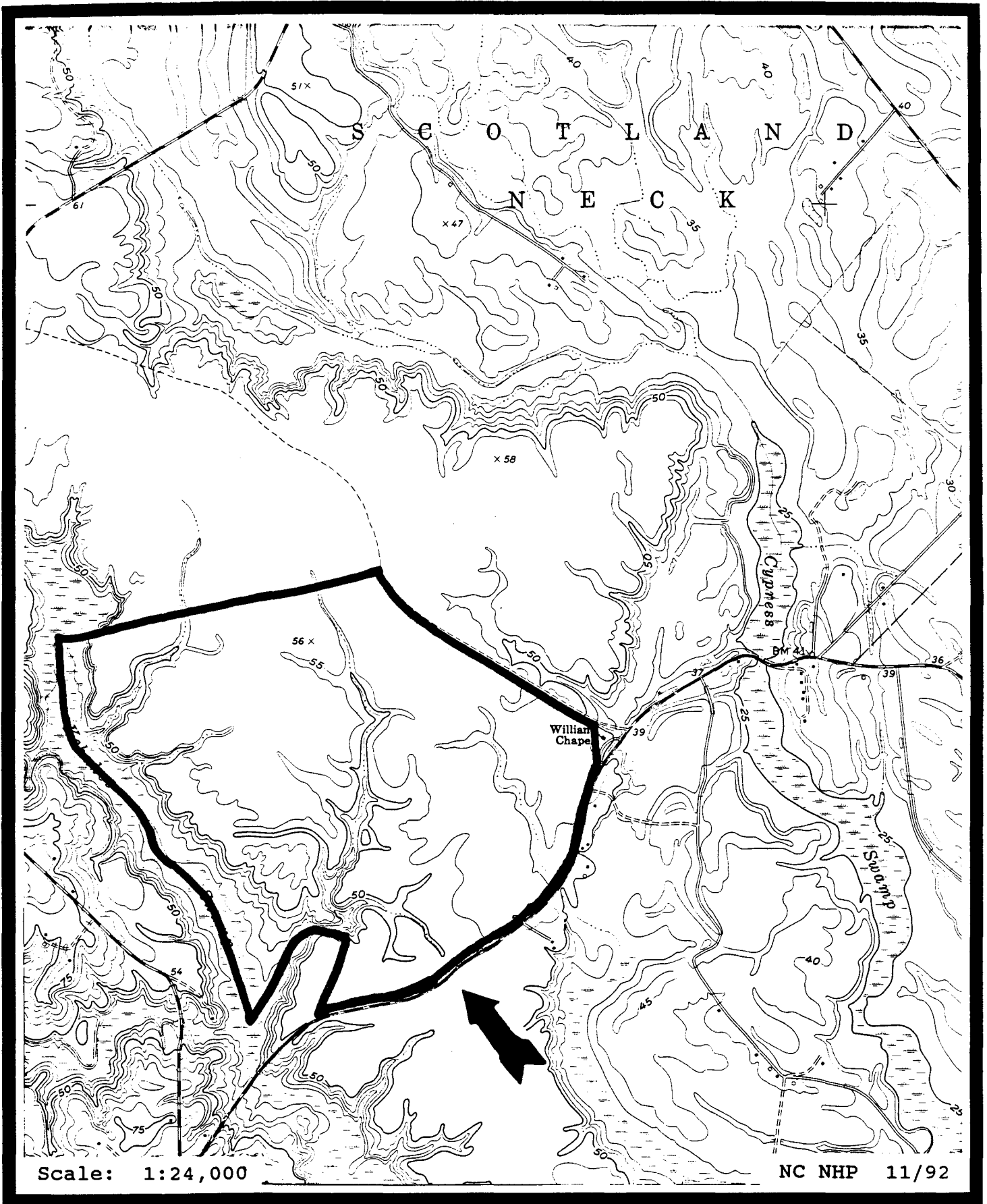
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The forests here have mature canopies and have no evidence of logging. To preserve the integrity of this site logging should not be permitted. Also the alluvial pond should not be drained. The owner has been contacted about protection of the natural area and intends to continue protecting the site. However, no permanent protection has been arranged.

COMMENTS: It is recommended that the bluffs to the north and south of this area be surveyed, preferably in spring or early summer. Additional rich, basic soils might be present, in addition to the slope in the natural area.

REFERENCES:

LeGrand, H.E., Jr., M. Lynch, K. Lynch, D. Carter, and A. Carter.
1985. Hills Ferry: Preliminary Site Reconnaissance Survey.
N.C. Natural Heritage Program.



Site Name: Kehukee Swamp Uplands
 Site Code: HA4
 Quadrangle: Norfleet

SITE NAME: Kehukee Swamp Uplands

SITE CODE: HA4

SIZE: 600 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Halifax

QUADRANGLE: Norfleet

LOCATION: This site is in the Roanoke River watershed in southeastern Halifax County in the Coastal Plain Province of North Carolina. The south portion of the site borders SR 1804; about 5 miles east of Scotland Neck, N.C.

SIGNIFICANT FEATURES: This site contains a large, high quality Dry-Mesic Oak-Hickory Forest in a portion of the state where they are rare.

GENERAL DESCRIPTION:

In general, the site is an interstream flat located on a marine-deposited Coastal Plain terrace (Wicomico Terrace). It is bordered on the west by Kehukee Swamp drainage and on the east by a floodplain (valley wall) of the Roanoke River. The sandy clay loam soils at this site are probably moderately well-drained ultisols.

This natural area supports a large, high quality Dry-Mesic Oak-Hickory Forest. The canopy dominants of this forest are white oak (Quercus alba) and loblolly pine (Pinus taeda). Other trees present are other oaks (Quercus spp.) and hickories (Carya spp.). The average dbh's of these trees are 12-18 inches.

OWNERSHIP: Multiple private ownership.

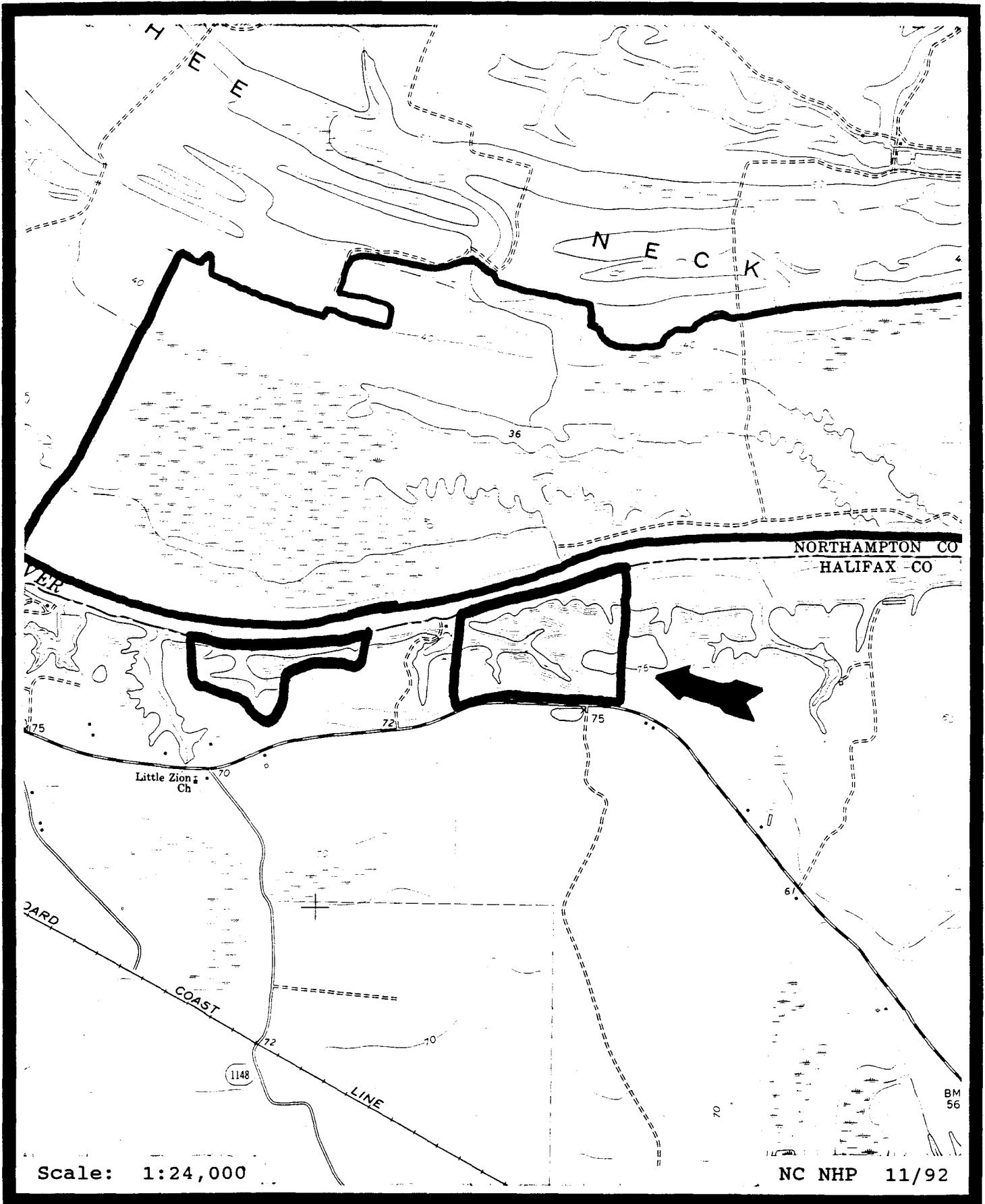
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Clearcutting is the greatest threat to the site. The adjacent terrace tracts have been clearcut and converted to loblolly pine plantations. The site has been selectively logged at intervals in the past. The last cut occurred probably over 20 years ago. The fire history of the site needs to be determined. The owners of this site need to be informed of the significance of this natural area and of the various protection options available.

COMMENTS: This site was seen only from the road. Therefore, a site survey for extent and quality of the community is highly recommended.

REFERENCES:

Lynch, J.M. 1992. Kehukee Swamp Uplands. Site Survey Report. The North Carolina Nature Conservancy.



Site Name: Larkspur Ridge
 Site Code: HA5
 Quadrangle: Halifax

SITE NAME: Larkspur Ridge

SITE CODE: HA5

SIZE: 97 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Halifax

QUADRANGLE: Halifax

LOCATION: This site is in the Roanoke River watershed in eastern Halifax County in the Coastal Plain Province of North Carolina. It is along the south bank of the Roanoke River; about 1 mile northeast of the intersection of NC 561 and SR 1148.

SIGNIFICANT FEATURES:

1. Two good quality natural communities are present in this natural area: Coastal Plain Levee Forest (Brownwater Subtype) and Basic Mesic Forest (Coastal Plain Subtype).

2. This site contains two rare species of plants: isopyrum (Enemion biternatum) and sessile-flowered trillium (Trillium sessile), both significantly rare species.

3. Also present is the cerulean warbler (Dendroica cerulea), a Federal Candidate species.

GENERAL DESCRIPTION:

Larkspur Ridge and its terraces are bordered on the north by the Roanoke River, on the west by a small tributary and beaverpond, on the east by a cut-over floodplain and slope hardwood forest, and on the south by a pine plantation. Above a relatively narrow floodplain and high natural levee, the primarily north-facing slopes of the terrace and ridge rise about 35 feet. The site ranges from xeric to hydric and contains clayey loam, sandy loam, and silty loam soils high in calcium and magnesium and thus high in pH. The combination of north-facing slopes and high base soils creates a micro-environment which is relatively cooler, moister, and richer in soil nutrients than the surrounding region. This site has not been logged for at least 50 years and the forests are mature.

Present on the north-facing slopes adjacent to the river is a Basic Mesic Forest (Coastal Plain Subtype) with a canopy dominated almost entirely by shagbark hickory (Carya ovata). The subcanopy is dominated by southern sugar maple (Acer floridanum). Painted buckeye (Aesculus sylvatica) and pawpaw (Asimina triloba) are the shrub layer dominants. A rich assemblage of herbs typical of the montane region are present here and include: woodland stonecrop (Sedum ternatum) and dwarf larkspur (Delphinium tricornis). Rare plant species present are isopyrum (Enemion biternatum) and sessile-flowered trillium (Trillium sessile).

A Coastal Plain Levee Forest (Brownwater Subtype) occurs in a thin band 30-100 yards wide between the Roanoke River and the slopes. The canopy dominant in this forest is green ash (Fraxinus pennsylvanica). Boxelder (Acer negundo) is the

dominant subcanopy tree. The shrub layer is characterized by spicebush (Lindera benzoin), painted buckeye, and pawpaw on the higher terraces. On these higher terraces, baby blueeyes (Nemophila microcalyx) is abundant along with many of the herb species characteristic of the rich slope community.

The oak-hickory forest at this site occurs on level inter-stream divides and along slopes of small streams not directly adjacent to the river. The canopy dominants in this forest are white oak (Quercus alba) and mockernut hickory (Carya tomentosa), although several other species are minor constituents. The shrub layer is dominated on the drier slopes by flowering dogwood (Cornus florida) and by American hornbeam (Carpinus caroliniana) in the wetter areas.

OWNERSHIP: This site is owned by The Nature Conservancy.

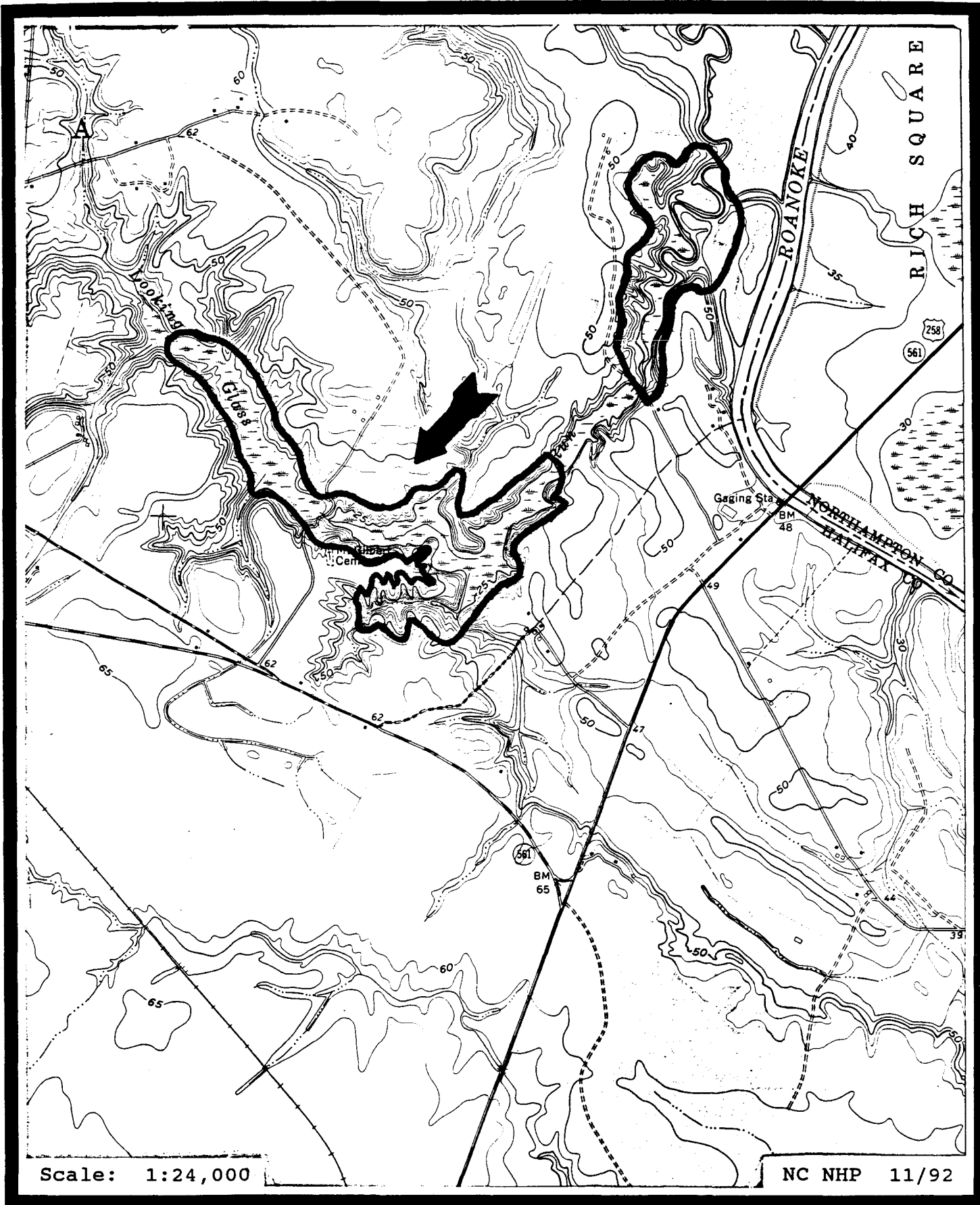
PROTECTION STATUS: This site is a Nature Conservancy Preserve. Though not yet a Registered Natural Heritage Area or Dedicated State Nature Preserve, the site is fully protected.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site needs little or no management. The Nature Conservancy might need to work with adjacent landowners to prevent future clear-cutting immediately adjacent to the preserve boundaries.

COMMENTS: A highly significant natural area, featuring similar natural resources, was clear-cut in 1980-81. That site, the Roanoke Bluffs, contained several rare plants not found at Larkspur Ridge.

REFERENCES:

- Lynch, J.M. 1979. Larkspur Ridge. Natural Area Report. N.C. Natural Heritage Program.
- _____. 1981. Roanoke River Preserve Design Project. Submitted to N.C. Natural Heritage Program and the North Carolina Nature Conservancy.
- Roe, C. and J.H. Moore. 1982. Larkspur Ridge. Natural Area Report. N.C. Natural Heritage Program.
- Seaton, K. 1981. Larkspur Ridge Natural Area. Report compiled for Department of Botany, University of North Carolina, Chapel Hill, N.C.



Site Name: Looking Glass Run Swamp and Bluffs
 Site Code: HA6
 Quadrangle: Scotland Neck

SITE NAME: Looking Glass Run Swamp and Bluffs

SITE CODE: HA6

SIZE: 164 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Halifax

QUADRANGLE: Scotland Neck

LOCATION: This site is in the Roanoke River watershed in eastern Halifax County in the Coastal Plain of North Carolina. It is north of NC 561 and west of NC 268; about 5 miles north of Scotland Neck, N.C.; adjacent to Mt. Gilbert Cemetery.

SIGNIFICANT FEATURES: This site has a fairly high quality Cypress-Gum Swamp (Brownwater Subtype) and a high quality Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant).

GENERAL DESCRIPTION:

Located along Looking Glass Run are bluffs and a swamp. The geology at this site is of the Cape Fear Formation. This site supports two high quality natural communities: Cypress-Gum Swamp (Brownwater Subtype) and Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant). These forests are mature and contain trees with an estimated average dbh of 1 foot; some individuals have a dbh as large as 2.5-3 feet.

The Cypress-Gum Swamp (Brownwater Subtype) at this site is of high quality and covers about 200 acres. This swamp has a well-developed canopy containing baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) as the dominant species. Carolina ash (*Fraxinus caroliniana*) dominates the subcanopy. The common shrub layer species are Virginia sweetspire (*Itea virginica*), tag alder (*Alnus serrulata*), and stiff dogwood (*Cornus stricta*). The herb layer is dominated by river oats (*Chasmanthium latifolia*). Although this is a high quality site, some selective cutting has occurred here.

The Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) at this site is located along the bluff and is of fairly high quality. It covers an area of about 50 acres and has a well-developed canopy composed of American beech (*Fagus grandifolia*), white oak (*Quercus alba*), and tuliptree (*Liriodendron tulipifera*). Flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), red maple (*Acer rubrum*), and American hornbeam (*Carpinus caroliniana*) are common in the subcanopy. The shrub layer is dominated by swamp doghobble (*Leucothoe racemosa*) and hillside blueberry (*Vaccinium pallidum*). Pipsissewa (*Chimaphila maculata*), bloodroot (*Sanguinaria canadensis*), and crane fly orchid (*Tipularia discolor*) are common in the herb layer. Clearcutting has occurred on the upland areas and has degraded the bluff.

OWNERSHIP: Presumed privately owned; leased by a gun club.

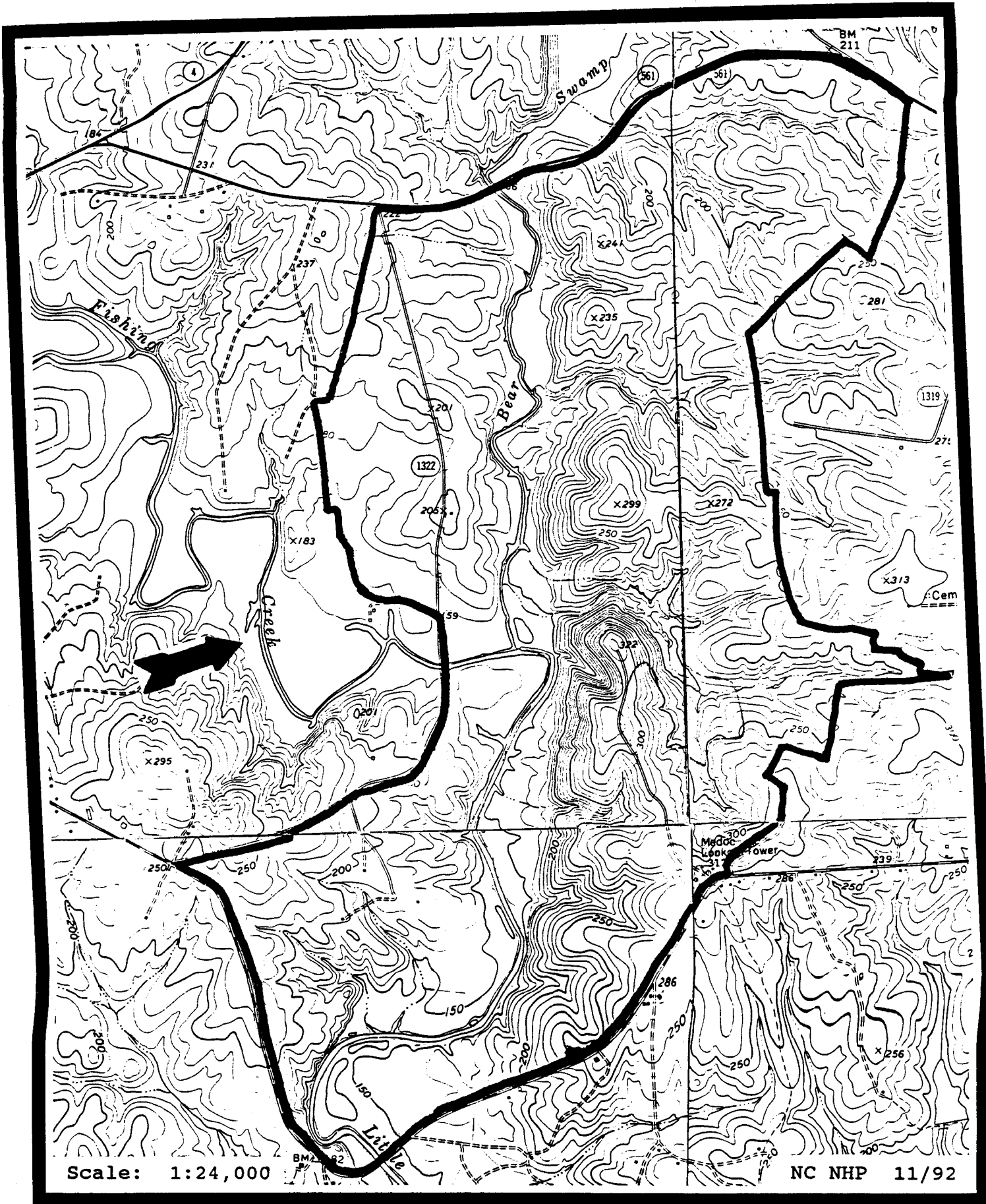
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Selective cutting has occurred in the swamp and clearcutting has taken place in the uplands. It is recommended that this site be protected from logging. The landowner should be contacted to discuss the significance of the site and protection options.

COMMENTS: Because this site was surveyed in the later part of the growing season, survey work is needed in the spring. This work could locate rare species not seen during the fall site visit.

REFERENCES:

Murrell, Z.E. 1991. Looking Glass Run Swamp and Bluffs. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Medoc Mountain State Park
 Site Code: HA7
 Quadrangle: Hollister, Aurelian Springs, Essex, Ringwood

SITE NAME: Medoc Mountain State Park

SITE CODE: HA7

SIZE: 2287 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Halifax

QUADRANGLE: Hollister, Aurelian Springs, Essex, Ringwood

LOCATION: This site is in the Tar River watershed in western Halifax County in the Piedmont Province of North Carolina. It is about 1.1 mile west of NC 48 on SR 1002.

SIGNIFICANT FEATURES:

1. This site contains three good quality natural communities: Piedmont/Low Mountain Alluvial Forest, Piedmont Monadnock Forest, and Mesic Mixed Hardwood Forest (Piedmont Subtype).

2. Also present is a population of the Neuse River waterdog (Necturus lewisi), a salamander of Special Concern.

GENERAL DESCRIPTION:

Medoc Mountain State Park lies in the "fall zone" transition area between the Piedmont and Coastal Plain. Although this site is technically in the Piedmont, evidence of coastal sediments and terrain are present immediately east of the park. The most prominent features in the park are the bluffs along Little Fishing Creek and the 170-foot high ridge forming Medoc Mountain. This mountain is actually a water eroded, north-south trending ridge composed of Upper Cambrian to the Middle Paleozoic biotite granite gneiss, containing a deposit of the metal molybdenum on its lower slopes. The ridge is a residual landform, the product of erosion of the surrounding softer argillite and alluvial sediments.

This state park contains two natural areas: Medoc Mountain Natural Area and Little Fishing Creek Bluffs Natural Area. Contained in these natural areas are three natural community types: Piedmont/Low Mountain Alluvial Forest, Piedmont Monadnock Forest, and Mesic Mixed Hardwood Forest (Piedmont Subtype).

Situated on a floodplain-braided stream complex is a Piedmont/Low Mountain Alluvial Forest near the confluence of Little Fishing Creek and the tributary which runs around the north base of the mountain. In this forest the canopy dominants are sweetgum (Liquidambar styraciflua), mostly on the higher floodplain, and river birch (Betula nigra), mostly in abandoned stream channels. The subcanopy is dominated by American hornbeam (Carpinus caroliniana). The herb layer is lush and is dominated by various grasses and sedges.

Located at this site is a Piedmont Monadnock Forest. This community type is more typical of the western Piedmont and mountains. The forest at this site is the easternmost Piedmont

Monadnock Forest in the state. At this site the forest occurs on the mountain's ridge. On the sheltered northeast-facing side of the mountain the Monadnock Forest is dominated by chestnut oak (Quercus montana) and a mixture of other oaks such as white oak (Q. alba), southern red oak (Q. falcata), and black oak (Q. velutina). The shrub layer here is dominated by mountain laurel (Kalmia latifolia). Further up the ridge and facing in a south to southwest direction the community is dominated by shortleaf oak (Q. ecinata) and chestnut oak in the canopy. Mixed blueberries such as sparkleberry (Vaccinium arboreum), deerberry (V. stamineum), and hillside blueberry (V. pallidum) dominate the shrub layer.

Upstream from the Medoc ridge is the Little Fishing Creek Bluffs Natural Area. This site contains a Mesic Mixed Hardwood Forest (Piedmont Subtype) on very steep, sheltered, north-facing bluffs over argillite (a highly compacted claystone or mudstone). This community contains a stand of mature American beech (Fagus grandifolia). Other hardwoods present are red maple, white oak, sourwood (Oxydendrum arboreum), and black gum (Nyssa sylvatica). The shrub layer is characterized by mountain laurel and common wild azalea (Rhododendron periclymenoides). The herb here is sparse. The streamside floodplain adjacent to these bluffs supports large loblolly pine (Pinus taeda), willow oak (Quercus phellos), and sweetgum trees.

Along with typical wildlife, the rare Neuse River waterdog (Necturus lewisi), an amphibian of Special Concern, is present in the creek.

OWNERSHIP: This natural area is owned by the state of North Carolina as a state park.

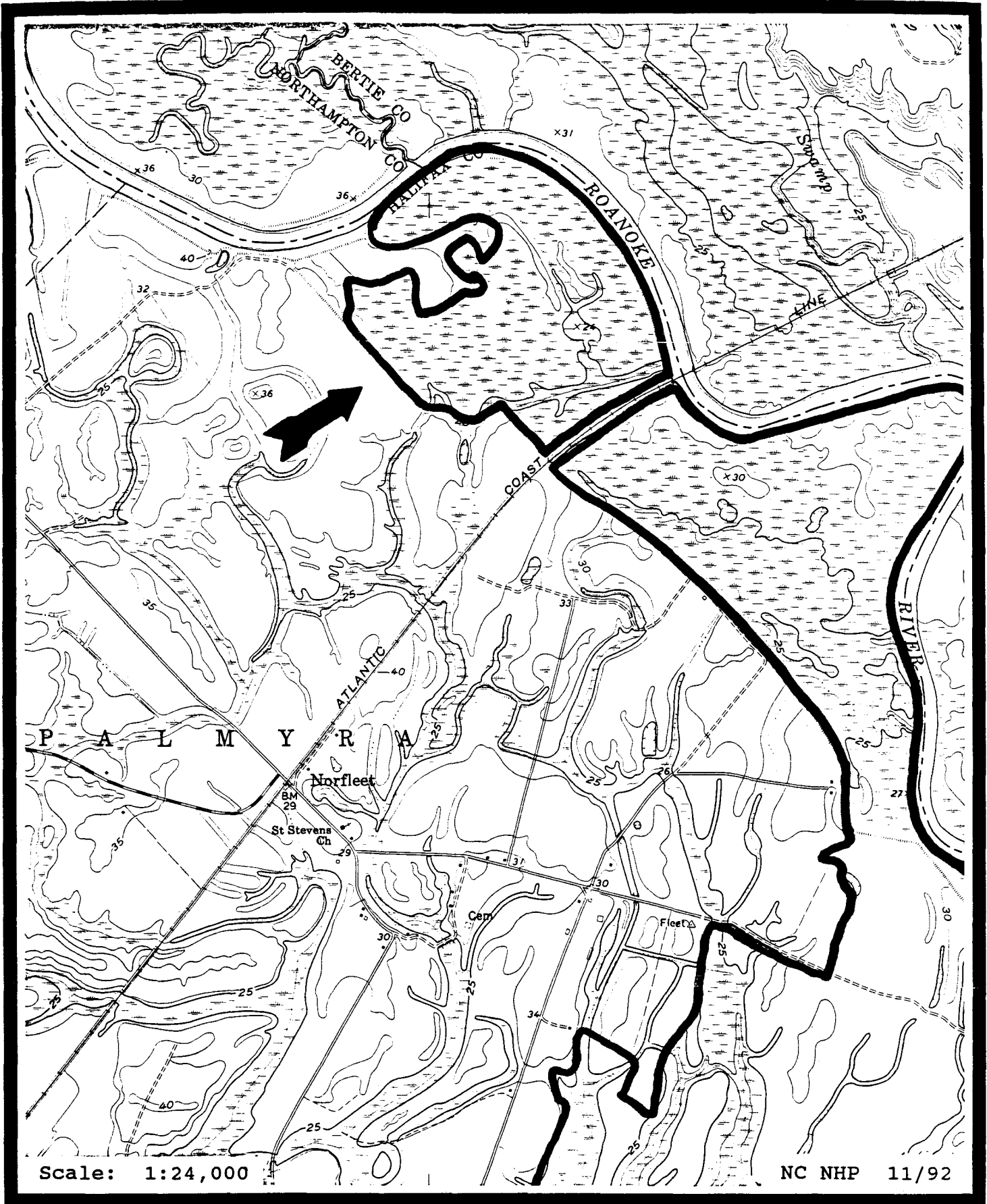
PROTECTION STATUS: Of this site, 205 acres are a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This natural area should be protected to maintain the integrity of the natural communities and rare animal population present at this site. This park provides an excellent outdoor laboratory for studying succession over a variety of soils and land forms.

COMMENTS: None

REFERENCES:

- Braswell, A.L. 1980. Letter about animal species collected at Medoc Mountain State park to John Taggart, N.C. State Parks.
Taggart, J.B. 1980. Medoc Mountain Park Natural Areas. Report submitted to N.C. Division of Parks and Recreation.



Site Name: Norfleet Cottonwood Forest
 Site Code: HA8
 Quadrangle: Norfleet

SITE NAME: Norfleet Cottonwood Forest

SITE CODE: HA8

SIZE: 250 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Halifax

QUADRANGLE: Norfleet

LOCATION: This site is in the Roanoke River watershed in southeastern Halifax County in the Coastal Plain Province of North Carolina. It is about 1.5 miles north-northeast of Norfleet, N.C. and SR 1800.

SIGNIFICANT FEATURES:

1. This site contains big shellbark hickory (Carya laciniosa), a State Candidate species.
2. Another rare species present at this site is the cerulean warbler (Dendroica cerulea), a Federal Candidate.
3. This site features an old-growth stand of eastern cottonwood (Populus deltoides) and is an important wildlife area.

GENERAL DESCRIPTION:

Norfleet Cottonwood Forest is located in the inside curve of a bend in the Roanoke River. This site is on an alluvial floodplain behind a man-made levee adjacent to the riverbank. The area is low, essentially flat, and frequently flooded. The site is presumed to contain alluvial sediments over the Yorktown Formation. The soils are silty to clayey loam.

Located at this site on the second bottom of the Roanoke River floodplain is an old-growth stand of eastern cottonwood (Populus deltoides), with average dbh's of 3.2 feet and heights of 140 feet. The largest cottonwood measured had a dbh of 6.6 feet. Scattered associated canopy trees include American sycamore (Platanus occidentalis), sugarberry (Celtis laevigata), and cherrybark oak (Quercus pagoda). Scattered subcanopy species include slippery elm (Ulmus rubra), red maple (Acer rubrum), and sweetgum (Liquidambar styraciflua). The dominant shrub is deciduous holly (Ilex decidua). Greenbrier (Smilax spp.) is abundant throughout this forest and in some places forms almost impenetrable tangles. Big shellbark hickory (Carya lacinosa), a State Candidate species, is present on both sides of a small gut near the southern edge of the forest. This forest represents a mosaic of Coastal Plain Bottomland Hardwoods (Brownwater Subtype) and Coastal Plain Levee Forest (Brownwater Subtype) despite it being removed from the immediate riverbank.

Located between the cottonwood stand and the river channel is a narrow natural levee which supports a Coastal Plain Levee Forest dominated by sugarberry, American sycamore, and American elm (Ulmus americana). Along the back side of the cottonwood stand is a low area inundated for long periods. This area contains a backswamp which supports a Cypress-Gum Swamp (Brownwater Subtype) community

type consisting of an almost pure stand of old-growth water tupelo (Nyssa aquatica).

This natural area is heavily used for foraging and feeding by wild turkey (Meleagris gallopavo). The large trees at this site provide excellent breeding habitat for the cerulean warbler (Dendroica cerulea), a Federal Candidate species. The overall wildlife values of the natural area are considered high.

OWNERSHIP: Single private ownership.

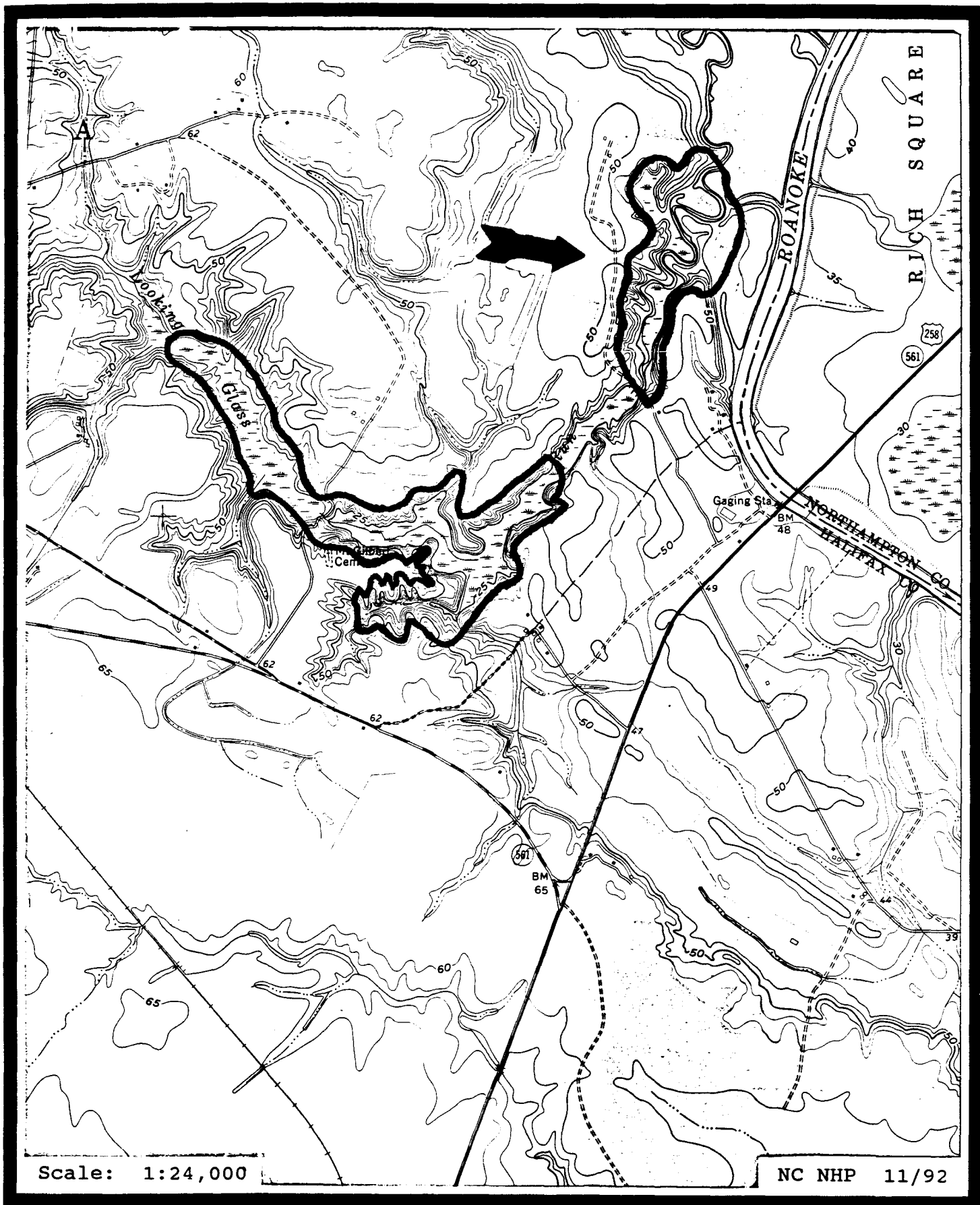
PROTECTION STATUS: This site has no formal protection status; however, there is an informal agreement with the landowner to voluntarily protect the natural area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This natural area needs little or no management.

COMMENTS: Despite the high wildlife value of the site, it is not within the acquisition boundary of the Roanoke River National Wildlife Refuge.

REFERENCES:

- Lynch, J.M. and L. Peacock. 1980. Norfleet Cottonwood Stand. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- _____. 1981. Roanoke River Preserve Design Project. Submitted to N.C. Natural Heritage Program and the North Carolina Nature Conservancy.
- Moore, J., C. Roe, H. LeGrand, and M. Lynch. 1985. Temple - Roanoke River Bottomland Forest and Cottonwood Stand. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: North Looking Glass Run Bluffs
 Site Code: HA9
 Quadrangle: Scotland Neck

SITE NAME: North Looking Glass Run Bluffs

SITE CODE: HA9

SIZE: 89 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Halifax

QUADRANGLE: Scotland Neck

LOCATION: This site is in the Roanoke River watershed in eastern Halifax County in the Coastal Plain Province of North Carolina. It is northwest of gaging station at US 258 bridge over Roanoke River; bluffs are north of dirt road along west side of Looking Glass Run.

SIGNIFICANT FEATURES: This site supports a mature, good quality, Basic Mesic Forest (Coastal Plain Subtype) with very large buckeye (Aesculus sp.) and American beech (Fagus grandifolia) trees.

GENERAL DESCRIPTION:

Near the Roanoke River at the north end of Looking Glass Run are dissected bluffs. The geology at this site is of the Cape Fear Formation. This site supports a mature Basic Mesic Forest (Coastal Plain Subtype).

The Basic Mesic Forest at this site is of good quality and covers an area of about 50 acres. This forest has a very well-developed canopy with American beech (Fagus grandifolia) and swamp chestnut oak (Quercus michauxii) as the dominant tree species. The estimated average dbh of these trees is 1.5 feet and the maximum dbh is about 2.5 feet. The subcanopy is dominated by painted buckeye (Aesculus sylvatica), American hornbeam (Carpinus caroliniana), and flowering dogwood (Cornus florida). American strawberrybush (Evonymus americana) and bladdernut (Staphylea trifolia) are common in the shrub layer. The herb layer is dominated by Christmas fern (Polystichum acrostichoides). This forest is bordered by a Cypress-Gum Swamp (Brownwater Subtype) to the west and clearcut areas and fields to the east.

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

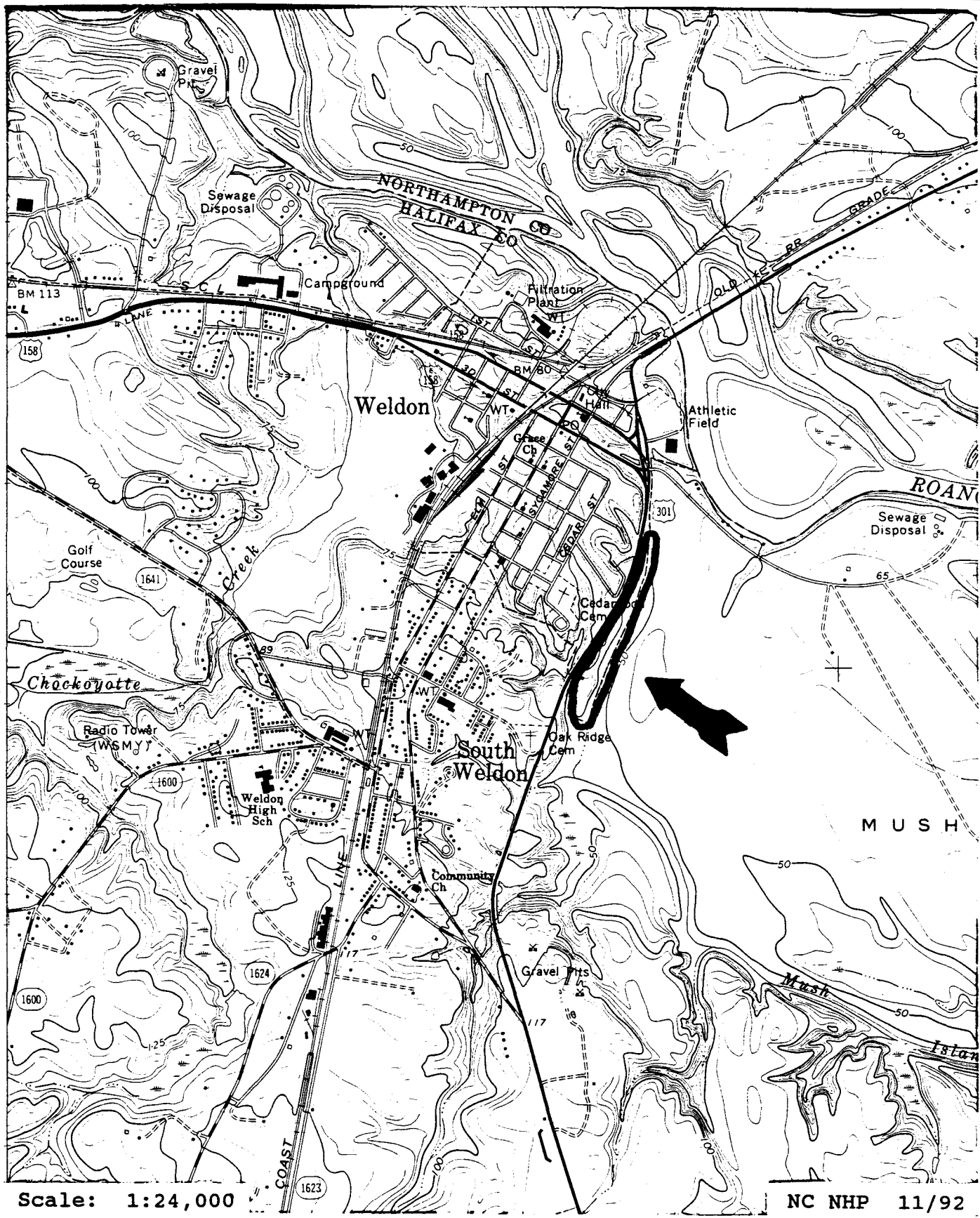
MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site is surrounded by fields and clearcuts and logging is its greatest threat. The landowner should be contacted to discuss the significance of the site and to discourage clearcutting.

COMMENTS: This site was surveyed in the fall; therefore, a spring survey is recommended to locate additional herbaceous species. Basic Mesic Forests often have a rich and diverse

herbaceous flora, much of which dies back by summer or early fall and is thus missed during a fall season survey.

REFERENCES:

Murrell, Z.E. 1991. North End Looking Glass Run Bluffs. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Phlox Woods
 Site Code: HA10
 Quadrangle: Weldon

SITE NAME: Phlox Woods

SITE CODE: HA10

SIZE: 20 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Halifax

QUADRANGLE: Weldon

LOCATION: This site is in the Roanoke River watershed in northern Halifax County in the Coastal Plain Province of North Carolina. It is within the city limits of Weldon; on the east side of US 301; 0.5 mile south of the junction of US 301 and SR 1150.

SIGNIFICANT FEATURES:

1. This site contains two rare plant species: sessile-flowered trillium (Trillium sessile) and isopyrum (Enemion biternatum), both significantly rare in the state.
2. A good quality Basic Mesic Forest (Coastal Plain Subtype) is present at this site.

GENERAL DESCRIPTION:

This site is bordered on the west by US 301, on the east by Mush Island Gut, and on the north and south by similar habitat. Present at this site is a north-south trending ridge with east and west-facing slopes. The east-facing slopes have a toe of about 50 feet above sea level and crest at 65-85 feet. This slope grades into a low, flat alluvial floodplain along Mush Island Gut, a tributary of the Roanoke River. This area is very rarely flooded. Slope angles vary from 20-55°. The surficial deposits are sands and clays of the Wicomico Formation, a Pleistocene terrace.

Due to the unusual topo-edaphic conditions at Phlox Woods, many species of herbs are found here which are primarily restricted to the mountains and Piedmont region, particularly ones occurring on circumneutral-basic deposits. This site contains an unusually high diversity of montane species, including several long-range disjuncts.

Occurring along the slope bases and on the adjacent alluvial floodplain is an example of a Coastal Plain Bottomland Hardwoods community type. The canopy dominants in this community are sugarberry (Celtis laevigata) and swamp chestnut oak (Quercus michauxii). In the subcanopy boxelder (Acer negundo) is the dominant. The common shrub is spicebush (Lindera benzoin). This community contains a diverse assemblage of herbs including wild blue phlox (Phlox divaricata), wild geranium (Geranium maculatum), sessile-flowered trillium (Trillium sessile), and isopyrum (Enemion biternatum).

A good quality Basic Mesic Forest (Coastal Plain Subtype) occurs along the slopes and along the crest of the hills. The canopy of this community is dominated by swamp chestnut oak,

slippery elm (Ulmus rubra), and bitternut hickory (Carya cordiformis). Dominant subcanopy species are southern sugar maple (Acer floridanum) and painted buckeye (Aesculus sylvatica). The herb layer is diverse and supports species such as black cohosh (Cimicifuga racemosa), green violet (Hybanthus concolor), bloodroot (Sanguinaria canadensis), and tall thimbleweed (Anemone virginiana).

OWNERSHIP: This site is partially owned by an individual and partially by the town of Weldon, N.C.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

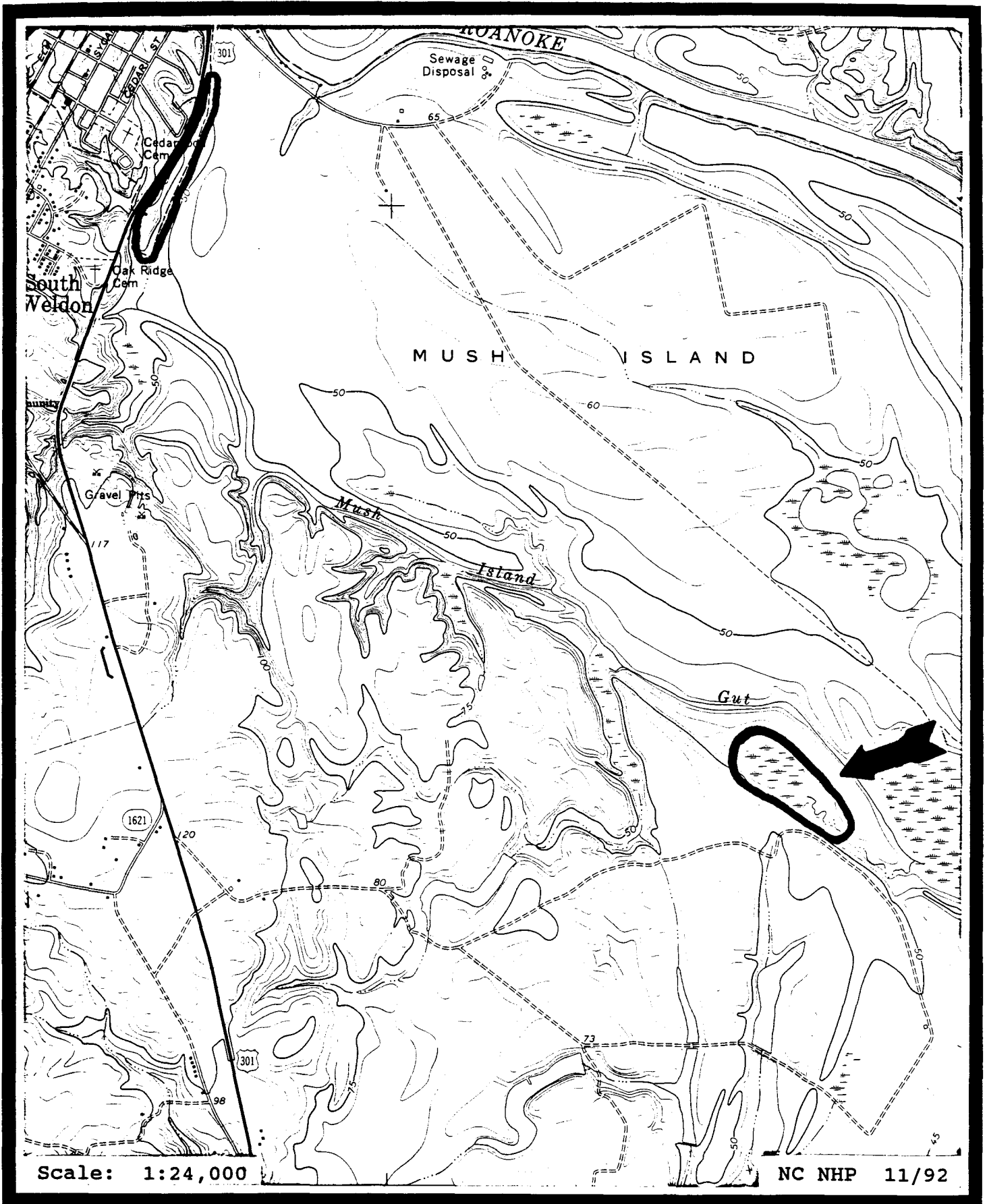
MANAGEMENT OR PROTECTION RECOMMENDATIONS: The greatest threat to the area may be from two exotic plant species, Japanese honeysuckle (Lonicera japonica) and privet (Ligustrum sinense). The plants need to be controlled at this site. Trails made by ORV's through the site have not yet caused much damage; however, the potential exists for trails to be made through sensitive areas.

COMMENTS: This natural area has a remarkable plant diversity for such a tiny amount of acreage.

REFERENCES:

Lynch, J.M. 1979. Phlox Woods. Natural Area Report. N.C. Natural Heritage Program.

_____. 1981. Roanoke River Preserve Design Project. Submitted to N.C. Natural Heritage Program and the North Carolina Nature Conservancy.



Site Name: Pierce's Farm Heronry
 Site Code: HA11
 Quadrangle: Weldon

SITE NAME: Pierce's Farm Heronry

SITE CODE: HA11

SIZE: 32 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Halifax

QUADRANGLE: Weldon

LOCATION: This site is in the Roanoke River watershed in northern Halifax County in the Coastal Plain Province of North Carolina. It is 1.75 miles east of the junction of US 301 and SR 1621.

SIGNIFICANT FEATURES:

1. This site provides habitat for two rare animal species: anhinga (Anhinga anhinga) and Mississippi kite (Ictinia mississippiensis), both significantly rare in the state.

2. This site is a wading bird rookery with an active great blue heron (Ardea herodias) nesting colony. This site is one of the most inland heronries in the state.

GENERAL DESCRIPTION:

This site contains two somewhat similar ponds. They are located in the Roanoke River floodplain where the river may have been located a few thousand years ago. Both of these ponds were swamps several decades ago, but dams placed on them have created large ponds, with many dead trees and swamp vegetation.

The pond at the northern end of the site is a heronry. It is half open water and half wooded swamp. Broadleaf cattails (Typha latifolia) are abundant in this pond, forming a marsh at its southern end. Most of the trees in the swamp appear to be water tupelo (Nyssa aquatica). This site contains an active great blue heron (Ardea herodias) nesting colony. This site is one of the most inland heronries in the state. Other visitors to this site include two rare kite bird species: anhinga (Anhinga anhinga) and Mississippi kite (Ictinia mississippiensis), both listed as significantly rare in the state. The anhinga probably breeds at the site, whereas the kite may well breed in nearby swamps or bottomlands along the Roanoke River.

OWNERSHIP: Single private ownership.

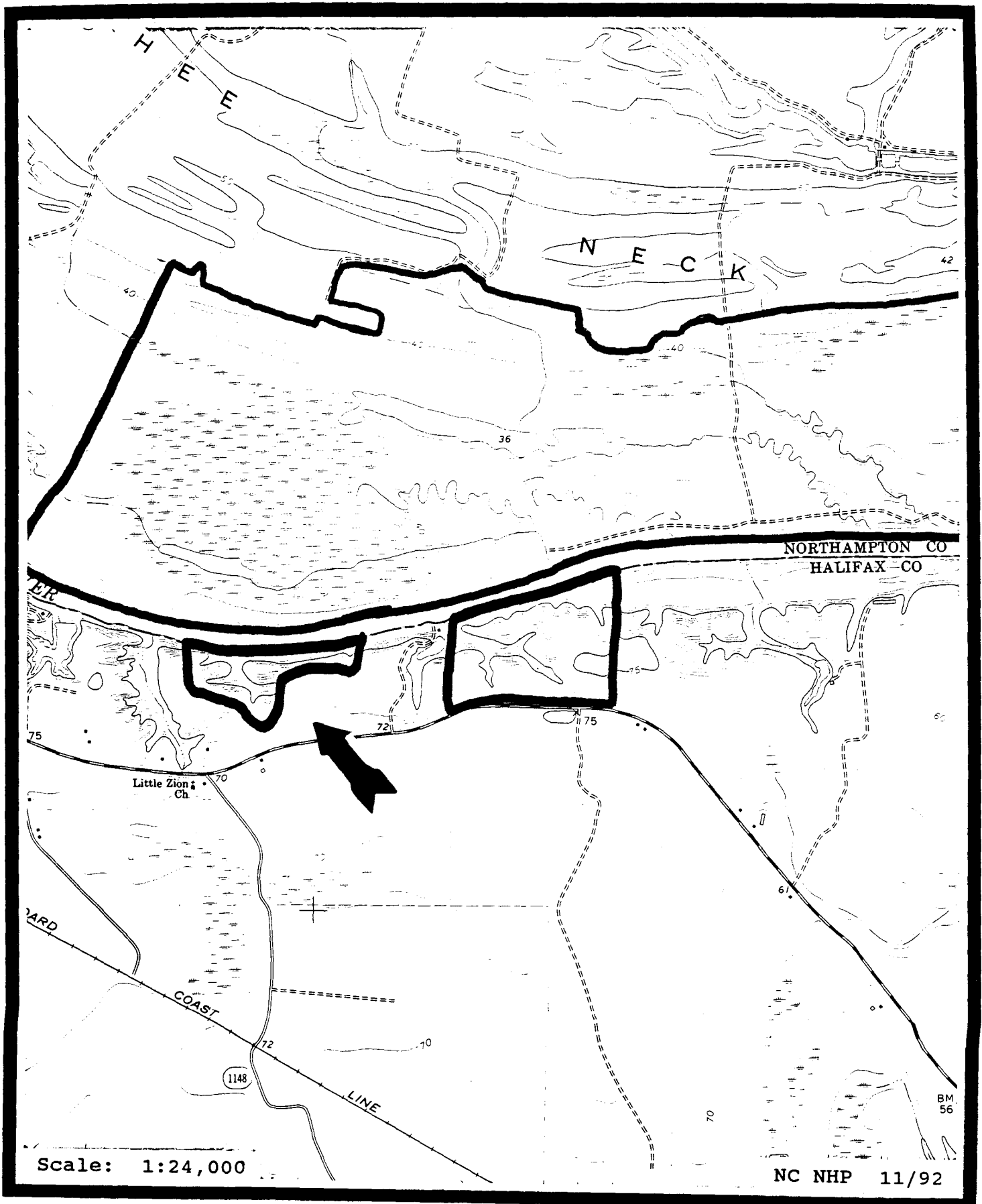
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This natural area should not be disturbed during the breeding season. Much of the area around the pond is cultivated field. People working in this field could disturb birds during breeding season. The water level needs to be maintained as it presently is. An increase in the water level could flood the marsh. The landowner should be informed of the significance of the site and of the various protection options available.

COMMENTS: Futher updates on the nesting birds at the site are needed, as the information presented in this site report is based on two 1985 visits.

REFERENCES:

LeGrand, H.E., Jr., J.M. Lynch, and R. Yelverton. 1985.
Pierce's Farm Heronry. Preliminary Site Reconnaissance
Survey.



Site Name: Roanoke Big Oak Woods
 Site Code: HA12
 Quadrangle: Halifax

SITE NAME: Roanoke Big Oak Woods

SITE CODE: HA12

SIZE: 38 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Halifax

QUADRANGLE: Halifax

LOCATION: This site is in the Roanoke River watershed in northern Halifax County in the Coastal Plain Province of North Carolina. It is on the south bank of the Roanoke River; north of NC 561; about 3 miles east of US 301; north-northeast of the intersection of NC 561 and SR 1148.

SIGNIFICANT FEATURES:

1. This site contains three good quality natural community types: Coastal Plain Levee Forest (Brownwater Subtype), Coastal Plain Small Stream Swamp (Brownwater Subtype), and Basic Mesic Forest (Coastal Plain Subtype).

2. The cerulean warbler (Dendroica cerulea), a Federal Candidate species, is present at this site.

3. Also present at this site is dwarf stinging nettle (Urtica chamidryoides), a significantly rare plant in the state. This one of only a few sites in the state for this species.

GENERAL DESCRIPTION:

This site is characterized by a series of primarily north-facing, mesic slopes located adjacent to a narrow natural levee along the Roanoke River. This natural area contains some of the best examples of high-quality, old-growth mixed hardwood slopes and natural levee natural communities along the Roanoke River.

This site contains three good quality natural community types: Coastal Plain Levee Forest (Brownwater Subtype), Coastal Plain Small Stream Swamp (Brownwater Subtype), and Basic Mesic Forest (Coastal Plain Subtype). The Coastal Plain Levee Forest (Brownwater Subtype) occurs on alluvial soils adjacent to the river. Canopy trees include a mixture of alluvial hardwoods such as sugarberry (Celtis laevigata), American sycamore (Platanus occidentalis), green ash (Fraxinus pennsylvanica), and American elm (Ulmus americana). Common subcanopy species include boxelder (Acer negundo), pawpaw (Asimina triloba), and painted buckeye (Aesculus sylvatica). The herb layer is fairly dense and is composed of grasses, sedges, and poison ivy (Rhus radicans); the significantly rare dwarf stinging nettle (Urtica chamidryoides) occurs in this community as well. Woody vines are abundant and include various grapes (Vitis spp.), poison ivy, Carolina supplejack (Berchemia scandens), trumpetvine (Campsis radicans), and crossvine (Bignonia capreolata).

The Coastal Plain Small Stream Swamp (Brownwater Subtype) occurs along a small stream which drains a portion of the slopes and adjacent upland. The wetter clay soils along the drainage are frequently flooded by backwaters of the Roanoke River;

consequently, hydric vegetation dominates. Baldcypress (Taxodium distichum) forms a small stand along the drainage near its confluence with the river. The cypress stand is in mature condition and adds to the overall diversity of this site.

Restricted to the slope areas where drainage is better and flooding is rare to absent is a Basic Mesic Forest (Coastal Plain Subtype). Common tree species include Shumard's oak (Quercus shumardii), swamp chestnut oak (Q. michauxii), loblolly pine (Pinus taeda), cherrybark oak (Q. pagoda), bitternut hickory (Carya cordiformis), shagbark hickory (C. ovata), black walnut (Juglans nigra), and sweetgum (Liquidambar styraciflua). A distinct understory of American hornbeam (Carpinus caroliniana), pawpaw, and painted buckeye is present in this forest. Notable herbs on the slopes include dwarf larkspur (Delphinium tricornis), heartleaf skullcap (Scutellaria ovata), and cove bladder-fern (Cystopteris protrusa).

OWNERSHIP: Private ownership.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site needs little management. However, the owner has logged much of the tract up to the boundaries of the Registered Natural Heritage Area. Monitoring is needed to determine if weedy species such as Japanese honeysuckle (Lonicera japonica) are encroaching on the natural area.

COMMENTS: This site has the potential for supporting sessile-flowered trillium (Trillium sessile) and isopyrum (Enemion biternatum), both significantly rare species in the state.

REFERENCES:

- LeGrand, H. and M. Lynch. 1985. Turner tract on Roanoke River. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- Lynch, J.M. 1983. J.S. Turner and Sons, Inc. Tract. Potential Preserve Site Survey. The North Carolina Nature Conservancy.

JOHNSTON COUNTY NATURAL AREAS

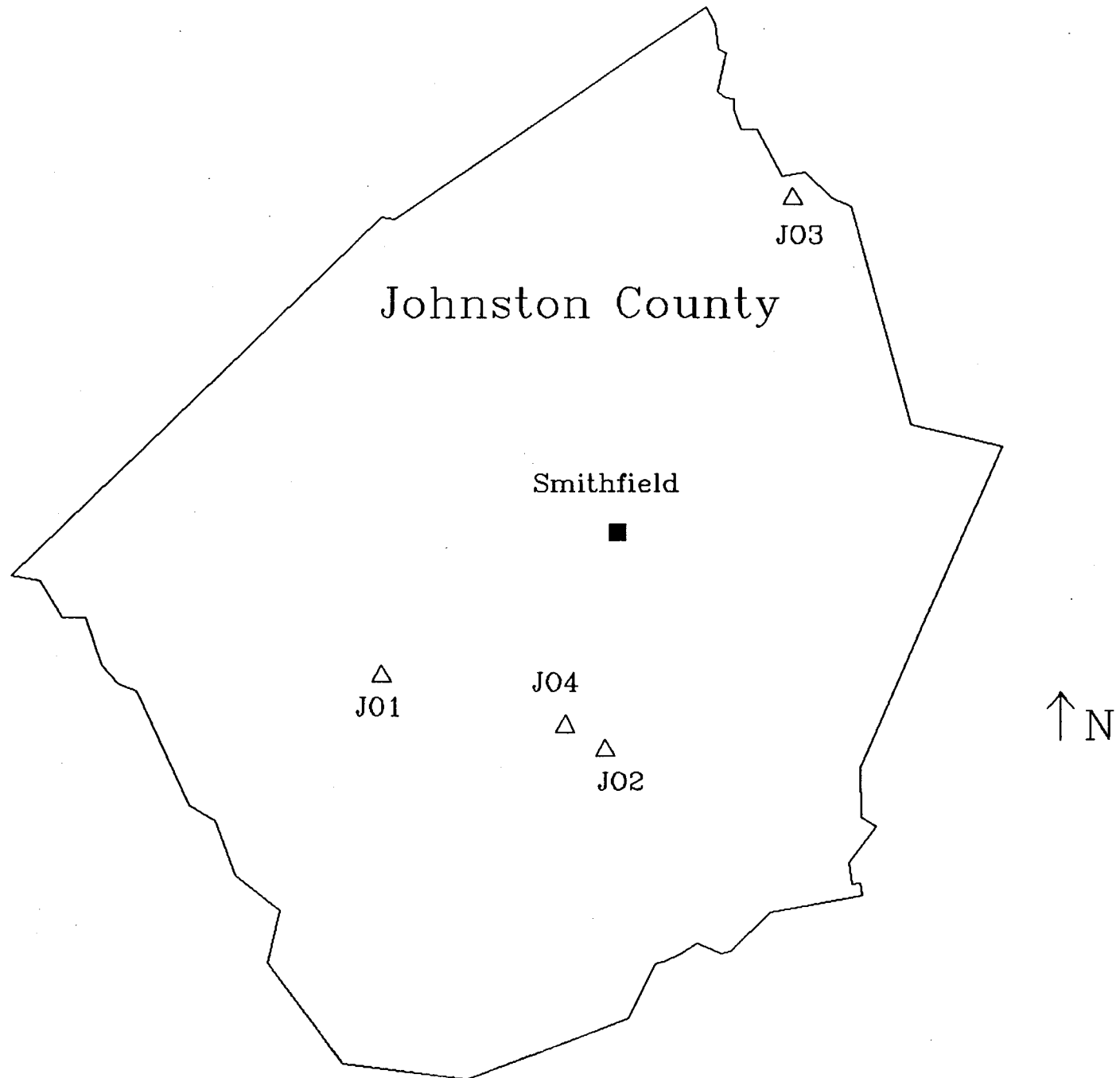
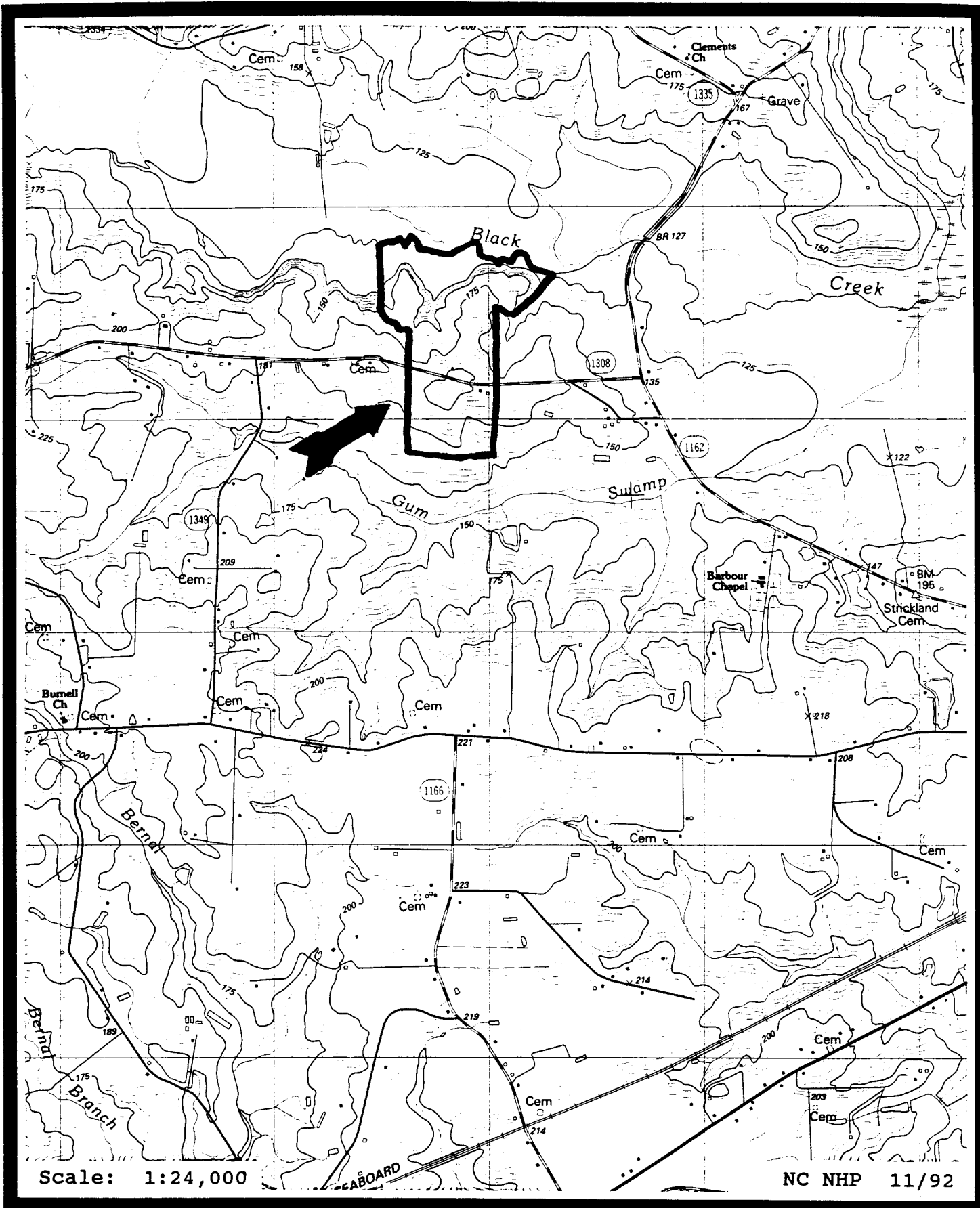


Figure 12. Significant natural areas in the A/P III study area portion of Johnston County



Site Name: Black Creek Bluff and Sandhill
 Site Code: J01
 Quadrangle: Four Oaks

SITE NAME: Black Creek Bluff and Sandhill

SITE CODE: J01

SIZE: 120 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Johnston

QUADRANGLE: Four Oaks

LOCATION: This site is in the Neuse River watershed in southern Johnston County in the Coastal Plain Province of North Carolina. It is a wooded hillside area located on both sides of SR 1308; about 0.5 miles west of SR 1162; about 2 miles northwest of Four Oaks, N.C.

SIGNIFICANT FEATURES: This site supports three natural communities, one of which is a good quality Pine/Scrub Oak Sandhill with high quality longleaf pines (*Pinus palustris*). The site also contains a bluff that is in good condition.

GENERAL DESCRIPTION:

SR 1308 passes through the Pine/Scrub Oak Sandhill portion of this site. The highest point of the natural area is just south of this road. From here it gently slopes to the north to a very steep bluff. Below the bluff is a flat bottomland area, much of which is permanently wet. The site has a range of moisture conditions and also has diverse natural communities. The sandhill area is extremely dry, but the bluffs above Black Creek Springs feed small tributaries to Black Creek. The geology at this site is of the Cape Fear Formation.

Three natural community types are located at this site: Pine/Scrub Oak Sandhill, Piedmont/Coastal Plain Heath Bluff, and Coastal Plain Bottomland Hardwoods (Brownwater Subtype). The Pine/Scrub Oak Sandhill at this site is an open forest with a sparse herb layer and many ericaceous shrubs. The canopy layer consists of scarlet oak (*Quercus coccinea*), southern red oak (*Q. falcata*), blackjack oak (*Q. marilandica*), post oak (*Q. stellata*), sand hickory (*Carya pallida*), and a mixture of longleaf pine (*Pinus palustris*) and loblolly pine (*P. taeda*). The subcanopy is dominated by blackjack oak. This is a high quality longleaf site for Johnston County. The number and age of the trees (to about 350 years) and the good longleaf pine seedling regeneration make this a significant site.

The Piedmont/Coastal Plain Heath Bluff at this site extends beyond the area surveyed. Common trees of the canopy are red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), tuliptree (*Liriodendron tulipifera*), Virginia pine (*P. virginiana*), and northern red oak (*Q. rubra*). The subcanopy contains American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), sourwood (*Oxydendrum arboreum*), and red maple. The shrub layer is dominated by horsesugar (*Symplocos tinctoria*), witch-hazel (*Hamamelis virginiana*), and mountain laurel (*Kalmia latifolia*),

which is nearly impenetrable in areas. The herb layer is dominated by pussytoes (Antennaria sp.), galax (Galax aphylla), and trailing arbutus (Epigaea repens). Above the bluff is the Pine/Scrub Oak Sandhill and below is the Coastal Plain Bottomland Hardwoods (Brownwater Subtype). The bluff is in good condition and is narrow, yet extends about 1 mile along the southern edge of the Black Creek floodplain.

The Coastal Plain Bottomland Hardwoods (Brownwater Subtype) at this site covers a large area and has a canopy composed of bottomland hardwoods such as swamp chestnut oak (Q. michauxii), water oak (Q. nigra), tupelo (Nyssa sp.), red maple, and sweetgum. The subcanopy contains American hornbeam and American holly. Common shrub species are tag alder (Alnus serrulata), giant cane (Arundinaria gigantea), sweetbay (Magnolia virginiana), and swamp red bay (Persea palustris). The herb layer is diverse, has many vines, and contains, for example, sedges (Carex spp.), Indian cucumber-root (Medeola virginiana), lizard's-tail (Saururus cernuus), and netted chainfern (Woodwardia areolata). This community is not pristine because logging occurred there perhaps 10-20 years ago.

OWNERSHIP: Private ownership.

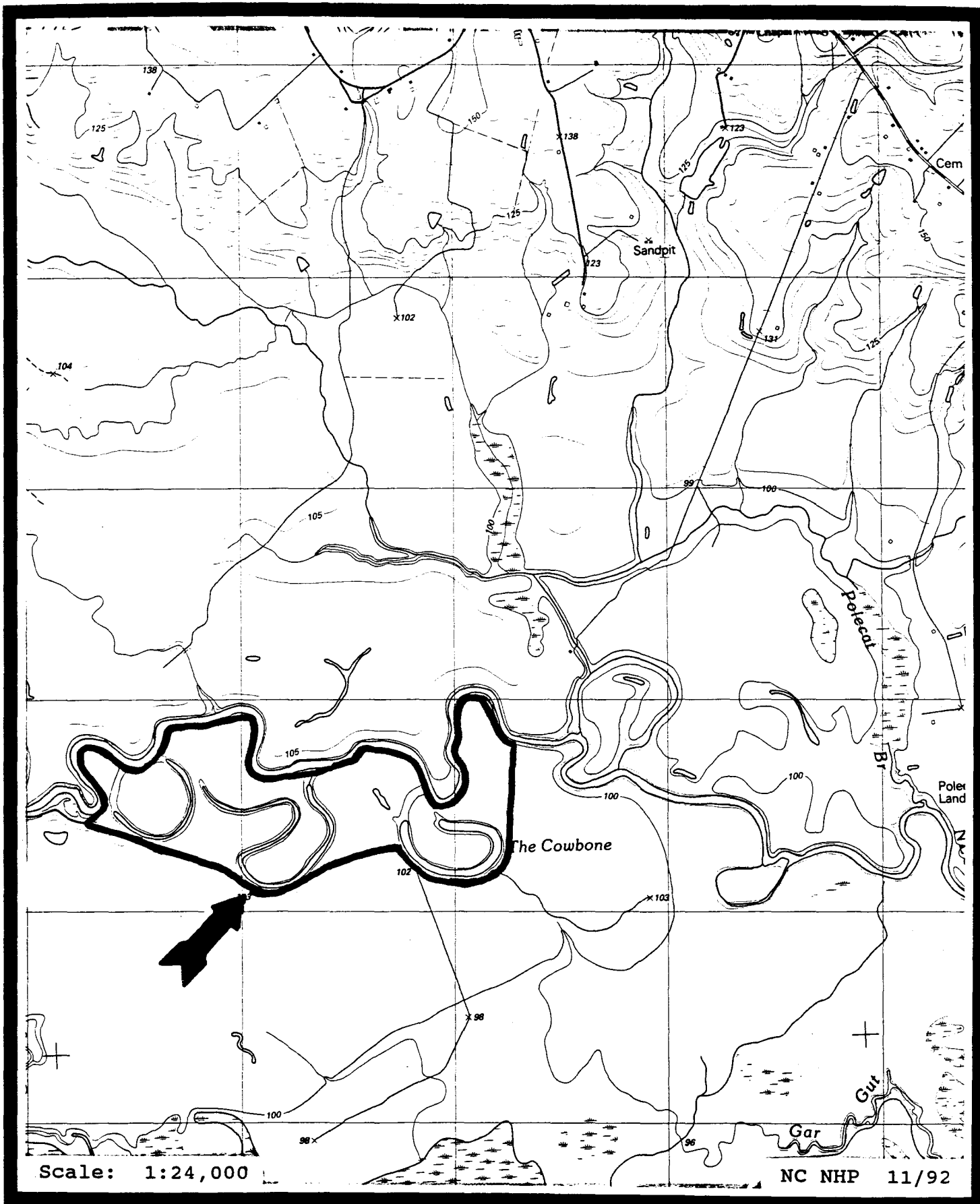
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The greatest threat to this site is logging. The longleaf pine areas have been selectively logged perhaps 10-20 years ago. Other threats include encroachment of Japanese honeysuckle (Lonicera japonica) into the floodplain and red maple and sweetgum seedlings into the sandhill area. It is recommended that fire be used in the upland areas to suppress the growth of red maple and sweetgum and to encourage better longleaf pine seedling recruitment. The landowner should be informed of the significance of the site and encouraged to protect it.

COMMENTS: Because of the extent of the three community types, large portions of the area were not surveyed. It is recommended that the site be revisited for a more thorough survey. A visit in the later part of the growing season may yield more sandhill herbaceous flora.

REFERENCES:

Nordman, C. 1991. Black Creek Bluff & Sandhill near Four Oaks. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Cowbone Oxbows
 Site Code: JO2
 Quadrangle: Four Oaks NE

SITE NAME: Cowbone Oxbows

SITE CODE: JO2

SIZE: 260 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Johnston

QUADRANGLE: Four Oaks NE

LOCATION: This site is in the Neuse River watershed in southern Johnston County in the Coastal Plain Province of North Carolina. It is in the center of the Four Oaks NE quad map; about 6 river miles downstream from I-95.

SIGNIFICANT FEATURES:

1. This site has an outstanding example of a Coastal Plain Levee Forest (Brownwater Subtype) with many large trees and an Oxbow Lake, an uncommon geomorphic feature and community type.

2. One of the largest concentrations of Oxbow Lakes in the state occurs at this site. Oxbow Lakes are rare both as a geomorphic feature and as a natural community.

GENERAL DESCRIPTION:

The Neuse River below Smithfield, N.C. spreads out into a vast floodplain up to 7 miles wide. This is the largest contiguous piece of undeveloped land in Johnston County or any of the adjacent counties, and is one of the largest in the Upper Coastal Plain. The condition of this large floodplain area varies. Substantial portions have been clearcut or heavily logged in recent years, and some areas were mined and cleared for fields in the past. A thorough exploration of this area was beyond the scope of this study. This site and the Sage Pond--Neuse River Floodplain natural area (Site JO2) are areas of particular high quality and are areas easily accessible from the river. Other substantial high quality areas are likely to be present.

The Cowbone Oxbows site contains a series of oxbow lakes on the south side of the Neuse River. An old growth, excellent quality Coastal Plain Levee Forest (Brownwater Subtype) is located on the north side of the middle oxbow (between the oxbow and the Neuse River). Three other natural community types are also present at this site: Coastal Plain Bottomland Hardwoods (Brownwater Subtype), Oxbow Lake, and Cypress-Gum Swamp (Brownwater Subtype).

The excellent quality, old growth Coastal Plain Levee Forest (Brownwater Subtype) has a higher diversity than the surrounding communities. The soil on the levee is probably richer than elsewhere at this site. The levee is cut off from the surrounding areas by the river and oxbows, thus making it inaccessible to logging. The canopy and subcanopy are diverse. They contain many large individuals of the following trees species: swamp chestnut oak (Quercus michauxii), green ash (Fraxinus pennsylvanica), bitternut hickory (Carya cordiformis),

cherrybark oak (Q. pagoda), tuliptree (Liriodendron tulipifera), possum-haw (Ilex decidua), American hornbeam (Carpinus caroliniana), and common pawpaw (Asimina triloba). Common to the shrub layer is giant cane (Arundinaria gigantea). Vines are large and diverse. The herb layer is well-developed and contains, for example, Japanese grass (Microstegium vimineum), Virginia wild rye (Elymus virginicus), and clearweed (Pilea pumila).

Three large and several smaller Oxbow Lake communities exist at this site. Most have a semi-open canopy consisting of American sycamore (Platanus occidentalis), bald cypress (Taxodium distichum), black willow (Salix nigra), and river birch (Betula nigra). These trees actually hang over from the banks or are rooted in the shallow edges of the lakes. Deeper water contains only baldcypress, as individual trees or in small groves. The subcanopy, shrub, and herb layers are sparse. One lake has an open canopy dominated by American elm (Ulmus americana), swamp cottonwood (Populus heterophylla), and bitternut hickory. As with the other community, its subcanopy and shrub layers have a low diversity; however, its herb layer is more diverse.

Two areas of Cypress-Gum Swamp (Brownwater Subtype) exist in sloughs at this site. Baldcypress is the dominant or only canopy species present. Herbs are scattered and include mock bishop's weed (Ptilimnium capilaceum) and green arrow-arum (Peltandra virginica). Cypress-Gum Swamps appear to be very restricted in this portion of the Neuse River floodplain.

Between the Oxbow Lake and Cypress-Gum Swamps are communities that are transitional between Coastal Plain Forest and Coastal Plain Bottomland Hardwoods. One area has a canopy dominated by cherrybark oak, sweetgum (Liquidambar styraciflua), sugarberry (Celtis laevigata), American sycamore (Platanus occidentalis), and water hickory (Carya aquatica). Its subcanopy contains red mulberry (Morus rubra), possum-haw, American hornbeam, and common pawpaw. Its vine and herb diversities are low. The other bottomland community has a canopy dominated by sugarberry and a subcanopy dominated by possum-haw. Its shrub layer is dominated by spicebush (Lindera benzoin). As with the other bottomland community, the vine and herb diversity is low.

Animals observed at the site include numerous species of birds, as well as white-tailed deer (Odocoileus virginianus), southern leopard frog (Rana sphenoccephala), and Fowler's toad (Bufo woodhousei).

OWNERSHIP: Private ownership.

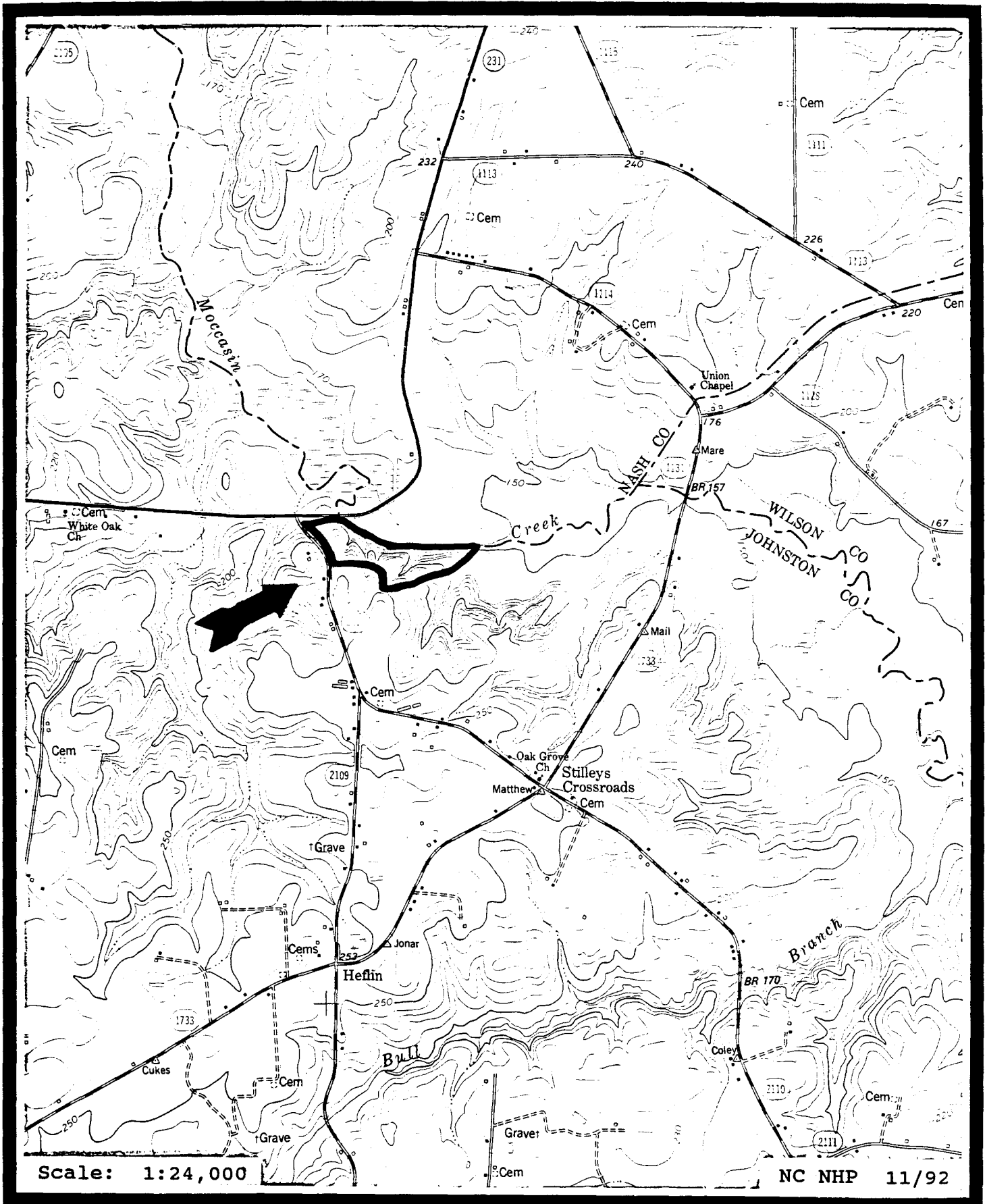
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The greatest threat to this site is logging. The landowners should be informed of the significance of the site and of the various protection options available.

COMMENTS: This site was visited in midsummer. An early spring survey may yield more herbaceous flora. This natural area is bordered by younger and more disturbed forests away from the river. High quality communities may exist nearby in other areas.

REFERENCES:

Schafale, M. and C. Nordman. 1991. The Cowbone Oxbows. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Flower Hill--Moccasin Creek Bluffs
 Site Code: JO3
 Quadrangle: Stancils Chapel

SITE NAME: Flower Hill--Moccasin Creek Bluffs

SITE CODE: J03

SIZE: 20 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Johnston

QUADRANGLE: Stancils Chapel

LOCATION: This site is in the Neuse River watershed in northeastern Johnston County in the extreme upper Coastal Plain Province of North Carolina. It is 4.3 miles south of Middlesex, N.C.; off of NC 231 along Moccasin Creek.

SIGNIFICANT FEATURES:

1. This natural area contains the largest stand of Catawba rhododendron (Rhododendron catawbiense) in the North Carolina Coastal Plain.

2. It contains a good quality Piedmont/Coastal Plain Heath Bluff community with Piedmont and mountain herbaceous disjuncts.

GENERAL DESCRIPTION:

This site contains a series of north-facing creek bluffs along Moccasin Creek. The bluffs are cut into felsic volcanic rock, mainly phyllite, with a few quartzite veins. The top of the bluff and the upland south of the bluff are covered with Coastal Plain sediments. This upland at 245-275 feet elevation represents the Brandywine geomorphic surface. The bluff slopes are as great as 55°; the heights of the bluff vary from 40 to 80 feet. Deep ravines, most with permanent springs, separate the segments of creek bluff.

The site is generally in very good condition. The bluffs and ravines at this site support a Piedmont/Coastal Plain Heath Bluff community. This forest has a canopy dominated by chestnut oak (Quercus prinus), which is at the eastern end of its range at this site. The shrub layer is dense and includes catawba rhododendron (Rhododendron catawbiense) eight to ten feet high, serviceberry (Amelanchier canadensis), pink azalea (Rhododendron nudiflorum), witch hazel (Hamamelis virginiana), and horsesugar (Symplocos tinctoria). Herbs present at this site include trailing arbutus (Epigaea repens), galax (Galax urceolata), Catesby's trillium (Trillium catesbaei), bellwort (Uvularia sessilifolia), trout lily (Erythronium americanum), crane-fly orchid (Tipularia discolor), and wild ginger (Asarum canadense). Ferns in the vicinity include cinnamon fern (Osmunda cinnamomea), Christmas fern (Polystichum acrostichoides), and netted chainfern (Woodwardia areolata).

The floodplain below the bluffs is inhabited by wood ducks (Aix sponsa) and hooded mergansers (Lophodytes cucullatus).

OWNERSHIP: Flower Hill--Moccasin Creek is partly owned by the Triangle Land Conservancy and partly privately owned.

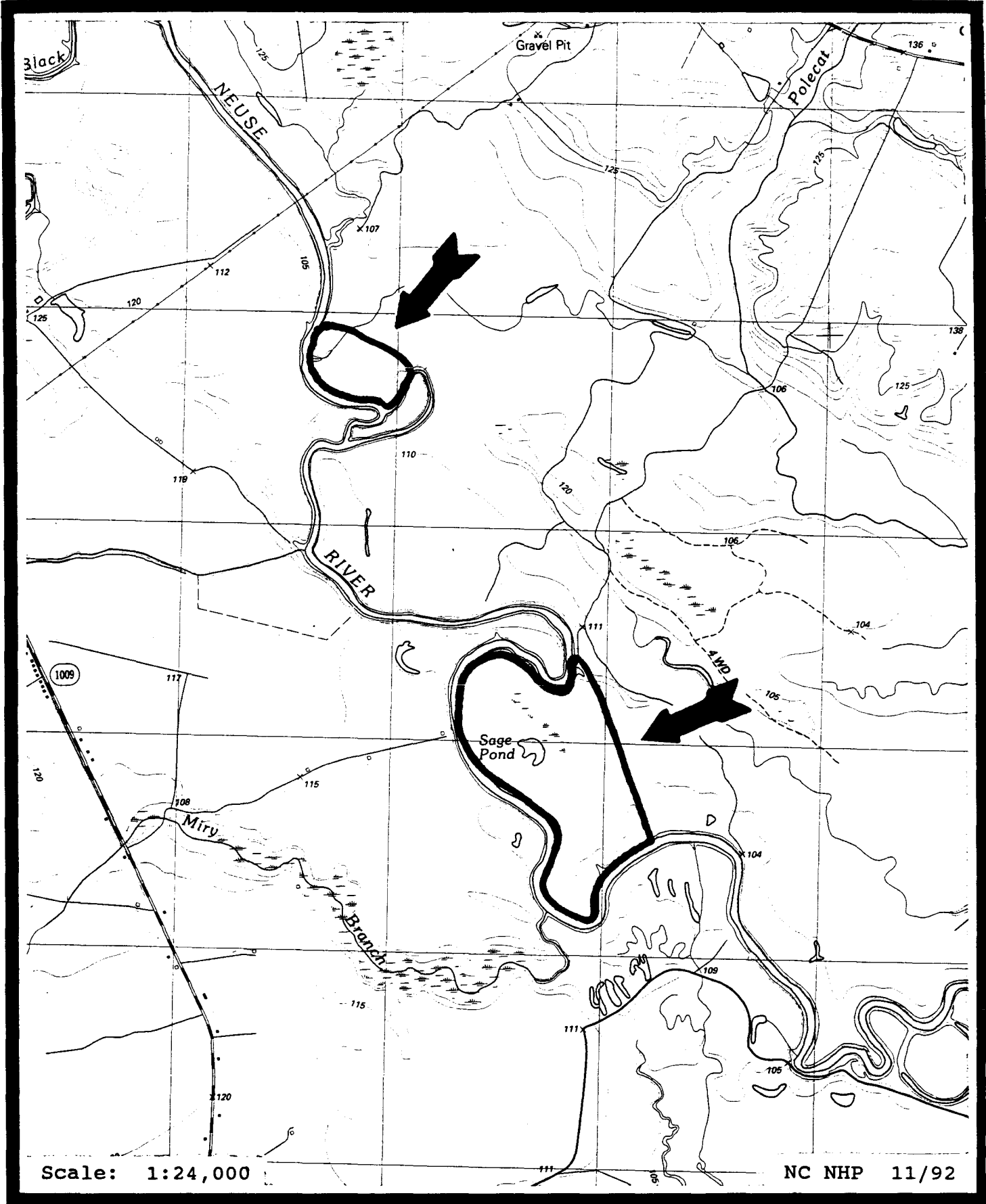
PROTECTION STATUS: A portion of this site is a Registered Natural Heritage Area and part of it is owned and protected by the Triangle Land Conservancy as a natural area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Some management concerns include logging threats, damage to plants by visitors, and trash dumping. A property line clearing of several feet in width was recently cut through a portion of the bluffs.

COMMENTS: The proposed raising of the water level of Buckhorn Reservoir might impact the floodplain below the bluffs and possibly the base of the bluffs during flood stages.

REFERENCES:

Gregory, R. and P. Clark. 1972. Flower Hill. Report to N.C. Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Sage Pond--Neuse River Floodplain
 Site Code: JO4
 Quadrangle: Four Oaks NE

SITE NAME: Sage Pond--Neuse River Floodplain

SITE CODE: JO4

SIZE: 176 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Johnston

QUADRANGLE: Four Oaks

LOCATION: This site is in the Neuse River watershed in Johnston County in the Coastal Plain Province of North Carolina. It actually includes two sites on the northeast side of the Neuse River, 2 and 4 river miles downstream from I-95, respectively.

SIGNIFICANT FEATURES: The natural area supports good examples of Coastal Plain Levee Forest, Coastal Plain Bottomland Hardwoods, and Oxbow Lakes.

GENERAL DESCRIPTION:

The Neuse River below Smithfield, N.C. spreads out into a vast floodplain up to 7 miles wide. This is the largest contiguous piece of undeveloped land in Johnston County or any of the adjacent counties, and is one of the largest in the Upper Coastal Plain. The condition of the large area varies. Substantial portions have been clearcut or heavily logged in recent years, and some areas were mined and cleared for fields in the past. A thorough exploration of this area was beyond the scope of this study. The two units of this site (Sage Pond--Neuse River Floodplain) and the Cowbone Oxbows (Site JO2) are areas of particular high quality and are areas easily accessible from the river. Other substantial high quality areas are likely to be present.

The upper of the two areas at this site contains a high quality Coastal Plain Levee Forest community dominated by sycamore (Platanus occidentalis), American elm (Ulmus americana), sugarberry (Celtis laevigata), and box elder (Acer negundo). It contains a number of species suggestive of very rich soils, such as bladdernut (Staphylea trifolia), black walnut (Juglans nigra), and wild ginger (Asarum canadense), as well as unusual species such as silver maple (Acer saccharinum). This forest may grade into a Coastal Plain Bottomland Hardwoods away from the river.

The larger downstream area of this site has two small lakes formed in abandoned channel segments. The larger, Sage Pond, has been dammed by beavers, which has raised the water level. It appears, however, that this lake was previously an oxbow lake, but is transitional to the Coastal Plain Semipermanent Impoundment community type. The ponds have an open canopy of bald cypress (Taxodium distichum), with a few water tupelo (Nyssa aquatica). Duckweed (Lemna valdiviana) is abundant on the water surface. Other herbs are sparse. Species such as St. John's-wort (Hypericum walteri), false nettle (Boehmeria cylindrica), climbing hempvine (Mikania scandens), and giant sedge (Carex gigantea) occur on the shallower edges and on stumps.

Around the Oxbow Lakes is a Coastal Plain Bottomland Hardwoods community. Sweetgum (Liquidambar styraciflua) and cherrybark oak (Quercus pagoda) are the most abundant canopy species. The understory is dominated by American hornbeam (Carpinus caroliniana). This forest was cut some years ago. A few larger trees occur, but most are only now reaching maturity.

OWNERSHIP: Multiple private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The surrounding areas are used for forestry and agriculture. Some nearby areas are still wooded and have a high wildlife value. Landowners should be informed of the significance of the site and of the various protection options available. A recommended protection procedure is land registry through the Natural Heritage Program.

COMMENTS: The extent of the site away from the river is poorly known. The whole area is in need of further survey work.

REFERENCES:

Nordman, C. and M. Schafale. 1991. Sage Pond--Neuse River Floodplain. Site Survey Report. N.C. Natural Heritage Program.

LENOIR COUNTY NATURAL AREAS

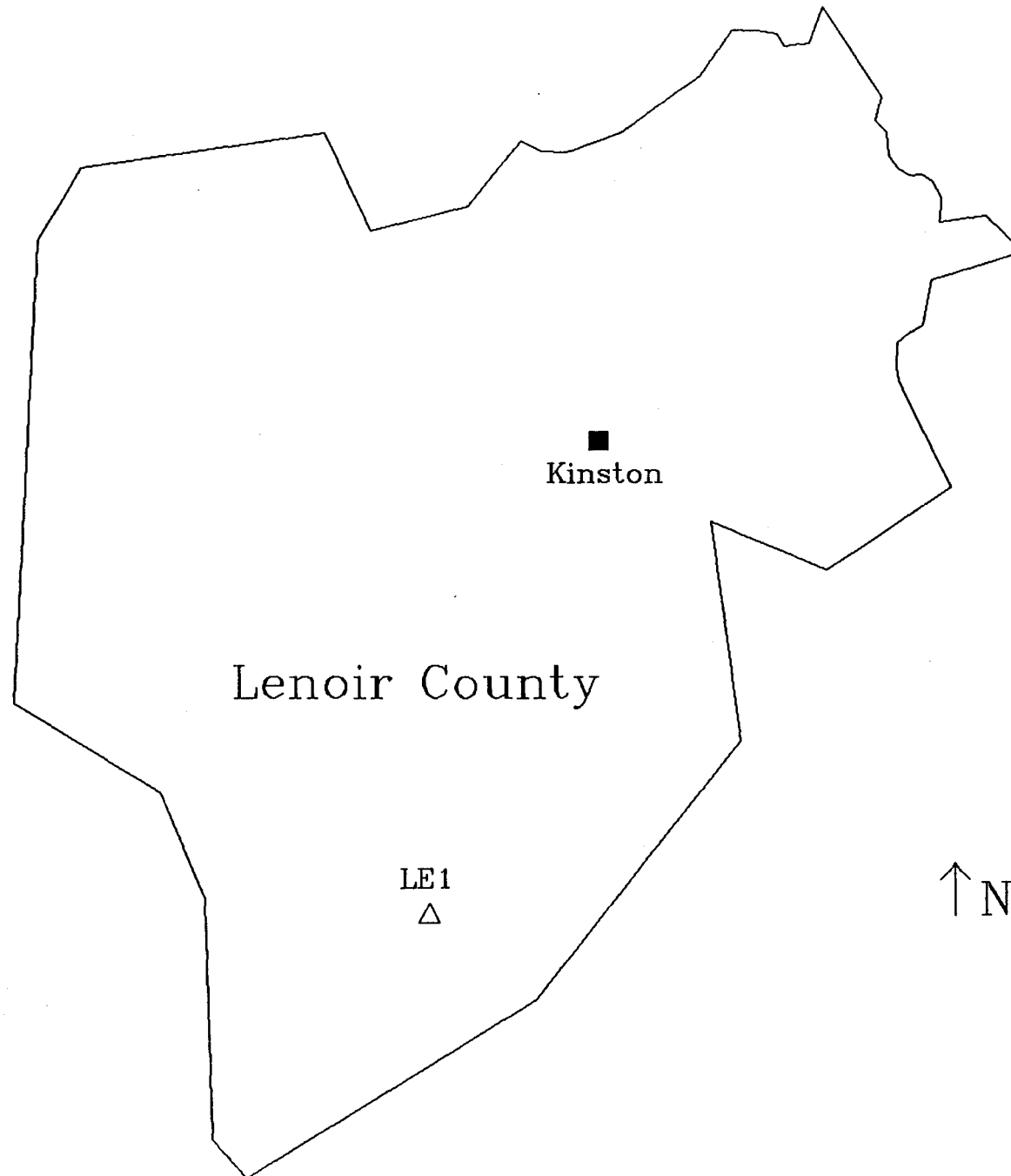
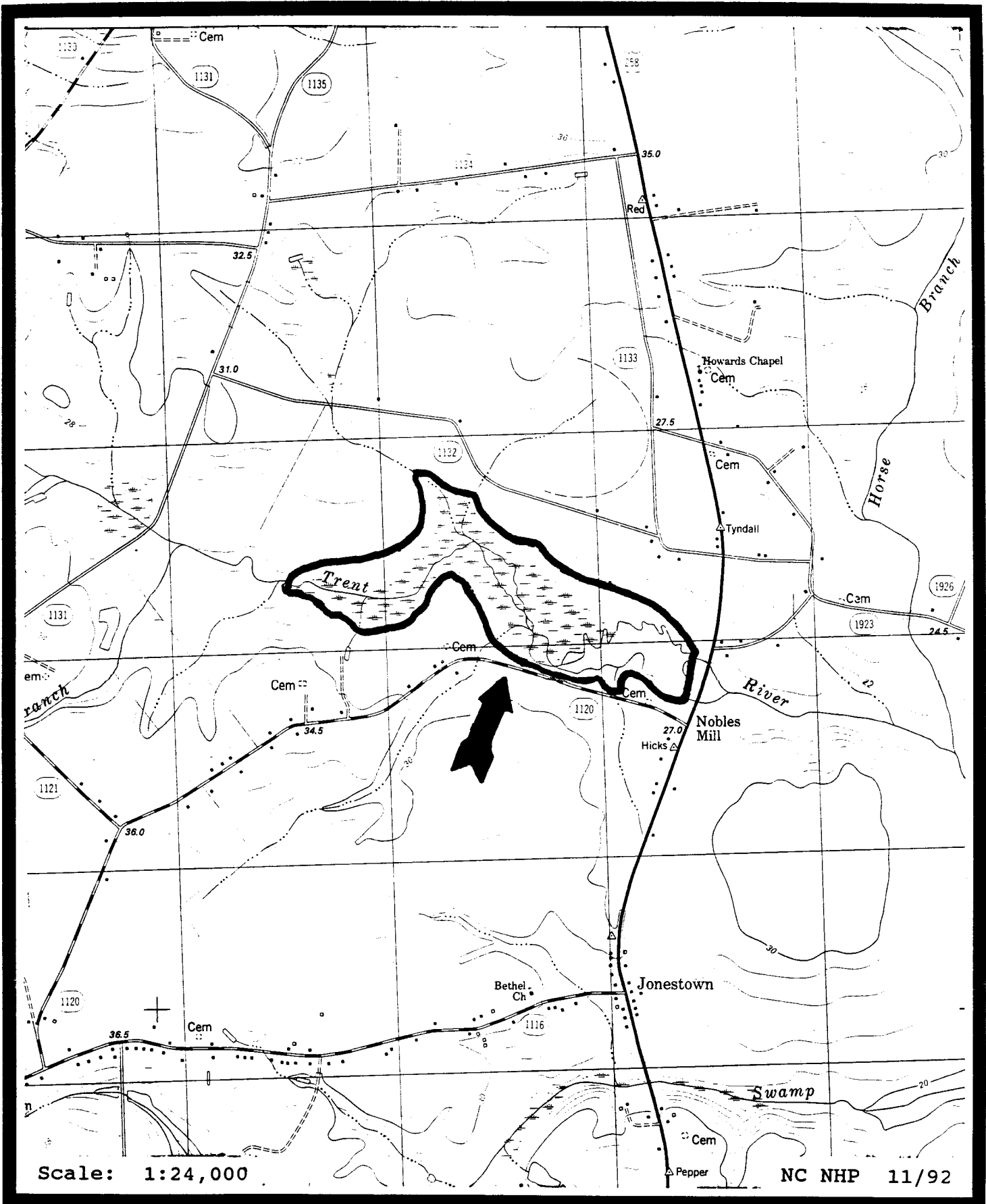


Figure 13. Significant natural areas in the A/P III study area portion of Lenoir County



Site Name: Noble's Millpond
 Site Code: LE1
 Quadrangle: Pink Hill

SITE NAME: Noble's Millpond

SITE CODE: LE1

SIZE: 189 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Lenoir

QUADRANGLE: Pink Hill

LOCATION: This site is in the Neuse River watershed in southern Lenoir County in the Coastal Plain Province of North Carolina. It is just north of SR 1120 and east of US 258; 3 miles north of the Lenoir/Jones county line.

SIGNIFICANT FEATURES: This site contains a high quality, old millpond (Coastal Plain Semipermanent Impoundment) with two distinct vegetation types and excellent wildlife habitat.

GENERAL DESCRIPTION:

This site contains an excellent quality, old millpond which supports a Coastal Plain Semipermanent Impoundment. This community is dominated by baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*). The easternmost part of the pond near the mill has an open canopy. The rest of the area has a canopy that is only semi-open. The geology at this site is of the Peedee Formation. In the areas that are not inundated the soils are of the Johnston series.

The Coastal Plain Semipermanent Impoundment could be divided into two areas each containing a distinct vegetation type: a cypress and gum swamp and a small stream swamp. The cypress and gum swamp area occupies the center of the natural area, is the permanently inundated portion of the impoundment, and is surrounded by the small stream swamp. The canopy of the cypress gum swamp is dominated by baldcypress and water tupelo and contains as subdominants red maple (*Acer rubrum*) and swamp chestnut oak (*Quercus michauxii*). The shrub layer consists of titi (*Cyrilla racemiflora*), buttonbush (*Cephalanthus occidentalis*), swamp loosestrife (*Decodon verticillatus*), Chinese privet (*Ligustrum sinense*), and highbush blueberry (*Vaccinium corymbosum*). The herb layer contains false nettle (*Boehmeria cylindrica*), Virginia water-horehound (*Lycopus virginicus*), hop sedge (*Carex lupulina*), and New York fern (*Thelypteris noveboracensis*).

The small stream swamp occupies the areas which occasionally or never flood. It has a well-developed canopy and has a higher species diversity than the cypress gum swamp. Its canopy consists of baldcypress, water tupelo, red maple, swamp chestnut oak, water oak (*Q. nigra*), sweetgum (*Liquidambar styraciflua*), and tuliptree (*Liriodendron tulipifera*). The subcanopy, shrub, and herb layers are more diverse than in the prior vegetation type. Some of the common species in these layers are American holly (*Ilex opaca*), flowering dogwood (*Cornus florida*), sweetbay (*Magnolia virginiana*), giant cane (*Arundinaria gigantea*),

partridgeberry (Mitchella repens), and lizard's-tail (Saururus cernuus).

This site supports excellent wildlife habitat. There are many standing dead trees which make good habitat for cavity nesting birds. Numerous species of birds occur at this site including green-backed heron (Butorides striatus), prothonotary warbler (Protonotaria citrea), red-shouldered hawk (Buteo lineatus), barred owl (Strix varia), and wood duck (Aix sponsa). Other animal species present at this site are white-tailed deer (Odocoileus virginianus), raccoon (Procyon lotor), gray squirrel (Sciurus carolinensis), beaver (Castor canadensis), and painted turtle (Chrysemys picta).

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site should not be logged. The dam and millpond need to be maintained to preserve the site's integrity. The habitat is excellent for wood ducks and may be of interest to the N.C. Wildlife Resources Commission. The landowner should be told of the significance of the site and informed of the various land protection options.

COMMENTS: This natural area needs further surveying at the northern edge of the millpond and in the western portion of the site. There is the potential for finding many more impoundment species with subsequent surveys.

REFERENCES:

Nordman, C. 1991. Noble's Millpond. Site Survey Report. N.C. Natural Heritage Program.

NASH COUNTY NATURAL AREAS

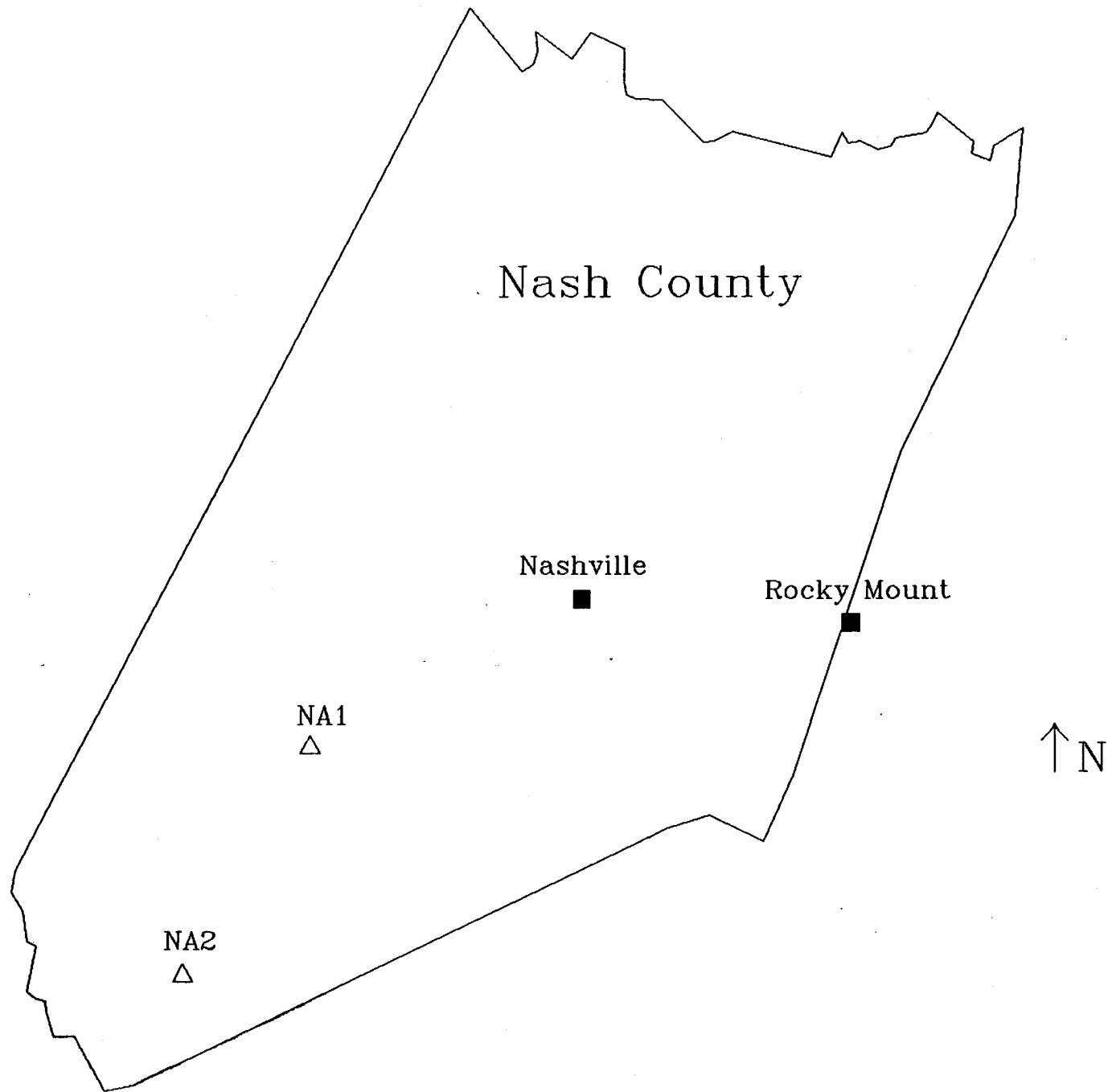
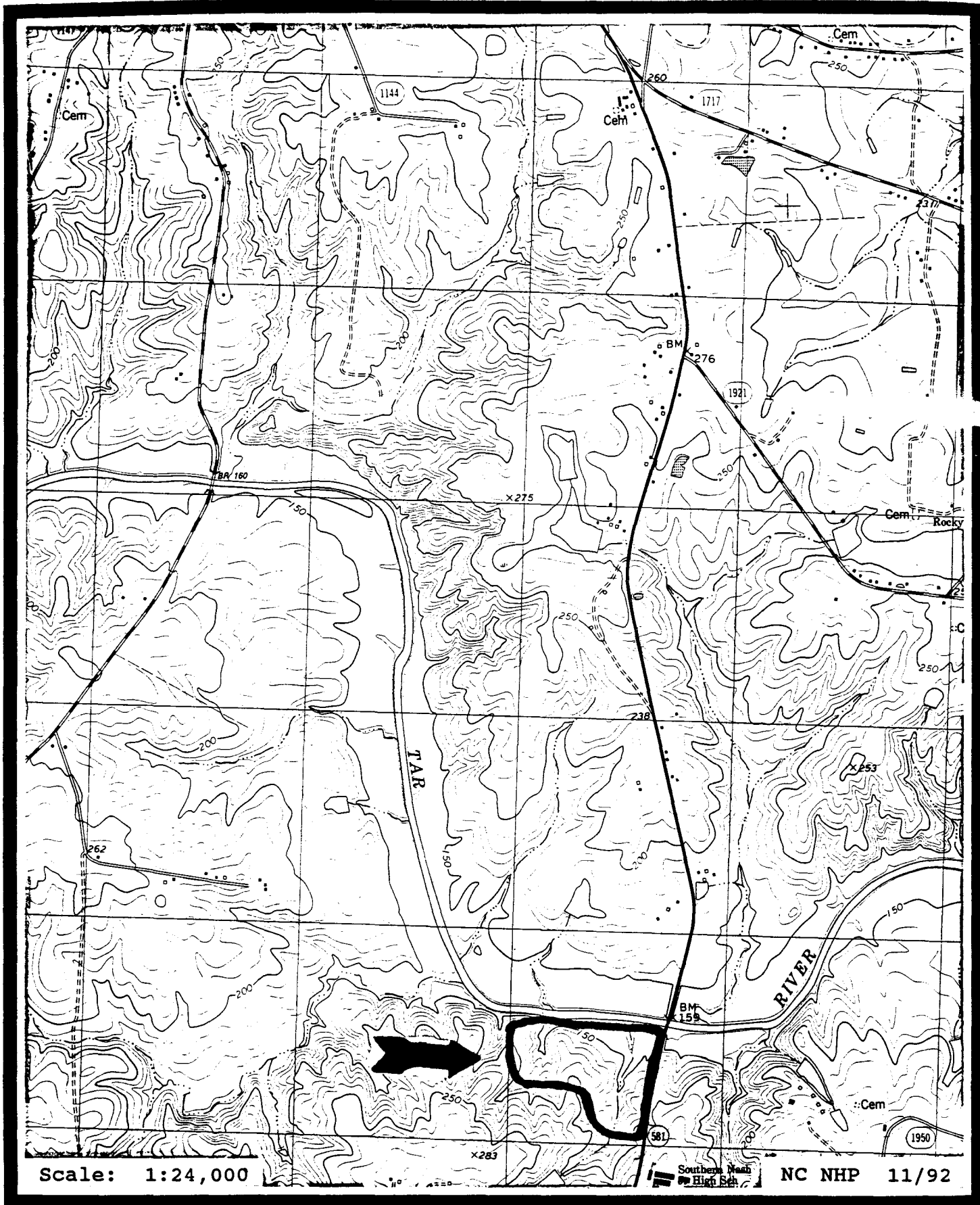


Figure 14. Significant natural areas in the A/P III study area portion of Nash County



Site Name: Tar River--Spring Hope Slopes
 Site Code: NA1
 Quadrangle: Spring Hope

SITE NAME: Tar River--Spring Hope Slopes

SITE CODE: NA1

SIZE: 56 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Nash

QUADRANGLE: Spring Hope

LOCATION: This site is in the Tar River watershed in western Nash County in the Piedmont Province of North Carolina. It is south of Spring Hope, N.C.; about 5 miles south of Tar River and west of NC 581.

SIGNIFICANT FEATURES: Although small, this site has three good natural community types: Piedmont/Mountain Levee Forest, Piedmont/Mountain Bottomland Forest, and Mesic Mixed Hardwood Forest (Piedmont Subtype).

GENERAL DESCRIPTION:

This site contains a river levee that is bordered by a bottomland forest and a small stream adjacent to a west-facing bluff. The geology is of felsic metavolcanic rock. The site supports three good quality community types: Piedmont/Mountain Levee Forest, Piedmont/Mountain Bottomland Forest, and Mesic Mixed Hardwood Forest (Piedmont Subtype). The estimated average dbh of the canopy trees is 1.5 feet, with a maximum dbh of about 2.5 feet.

The Piedmont/Mountain Levee Forest is adjacent to the river and has a well-developed canopy and herb layer. It covers an area of about 1-2 acres. Sycamore (Platanus occidentalis), river birch (Betula nigra), and box elder (Acer negundo) are the dominant canopy trees. The subcanopy has as its common trees painted buckeye (Aesculus sylvatica), American hornbeam (Carpinus caroliniana), and American holly (Ilex opaca). Parsleyleaf hawthorn (Crataegus marshallii) is the dominant shrub species and rattlesnake fern (Botrychium virginianum) is the most common herb species.

The Piedmont/Mountain Bottomland Forest is adjacent to the Piedmont/Mountain Levee Forest and bluff and covers about 5 acres. The canopy is well-developed and is dominated by tuliptree (Liriodendron tulipifera) and sweetgum (Liquidambar styraciflua). The subcanopy has as common trees American hornbeam (Carpinus caroliniana) and southern sugar maple (Acer floridanum). American strawberrybush (Evonymus americana) is the common shrub species. Christmas fern (Polystichum acrostichoides) is dominant in the herb layer.

The Mesic Mixed Hardwood Forest (Piedmont Subtype) is on the west-facing bluff between NC 581 and a small stream and covers an area of about 2 acres. The canopy is well-developed and is dominated by American beech (Fagus grandifolia), tuliptree, and red oak (Quercus rubra). Slippery elm (Ulmus rubra), American hornbeam, and hophornbeam (Ostrya virginiana) dominate the

subcanopy. The shrub layer is well-developed and has arrowwood (Viburnum dentatum) as its common species. The herb layer is dominated by rattlesnake fern and turpentine root (Aristolochia serpentaria).

OWNERSHIP: Private ownership.

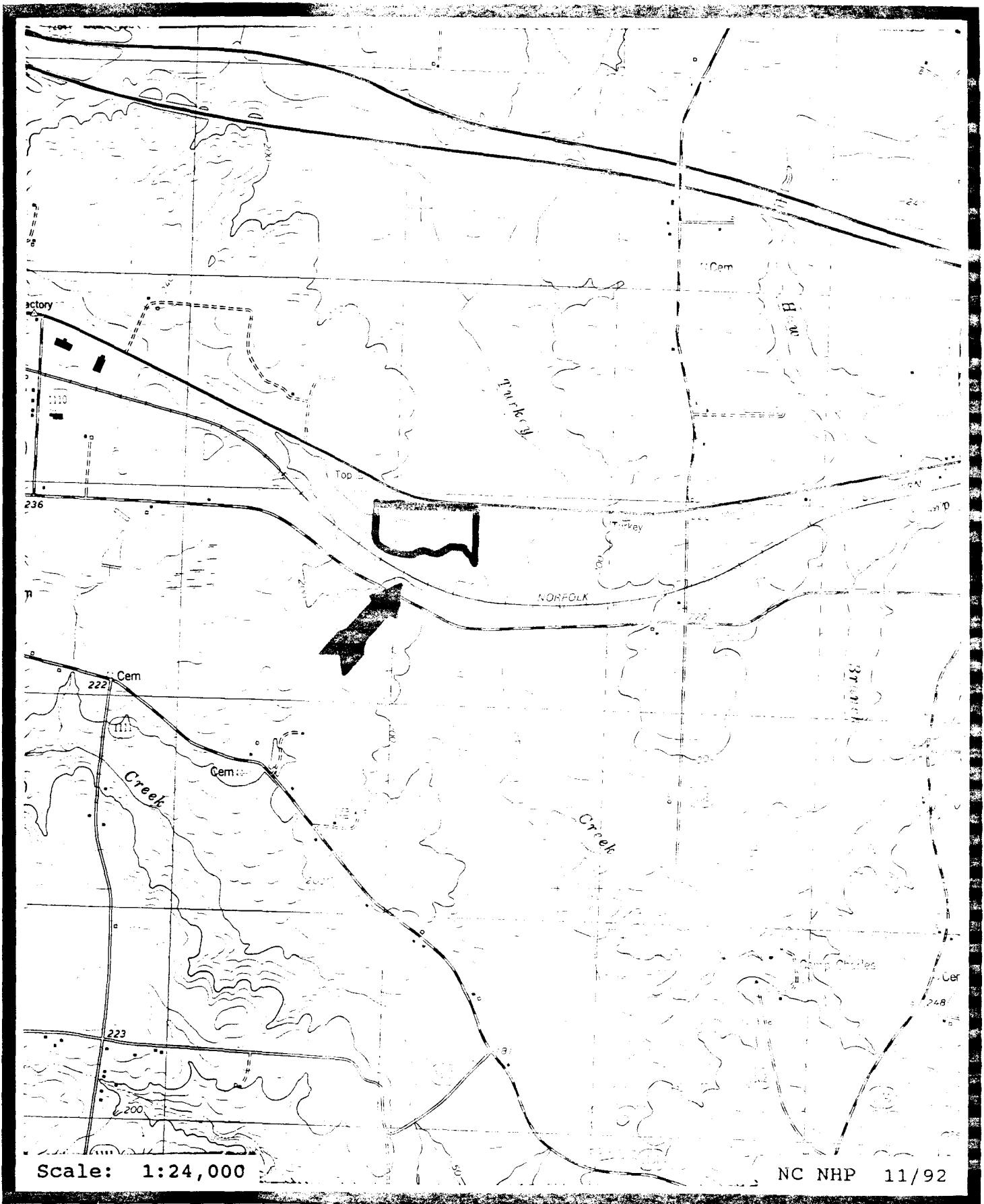
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Areas on all sides of this site have been clearcut; therefore, clearcutting is a major threat to the integrity of this site's natural communities. This site needs to be protected from clearcutting. The landowner should be encouraged to adopt proper management practices.

COMMENTS: Although this site was surveyed in late spring, it needs further survey work earlier in the spring to check for herbaceous flora. For example, this site appears to be suitable for isopyrum (Enemion biternatum), a significantly rare species, yet it was not seen during the site visit. The quality of the Piedmont/Mountain Levee Forest also needs to be rechecked.

REFERENCES:

Murrell, Z.E. 1991. Tar River--Spring Hope Slopes. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Turkey Creek Preserve
 Site Code: NA2
 Quadrangle: Middlesex

SITE NAME: Turkey Creek Preserve

SITE CODE: NA2

SIZE: 25 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Nash

QUADRANGLE: Middlesex

LOCATION: This site is in the Neuse River watershed in Nash County in the Piedmont Province of North Carolina. It is east of Middlesex, N.C. and west of Bailey, N.C.; on the south side of US 264A; west of Turkey Creek.

SIGNIFICANT FEATURES:

1. This natural area contains the largest known population in North Carolina of Carolina least trillium (Trillium pusillum), a Federal Candidate and State Endangered species.
2. A number of rare or uncommon herb species for North Carolina are present at this site.
3. This area contains an excellent diversity of flora, particularly showy wildflowers growing in the right-of-way along US 264A and also features a good mixture of Coastal Plain and Piedmont floral elements.

GENERAL DESCRIPTION:

This natural area lies in a wide floodplain of Turkey Creek. It supports a medium-age Coastal Plain Small Stream Swamp community, even though the site is in the extreme lower Piedmont. Oaks and other hardwoods dominate the canopy, especially white oak (Quercus alba), willow oak (Q. phellos), and swamp chestnut oak (Q. michauxii). A number of Coastal Plain species are present in the understory and shrub layer, such as sweetbay (Magnolia virginiana), titi (Cyrilla racemiflora), and sweet pepperbush (Clethra alnifolia). The most significant species present is the Carolina least trillium (Trillium pusillum), a Federal Candidate and State Endangered species, which occurs here in larger numbers than elsewhere in the state. This site contains a number of rare or uncommon herb species for North Carolina. Included are tassel-rue (Trautvetteria carolinensis), essentially unknown in the state away from the mountains; monkshood (Aconitum uncinatum), perhaps at its easternmost site in the state; and southern rein-orchid (Habenaria flava), a rather rare orchid in the state. This area contains an excellent diversity of flora, particularly showy flowers which occur in the frequently mowed right-of-way along US 264A. Included among these are bunchflower (Melanthium virginicum), wild sweet-William (Phlox maculata), and obedient plant (Dracocephalum purpureum). The site also features a good mixture of Coastal Plain and Piedmont floral elements, including redbay (Persea borbonia) and Virginia thistle (Cirsium virginianum) of the Coastal Plain, and monkshood and tassel-rue of the Piedmont and mountains.

In the surrounding area, a large and recent clearcut lies on the north side of the road. On the east side of the natural area lies an abandoned field. To the south are railroad tracks and to the west lie wooded uplands with residences.

OWNERSHIP: Turkey Creek Preserve is privately owned by The Nature Conservancy.

PROTECTION STATUS: This site is a Nature Conservancy Preserve and is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Threats to this site include utility company operations along the right-of-way. For example, trucks make ruts in the ground where a variety of plants grow and workers make trails to the telephone poles along the right-of-way. Mowing along the right-of-way has destroyed and marked the least trillium population. It is uncertain whether or not certain species recover well from mowing. Mowing should be avoided in the growing season, if at all possible. Another disturbance to the land includes trash dumping. To protect lands adjacent to this natural area, management agreements or easements may be appropriate.

COMMENTS: The former forest north of the road, now clearcut, was a Registered Natural Heritage Area. There was a large population of the trillium growing in the shade of the forest. The clearcutting of the forest caused the Registry to be rescinded and led to the demise of the trillium (to the north of US 264A).

REFERENCES:

Moore, J.H. 1986. Turkey Creek Least Trillium Site. Report to N.C. Natural Heritage Program.
LeGrand, H.E., Jr. 1990. Turkey Creek Preserve Design. Report to North Carolina Nature Conservancy.

NORTHAMPTON COUNTY NATURAL AREAS

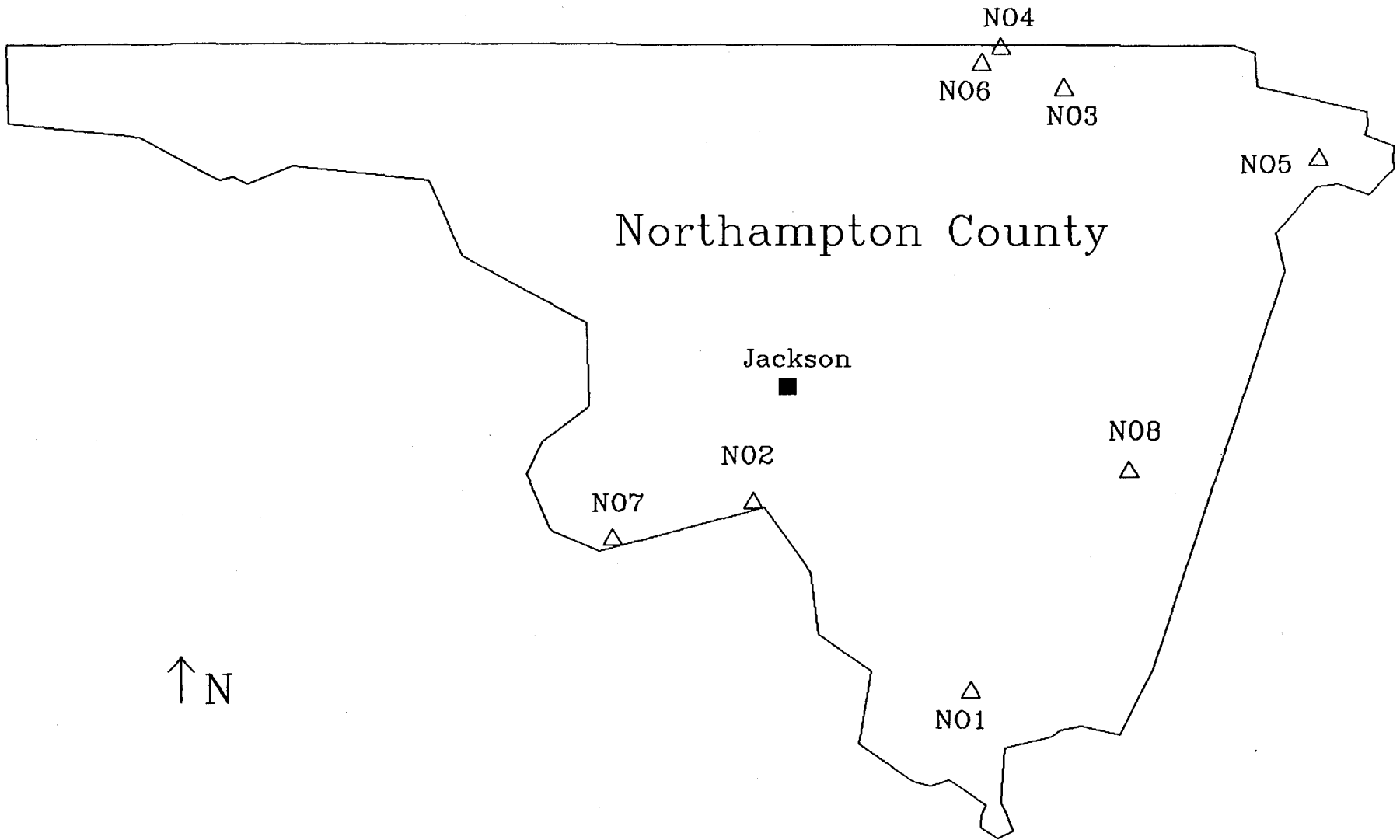
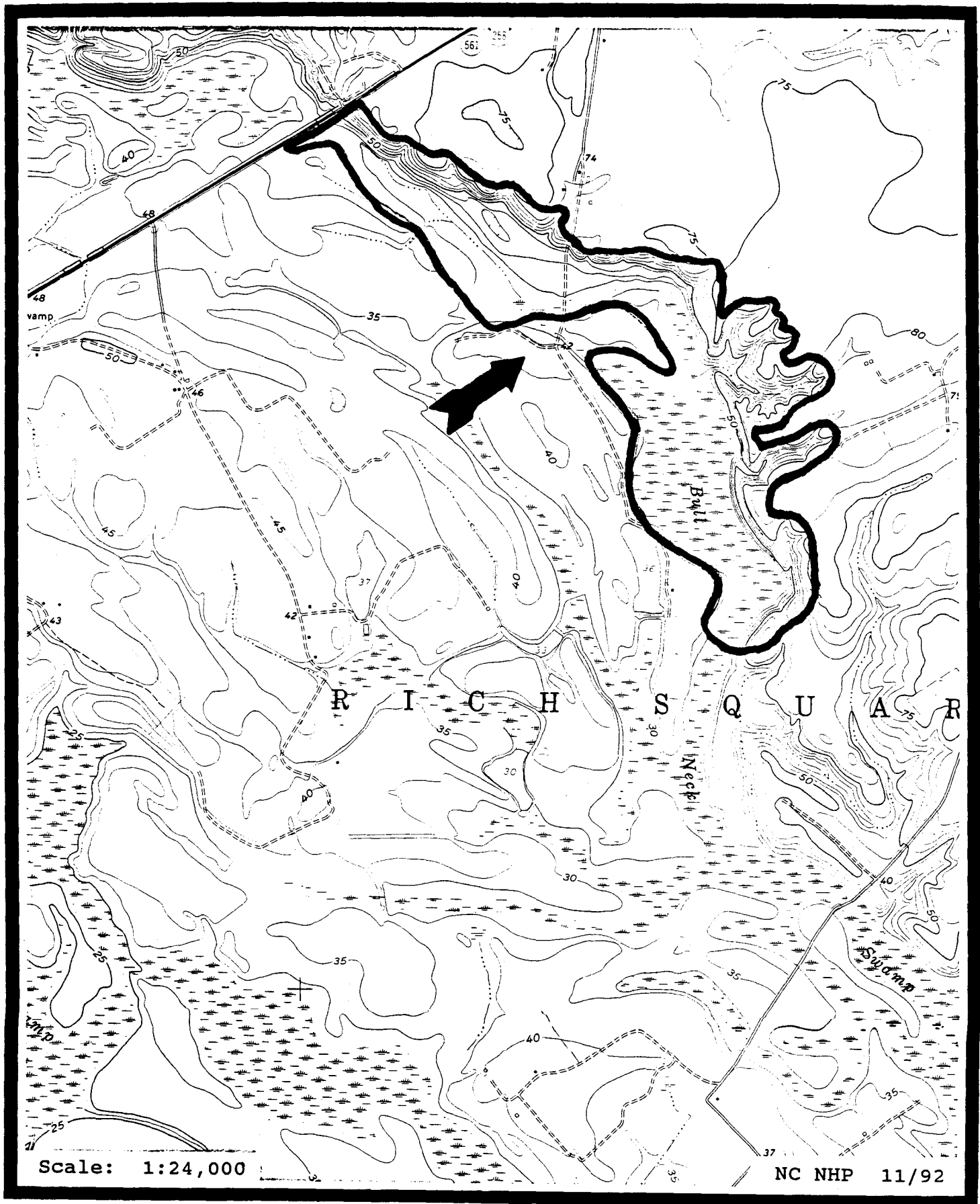


Figure 15. Significant natural areas in the A/P III study area portion of Northampton County



Site Name: Bull Neck Swamp and Bluffs
 Site Code: NO1
 Quadrangle: Norfleet

SITE NAME: Bull Neck Swamp and Bluffs

SITE CODE: NO1

SIZE: 417 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Northampton

QUADRANGLE: Norfleet

LOCATION: This site is in the Roanoke River watershed in southern Northampton County in the Coastal Plain Province of North Carolina. It is about 3 miles south of Rich Square, N.C.; 3.5 miles northeast of the intersection of Roanoke River and US 258; the bluffs are on the north side of Bull Neck Swamp.

SIGNIFICANT FEATURES:

1. This site contains three natural community types with very large trees and well-developed understories.
2. Located at this site is a disjunct population of glade fern (*Athyrium pycnocarpon*), a typically montane species.

GENERAL DESCRIPTION:

Southwest-facing bluffs, adjacent swamp, and bottomland forest occur along an old oxbow of the Roanoke River. The geology in this area is of the Cape Fear Formation. This site contains three natural community types: Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant), Cypress-Gum Swamp (Brownwater Subtype), and Coastal Plain Bottomland Hardwoods (Brownwater Subtype).

The Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) covers about 100 acres and is of excellent quality and condition. It is located along the bluff and is bordered by an upland flat that has been clearcut. The lower portion of the site grades into Cypress-Gum or Bottomland Hardwood Forest. The canopy is well developed and is dominated by American beech (*Fagus grandifolia*), tuliptree (*Liriodendron tulipifera*), southern red oak (*Quercus falcata*), and sweetgum (*Liquidambar styraciflua*). The subcanopy is dominated by flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), American hornbeam (*Carpinus caroliniana*), and red maple (*Acer rubrum*). Giant cane (*Arundinaria gigantea*) and arrowwood (*Viburnum dentatum*) are the common shrub species. The herb layer is well-developed and is dominated by Christmas fern (*Polystichum acrostichoides*), beechdrops (*Epifagus virginiana*), and southern lady fern (*Athyrium filix-femina* var. *asplenioides*). Also present in the herb layer is a disjunct population of glade fern (*Athyrium pycnocarpon*), a typically montane species.

The Cypress-Gum Swamp (Brownwater Subtype) is of good quality and condition and covers about 175 acres. It is adjacent to the bluff and the Bottomland Hardwood Forest. The canopy is well developed and is dominated by baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*). The subcanopy is dominated by Carolina ash (*Fraxinus caroliniana*) and the shrub

layer by common spicebush (Lindera benzoin). Partridgeberry (Mitchella repens) is the dominant herb species.

The Coastal Plain Bottomland (Brownwater Subtype) is in excellent quality and condition. It is located at the foot of the south-facing bluff and covers about 25-50 acres. The canopy is well developed and is dominated by willow oak (Quercus phellos) and swamp chestnut oak (Q. michauxii). The subcanopy is dominated by American holly (Ilex opaca), sweetbay (Magnolia virginiana), and American elm (Ulmus americana). Beautyberry (Callicarpa americana), common spicebush, and possum-haw (Ilex decidua) are the common shrub species. The herbaceous layer is dominated by sedges (Carex sp.).

Faunal observations were made during the survey. White-tailed deer (Odocoileus virginianus), Eastern chipmunks (Tamias striatus), and gray squirrels (Sciurus carolinensis) occur at this site.

OWNERSHIP: Multiple private ownership.

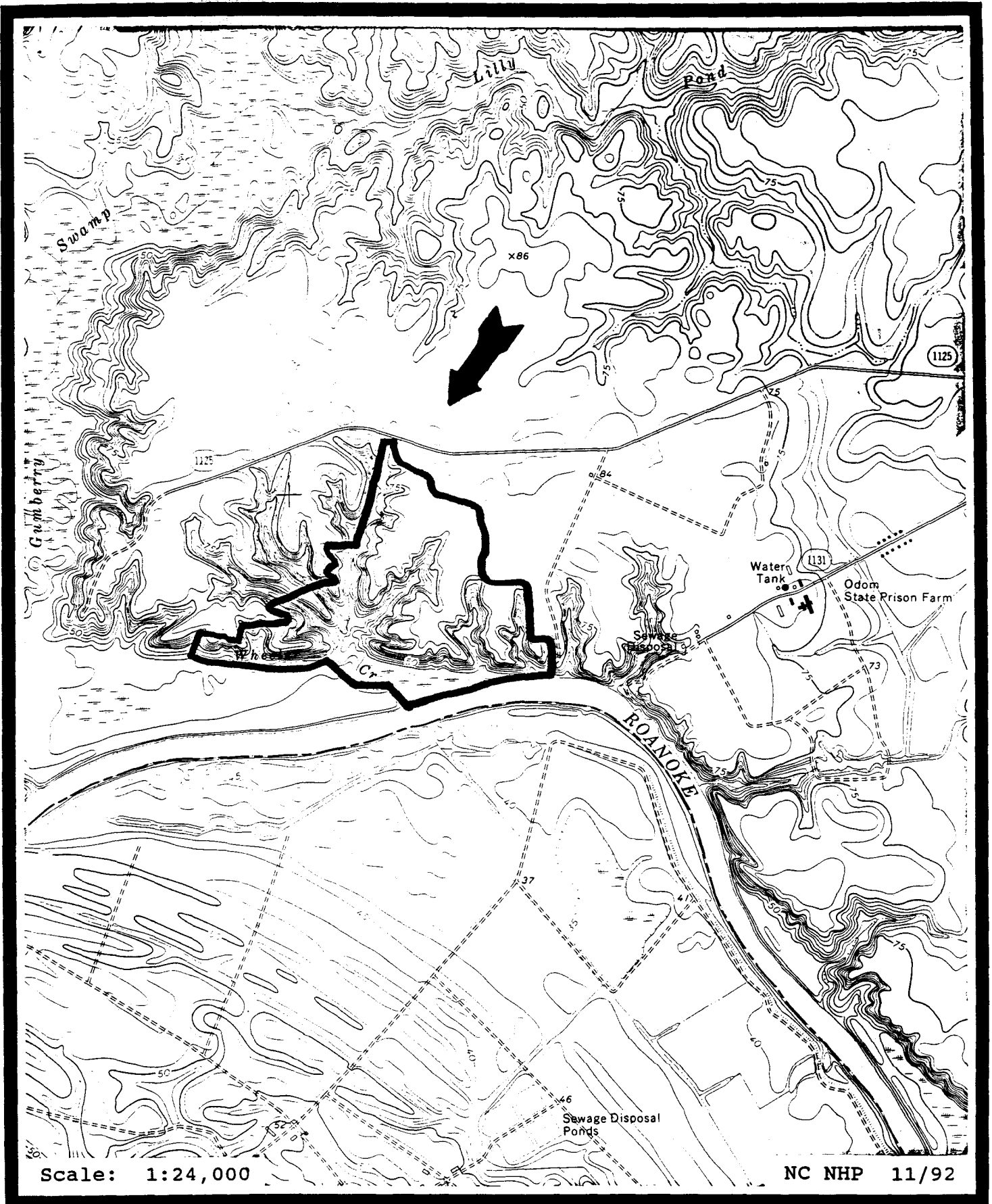
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Because much of the surrounding areas have been clearcut, this site's greatest threat is clearcutting. The landowners should be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: Because this site was visited during the fall, a spring survey is highly recommended for finding additional rare herbs.

REFERENCES:

Murrell, Z.E. 1991. Bull Neck Swamp and Bluffs. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Camassia Slopes
Site Code: NO2
Quadrangle: Boones Crossroads

SITE NAME: Camassia Slopes

SITE CODE: NO2

SIZE: 215 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Northampton

QUADRANGLE: Boones Crossroads

LOCATION: This site is in the Roanoke River watershed in southern Northampton County in the Coastal Plain Province of North Carolina. It is located between SR 1125 and the Roanoke River, about 2 miles west of Boones Crossroads, N.C.

SIGNIFICANT FEATURES:

1. This natural area contains four good quality natural community types: Coastal Plain Levee Forest (Brownwater Subtype), Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant), Basic Mesic Forest (Coastal Plain Subtype), and Dry-Mesic Oak-Hickory Forest.

2. Four rare species of plants are present at this site: wild hyacinth (Camassia scilloides), a State Threatened species; and isopyrum (Enemion biternatum), veined skullcap (Scutellaria nervosa), and sessile-flowered trillium (Trillium sessile), all three significantly rare species.

3. A rare species of bird is also present at this site, the cerulean warbler (Dendroica cerulea), a Federal Candidate species.

GENERAL DESCRIPTION:

Camassia Slopes is an area of slopes and ravines located along the steep northern bank of the Roanoke River. This rich alluvial terrace contains high-base soils and supports good quality examples of four natural community types: Coastal Plain Levee Forest (Brownwater Subtype), Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant), Basic Mesic Forest (Coastal Plain Subtype), and Dry-Mesic Oak-Hickory Forest. Also present is a small Cypress-Gum Swamp natural community. The origin of the high-base soils at this natural area is uncertain, as there appear to be no underlying mafic rocks in this portion of the Coastal Plain.

Growing at this site are 25 species of vascular plants that are regionally-rare or are disjunct from their population centers in the Piedmont and mountain regions of the state. Most of these are species typically found in circumneutral or basic soils, which are very rare in the Coastal Plain. The disjunct species are probable remnants from the Pleistocene glaciation period. Several rare plant species are present at this site: a large population of wild hyacinth (Camassia scilloides), a State Threatened species, and populations of isopyrum (Enemion biternatum), veined skullcap (Scutellaria nervosa), and sessile-flowered trillium (Trillium sessile), all three significantly rare species.

The slopes at this site are forested by mesic hardwood species. The dominant tree species are swamp chestnut oak (Quercus michauxii) and Shumard's oak (Q. shumardii), which are characteristic of southern bottomlands. Various hickories (Carya spp.), American beech (Fagus grandifolia), and American sycamore (Platanus occidentalis), which are often large in size, are also present in the canopy layer. The understory is characterized by tree-sized painted buckeye (Aesculus sylvatica) and pawpaw (Asimina triloba), both of which are more typical of piedmont forests.

The river floodplain at the foot of the slopes contains natural levees, examples of a Coastal Plain Levee Forest (Brownwater Subtype) community type, and backswamps, examples of Cypress-Gum Swamp natural community. The latter community is located on the flat, colluvial deposits along Wheeler Creek and its tributaries within the natural area. This community supports a well-developed stand of baldcypress (Taxodium distichum). Several distinct zones of wetland shrub and herb species are established under the baldcypress. The juxtaposition within such a limited area of upland and wetland communities is of special scientific interest.

Several uncommon bird species breed here, most notably the wild turkey (Meleagris gallopavo) and cerulean warbler (Dendroica cerulea), a Federal Candidate species.

OWNERSHIP: This site is partially owned by the state and administered by the N.C. Department of Corrections and partially owned by The Nature Conservancy.

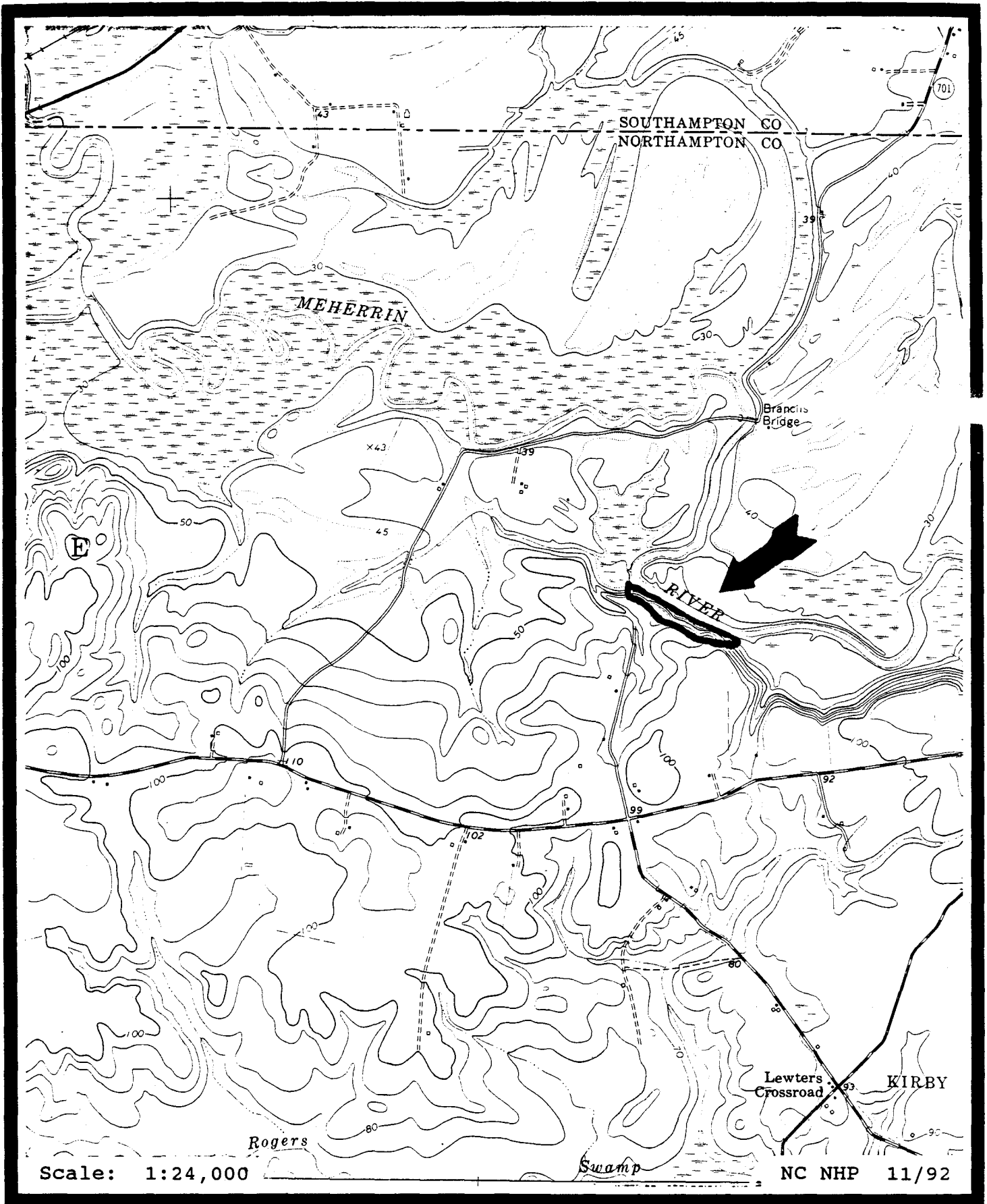
PROTECTION STATUS: The Nature Conservancy portion of this site is a Dedicated State Nature Preserve. The portion owned by the state is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Threats to the site include herbivory and excavation by woodchucks (Marmota monax).

COMMENTS: The combination of wetland and upland forest communities, many rare species, and unusual geology and soils, make this site an extraordinary scientific and educational resource, as well as a place of exceptional natural beauty.

REFERENCES:

- Lynch, J.M. 1981. Roanoke River Preserve Design Project. Submitted to the N.C. Natural Heritage Program and The North Carolina Nature Conservancy.
- Mayes, C. Date Unknown. Site Stewardship Abstract. The North Carolina Nature Conservancy.



Site Name: Meherrin River Bluffs north of Kirby
Site Code: NO3
Quadrangle: Margarettsville

SITE NAME: Meherrin River Bluffs north of Kirby

SITE CODE: NO3

SIZE: 7 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Northampton

QUADRANGLE: Margarettsville

LOCATION: This site is in the Meherrin River watershed in northern Northampton County in the Coastal Plain Province of North Carolina. It is about 1.6 miles north-northwest of Kirby, N.C.; bluffs are adjacent to Meherrin River.

SIGNIFICANT FEATURES: A high quality Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) with large trees and some disturbance is located at this site.

GENERAL DESCRIPTION:

This site contains steep bluffs that rise above the Meherrin River. It is bordered to the south by cultivated fields and to the east and west by clearcuts. Fortunately, the crest of the bluff was not timbered to the bluff's edge, which has protected the community from further degradation. The geology of the site is of the Yorktown Formation and the soil is of Coastal Plain clay and sand.

A high quality Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) is located on the steep bluffs and covers about 20 acres. The canopy is well developed and has very large trees with an estimated average dbh of 1.75 feet and a maximum dbh of about 2.5 feet. American beech (Fagus grandifolia), white oak (Quercus alba), and red oak (Q. rubra) dominate the canopy. The American beech trees have dbh's of 2-2.5 feet. The subcanopy is dominated by flowering dogwood (Cornus florida) and American holly (Ilex opaca). American strawberrybush (Evonymus americana) and deerberry (Vaccinium stamineum) are the common shrub species present. The herb layer is dominated by pipsissewa (Chimaphila maculata), heartleaf (Hexastylis virginica), and galax (Galax urceolata).

OWNERSHIP: Private ownership.

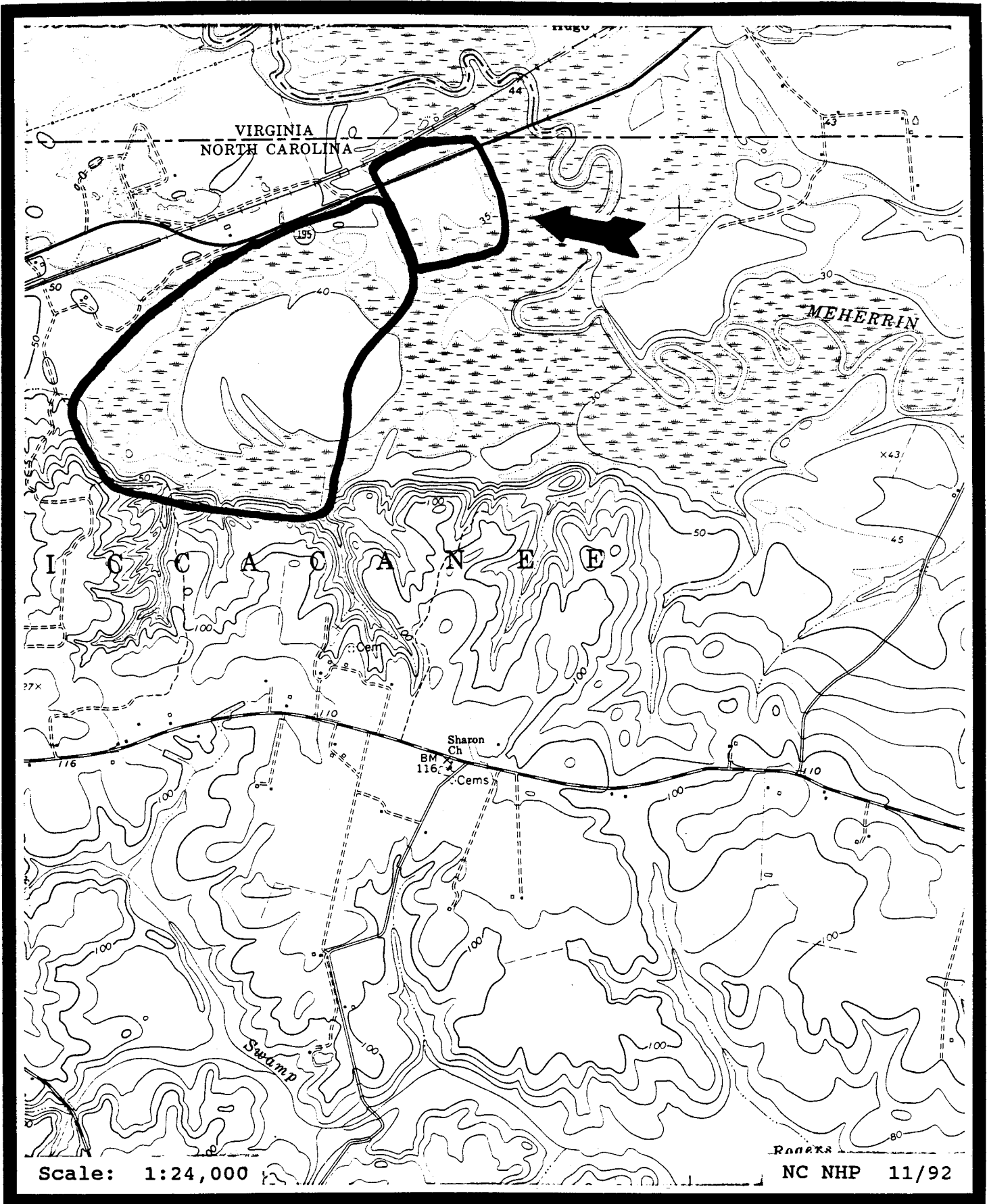
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The major threat to the site is clearcutting. The site should not be clearcut nor should the trees on the bluff be cut to the bluff's edge. The landowner should be informed of the significance of the site and the various protection options available.

COMMENTS: Additional survey work for rare species is recommended.

REFERENCES:

Murrell, Z.E. 1991. Meherrin River Bluffs north of Kirby. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Meherrin River Bottomland Forest
 Site Code: NO4
 Quadrangle: Margarettsville

SITE NAME: Meherrin River Bottomland Forest

SITE CODE: NO4

SIZE: 66 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Northampton

QUADRANGLE: Margarettsville

LOCATION: This site is in the Meherrin River watershed in northern Northampton County in the Coastal Plain Province of North Carolina. It is just south of the North Carolina/Virginia border; along NC 186 just southwest of bridge over Meherrin River at state border; forest is on southeast side of road just inside the state line.

SIGNIFICANT FEATURES:

1. This natural area contains a rare plant, Douglass's bittercress (Cardamine douglassii), a significantly rare species.
2. This site is one of the few bottomlands along the Meherrin River with a good herbaceous layer. Most sites either have Japanese honeysuckle (Lonicera japonica) in abundance or are devoid of native herbaceous vegetation because of frequent flooding.

GENERAL DESCRIPTION:

This natural area is a bottomland site with little or no standing water and a few scattered wooded pools. Parts of this area probably flood for a few days several times each year. In general, the site is flat and seasonally wet and contains alluvial soils. This natural area supports a mature example of a Coastal Plain Bottomland Hardwoods (Brownwater Subtype) community type.

The Coastal Plain Bottomland Hardwoods (Brownwater Subtype) community present at this site contains a variety of hardwood species in its canopy. Canopy trees include cherrybark oak (Quercus pagoda), swamp chestnut oak (Q. michauxii), overcup oak (Q. lyrata), and sweetgum (Liquidambar styraciflua). The subcanopy layer is composed of boxelder (Acer negundo), American holly (Ilex opaca), possum haw (I. decidua), and American hornbeam (Carpinus caroliniana). The shrub layer is well-developed and is composed of common pawpaw (Asimina triloba), black haw (Viburnum prunifolium), and arrowwood (V. dentatum). The herb layer is diverse and contains species such as Douglass's bittercress (Cardamine douglassii), a significantly rare species, Virginia springbeauty (Claytonia virginica), netted chainfern (Woodwardia areolata), and Atamasco lily (Zephyranthes atamasco).

OWNERSHIP: Private ownership; owned or leased by a hunt club.

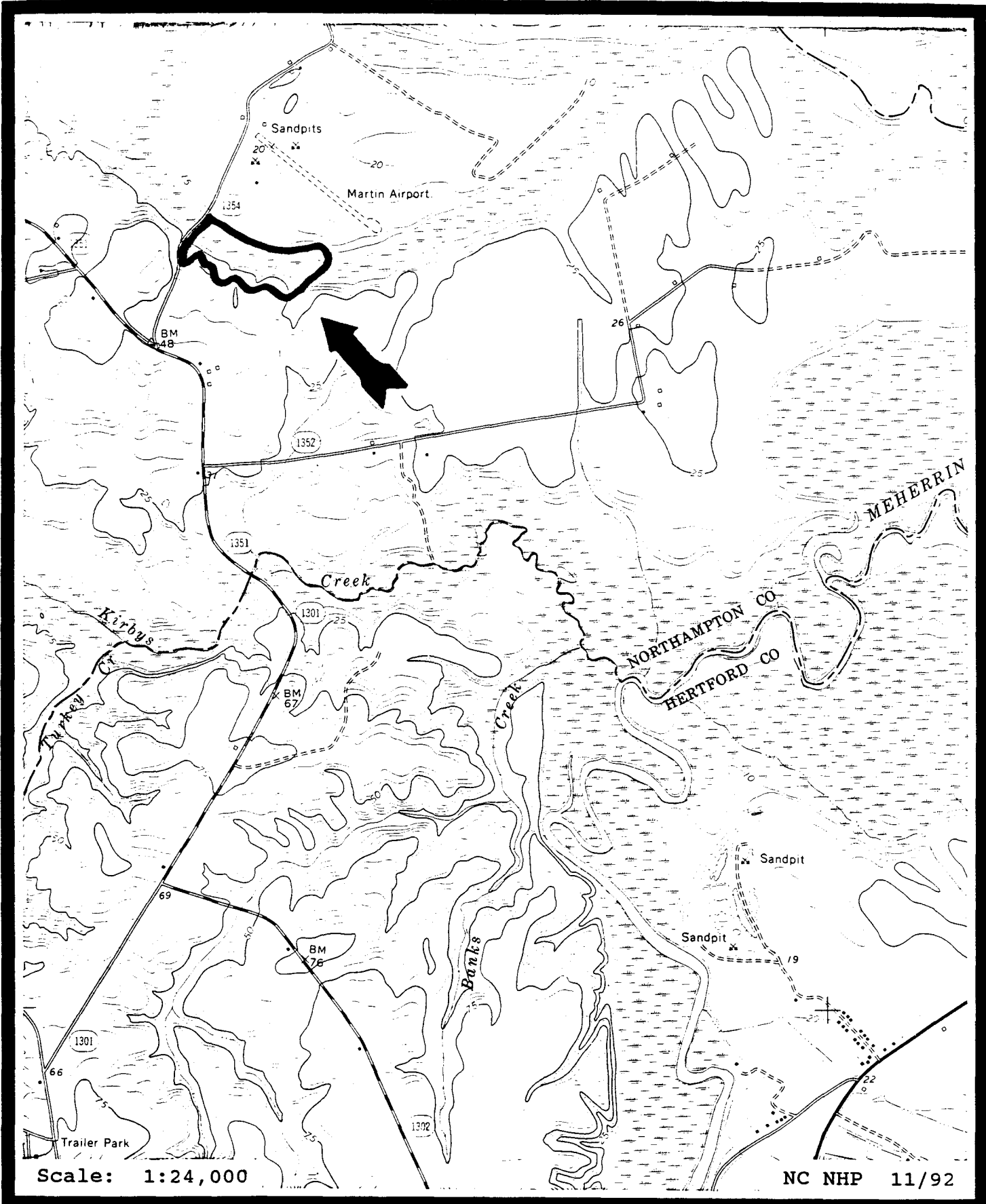
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The forest may have been logged about 50 years ago. The forest should be allowed to continue maturing. The landowner should be informed of the significance of the site and the various protection options available.

COMMENTS: This natural area has the potential to support buttercup phacelia (Phacelia ranunculacea), a State Candidate species. This site was visited in 1991 and is said to still be in good condition. The area is probably important for wildlife, such as breeding songbirds and game animals. This site was visited in 1991. It is still intact, however, there is some garbage at this site, probably thrown from the highway.

REFERENCES:

LeGrand, H.E., Jr., M. Lynch, and K. Lynch. 1985. Meherrin River Bottomland Forest. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: Meherrin River Oxbow Bluffs
 Site Code: N05
 Quadrangle: Murfreesboro

SITE NAME: Meherrin River Oxbow Bluffs

SITE CODE: N05

SIZE: 29 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Northampton

QUADRANGLE: Murfreesboro

LOCATION: This site is in the Meherrin River watershed in eastern Northampton County in the Coastal Plain Province of North Carolina. It is about 4 miles north-northwest of Murfreesboro, N.C.; about 0.5 miles southwest of Martin Airport; on north-facing bluffs and flats along an old oxbow of the Meherrin River.

SIGNIFICANT FEATURES: This oxbow site contains a high quality bluff and a swamp with two natural community types: Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) and Cypress-Gum Swamp (Brownwater Subtype).

GENERAL DESCRIPTION:

A steep north-facing bluff and a swamp flat occur at the oxbow. The geology is of the Yorktown Formation. Two natural community types are present at this site: Mesic Mixed Hardwood Forest (Coastal Plain Subtype) and Cypress-Gum Swamp (Brownwater Subtype). Trees at this site are estimated to have an average dbh of 1 foot and a maximum dbh of 2-2.5 feet.

The Mesic Mixed Hardwood Forest (Coastal Plain Subtype) is on the north-facing slopes along the oxbow and covers about 10 acres. It is a good quality forest with a closed canopy and large vines. American beech (Fagus grandifolia), white oak (Quercus alba), and red oak (Q. rubra) are the dominant trees in the canopy. American holly (Ilex opaca) and swamp tupelo (Nyssa biflora) are the common subcanopy species. The shrub layer is dominated by deerberry (Vaccinium stamineum) and American strawberrybush (Evonymus americana). The herb layer is dominated by southern lady fern (Athyrium filix-femina var. asplenioides) and partridgeberry (Mitchella repens).

The Cypress-Gum Swamp (Brownwater Subtype) is along a flat at the oxbow and has bluffs to the south and clearcuts to the north. It is of high quality and covers about 20 acres. The canopy is well-developed and contains water tupelo (Nyssa aquatica) and baldcypress (Taxodium distichum) as its dominants. The subcanopy is characterized by Carolina ash (Fraxinus caroliniana). The herb layer is dominated by partridgeberry and cinnamon fern (Osmunda cinnamomea).

OWNERSHIP: Private ownership.

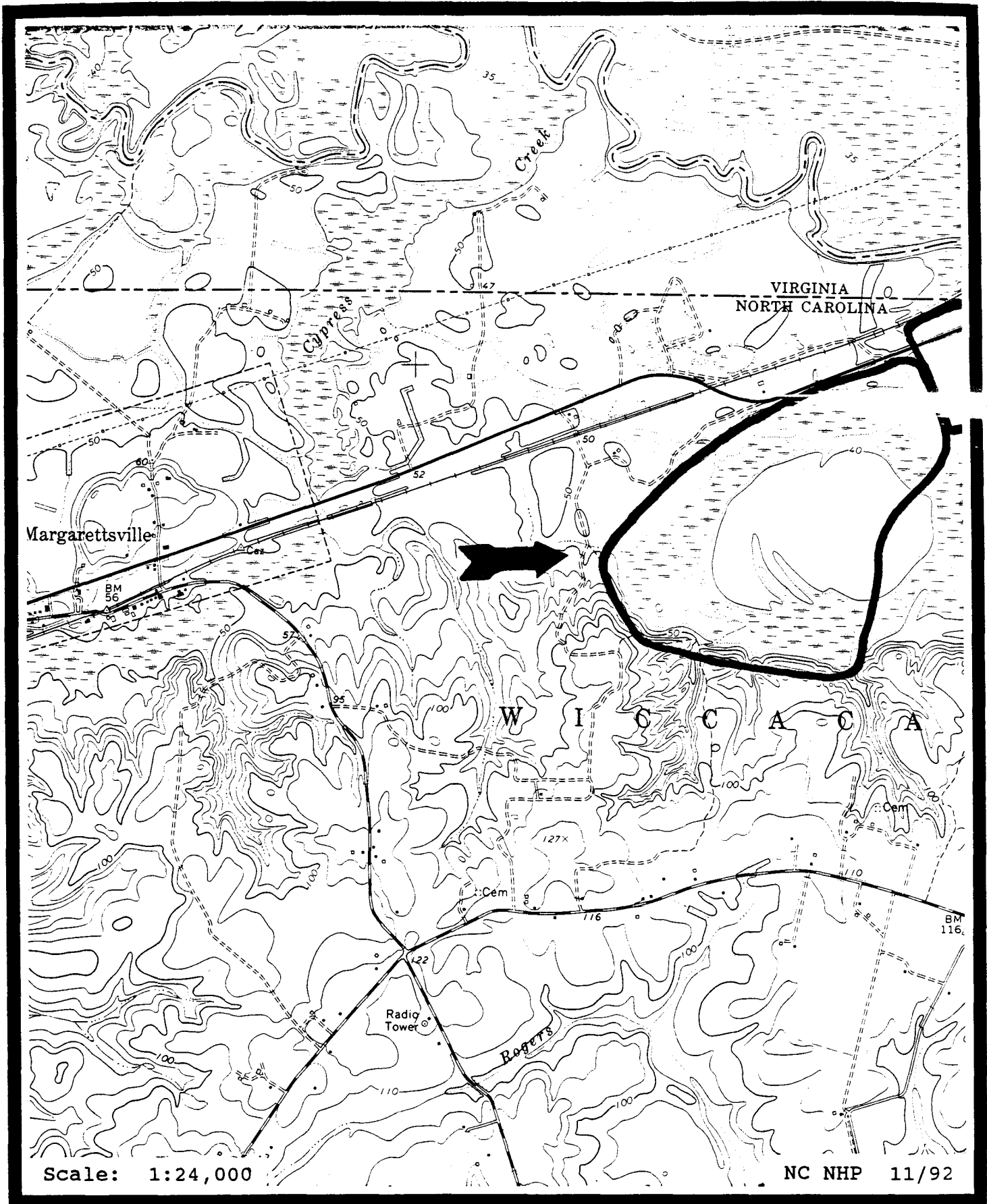
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site has clearcuts to the northwest (across SR 1354), sand mining to the northeast of the oxbow, clearcuts to the southeast of the bluffs, and development to the southwest of the bluffs. The major threat to this site is encroachment by development and logging. The landowner should be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: The site survey was conducted in October; therefore, a spring visit may yield better data on herbaceous flora.

REFERENCES:

Murrell, Z.E. 1991. Meherrin River Bluffs at SR 1354. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Meherrin River Slopes and Swamp
 Site Code: NO6
 Quadrangle: Margarettsville

SITE NAME: Meherrin River Slopes and Swamp

SITE CODE: NO6

SIZE: 360 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Northampton

QUADRANGLE: Margarettsville

LOCATION: This site is in the Meherrin River watershed in northern Northampton County in the Coastal Plain Province of North Carolina. It contains a swamp in an abandoned oxbow and an adjacent bluff of the Meherrin River, about 1.2 miles east of Margarettsville, N.C.

SIGNIFICANT FEATURES: Significant at this site are a high bluff, intact oxbow and three mature natural community types: Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant), Cypress-Gum Swamp (Brownwater Subtype), and Coastal Plain Bottomland Hardwoods (Brownwater Subtype).

GENERAL DESCRIPTION:

A very broad oxbow of the Meherrin River is present at this site. It is bordered to the south by an extensive north-facing slope. Also present at this site are bottomlands along the river. The geology is of the Yorktown Formation with clay and sand soils. Three mature natural community types are present at this site: Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant), Cypress-Gum Swamp (Brownwater Subtype), and Coastal Plain Bottomland Hardwoods (Brownwater Subtype).

The Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant) is of high quality and covers about 100 acres. It is located on the north-facing bluffs south of the oxbow and is adjacent to Cypress-Gum Swamp to the north and clearcuts and fields to the south. It has a well-developed canopy and a diverse herbaceous layer. American beech (Fagus grandifolia), tuliptree (Liriodendron tulipifera), and mockernut (Carya alba) are the dominant tree species in the canopy. The subcanopy has as its common species American holly (Ilex opaca), sourwood (Oxydendrum arboreum), and flowering dogwood (Cornus florida). Fringetree (Chionanthus virginicus) and American strawberrybush (Evonymus americana) are common in the shrub layer. The herb layer is dominated by partridgeberry (Mitchella repens), turpentine root (Aristolochia serpentaria), and southern lady fern (Athyrium filix-femina var. asplenioides).

The Cypress-Gum Swamp (Brownwater Subtype) is of high quality and covers about 300 acres. It is located in the oxbow and is bordered by bluffs to the south, with a central area slightly higher in elevation containing a Coastal Plain Bottomland Hardwoods. The Cypress-Gum Swamp has a well-developed, low diversity canopy and low diversity shrub and herb layer. Water tupelo (Nyssa aquatica), baldcypress (Taxodium distichum), and swamp tupelo (Nyssa biflora) dominate the canopy.

Ash (Fraxinus sp.) dominates the subcanopy and flowering dogwood dominates the shrub layer. The herb layer has as its common species partridgeberry, lizard's tail (Saururus cernuus), clearweed (Pilea pumila), and false nettle (Boehmeria cylindrica).

The Coastal Plain Bottomland Hardwoods (Brownwater Subtype) covers about 200 acres, is located in the high elevation area in the center of the oxbow, and is bordered almost completely by Cypress-Gum Swamp. Some sections are of secondary growth (30-50 years) and certain portions are of relatively high quality. The canopy is dominated by cherrybark oak (Quercus pagoda), loblolly pine (Pinus taeda), and willow oak (Q. phellos). The subcanopy is dominated by American holly, possum-haw (Ilex decidua), and American hornbeam (Carpinus caroliniana). The shrub layer has as its dominant species common spicebush (Lindera benzoin) and Virginia sweetspire (Itea virginica). Sedges (Carex sp.) dominate the herb layer.

Faunal observations were made during the site visit. It was found that raccoon (Procyon lotor) and white-tailed deer (Odocoileus virginianus) occur at this site.

OWNERSHIP: Private ownership.

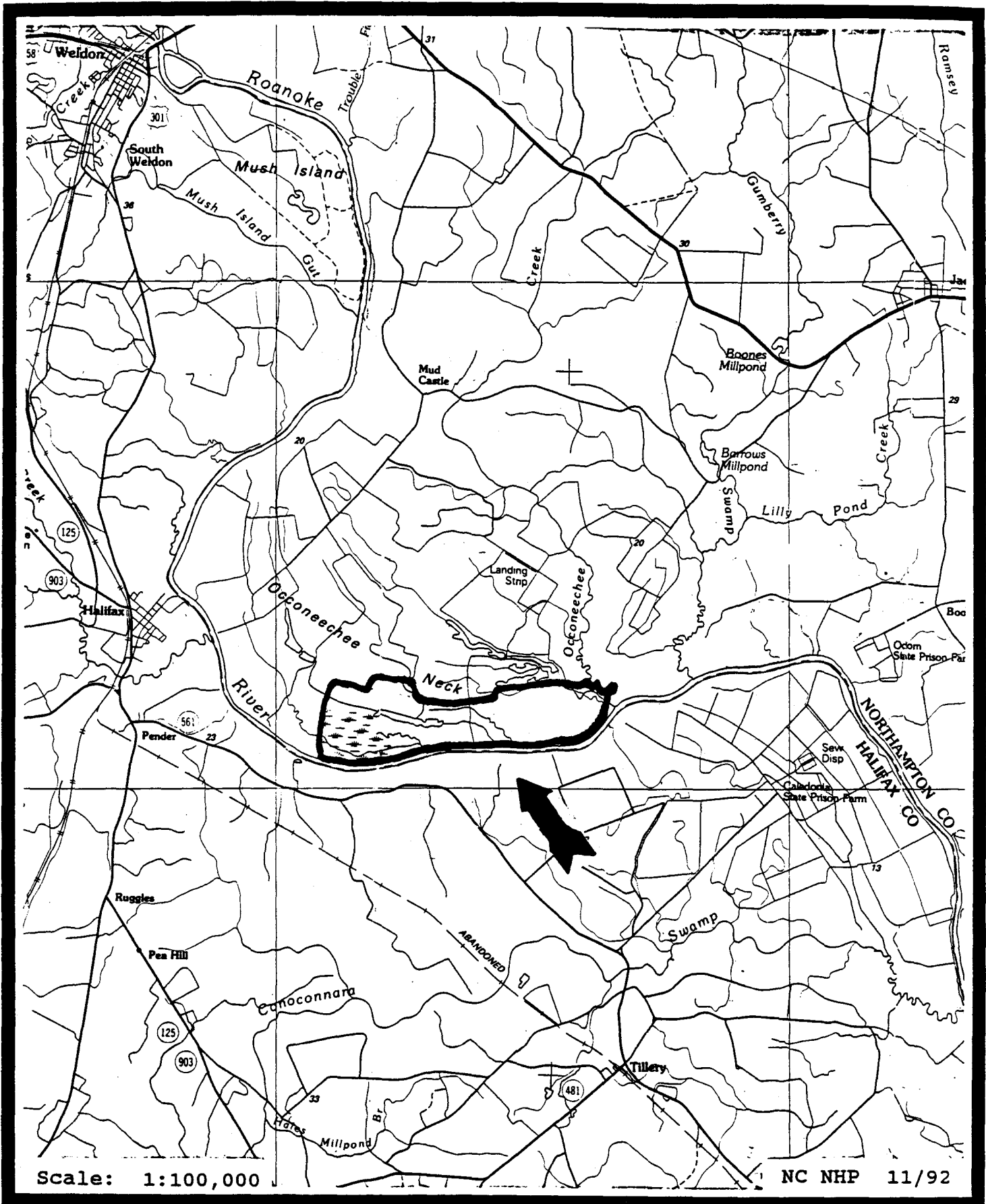
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The major threat to the site is clearcutting, which should be avoided. The landowner should be contacted to discuss the significance of the natural area and to discuss various protection options.

COMMENTS: Because this site was visited in the fall, a spring survey may be necessary to get a better understanding of the herbaceous layers in these communities.

REFERENCES:

Murrell, Z.E. 1991. Meherrin River Slopes and Swamp. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Occonechee Neck Floodplain Forest
 Site Code: N07
 Quadrangle: Roanoke Rapids

SITE NAME: Occoneechee Neck Floodplain Forest

SITE CODE: NO7

SIZE: 1800 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Northampton

QUADRANGLE: Roanoke Rapids (1:100,000 scale)

LOCATION: This site is in the Roanoke River watershed in southern Northampton County in the Coastal Plain Province of North Carolina. It is along the north bank of the Roanoke River; about 2.7 miles southeast of the end of SR 1128.

SIGNIFICANT FEATURES:

1. This site contains the best remaining tract of mature floodplain forest along the upper Roanoke River valley.
2. Three rare species of birds are present at this site: cerulean warbler (Dendroica cerulea), a Federal Candidate species; black vulture (Coragyps atratus), a species of Special Concern; and Mississippi kite (Ictinia mississippiensis), a significantly rare species.
3. This natural area contains a wading bird rookery.

GENERAL DESCRIPTION:

The Occoneechee Neck Floodplain Forest is situated on a broad, relatively flat natural levee. The levee is bisected by several narrow, steep-banked streams which drain a small backswamp depression north of the levee. Portions of this depression contain beaverponds. The natural area is bounded on the north by agricultural fields, on the west by heavily cut-over floodplain forest, on the south by the Roanoke River, and on the east by grazed and cut-over floodplain forest. Three natural community types are present at this site: Coastal Plain Levee Forest, Coastal Plain Bottomland Hardwoods, and Cypress-Gum Swamp. Soils at this site are fine silty loam and are well drained.

This natural area contains the most extensive and least disturbed example of a Coastal Plain Levee Forest in the upper Roanoke River floodplain. Its canopy is dominated by sugarberry (Celtis laevigata), green ash (Fraxinus pennsylvanica), and sycamore (Platanus occidentalis). The subcanopy is dominated by boxelder (Acer negundo). The shrub layer contains mostly spicebush (Lindera benzoin) with some buckeye (Aesculus sylvatica). The ground cover is dominated by giant cane (Arundinaria gigantea), bottlebrush grass (Hystrix patula), nemophila (Nemophila microcalyx), and mixed herbs.

The Cypress-Gum Swamp is extremely well-developed. It has as its dominant species baldcypress (Taxodium distichum) and water tupelo (Nyssa aquatica).

Several large relatively old beaverponds exist at this site along small streams draining the swamp. These beaverponds contain a diverse assemblage of aquatic plants including duckweeds (Lemna spp.), arrow arum (Peltandra sp.), pickerelweed (Pontederia cordata), smartweeds (Polygonum spp.), and others. These ponds provide habitat for a number of breeding birds and mammals. One of the beaverponds contains breeding colonies of great blue herons (Ardea herodias) and great egrets (Casmerodius albus), which nest in a tall grove of baldcypress. This is just one of seven known breeding colonies of these birds in the Roanoke River floodplain. These ponds also contain the oldest established beaver colonies in the Roanoke River floodplain.

Several rare and uncommon species of birds are present at this site. Rare species include black vulture (Coragyps atratus), a species of Special Concern; cerulean warbler (Dendroica cerulea), a Federal Candidate species; and Mississippi kite (Ictinia mississippiensis), a significantly rare species. Other noteworthy species of birds are red-shouldered hawk (Buteo lineatus) and Swainson's warbler (Limnothlypis swainsonii).

Another animal worth noting is the woodchuck (Marmota monax), which breeds at this site. This Roanoke River floodplain population is one of very few localities in the state's Coastal Plain for this species.

OWNERSHIP: Single private ownership.

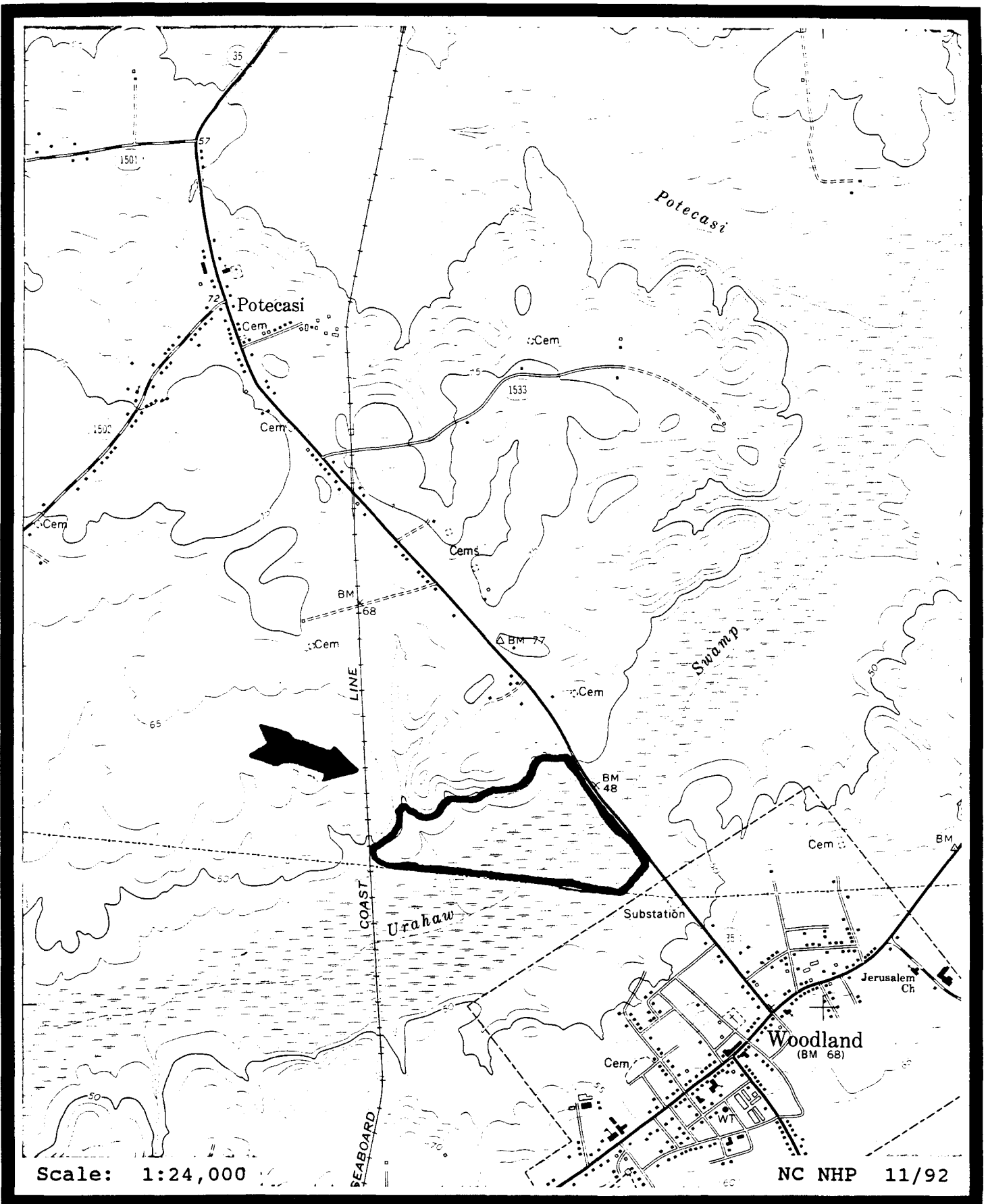
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Threats to this site include clearing for timber or for agricultural purposes. Dams located upstream cause the site to flood less frequently, which has resulted in slightly drier conditions. This may affect the forest composition on the levee. The landowner should be informed of the significance of the site and the various protection options available.

COMMENTS: The major land use of this site is for hunting activities. In general, the site had been selectively logged about 60-80 years ago; however, a large portion of the site described by Lynch in 1981 has since been logged. The eastern portion of the site still remains intact and is highly significant. Because of the logging, the acreage of the site is uncertain.

REFERENCES:

- Lynch, J.M. 1978. Occoneechee Neck Floodplain Forest. N.C. Natural Heritage Program.
- _____. 1981. Roanoke River Preserve Design Project. Submitted to the N.C. Natural Heritage Program and The North Carolina Nature Conservancy.



Site Name: Urahaw Swamp
 Site Code: NO8
 Quadrangle: Woodland

SITE NAME: Urahaw Swamp

SITE CODE: NO8

SIZE: 108 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Northampton

QUADRANGLE: Woodland

LOCATION: This site is in the Meherrin River watershed in eastern Northampton County in the Coastal Plain Province of North Carolina. It is northwest of Woodland, N.C. on the west side of NC 35.

SIGNIFICANT FEATURES: This site has a very high quality Cypress-Gum Swamp (Brownwater Subtype).

GENERAL DESCRIPTION:

A broad swamp is located at this site on the southwest side of the road. The geology is of the Yorktown Formation. The site contains an excellent quality Cypress-Gum Swamp (Brownwater Subtype) that covers about 100 acres. It is a large swamp, but major portions of it have been logged or clearcut and the uplands have been developed or clearcut. The canopy is closed and is dominated by water tupelo (Nyssa aquatica) and baldcypress (Taxodium distichum). The subcanopy is dominated by red maple (Acer rubrum), American hornbeam (Carpinus caroliniana), and Carolina ash (Fraxinus caroliniana). The estimated average tree dbh is 1.75 feet and the maximum dbh is about 3.5 feet. The shrub layer is not very well developed and is dominated by elderberry (Sambucus canadensis). The herb layer is also not well-developed and is dominated by lizard's tail (Saururus cernuus) and false nettle (Boehmeria cylindrica).

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The areas surrounding the swamp have been either developed or clearcut. This site should not be clearcut. The landowner should be contacted to discuss the significance of the site and the various land protection options available.

COMMENTS: Because this site was visited in the fall, a spring survey is recommended to gain a better understanding of the herb layer.

REFERENCES:

Murrell, Z.E. 1991. Urahaw Swamp. Site Survey Report. N.C. Natural Heritage Program.

ORANGE COUNTY NATURAL AREAS

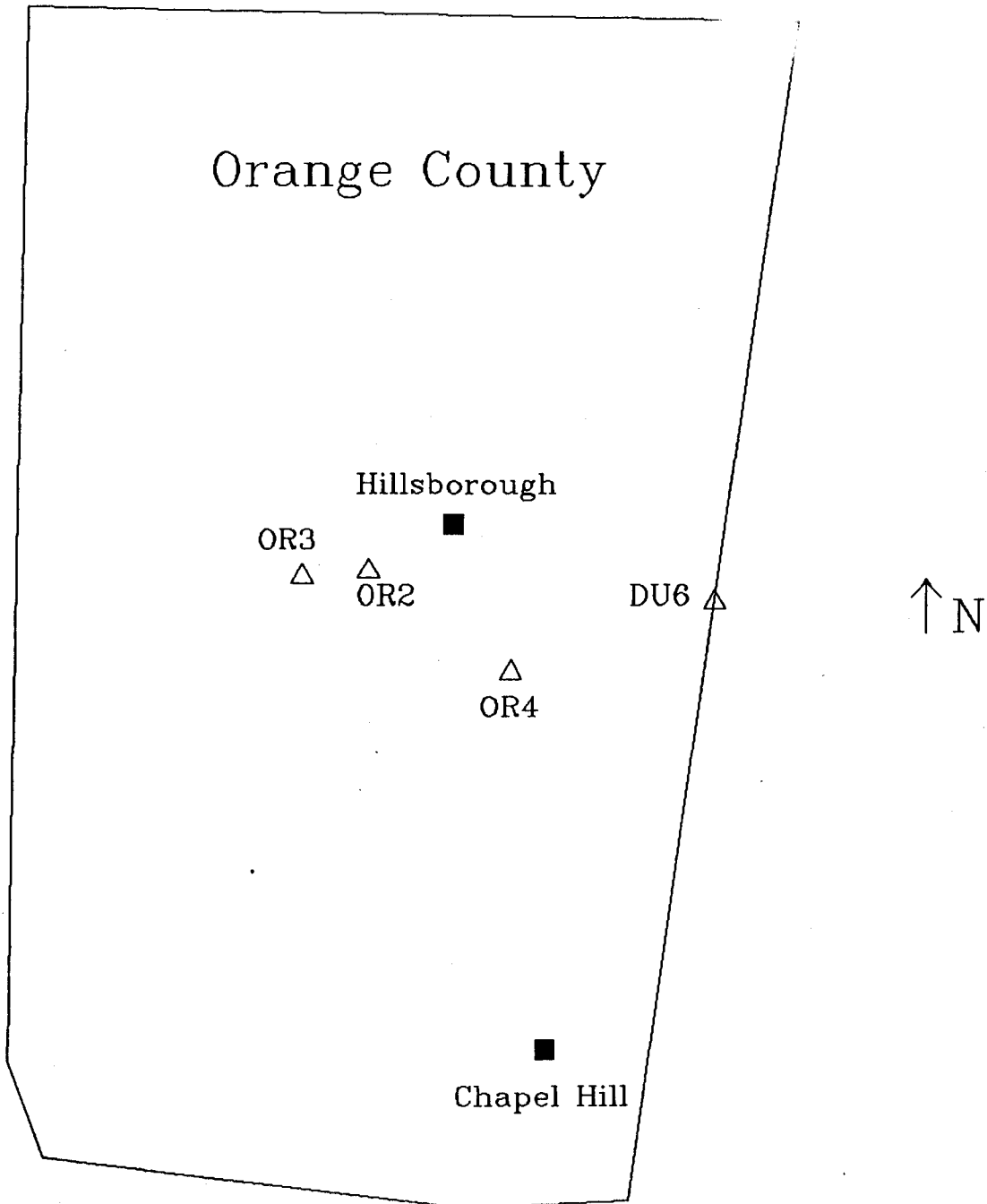
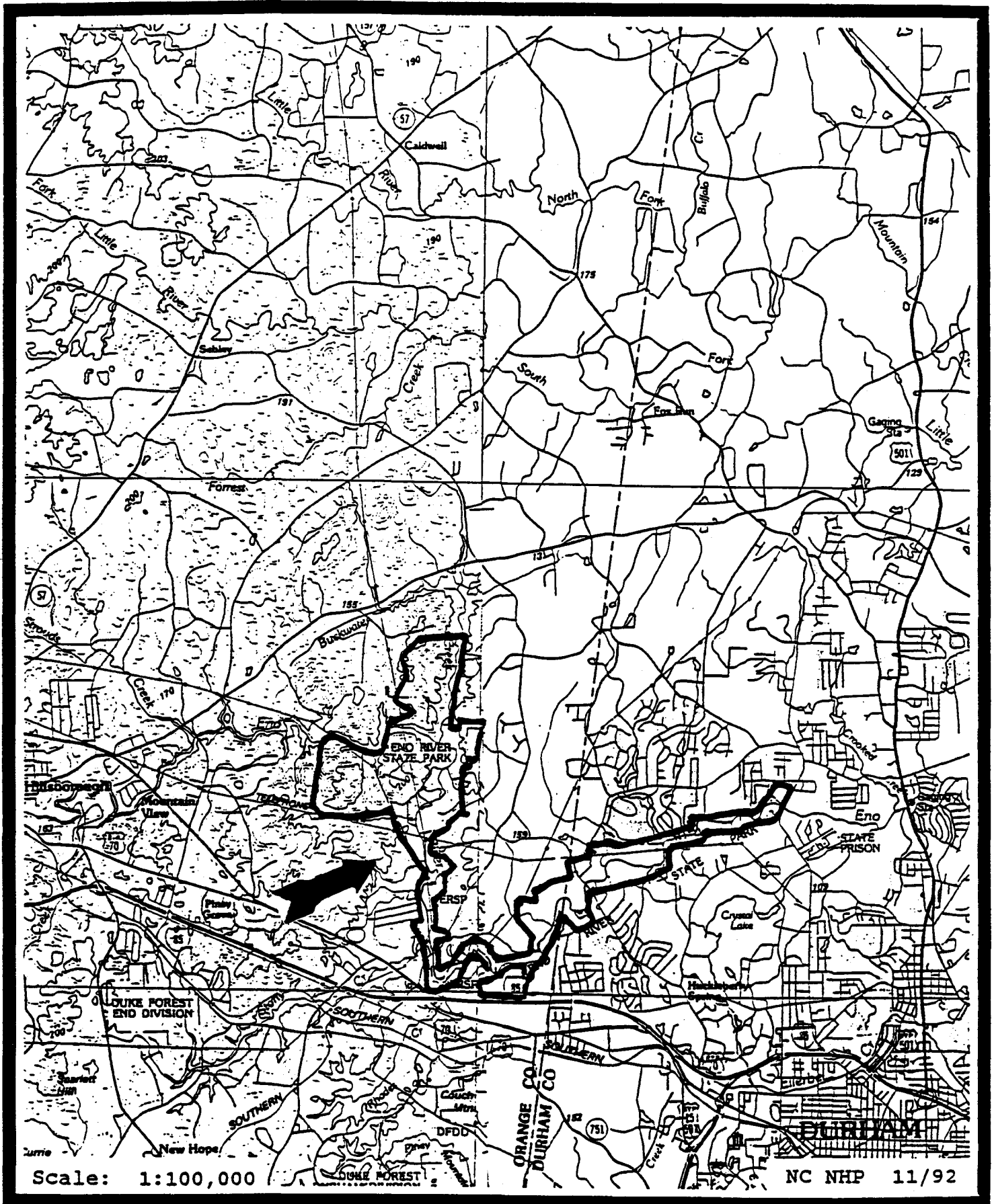


Figure 16. Significant natural areas in the A/P III study area portion of Orange County



Site Name: Eno River State Park and Vicinity
 Site Code: DU6
 Quadrangle: Henderson, Greensboro

SITE NAME: Eno River State Park and Vicinity

SITE CODE: DU6

SIZE: about 3100 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Orange, Durham

QUADRANGLE: Henderson, Greensboro (1:100,000 scale)

LOCATION: This site is in the Neuse River watershed in eastern Orange County and western Durham County in the Piedmont Province of North Carolina. It extends along the Eno River from about 2 miles east of Lawrence Road (SR 1561) near Hillsborough, downstream to Guess Road (SR 1003) in Durham. The site includes lands currently within the state park lands, lands within the planned acquisition boundary, and adjacent lands that are of natural significance.

SIGNIFICANT FEATURES:

1. Three rare aquatic vertebrate species are present at this site: the Carolina darter (Etheostoma collis) and the Neuse River waterdog (Necturus lewisi), state-listed as Special Concern, and the Roanoke bass (Ambloplites cavifrons), listed as significantly rare.

2. Five rare aquatic invertebrate species are present in this natural area: the yellow lampmussel (Lampsilis cariosa), a Federal Candidate and State Threatened species, the green floater (Lasmigona subviridis), a Federal Candidate and State Endangered species; the triangle floater (Alasmidonta undulata) and the squawfoot (Strophitus undulatus), state-listed as Threatened; and the panhandle pebblesnail (Somatogyrus virginicus), a globally rare snail.

3. A species of dragonfly significantly rare in North Carolina, Thorey's grayback dragonfly (Tachopteryx thoreyi), has been reported for this natural area.

4. This site supports high quality examples of eight different natural community types typical of the Piedmont: Piedmont/Coastal Plain Heath Bluff, Piedmont/Coastal Plain Acidic Cliff, Dry-Mesic Oak-Hickory Forest, Dry Oak-Hickory Forest, Mesic Mixed Hardwood Forest, Piedmont/Low Mountain Alluvial Forest, Rocky Bar and Shore, and Upland Depression Swamp.

GENERAL DESCRIPTION:

Eno River State Park and Vicinity encompasses about 2200 acres of land along the Eno River. The portion of the Eno River that flows through this site is a significant aquatic habitat (Aquatic Habitat AH4) and supports a large number of rare species. Aquatic invertebrates include the squawfoot (Strophitus undulatus), triangle floater (Alasmidonta undulata), green floater (Lasmigona subviridis), and yellow lampmussel (Lampsilis cariosa), all state listed as threatened. This aquatic habitat

may be the only remaining location for the panhandle pebblesnail (Somatogyrus virginicus) in the world. Aquatic vertebrate species include the Neuse River waterdog (Necturus lewisi), the Carolina darter (Etheostoma collis), and the Roanoke bass (Ambloplites cavifrons).

In addition to protecting the river, the park lands protect good examples of seven different natural community types, as well as several rare species. Five natural areas consisting of large units and a partial corridor along the river have been specifically identified within the park: Buckwater Branch Ridge and Slopes, Cox's Mountain, Cate's Ford, Mountain Spleenwort and Rhododendron Bluffs, and Cabelands and Rhododendron Slope. Situated adjacent to centers of extensive development, these natural areas retain some of the features which once were prevalent in the Piedmont. Good quality examples of seven natural community types are present in Eno River State Park: Piedmont/Coastal Plain Heath Bluff, Piedmont/Coastal Plain Acidic Cliff, Dry-Mesic Oak-Hickory Forest, Dry Oak-Hickory Forest, Mesic Mixed Hardwood Forest, Piedmont/Low Mountain Alluvial Forest, and Rocky Bar and Shore.

Buckwater Branch Ridge and Slopes is a north-south running ridge north of Eno River and west of Buckwater Creek. It supports outstanding xerophytic vegetation and is one of only two sites within the county where the regionally-rare pepper-and-salt skipper butterfly (Amblyscirtes hegon) is known to occur. On the ridgetop is a high quality post oak (Quercus stellata) dominated forest.

Cox's Mountain is an upland site with good examples of Mesic Mixed Hardwood Forest and Dry-Mesic Oak-Hickory Forest communities. The spring at this site is inhabited by Thorey's grayback dragonfly (Tachopteryx thoreyi). The regionally-rare doll's eyes (Actaea pachypoda) has also been reported for Cox's Mountain and is known from no other location in Orange County.

The Cate's Ford area contains acidic cliff upland forests and some of the best developed riparian communities within Orange County. Also of significance at Cate's Ford is one of the best natural exposures of Paleozoic metavolcanic rock and pyroclastic rock, which is widespread in the Piedmont.

The Mountain Spleenwort and Rhododendron Bluffs is the easternmost known location in the Carolinas for the mountain spleenwort (Asplenium montanum), a regionally-rare species disjunct from the mountains. This is one of only two known locations for this species in the eastern Piedmont. The steep north-facing bluff at this site is the location of a population of catawba rhododendron (Rhododendron catawbiense), a regionally-rare disjunct from the mountains. The red-backed salamander (Plethodon cinereus) is a regionally-rare, disjunct animal species that occurs in this natural area.

Cabelands and Rhododendron Slope contains several state-listed animal species. Regionally-rare species included in this section of the park are catawba rhododendron, maidenhair fern (Adiantum pedatum), galax (Galax urceolata), sumo mite

(Allothrombium sp.), and pileated woodpecker (Dryocopus pileatus).

In addition, the Eno River Uplands and Vernal Pools area lies southwest of the Cate's Ford area. The "vernal pools" are Upland Depression swamp communities dominated by willow oak (Quercus phellos) and overcup oak (Q. lyrata). These communities also contain wetland shrubs such as buttonbush (Cephalanthus occidentalis) and leucothoe (Leucothoe racemosa), as well as sphagnum moss (Sphagnum sp.). These pools are long-lasting, fish-free, and important breeding sites for salamanders. The surrounding forests are typical Dry-Mesic Oak-Hickory Forest and Dry Oak-Hickory Forest.

OWNERSHIP: The majority of this natural area is owned by the state. The smaller parcels are privately owned.

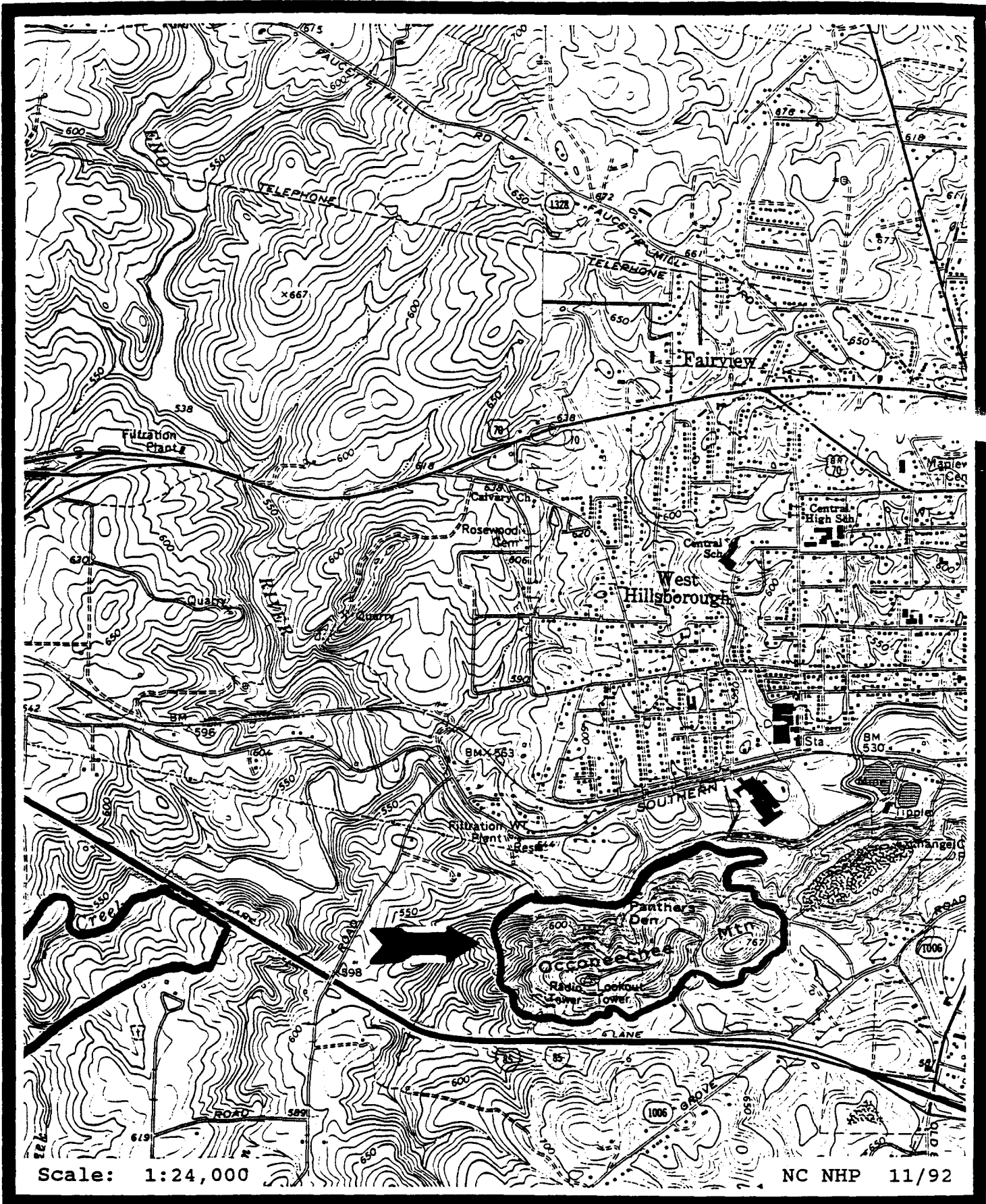
PROTECTION STATUS: Most of this site is a North Carolina State Park and portions of it are also a Registered Natural Heritage Area. The privately owned lands are not protected.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Much of the privately owned land adjacent to this natural area is already developed or is threatened by logging and development. Similar fates threaten the private lands within the natural area. The Eno River is subjected to pollution from upstream sources and from tributaries that feed it. Other threats include encroachment from Japanese honeysuckle (Lonicera japonica) and Japanese grass (Microstegium vimineum) in the floodplain and mesic slope communities. It is recommended that private inholdings be acquired by the State to further protect the integrity of the aquatic habitat as well as the natural communities.

COMMENTS: Annually, the Eno River Preservation Association, a non-profit organization, holds a 3-day festival to raise money to protect land along the Eno River. Land is purchased by the Eno River Preservation Association, which in turn gives the land to the state to be incorporated into the Eno River State Park. Presently, the park covers 2,186 acres. According to the park's master plan, it will eventually cover 3,126 acres.

REFERENCES:

Sather, D. and S. Hall. 1988. Inventory of the natural areas and wildlife habitats of Orange County, North Carolina. Report to Triangle Land Conservancy and N.C. Natural Heritage Program.



Site Name: Occonechee Mountain
 Site Code: OR2
 Quadrangle: Hillsborough, Efland

SITE NAME: Occonechee Mountain

SITE CODE: OR2

SIZE: 164 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Orange

QUADRANGLE: Hillsborough, Efland

LOCATION: This site is in central Orange County in the Piedmont Province of North Carolina. It is southwest on Orange Grove Road (SR 1006) about 0.5 mile south of the junction of Eno River and NC 86.

NOTABLE FEATURES:

1. This site contains very unusual examples of several uncommon communities, including Piedmont Monadnock Forest, Piedmont Coastal Plain Acidic Cliff, and a community that resembles Pine/Oak Heath, a community of the mountain region.
2. Rare plants found at this site include three State Candidate species: Bradley's spleenwort (Asplenium bradleyi), witch alder (Fothergilla major), and sweet pinesap (Monotropis odorata).
3. Several disjunct montane plant species are present on the mesic slopes. These include mountain spleenwort (Asplenium montanum) and wild sarsaparilla (Aralia nudicaulis) which reach their easternmost limits at this site. This is one of only two known locations for mountain spleenwort in the eastern Piedmont.
4. A species of Special Concern, the Cooper's hawk (Accipiter cooperi), is also found at this site.
5. The dry summit forests provide habitat for several butterflies with restricted distributions. These include the brown elfin (Incisalia augustus), the silvery checkerspot (Chlosyne nycteis), and the sleepy duskywing (Erynnis brizo).

GENERAL DESCRIPTION:

Occonechee Mountain, running east to west, provides the largest extent of north-facing slope anywhere in the region. The summit peaks at over 860 feet, and is the highest point in Orange County. The siliceous rock formations of the summit and upper slopes support a dry montane community. This mountain supports numerous habitats and several different natural community types.

Although disturbed, a bottomland forest is located along a levee on the south bank of the Eno River. It contains large specimens of river birch (Betula nigra), box elder (Acer negundo), sycamore (Platanus occidentalis), sweetgum (Liquidambar styraciflua), walnut (Juglans nigra), and tuliptree (Liriodendron tulipifera).

The most important feature of the mountain's mesic slopes is the Panther's Den Ravine, found on the west side of an abandoned quarry, on the north-facing slope of Occonechee Mountain. This

site contains a massive vertical rock wall above the Piedmont/Mountain Levee Forest. The cliff and ravine remain cool and damp year round and support several disjunct montane species including mountain spleenwort (Asplenium montanum), Bradley's spleenwort (A. bradleyi), wild sarsaparilla (Aralia nudicaulis), catawba rhododendron (Rhododendron catawbiense), sweet pinesap (Monotropis odorata), and interrupted fern (Osmunda claytoniana).

Above the base of Occoneechee's northern slope the forest grades from a Piedmont/Mountain Levee Forest and Mixed Mesic Hardwood Forest (Coastal Plain Subtype) to a Dry-Mesic Oak-Hickory Forest. Covering most of this face of Occoneechee are great thickets of mountain laurel (Kalmia latifolia) and galax (Galax aphylla). Gathered in the mid-slope forest is the regionally-rare witch alder (Fothergilla major). Animals characteristic of this mesic site are the sumo mite (Allothrombium sp.), Cooper's hawk (Accipiter cooperi), woodcock (Philohela minor), yellow-throated warbler (Dendroica dominica), eastern mole (Scalopus aquaticus), beaver (Castor canadensis) and hackberry butterfly (Asterocampa celtis).

On the northern edge of the ridgeline is a natural community that closely resembles a Pine/Oak Heath community type (a community of the mountain region of North Carolina). The open and sparse canopy is dominated by Virginia pines (Pinus virginiana). The subcanopy is composed of serviceberry (Amelanchier arborea), sourwood (Oxydendrum arboreum), and red maple (Acer rubrum). The shrub layer consists mostly of blueberries (Vaccinium pallidum, V. tenellum, V. stamineum), huckleberries (Gaylussacia baccata), and staggerbush (Lyonia mariana), with scattered mountain laurel (Kalmia latifolia). Bracken fern (Pteridium aquilinum) occurs here in great patches mixed with the heaths. The herb layer is dry and sparse with various grasses such as broom straw (Schizachyrium scoparium) and oat grass (Danthonia sp.). Restricted to this community is the regionally-rare butterfly the brown elfin (Incisalia augustus).

Piedmont Monadnock Forest is located on the flat summit and gentler upper slopes of the mountain. This forest is dominated by chestnut oaks (Quercus montana) and scarlet oaks (Q. coccinea) with sourwood and red maple occurring in the subcanopy. The heath layer in this forest shares many of the same species as the adjacent Virginia pine stands. Other heath species include wintergreen (Gaultheria procumbens) and trailing arbutus (Epigaea repens). The characteristic animal species of this community is the sleepy duskywing butterfly (Erynnis brizo).

On the easternmost knob, elevation 767 feet, a more stunted and open canopy than the surrounding Chestnut Oak Forest exists. The species that dominate here include: chestnut oak, blackjack oak, Virginia pine, and shortleaf pine. Blueberries, huckleberries, and bracken ferns are present, but herbs are nearly absent. The presence of reindeer lichen (Cladonia sp.), which covers cobbles and boulders of siliceous rock, is an indicator of dry, nutrient-poor conditions of this knob.

OWNERSHIP: This site is partially in multiple private ownership and partially in ownership of Hillsborough City Parks.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS (from Sather and Hall 1988):

"The entire Panther's Den area should be given the highest level of protection, including the construction of alternative trails to steer traffic away from this most sensitive ravine; any increase in trampling could easily destroy the populations of wild sarsaparilla and mountain spleenwort. No trail should be constructed until each individual plant of these species (which are directly adjacent to the existing trail) are carefully mapped.

"Hiking, nature study, and aesthetic enjoyment of the vistas should be encouraged along the ridge crest, but in order to preserve the integrity of the unique heath communities, trails should be carefully situated and constructed (preferably along the existing mountain road and powerline cut); any concentration of picnic and other recreational facilities should be located well away from the slopes and especially away from the Panther's Den area.

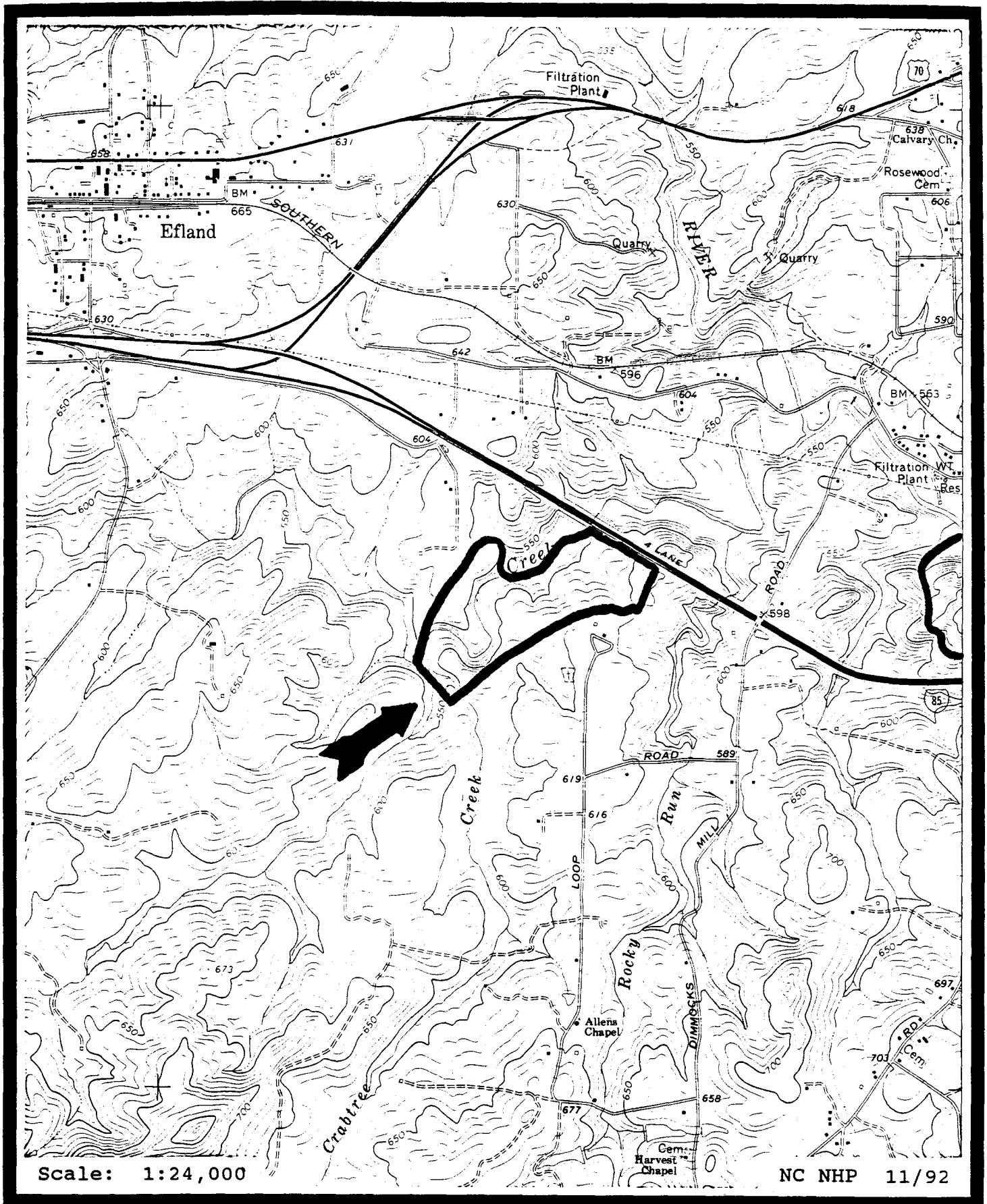
"Benefits of the construction of new radio towers should be weighed against the devaluation of the aesthetic value of the ridgeline of the highest summit in the county. The existing gravel road to the summit, if expanded to receive more regular vehicular traffic, would be disruptive to wildlife and erode much of the aesthetic experience for recreational visitors.

"This is the most significant area in the county, and therefore the site at which decisions about landscape modification should be made most conservatively in order to hand down to posterity an area as natural as possible."

COMMENTS: None

REFERENCES:

- Otte, D.K.S. 1976. Occonechee Mountain Natural Area. Botany 235 class report. University of North Carolina, Chapel Hill, N.C.
- Sather, D. and S. Hall. 1988. Inventory of the natural areas and wildlife habitats of Orange County, North Carolina. Report to Triangle Land Conservancy and N.C. Natural Heritage Program.
- Whetstone, D. 1977. Occonechee Mountain Natural Area. Evaluation report to National Landmarks Program.
- Wood, E. 1973. Pages 84-85. In A.E. Radford [ed.]. 1976. Vegetation, habitats, floras: Natural areas in the southeastern United States -- field data and information. Department of Biology, University of North Carolina, Chapel Hill, N.C.



Site Name: Sevenmile Creek Sugar Maple Bottom
 Site Code: OR3
 Quadrangle: Efland

SITE NAME: Sevenmile Creek Sugar Maple Bottom

SITE CODE: OR3

SIZE: 100 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Orange

QUADRANGLE: Efland

LOCATION: This site is in central Orange County in the Piedmont Province of North Carolina. It is along Sevenmile Creek between Crabtree Creek and I-85; most of the natural area is on the southeast side of the creek, but also included is a mucky drainage on the northwest side.

SIGNIFICANT FEATURES:

1. This site contains good examples of two natural community types: Basic Mesic Forest (Piedmont Subtype) and Piedmont/Low Mountain Alluvial Forest.

2. One rare plant species, purple fringeless orchid (Platanthera peramoena)- a State Candidate species, is found at this site. This is the only site for the purple fringeless orchid in Orange County.

3. A profuse herb layer is present with large patches of such regionally rare species as maidenhair fern (Adiantum pedatum) and blue cohosh (Caulophyllum thalictroides). This is the only site for blue cohosh in Orange County and much of the surrounding Piedmont.

4. The creek possesses a well-developed fish and freshwater mussel fauna which includes the notched rainbow mussel (Villosa constricta), significantly rare in North Carolina.

GENERAL DESCRIPTION:

This site is a narrow bottomland located within an upland stream valley. Its deep and rich circumneutral soils, the result of alluvial deposition on the floodplain and lower slopes, is responsible for the outstanding plant life located here. Trees present at this site include sugar maple (Acer saccharum spp. floridanum), swamp chestnut oak (Quercus michauxii), hackberry (Celtis laevigata), walnut (Juglans nigra), and northern shagbark hickory (Carya ovata). The shrub layer is composed of such basophilic species as bladdernut (Staphylea trifolia), redbud (Cercis canadensis), and hazelnut (Corylus americana). Many of the trees exceed a dbh of 2 feet indicating a long history without disturbance.

The circumneutral or basic pH of the soil together with the cool, moist conditions provided by the lengthy north-facing lower portion of the slope produce conditions favorable to a high diversity of herbaceous plants. Of particular interest is the large population of blue cohosh (Caulophyllum thalictroides), a disjunct species from the mountains with only one location in Orange County. Another typical montane species that grows with the blue cohosh is maidenhair fern (Adiantum pedatum). Another

noteworthy species is the purple fringeless orchid (Platanthera peramoena) which is located in the drainage ditch across the creek from the montane plants.

The stream that flows through this site provides a diversity of habitats for animals, including extensive areas of riffles and sandy-bottomed pools. This portion of Sevenmile Creek receives runoff from upstream fields, yet harbors healthy populations of darters, shiners, pickerels, other species of fish, and mussels. Present here is the notched rainbow mussel (Villosa constricta), a significantly rare species, found at only four other sites within Orange county. An indicator of the good fishing in the creek is the presence of the river otter (Lutra canadensis). Reflecting the good condition of the bottomland forest is the presence of the great-horned owl (Bubo virginianus) and the red-shouldered hawk (Buteo lineatus).

OWNERSHIP: This site is partially in multiple private ownership and partially in Orange County ownership.

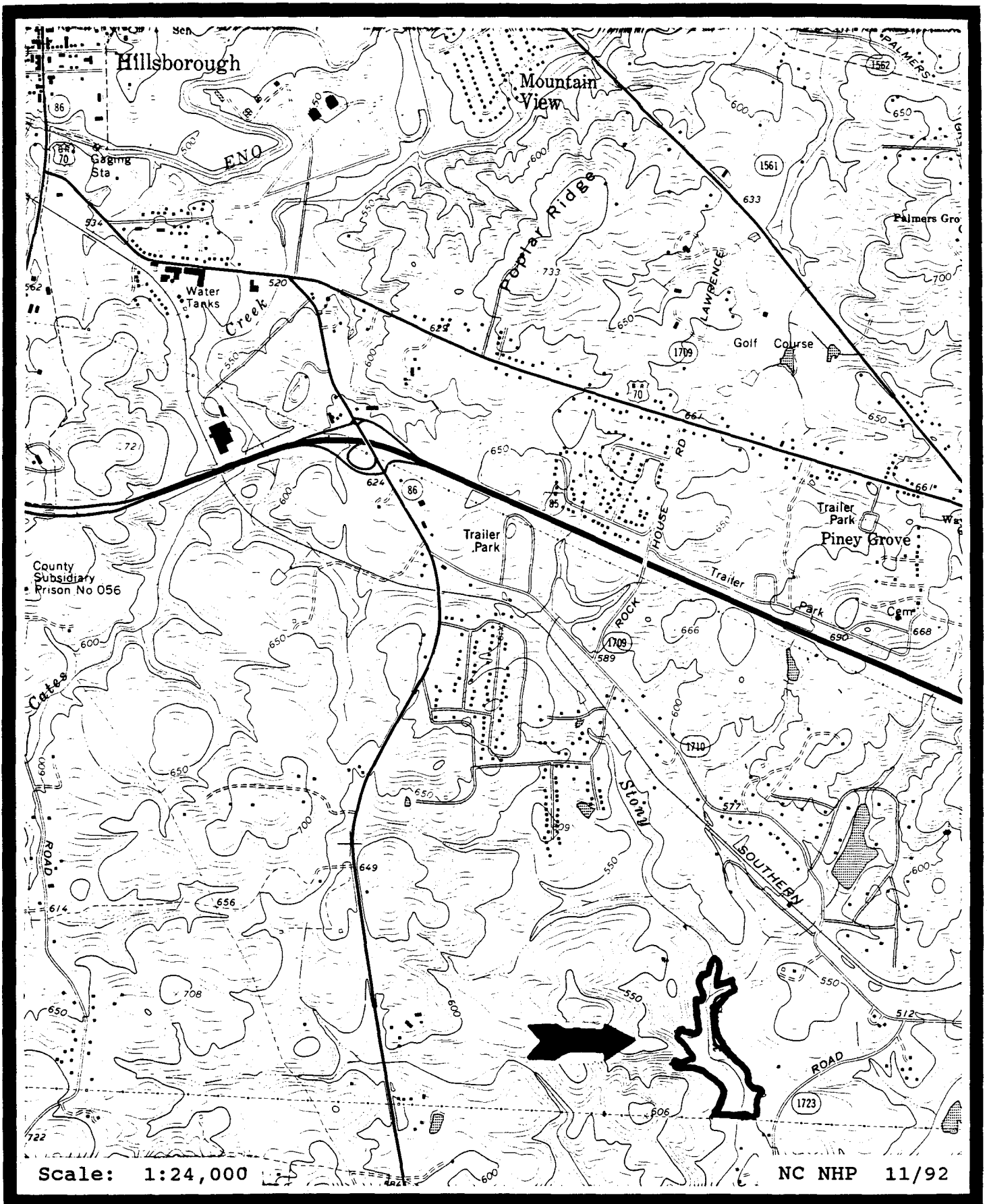
PROTECTION STATUS: The county owned lands are undeveloped, but their protection status is uncertain.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site is significant enough to be preserved as a county-owned natural area.

COMMENTS: Reservoir construction is a potential threat to this site. This site was last visited during the Orange County Inventory in 1988.

REFERENCES:

- Mansberg, L. 1986. Sevenmile Creek. Site survey report. N.C. Natural Heritage Program, Raleigh, N.C.
- Sather, D. and S. Hall. 1988. Inventory of the natural areas and wildlife habitats of Orange County, North Carolina. Report to Triangle Land Conservancy and N.C. Natural Heritage Program.



Site Name: Stony Creek Spring
 Site Code: OR4
 Quadrangle: Hillsborough

SITE NAME: Stony Creek Spring

SITE CODE: OR4

SIZE: 23 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Orange

QUADRANGLE: Hillsborough

LOCATION: This site is in central Orange County in the Piedmont Province of North Carolina. It is due west of the intersection of New Hope Church Road (SR 1723) and Old NC 10 (SR 1710).

SIGNIFICANT FEATURES:

1. An extremely large Low Elevation Seep is located in this area of Duke Forest.

2. This site supports one of the three largest concentrations of the four-toed salamander (Hemidactylium scutatum), a species of Special Concern, in Orange County.

3. The Thorey's grayback dragonfly (Tachopteryx thoreyi), a significantly rare species, also breeds in the restricted habitat offered by this spring.

GENERAL DESCRIPTION (from Sather and Hall 1988):

"The most significant feature of the Eno division of Duke Forest is the large spring [Low Elevation Seep] and adjoining bottomland that occurs along Stony Creek. The spring itself issues from the base of an east-facing slope into a wide and flat boggy area covered with an extensive growth of sphagnum moss. The presence of this moss is essential for the breeding of four-toed salamanders, which lay their eggs only under clumps of moss adjacent to shallow springs or pools; multiple nests were observed at this site in March of 1988. In addition to these state-listed animals, other species can be expected to occur here that also are restricted to spring habitats, including the mud salamander (Pseudotriton montanus) and red salamander (P. ruber).

"The vegetation occupying the wet areas here is characterized by species highly typical of wetlands. The canopy is composed almost solely of red maple (Acer rubrum) and sweetgum (Liquidambar styraciflua), while the subcanopy contains hop hornbeam (Ostrya virginiana), Virginia willow (Itea virginica), spicebush (Lindera benzoin), and American elm (Ulmus americana). Much more diverse is the luxuriant herb layer. Among the numerous species are royal fern (Osmunda regalis), cinnamon fern (O. cinnamomea), shield fern (Dryopteris sp.), lizard's tail (Saururus cernuus), jewel weed (Impatiens capensis), swamp rose (Rosa palustris), false nettle (Boehmeria cylindrica), lycopodium (Lycopodium virginicum), clearweed (Pilea pumila), and abundant sphagnum moss (Sphagnum sp.)."

OWNERSHIP: This site is owned by Duke University.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Notify the Duke Forest managers of the significance of the spring and adjoining bottomland forest. This forest is an important part of the natural area, since it is foraging habitat for adults of both the salamanders and the dragonflies.

COMMENTS: This site was last visited during the Orange County Inventory in 1988.

REFERENCES:

Sather, D. and S. Hall. 1988. Inventory of the natural areas and wildlife habitats of Orange County, North Carolina. Report to Triangle Land Conservancy and N.C. Natural Heritage Program.

PERSON COUNTY NATURAL AREAS

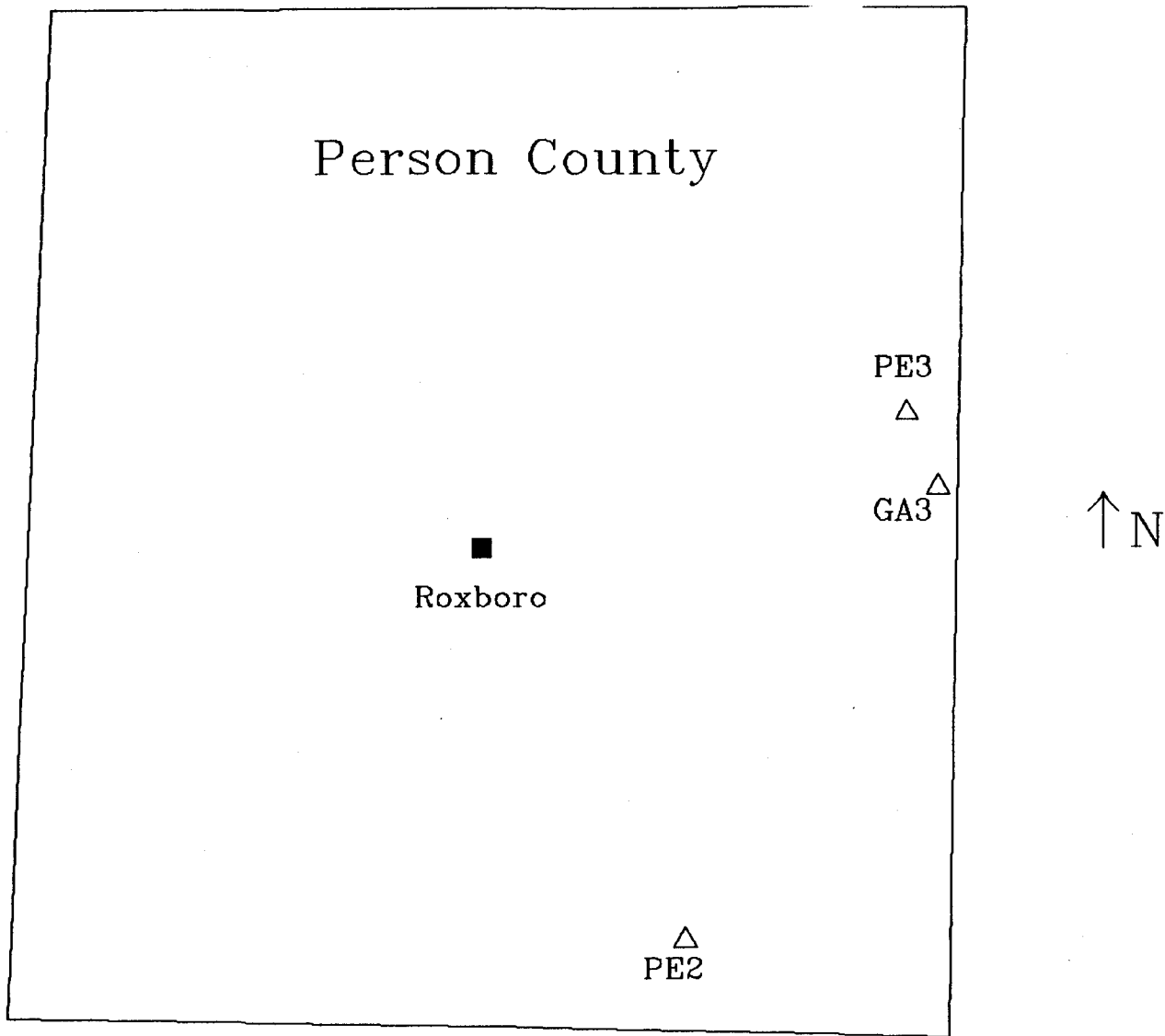
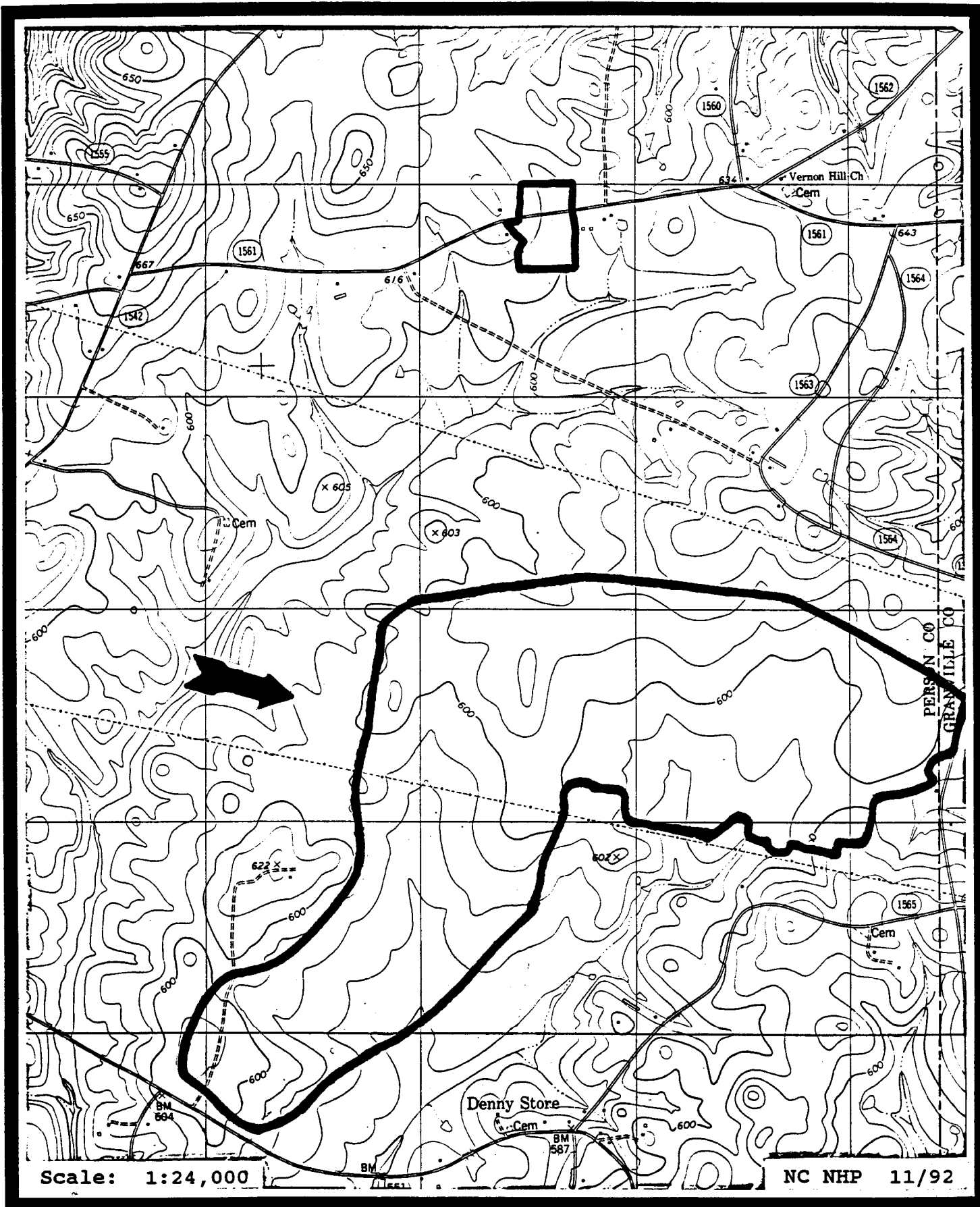


Figure 17. Significant natural areas in the A/P III study area portion of Person County



Site Name: Dennys Store Gabbro Forest
 Site Code: GA3
 Quadrangle: Triple Springs

SITE NAME: Dennys Store Gabbro Forest

SITE CODE: GA3

SIZE: 925 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Person, Granville

QUADRANGLE: Triple Springs

LOCATION: This site is in the Tar River watershed in eastern Person County and western Granville County in the Piedmont Province of North Carolina. It is along the Person/Granville county line, extending from SR 1313 (Granville) southwestward to SR 1536 (Person); about 1 mile north of the community of Dennys Store, N.C.

SIGNIFICANT FEATURES:

1. This natural area contains one of the more extensive areas of gabbro rock in the state.
2. A population of Lewis's heartleaf (Hexastylis lewisii), a State Candidate species, is present at this site.
3. This site supports a mature Basic Oak-Hickory Forest and several other natural communities.

GENERAL DESCRIPTION:

The topography at this site is quite flat and the underlying rock is a gabbro pluton. The site contains a mature Basic Oak-Hickory Forest. The surrounding areas are forested or are being used for agriculture and home sites. This site is somewhat of a continuation of the Goshen Gabbro Forest just to the east. Both of these natural areas lie over the same gabbro pluton.

The Basic Oak-Hickory Forest present at this site is mature and extensive and has an excellent variety of tree species. Common canopy species include: tuliptree (Liriodendron tulipifera), sweetgum (Liquidambar styraciflua), many oaks species [such as white oak (Quercus alba), willow oak (Q. phellos), southern red oak (Q. falcata), and black oak (Q. velutina)], and several hickory species [such as shagbark hickory (Carya ovata), pignut hickory (C. glabra), and red hickory (C. ovalis)]. The subcanopy contains flowering dogwood (Cornus florida), redbud (Cercis canadensis), and red mulberry (Morus rubra), among other species. The shrub layer contains lowbush blueberry (Vaccinium tenellum) and fringetree (Chionanthus virginicus). The herb layer at this site contains species such as: curlyheads (Clematis ochroleuca), partridgeberry (Mitchella repens), and perfoliate bellwort (Uvularia perfoliata). Lewis's heartleaf (Hexastylis lewisii), a State Candidate species, is also present at this site.

OWNERSHIP: Private ownership.

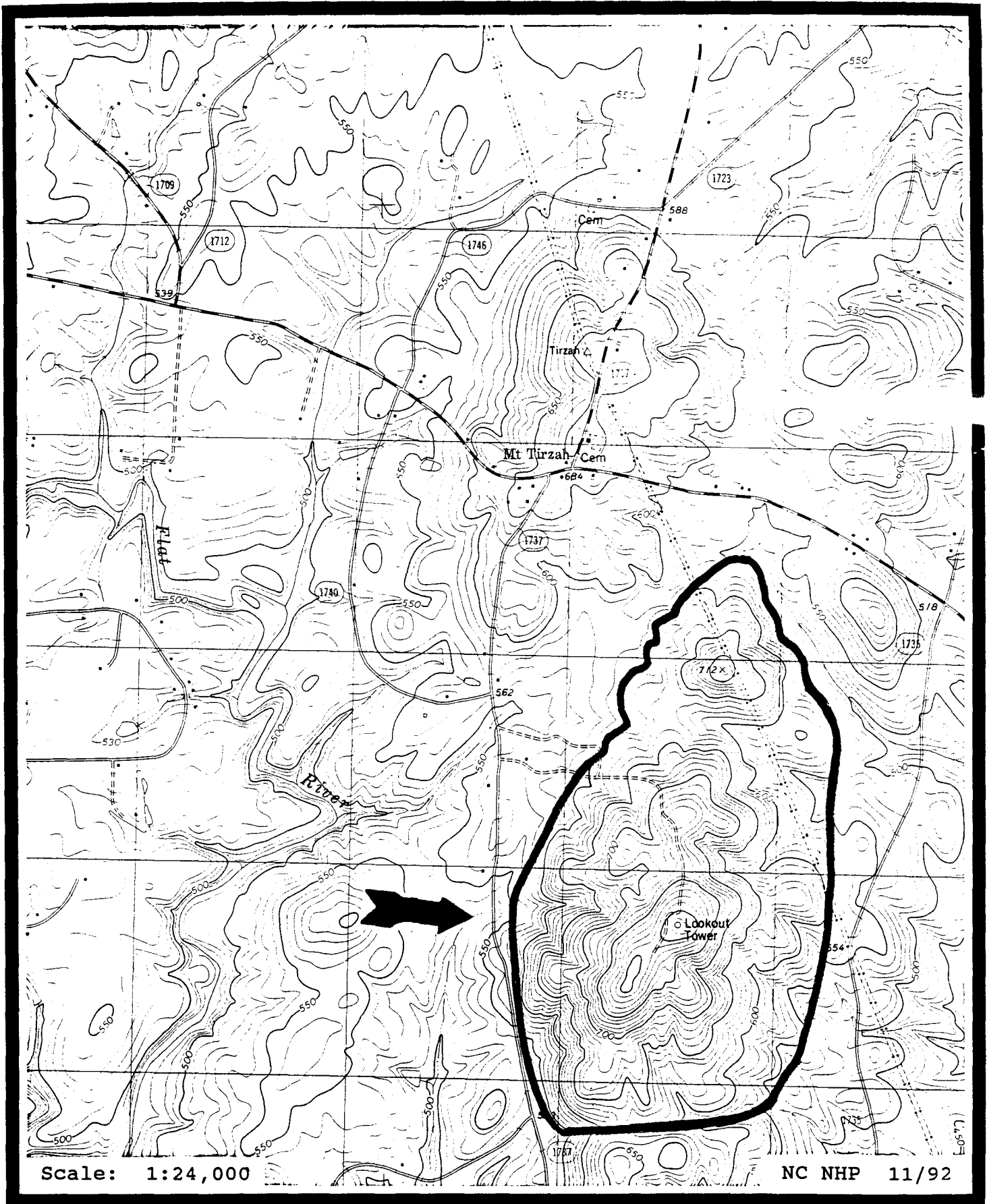
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site is likely to be logged, perhaps within the next few years. There is relatively little pressure from development in this area. Little management is required at this site. The landowner should be informed of the significance of the site and of the various protection options available.

COMMENTS: This site has the potential to support Indian physic (Porteranthus stipulata), a significantly rare species. The northern portions of this site need further survey work.

REFERENCES:

LeGrand, H.E., Jr. 1986. Dennys Store Gabbro Forest.
Preliminary Site Reconnaissance Survey. N.C. Natural
Heritage Program.



Site Name: Mount Tirzah Oak-Hickory Forest
 Site Code: PE2
 Quadrangle: Timberlake

SITE NAME: Mount Tirzah Oak-Hickory Forest

SITE CODE: PE2

SIZE: 690 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Person

QUADRANGLE: Timberlake

LOCATION: This site is in the Neuse River watershed in southern Person County in the Piedmont Province of North Carolina. It is south of SR 1715 and east of SR 1737.

SIGNIFICANT FEATURES:

1. This site contains a good quality Dry Oak-Hickory

Also present is a small population of Indian physic (Porteranthus stipulatus), a plant species significantly rare in the state.

GENERAL DESCRIPTION:

This site contains two summits. The northern, lower one of these is traversed by a transmission line. The southern summit has a road and a firetower. The surrounding slopes are wooded. Small ravines cut into these slopes and boulders are scattered throughout. The geology at the site is of Felsic Metavolcanic Rock.

This natural area contains a good quality second-growth Dry Oak-Hickory Forest. The composition of this forest suggests that portions of this site may have higher than normal pH. It is likely that a Dry-Mesic Oak-Hickory Forest also occurs at the site. The canopy of the forest is closed and is dominated by white oak (Quercus alba) and mockernut hickory (Carya tomentosa). Other canopy trees include among others chestnut oak (Q. prinus), northern red oak (Q. rubra), tuliptree (Liriodendron tulipifera), flowering dogwood (Cornus florida), red mulberry (Morus rubra), black cherry (Prunus serotina), winged elm (Ulmus alata), sweetgum (Liquidambar styraciflua), black gum (Nyssa sylvatica). The shrub layer is composed of New Jersey tea (Ceanothus americanus), downy arrowwood (Viburnum rafinesquianum), mapleleaf arrowwood (V. acerifolium), black haw (V. prunifolium), and fringetree (Chionanthus virginicus) along with young trees. The herb layer is fairly rich; it includes herbs such as grape fern (Botrychium dissectum), southern lady fern (Athyrium filix-femina var. aspleniodies), muscadine grape (Vitis rotundifolia), and pipsissewa (Chimaphila maculata). Indian physic (Porteranthus stipulatus), a significantly rare plant, was found in an old road bed at this site.

OWNERSHIP: Private ownership.

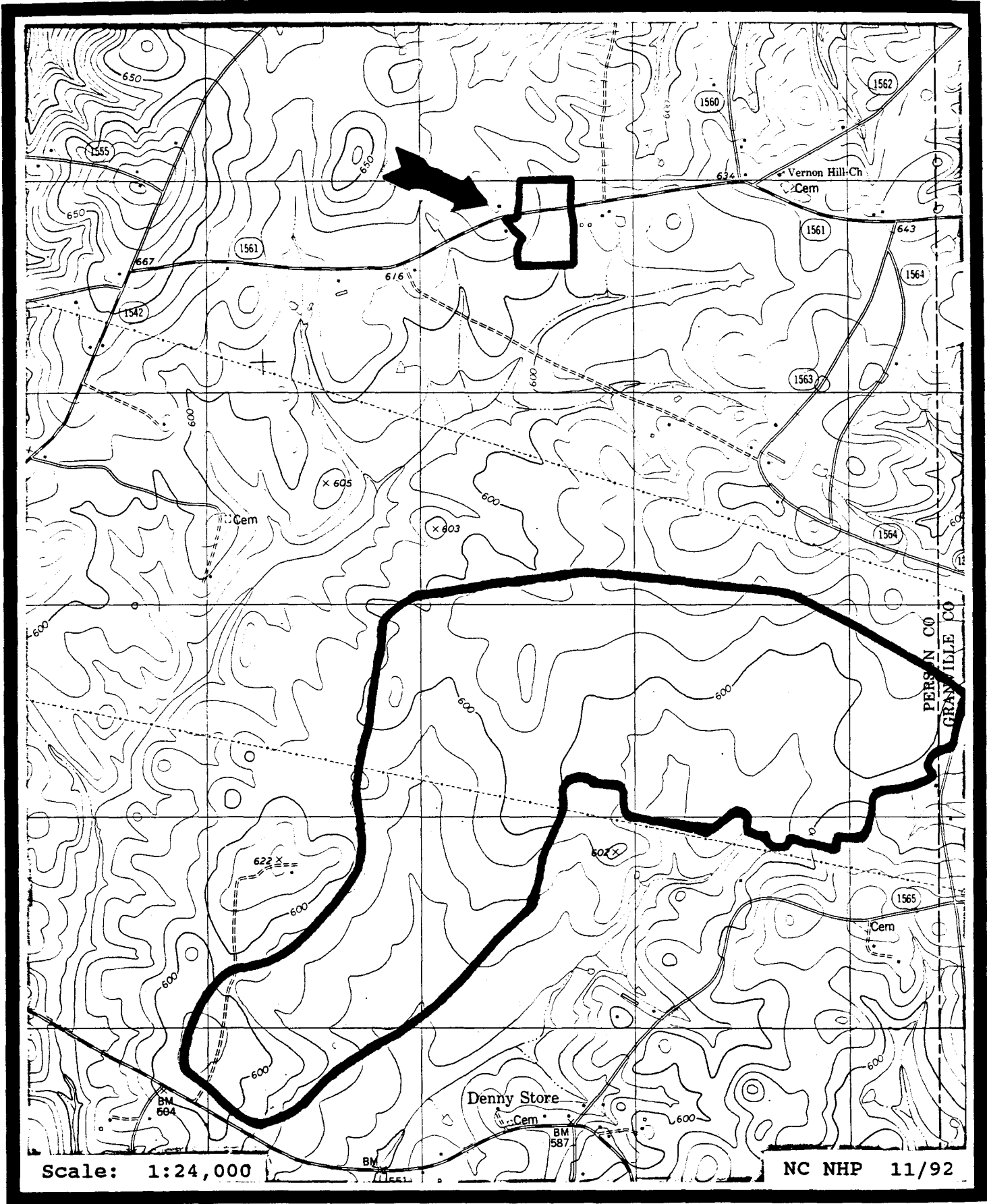
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site could be large enough to be considered as a county park, although houses have been built along the road. The communities and Indian physic population should be protected. The landowner needs to be informed of the significance of the site and of the various protection options available.

COMMENTS: Because this site is so large and because it was visited in late fall, further survey work for rare plants is recommended.

REFERENCES:

Kelly, A. and Z. Murrell. 1992. Mount Tirzah Oak-Hickory Forest. Site Survey Report. N.C. Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Vernon Hill Church Road Dry Forest
 Site Code: PE3
 Quadrangle: Triple Springs

SITE NAME: Vernon Hill Church Road Dry Forest

SITE CODE: PE3

SIZE: 12 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Person

QUADRANGLE: Triple Springs

LOCATION: This site is in the Tar River watershed in eastern Person County in the Piedmont Province of North Carolina. It is on the south side of SR 1561; about 0.6 mile west of the intersection of SR 1561 and SR 1560.

SIGNIFICANT FEATURES:

1. This natural area contains a very large population of Lewis's heartleaf (Hexastylis lewisii), a State Candidate species.
2. Indian physic (Porteranthus stipulatus), a significantly rare species, also occurs at this site.

GENERAL DESCRIPTION:

This natural area is apparently rather acidic and is definitely xeric. It is essentially flat and the underlying rock is argillite-graywacke.

This site contains a fairly mature Dry Oak-Hickory Forest with mostly a variety of oaks (Quercus spp.) in the canopy. The dominant trees include white oak (Q. alba), the most common, and southern red oak (Q. falcata), post oak (Q. stellata), scarlet oak (Q. coccinea), and blackjack oak (Q. marilandica). Shortleaf pine (Pinus echinata) is scattered throughout the canopy. In the subcanopy, black gum (Nyssa sylvatica) is abundant. In the shrub layer various blueberries (Vaccinium spp.), such as hillside blueberry (V. pallidum) and deerberry (V. stamineum), are abundant. Examples of herbaceous species present in this forest are large whorled pogonia (Isotria verticillata), dwarf iris (Iris verna), and leopard's-bane (Arnica acaulis). Lewis's heartleaf (Hexastylis lewisii) is abundant at this site and is scattered over several acres. A population of Indian physic (Porteranthus stipulatus) is located mainly along the road.

OWNERSHIP: Single private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The site should be left undisturbed so that the forest can mature. The landowner should be informed of the significance of the site and of the various protection options available.

COMMENTS: A further survey of the site is needed to determine the extent of the population of Indian physic.

REFERENCES:

LeGrand, H.E., Jr. 1985. Vernon Hill Church Road Dry Forest.
Preliminary Site Reconnaissance Survey. N.C. Natural
Heritage Program.

VANCE COUNTY NATURAL AREAS

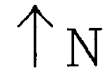
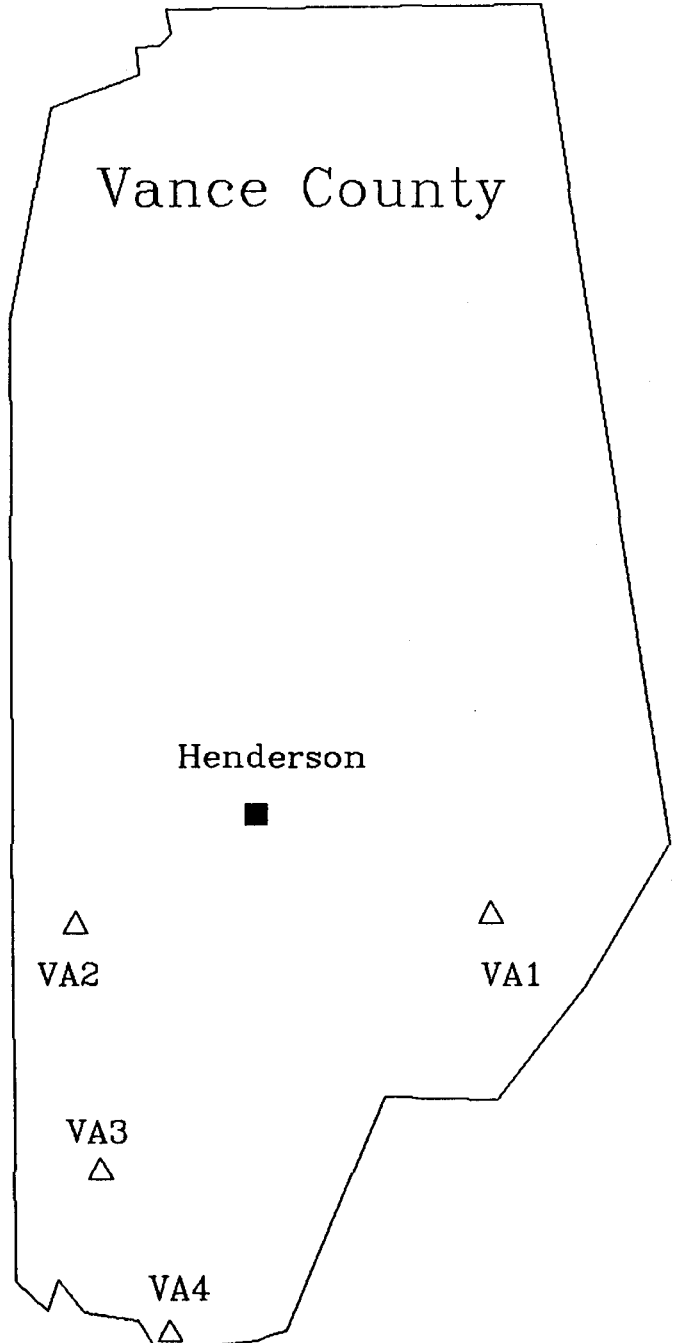
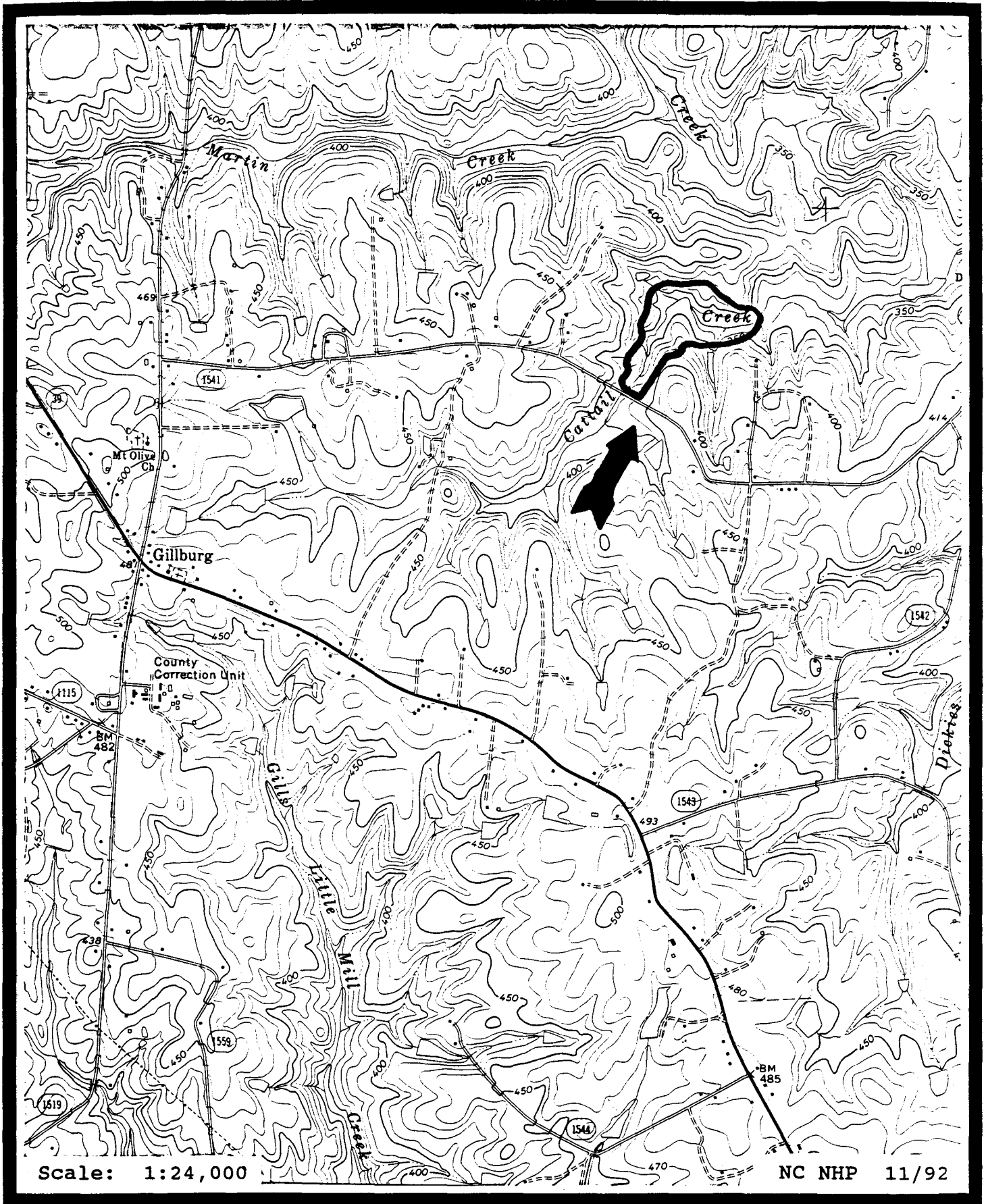


Figure 18. Significant natural areas in the A/P III study area portion of Vance County



Site Name: Cattail Creek Woods
 Site Code: VA1
 Quadrangle: Vicksboro

SITE NAME: Cattail Creek Woods

SITE CODE: VA1

SIZE: 39 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Vance

QUADRANGLE: Vicksboro

LOCATION: This site is in the Tar River watershed in eastern Vance County in the Piedmont Province of North Carolina. It is along Cattail Creek, north of SR 1541; about 3.5 miles southwest of Vicksboro, N.C.

SIGNIFICANT FEATURES:

1. This site contains a large population of Lewis's heartleaf (Hexastylis lewisii), a State Candidate species.
2. A good quality Dry Oak-Hickory Forest is also located at this site.

GENERAL DESCRIPTION:

At this site a small creek (Cattail Creek) flows across a granitic flatrock. Slopes occur along a 0.5 mile section of the creek. An old mill site is also located here. The soil at this site is derived from granite. This site supports two natural communities: Dry Oak-Hickory Forest and Granitic Flatrock.

The Dry Oak-Hickory Forest covers about 25 acres and is located along the slopes of the creek, adjacent to the granitic flatrock. This forest grades into a slightly more mesic forest along the creek and alluvial flat downstream from the outcrop. It is a good quality forest with uneven aged trees, yet has disturbance from farming and an old mill site. The canopy dominants are white oak (Quercus alba), mockernut (Carya alba), and loblolly pine (Pinus taeda). Red maple (Acer rubrum) and flowering dogwood (Cornus florida) are the subcanopy dominants. The shrub layer is dominated by hillside blueberry (Vaccinium pallidum) and American strawberrybush (Evonymus americana). Lewis's heartleaf (Hexastylis lewisii), a State Candidate species, and cranefly orchid (Tipularia discolor) dominate the herb layer.

The Granitic Flatrock community covers about 0.2 acre and is of fairly low quality. This community occurs on a granitic flatrock that is frequently scoured, as indicated by moss mats that are turned over in certain places. The species diversity at this site is low and mesic or streamside species are invading. Eastern redcedar (Juniperus virginiana), American hornbeam (Carpinus caroliniana), and elm (Ulmus sp.) dominate the canopy layer. The herb layer is dominated by fameflower (Talinum teretifolium), rough buttonweed (Diodea teres), and common broomsedge (Andropogon virginicus).

OWNERSHIP: Private ownership.

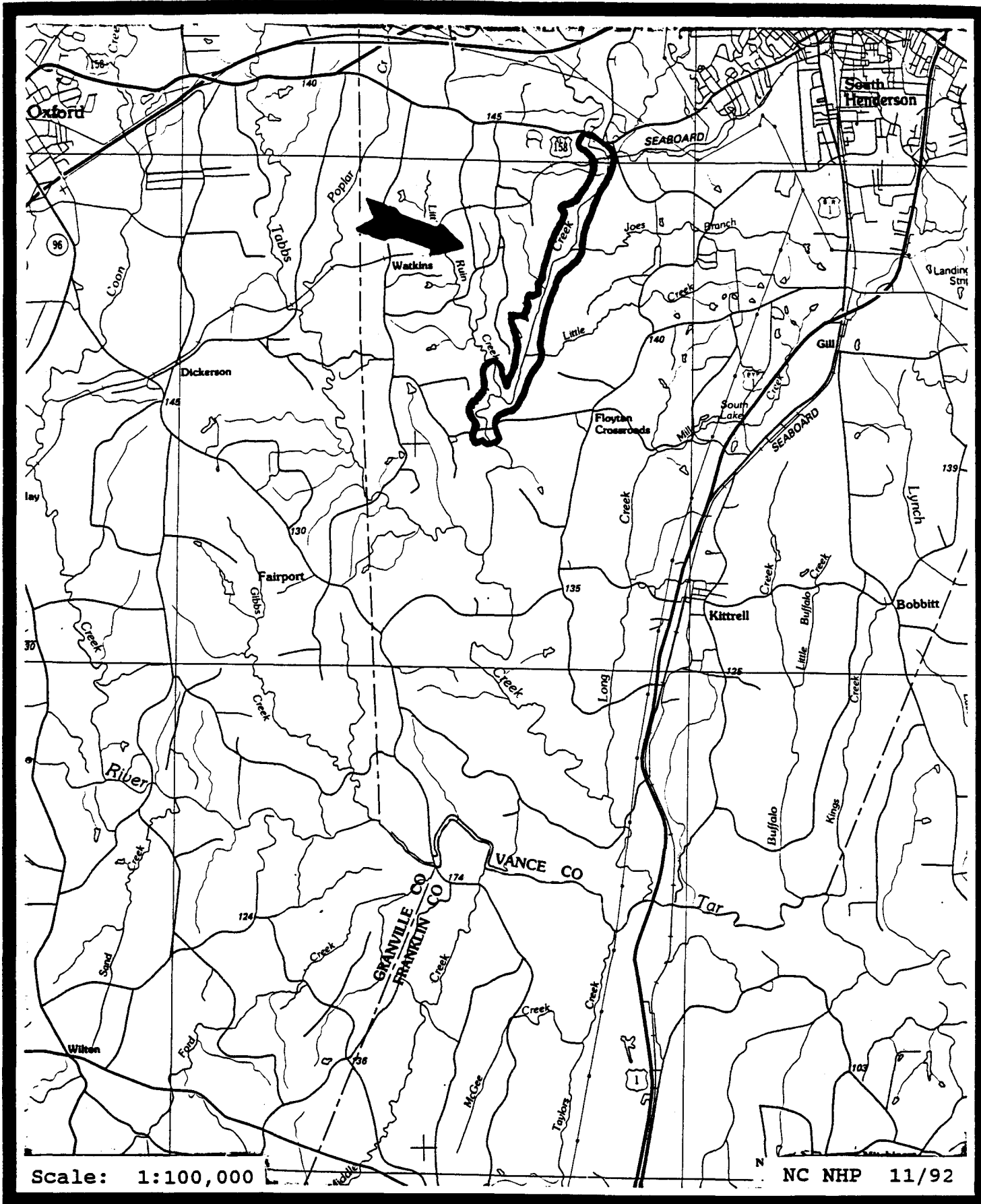
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Clearcutting and development have occurred to the east, west, and north of the site. On the upland margins of the slopes, furrows are evident indicating farming once occurred there. This site needs to be protected from clearcutting and development. The landowner should be contacted to discuss the significance of the site and the various protection options available.

COMMENTS: Because this site was visited in the fall, a spring survey may yield more herbaceous flora.

REFERENCES:

Murrell, Z.E. 1991. Cattail Creek Outcrop. Site Survey Report
N.C. Natural Heritage Program.



Site Name: Ruin Creek Slopes
 Site Code: VA2
 Quadrangle: Henderson

SITE NAME: Ruin Creek Slopes

SITE CODE: VA2

SIZE: 485 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Vance

QUADRANGLE: Henderson (1:100,000 scale)

LOCATION: This site is in the Tar River watershed in western Vance County in the Piedmont Province of North Carolina. It is southwest of Henderson, N.C.; between US 158 and just south of SR 1107.

SIGNIFICANT FEATURES:

1. Three good to excellent quality natural communities are present at this site: Mesic Mixed Hardwood Forest (Piedmont Subtype), Piedmont/Coastal Plain Heath Bluff, and Basic Mesic Forest (Piedmont Subtype), a rare community type.

2. *Isopyrum* (*Enemion biternatum*), a significantly rare plant species, is found at this site.

3. This site contains plants, such as chinquapin oak (*Quercus muehlenbergii*), that require soils containing significant amounts of calcium. Such plants are uncommon to this part of the Piedmont.

4. Another noteworthy species located at this site is southern nodding trillium (*Trillium rugelii*). This is apparently the easternmost population of this species in North Carolina.

5. This site contains an unusual geologic feature, a fault line, that produces a straight line of slopes and a wide floodplain.

GENERAL DESCRIPTION:

Ruin Creek is generally flat and sandy and has a wide floodplain (0.25-0.33 miles wide in most areas). Its west bank is steep and rises abruptly from the creek bed. At the northern end of the site is a large cove (about 3 acres) with north-facing slopes and fairly deep ravines. Near the southern end of the site, the floodplain narrows and the creek twists among large rock outcrops near SR 1107. The southern portion has a wider creek bank with a riverine community. In general, the steepest slopes lie along the west side of the creek. This natural area is on a granitic-gneiss boundary (or fault line). The presence of certain species indicates that the soils are basic. Three natural communities are present: Mesic Mixed Hardwood Forest (Piedmont Subtype), Piedmont/Coastal Plain Heath Bluff, and Basic Mesic Forest (Piedmont Subtype).

The Mesic Mixed Hardwood Forest (Piedmont Subtype) is prevalent in the coves and ravines near US 158 and also in the southern end of the site, near SR 1107 (north of the road). This community is of high quality; however, it covers a small area of

about 3-5 acres. The canopy is dominated by individuals of white oak (Quercus alba) and American beech (Fagus grandifolia) which have a dbh of about 1-2 feet. American hornbeam (Carpinus caroliniana), hophornbeam (Ostrya virginiana), and flowering dogwood (Cornus florida) are the subcanopy dominants. The shrub layer is dominated by painted buckeye (Aesculus sylvatica) and the herb layer is diverse.

The Piedmont/Coastal Plain Heath Bluff is east-facing and is on the west side of the creek. The canopy has scattered large trees of mixed age (dbh's of 1-2 feet) and is dominated by chestnut oak (Quercus prinus), red maple (Acer rubrum), and sugarberry (Celtis laevigata). The subcanopy has sugarberry (Celtis laevigata) as its dominant tree. In the shrub layer wild hydrangea (Hydrangea arborescens), common pawpaw (Asimina triloba), and mountain laurel (Kalmia latifolia) are the dominants. Sedges (Carex spp.) dominate the herb layer. This forest is in good to fair condition. Clearcutting has occurred to the top of the bluff on the west side of the creek.

The Basic Mesic Forest (Piedmont Subtype) natural community type is rare in North Carolina and this site contains an excellent example of it. This community is in excellent condition and covers about 3-8 acres. It occurs on the slopes and in the coves north and south of SR 1107. The forest contains trees of uneven age. The canopy has large trees (dbh's of 1-2 feet) and is dominated by sugar maple (Acer saccharum), red maple, tuliptree (Liriodendron tulipifera), river birch (Betula nigra), American beech, and sycamore (Platanus occidentalis). Also located in the canopy is chinquapin oak (Quercus muehlenbergii), a species which requires basic soils. The dominants of the subcanopy are maples (Acer sp.), flowering dogwood, hophornbeam, and American hornbeam. The shrub layer is dominated by bladdernut (Staphylea trifolia) and mapleleaf arrowwood (Viburnum acerifolium). The herb layer is dominated by isopyrum (Enemion biternatum), Christmas fern (Polystichum acrostichoides), ebony spleenwort (Asplenium platyneuron), and green violet (Hybanthus concolor). Also present in this layer is southern nodding trillium (Trillium rugelii), typically a more western species.

Along the creek is a Piedmont/Low Mountain Alluvial Forest containing many shallow pools. This forest has been thinned somewhat. Unfortunately, this forest has not been well described.

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

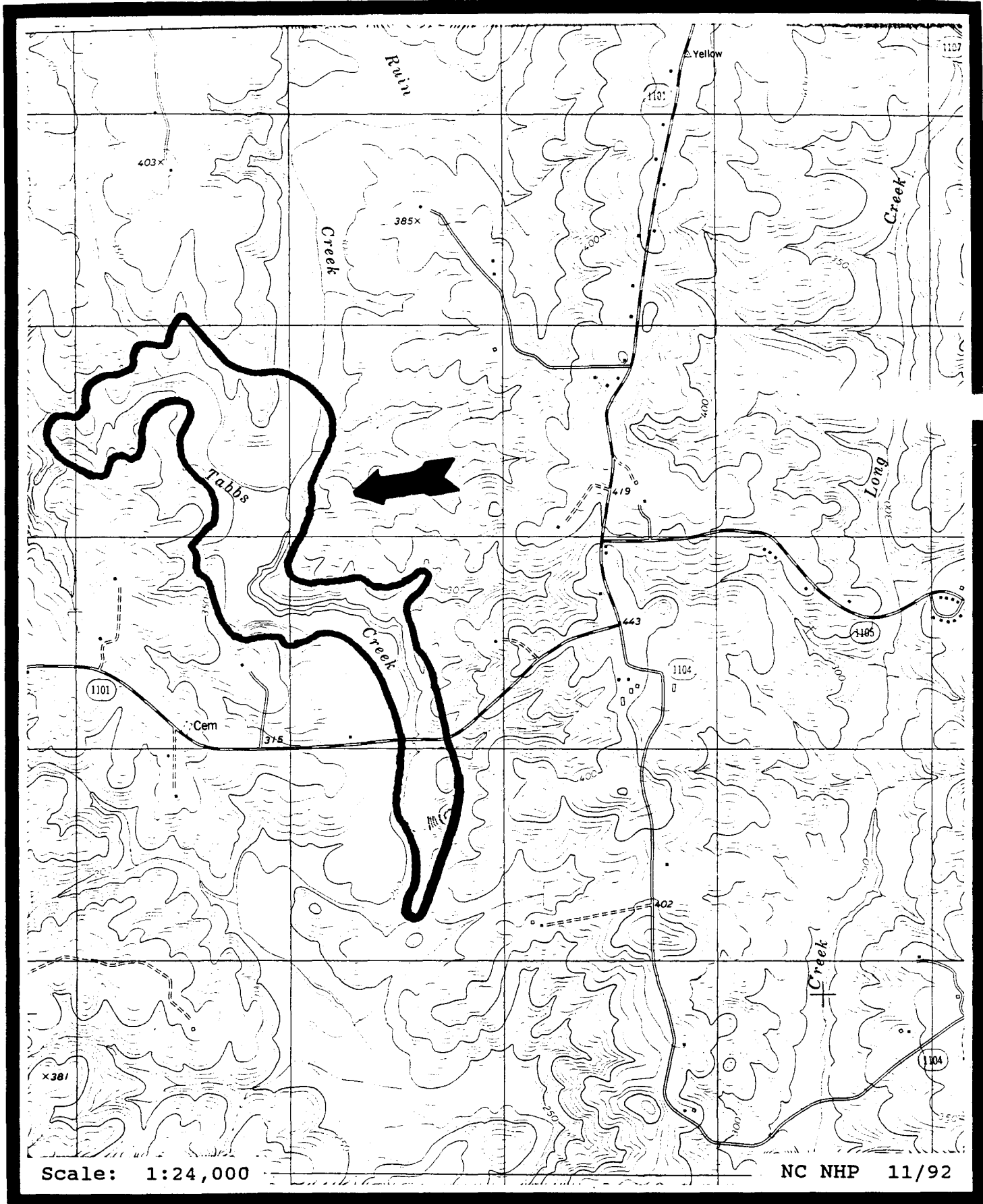
MANAGEMENT OR PROTECTION RECOMMENDATIONS: Threats to this site include development, clearcutting, and encroachment by non-native species, for example, Japanese honeysuckle (Lonicera japonica). Clearcutting has taken place up to the crest of the bluffs and along most of the east side of the creek. The Ruin Creek

corridor between the north and south cove sites is very narrow because of the clearcutting. Development and clearcutting should not be allowed to occur at Ruin Creek. The landowner should be informed of the significance of the site and of the various protection options available.

COMMENTS: It is recommended that an additional site survey be conducted to locate additional herbaceous species, locate more isopyrum populations, and get a better description of the Piedmont/Low Mountain Alluvial Forest located there.

REFERENCES:

LeGrand, H.E., Jr. 1985. Ruin Creek. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
Murrell, Z.E. 1991. Ruin Creek. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Tabbs Creek Rich Slopes
 Site Code: VA3
 Quadrangle: Kittrell

SITE NAME: Tabbs Creek Rich Slopes

SITE CODE: VA3

SIZE: 137 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Vance

QUADRANGLE: Kittrell

LOCATION: This site is in the Tar River watershed in southern Vance County in the Piedmont Province of North Carolina. It is about 2.5 miles west of Kittrell, N.C.; north and south of SR 1101 on Tabbs Creek.

SIGNIFICANT FEATURES:

1. Buttercup phacelia (Phacelia ranunculacea), a State endemic species, is present in this natural area. This is the only site for this species outside of the Haw-Cape Fear drainage in North Carolina.

2. Two excellent quality natural community types are present at this site: Piedmont/Mountain Bottomland Forest and Basic Mesic Forest (Piedmont Subtype), a rare community type in the state.

3. A very rich herbaceous flora exists at this site. A number of these plant species were not previously reported for Vance County.

GENERAL DESCRIPTION:

Slopes, bluffs, and a floodplain are located along Tabbs Creek in the vicinity of SR 1101. The classic, rich, hardwood slopes are fairly steep and are west, east, and north-facing. The site is at the interface of granitic and gneiss rocks with probably a mafic component. Near the top of one of the slopes is a rock outcrop. Parts of the slopes near their bases are also rocky. Two community types are present at this site: Basic Mesic Forest (Piedmont Subtype) and Piedmont/Mountain Bottomland Forest. The average estimated dbh of the trees in these forests is 1.5 feet and the maximum dbh is about 3-3.5 feet.

The Basic Mesic Forest (Piedmont Subtype) at this site is located on the bluffs and slopes. This forest is of excellent quality, based on tree size and the diversity of the herb layer. The canopy is closed and is dominated by tuliptree (Liriodendron tulipifera), southern red oak (Quercus falcata), shumard oak (Q. shumardii), black walnut (Juglans nigra), American beech (Fagus grandifolia), and sycamore (Platanus occidentalis). Painted buckeye (Aesculus sylvatica) 30 feet tall and hophornbeam (Ostrya virginiana) dominate the subcanopy. The shrub layer is dominated by common pawpaw (Asimina triloba), bladdernut (Staphylea trifolia), hydrangea (Hydrangea sp.), and arrowwood (Viburnum dentatum). The lower slopes have a rich herbaceous flora which includes Dutchman's breeches (Dicentra cucullaria), green violet (Hybanthus concolor), wild chervil (Chaerophyllum procumbens), yellow fumewort (Corydalis flavula), black cohosh (Cimicifuga

racemosa), common alumroot (Heuchera americana), and bloodroot (Sanguinaria canadensis). Buttercup phacelia (Phacelia ranunculacea), a State Candidate species, is also abundant in the herbaceous layer.

The Piedmont/Mountain Bottomland Forest located on the stream floodplain is of excellent quality, based on the size of its trees. This forest is interspersed with areas that appear to have been farmed in the last 50-75 years. The canopy has very large trees and is closed. It is dominated by sugarberry (Celtis laevigata) trees with a 2-3 feet dbh, red oak (Quercus rubra), tuliptree, box elder (Acer negundo), and river birch (Betula nigra). Possum-haw (Ilex decidua) dominates the subcanopy and common spicebush (Lindera benzoin) dominates the shrub layer. The herb layer is dominated by false nettle (Boehmeria cylindrica), Japanese grass (Microstegium vimineum), bottlebrush grass (Hystrix patula), and woodnettle (Laportea canadensis).

OWNERSHIP: Multiple private ownership.

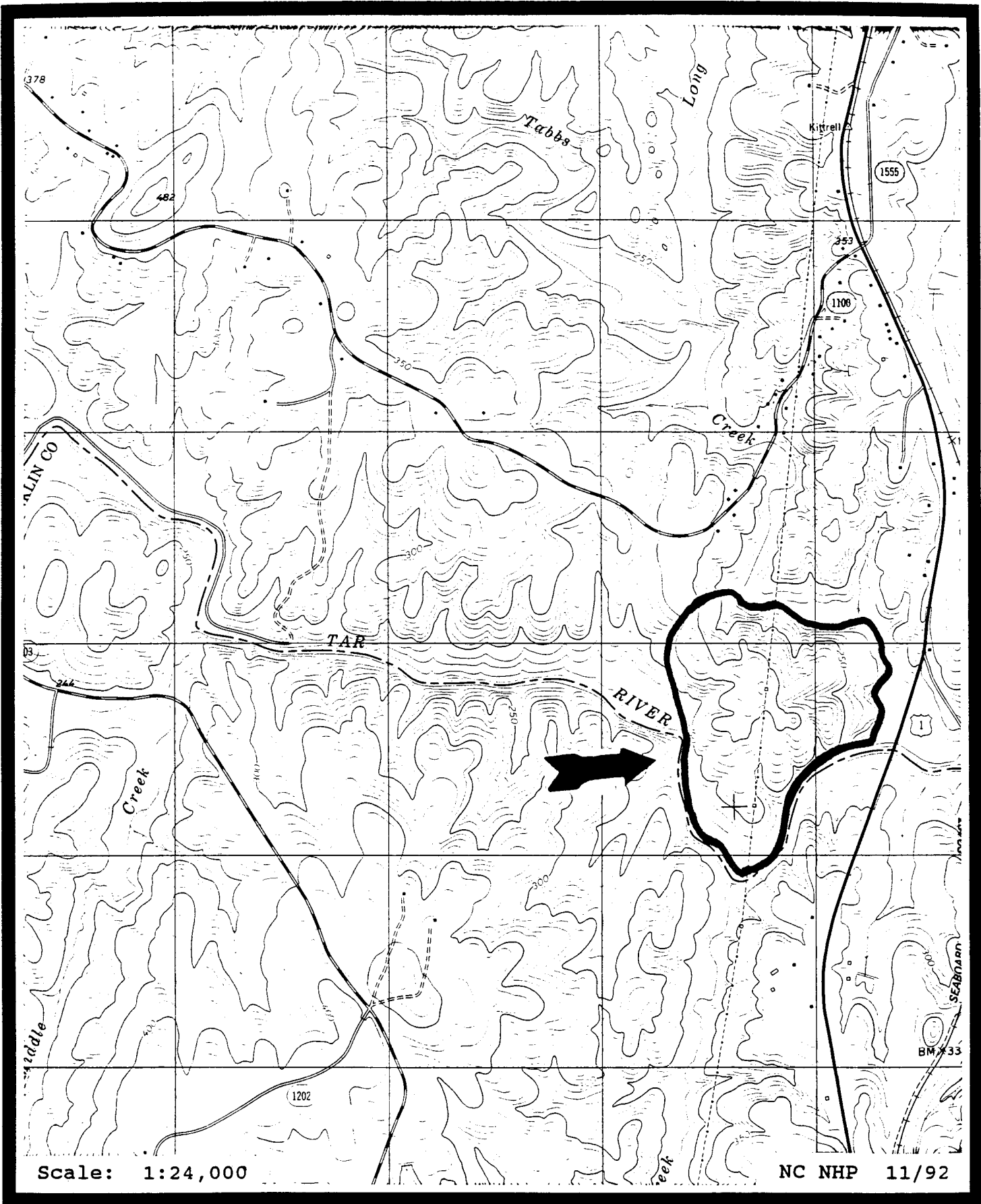
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Evidence of disturbances at this site include logging on the slope to the south of the site and grazing along the alluvial woods at the base of the slope. It is recommended that the area not be logged considering that the rich herbaceous flora is very fragile. The landowners should be informed of the significance of the site and of the various protection options.

COMMENTS: This site has potential for supporting isopyrum (Enemion biternatum), a significantly rare species. Since this survey was conducted in late summer, a spring visit may yield more herbaceous taxa.

REFERENCES:

- Murrell, Z.E. 1991. Tabbs Creek at SR 1101. Site Survey Report. N.C. Natural Heritage Program.
- LeGrand, H.E., Jr. and L. Mansberg. 1985. Tabbs Creek Rich Slopes. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: Tar River Camassia Slopes
 Site Code: VA4
 Quadrangle: Kittrell

SITE NAME: Tar River Camassia Slopes

SITE CODE: VA4

SIZE: 103 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Vance

QUADRANGLE: Kittrell

LOCATION: This site is in the Tar River watershed in southern Vance County in the Piedmont Province of North Carolina. It is along Tar River and Tabbs Creek; about 4 miles south of Kittrell, N.C.; just west of US 1.

SIGNIFICANT FEATURES:

1. Two rare plant species are located at this site: wild hyacinth (Camassia scilloides)- State Threatened, and isopyrum (Enemion biternatum)- significantly rare in the state.

2. This site contains a mature, good quality example of a Basic Mesic Forest (Piedmont Subtype) with large trees. This is a rare community type in the state.

GENERAL DESCRIPTION:

The general landscape is composed of an alluvial floodplain with natural levees. The area is flat to gently sloping, with considerable variation in microrelief. This includes small tributary streams crossing the floodplain, temporary pools, steep banks along the levee, and river channels. Some shallow depressions or excavations are present that have an unknown origin. The geology is of metamorphic-mixed gneiss and schist. Holocene sediments underlie the rich herb community.

Tabbs Creek is deeply cut and slow moving at this site. Slopes are fairly steep on the north side of the Tar River and south of Tabbs Creek. The Tar River is also deep and slow moving at this site. Two natural community types are supported here: Basic Mesic Forest (Piedmont Subtype) and Piedmont/Mountain Bottomland Forest.

The Basic Mesic Forest (Piedmont Subtype) is along the slopes of the Tar River and Tabbs Creek and is a good quality, relatively intact forest with large trees. It covers an area of about 50 acres. The canopy, which is closed, is dominated by American beech (Fagus grandifolia), tuliptree (Liriodendron tulipifera), sugarberry (Celtis laevigata), red maple (Acer rubrum), and red oak (Quercus rubra). The subcanopy is dominated by flowering dogwood (Cornus florida), painted buckeye (Aesculus sylvatica), American hornbeam (Carpinus caroliniana), hophornbeam (Ostrya virginiana), and witchhazel (Hamamelis virginiana). Black haw (Viburnum prunifolium) is the dominant shrub species. In the herb layer Virginia springbeauty (Claytonia virginiana), green dragon (Arisaema dracontium), jack-in-the-pulpit (Arisaema triphylla), sweet chervil (Osmorhiza longistylis), yellow fumewort (Corydalis flavula), wild ginger (Asarum canadense), gill-over-the-ground (Glechoma hederacea), green violet

(Hybanthus concolor), isopyrum (Enemion biternatum) and wild hyacinth (Camassia scilloides) are present. This is one of only two sites for wild hyacinth in North Carolina.

The Piedmont/Mountain Bottomland Forest is located along the banks of the Tar River and is in good condition. It covers about 50 acres and has a closed canopy with large trees. Ash (Fraxinus sp.), sugarberry (Celtis laevigata), tuliptree, box elder (Acer negundo), southern sugar maple (A. floridanum), American sycamore (Platanus occidentalis), and swamp chestnut oak (Quercus michauxii) dominate the canopy. The subcanopy is dominated by possum-haw (Ilex decidua) and hophornbeam. Common spicebush (Lindera benzoin) and Chinese privet (Ligustrum sinense) are the dominant shrub species. The herb layer is dominated by jumpseed (Tovara virginiana), small-flowered crowfoot (Ranunculus abortivus), and jack-in-the-pulpit.

Fauna observations were made during the site survey. Copperheads (Agkistrodon contortrix) and white-tailed deer (Odocoiles virginianus) occur at this site.

OWNERSHIP: Multiple private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Development is occurring in the area north of Tabbs Creek and the Tar River. The slopes of Tabbs Creek have been developed. Other disturbances to this site include recent logging, two ditches cut to channel small tributaries, and a powerline that passes through part of the site. The areas south of the Tar River and east of US 1 have been clearcut. The landowners need to be informed of the significance of the site and of the various protection options available.

COMMENTS: An additional site visit may yield more rare species.

REFERENCES:

- Murrell, Z.E. 1991. Tar River and Tabbs Creek at highway 1. Site Survey Report. N.C. Natural Heritage Program.
Peacock, L. and J.M. Lynch. 1981. Tar River Camassia Slope. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.

WAKE COUNTY NATURAL AREAS

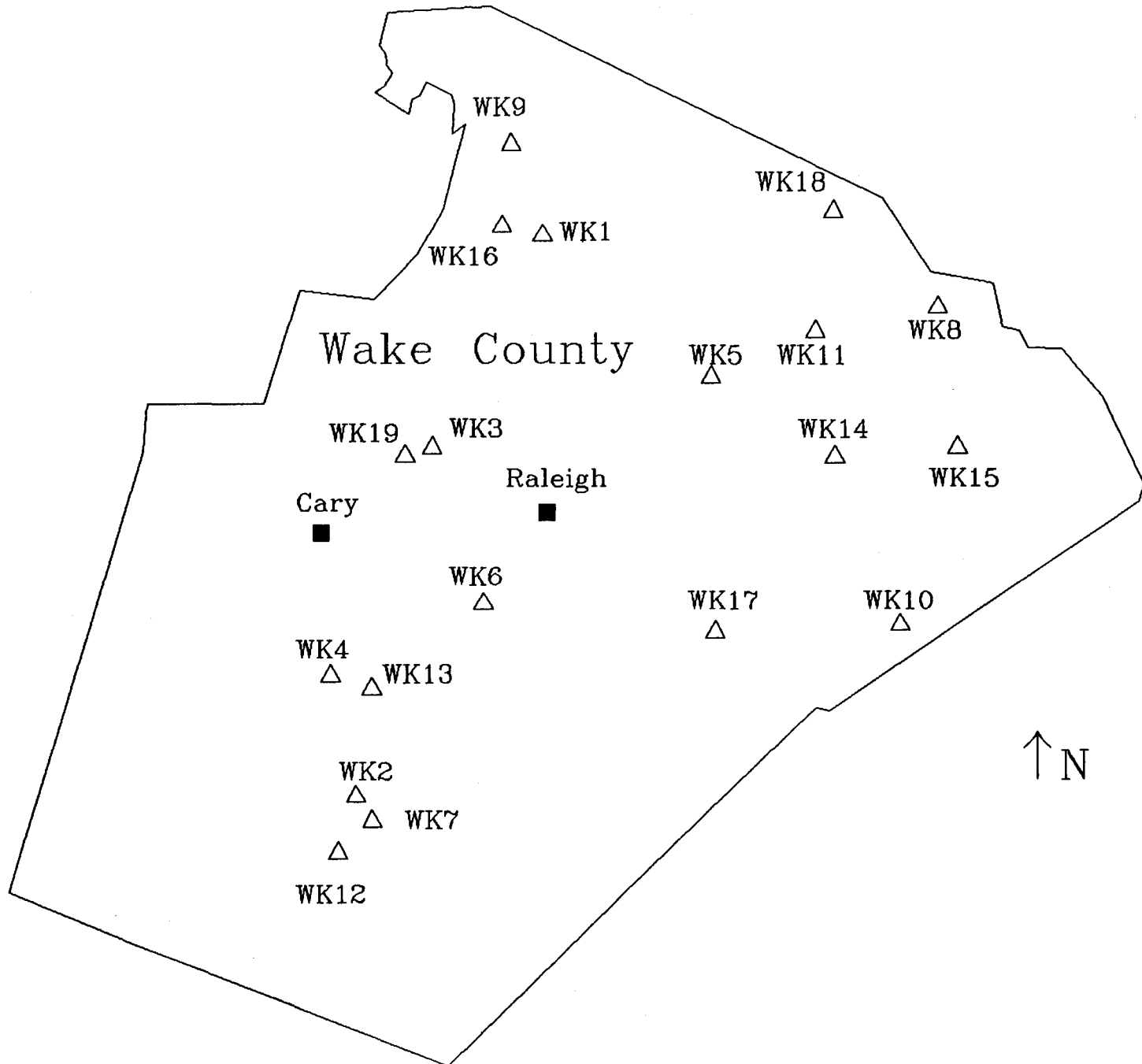
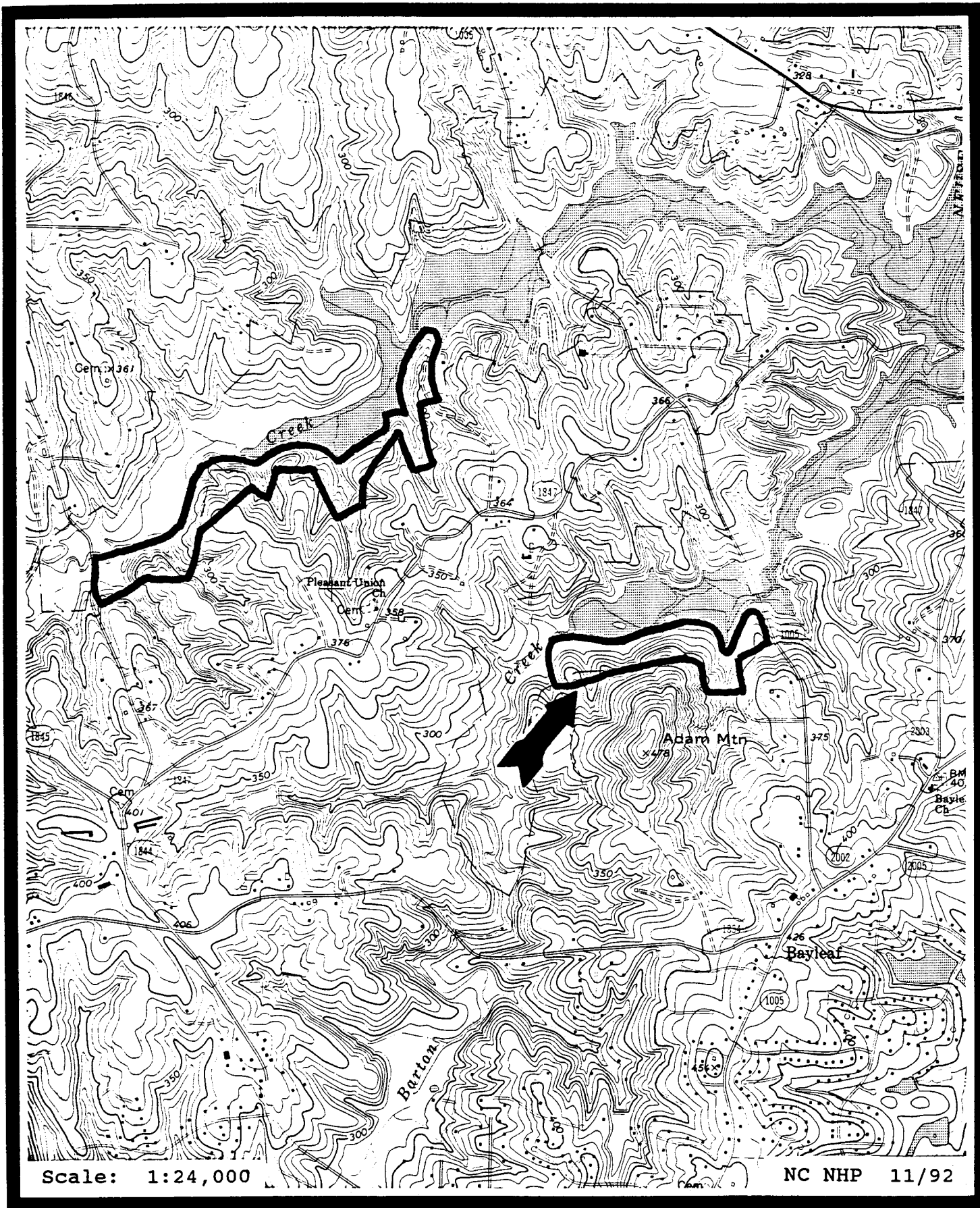


Figure 19. Significant natural areas in the A/P III study area portion of Wake County



Site Name: Adam Mountain
Site Code: WK1
Quadrangle: Bayleaf

SITE NAME: Adam Mountain

SITE CODE: WK1

SIZE: 40 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Wake

QUADRANGLE: Bayleaf

LOCATION: This site is in the Neuse River watershed in northern Wake County in the Piedmont Province of North Carolina. It is located between the arm of the Falls Lake extending southwest along Lower Barton Creek and west of SR 1005, about 1 mile northwest of Bayleaf, N.C.

SIGNIFICANT FEATURES:

1. Adam Mountain is an ultramafic intrusion which supports very distinctive, xeric, open, and barren-like natural community with unusual species associations. This community is an Ultramafic Outcrop Barren natural community, the only example in the Piedmont of North Carolina and one of only two or three sites in the state.

2. This natural area supports a population of the low wild-petunia (Ruellia humilis), a State Threatened species.

GENERAL DESCRIPTION (from Moore and LeGrand 1986):

"Adam Mountain, the second highest point in Wake County, is an ultramafic intrusion with serpentinite, talc, epidote, chlorite, and amphibolite. Float material consisting of boulders up to 10 feet long and 3 feet high is commonly scattered along the slopes. The soil derived from this formation is generally more circumneutral than the acidic soils typical in the region.

"The northeast and northwest slopes of Adam Mountain are forested predominantly by pines and second growth hardwoods. Mesic forests dominated by American beech (Fagus grandifolia) occur in several ravines and at the base of the north slope of Adam Mountain along the edge of the Lower Barton Creek bottomland.

"The area of greatest interest is the upper part of the north slope. The forest in this area appears to be extremely xeric, with an open canopy of somewhat stunted trees. Dominant trees are blackjack oak (Quercus marilandica), post oak (Q. stellata), white oak (Q. alba), black oak (Q. velutina), and shortleaf pine (Pinus echinata)... The herb layer is quite variable. Common throughout the area are curly-heads (Clematis ochroleuca), panic grass (Dichanthelium spp.), seneca snakeroot (Polygala senega), thoroughworts (Eupatorium album, E. pilosum), and a variety of other species. Also of note is the low wild-petunia (Ruellia humilis), [a State Threatened species], which occurs scattered through the area. Openings between trees are commonly occupied by patches of grass, primarily little bluestem (Schizachyrium scoparium). In the lower parts of the barren area, more mesic herbs occur, including mayapple (Podophyllum

peltatum), violets (Viola spp.), Christmas fern (Polystichum acrostichoides), meadow rue (Thalictrum sp.), and bellwort (Uvularia perfoliata). At its edge the barren gives way to closed-canopy forest of similar composition, which eventually grades to the surrounding pine or hardwood forest. Below it grades to Mesic Mixed Hardwoods Forests; above, to typical Dry-Mesic Oak-Hickory Forests.

"A second, more disturbed barren area occurs on a low ridge at the west end of the area. It has only scattered trees, ranging from small to large in size. The common species are loblolly pine (Pinus taeda), red maple, blackjack oak, black cherry (Prunus serotina), sassafras, and dogwood. Shrubs are sparse. The herb layer is dominated by little bluestem and lichen, with curly-heads, goldenrod (Solidago sp.), needle-grass, and other grasses common. This barren area grades to successional pine forest.

"The barren nature with the unusual species composition is believed to be caused by the underlying ultramafic substrate. Barren communities are associated with ultramafic outcrops in other states, and one example is well known in western North Carolina. Although this barren is less extremely developed than some of these others, it is the only example known in the Piedmont of North Carolina."

OWNERSHIP: This natural area is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

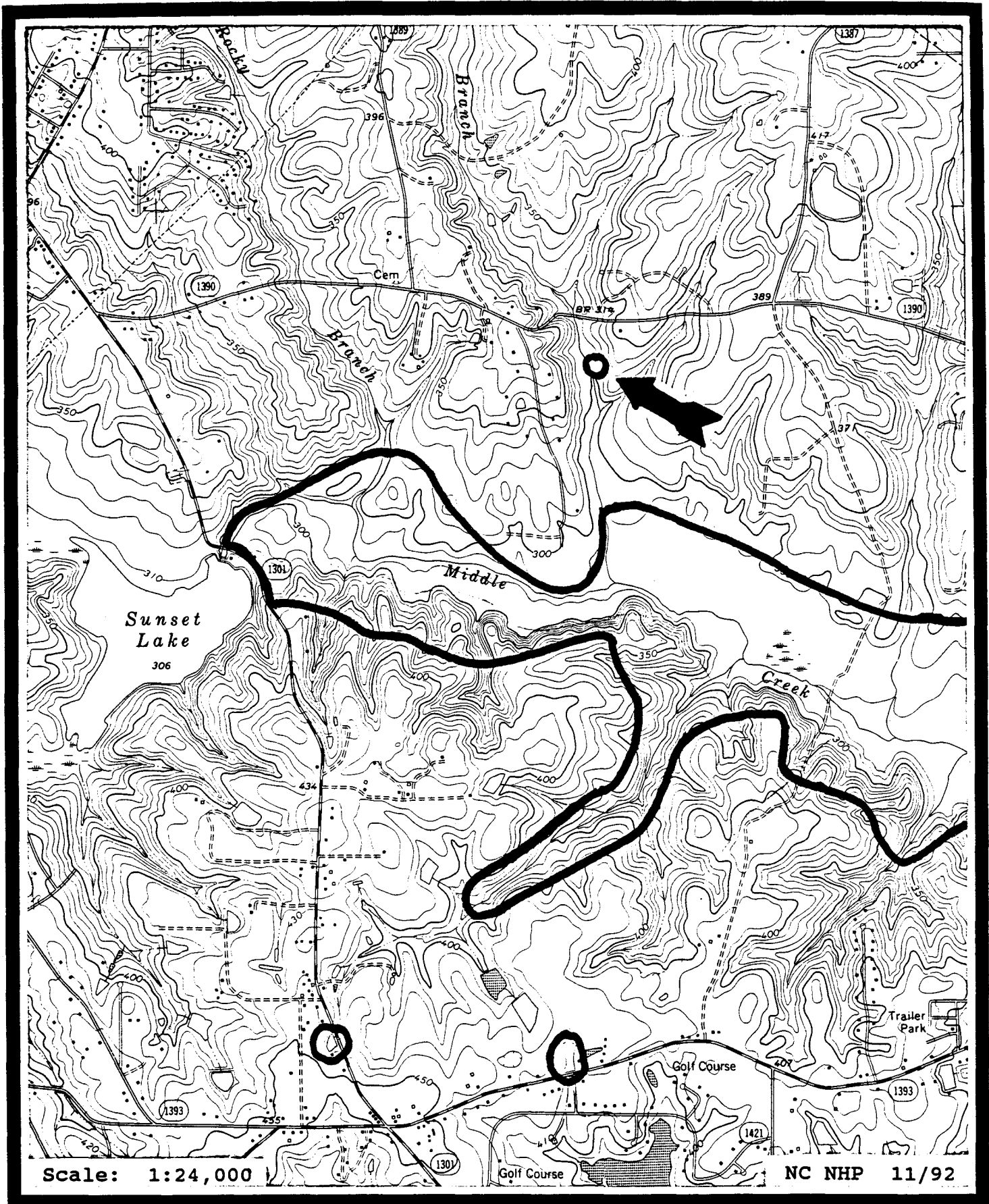
PROTECTION STATUS: This site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This site is managed by the N.C. Wildlife Resources Commission. Like barrens elsewhere, this natural community is probably dependent on fire to prevent slow expansion of woody vegetation. Consideration should be given to prescribed burning at the site.

COMMENTS: Subdivision and residential development has occurred on the privately owned upper portions of the mountain, just south of Corps land. A small portion of the ultramafic barren extends onto this private land and has been degraded by the development.

REFERENCES:

- LeGrand, Jr., H.E. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.
- Moore, J. and H. LeGrand, Jr. 1986. Falls Lake Natural Areas. Registry Report. N.C. Natural Heritage Program.
- Parker, III, J.M. 1979. Geology and mineral resources of Wake County. Department of Natural Resources and Community Development, Raleigh, N.C.



Site Name: Camp Branch Plant Site
 Site Code: WK2
 Quadrangle: Apex

SITE NAME: Camp Branch Plant Site

SITE CODE: WK2

SIZE: less than 1 acre

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Apex

LOCATION: This site is in the Neuse River watershed in western Wake County in the Piedmont Province of North Carolina. It is about 200 yards south of SR 1390, on the east side of Camp Branch; site is approximately 3.5 miles east of Holly Springs.

SIGNIFICANT FEATURES: This natural area contains a dense colony of Lewis's heartleaf (Hexastylis lewisii), a State Candidate species.

GENERAL DESCRIPTION (from LeGrand 1987):

"This site probably contains the densest colony of Lewis's heartleaf (Hexastylis lewisii) known in the state. In an area of less than 10X10 meters², several thousand leaves are present. Also, this site tends to have numerous flowering individuals each spring; many other colonies known in the state seldom if ever produce flowers. The site is in a wooded floodplain at the base of a gentle slope. The canopy trees in the immediate area are willow oak (Quercus phellos), white oak (Q. alba), and red maple (Acer rubrum)."

OWNERSHIP: Private ownership.

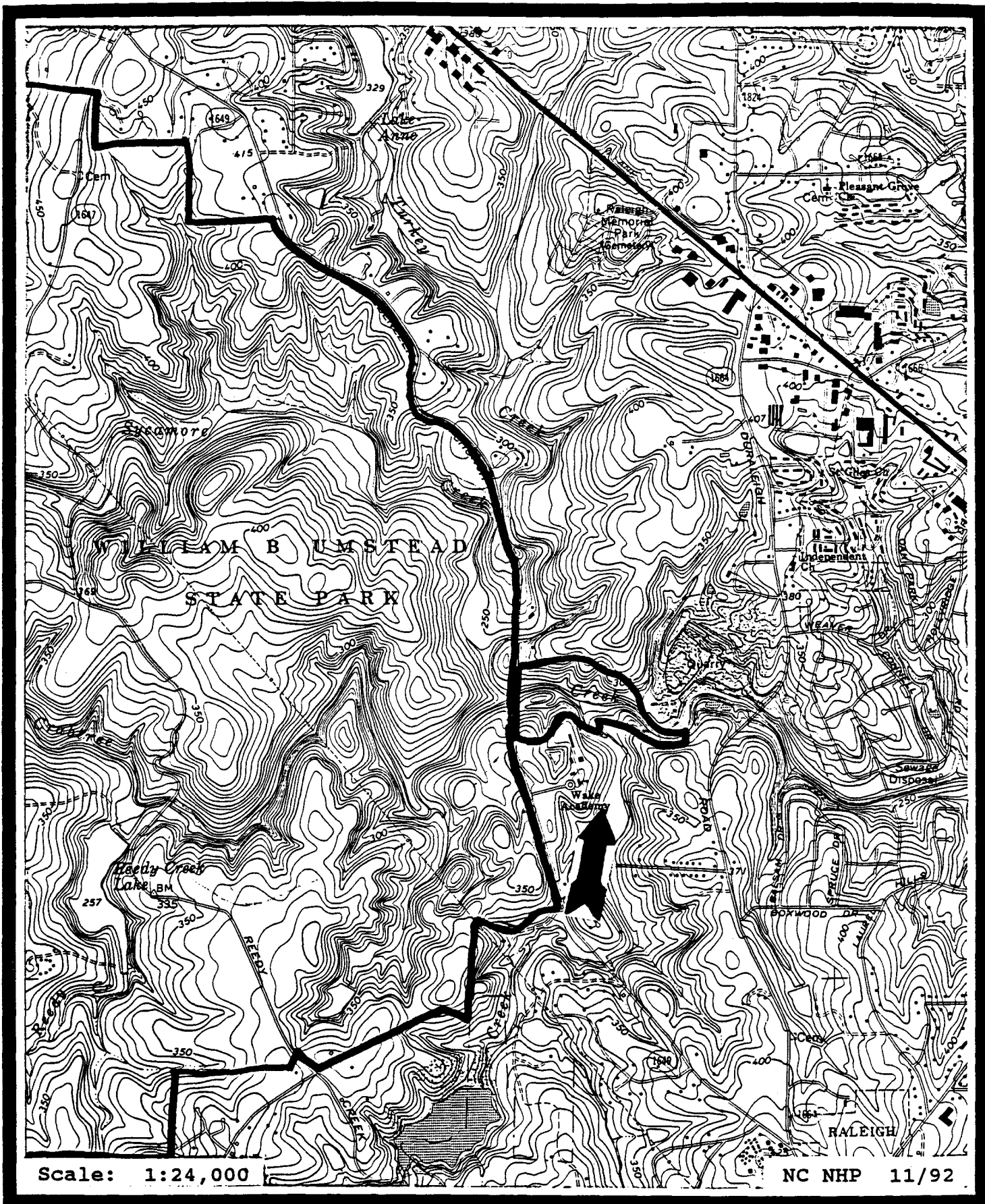
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Because this site contains such a large, vigorous population of Lewis's heartleaf, the site should be protected. The landowner should be contacted to encourage proper management practices or land registry.

COMMENTS: This site has apparently not been surveyed for at least three years. With the somewhat rapid population growth expected in the Holly Springs area in the upcoming decade, this site might be in serious jeopardy.

REFERENCES:

LeGrand, Jr., H.E. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.



Site Name: Crabtree Creek--Ebenezer Church Road Slopes
 Site Code: WK3
 Quadrangle: Raleigh West

SITE NAME: Crabtree Creek--Ebenezer Church Road Slopes

SITE CODE: WK3

SIZE: 46 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Raleigh West

LOCATION: This site is in the Neuse River watershed in western Wake County in the Piedmont Province of North Carolina. It is along both sides of Crabtree Creek (but primarily south of it) between Ebenezer Church Road (SR 1649) and SR 1664. The site is immediately downstream of Umstead State Park along Crabtree Creek.

SIGNIFICANT FEATURES:

1. Amphibolite rock present at this site causes the soil to be less acidic than in most of the county, perhaps almost circumneutral in pH, which contributes to a rich herb layer.

2. At this site is a steep north-facing slope with Catawba rhododendron (Rhododendron catawbiense), an uncommon plant in the eastern Piedmont. This is just one of about three sites for this species in the county.

3. Glade milkvine (Matelea decipiens), a significantly rare species, grows on exposures on amphibolite in the natural area.

4. An eastern disjunct population of the rather rare chinquapin oak (Quercus muhlenbergii) is also present.

GENERAL DESCRIPTION:

"This natural area is really a conglomerate of several distinct natural communities. The westernmost slopes are underlain by amphibolite, which produces a rich soil with a circumneutral to slightly acidic character. The forests on the slopes here are primarily Mesic Mixed Hardwoods, though Dalton (1985) considers them to be Basic Mesic Forest (Piedmont Subtype) instead. The canopy is dominated by American beech (Fagus grandifolia), with white oak (Quercus alba), hickories (Carya spp.), and tuliptree (Liriodendron tulipifera) also important. A lush spring-flowering herb layer is present, with green violet (Hybanthus concolor) a good indicator of circumneutral soil conditions. Also present on these slopes are ginseng (Panax quinquefolius) and doll's eyes (Actaea pachypoda).

"The alluvial forest (Piedmont/Mountain Alluvial Forest) along Crabtree Creek is a fairly typical one for the eastern Piedmont, with such trees as river birch (Betula nigra) and southern sugar maple (Acer floridanum) being common. One plant rare for the eastern Piedmont grows in abundance in one bottomland area -- Virginia waterleaf (Hydrophyllum virginianum). Bulbous cress (Cardamine bulbosa) is another uncommon wildflower of the bottomland" (LeGrand 1987).

A third community type (a Piedmont/Coastal Plain Heath Bluff) occurs on a steep north-facing slope at the extreme

eastern end of the natural area where the soils maintain a substantially lower Ph. This community has an open canopy with white oak, post oak (Q. stellata), and American beech (Fagus grandifolia) dominating. Also occurring here is a stand of Catawba rhododendron (Rhododendron catawbiense). Such stands of this typically montane shrub are scarce in the eastern Piedmont, though there are at least two other stands farther west on Crabtree Creek.

Field work at this natural area since 1987 has yielded several additional noteworthy plant species. The presence of a stand of chinquapin oak (Q. muhlenbergii), previously mistaken for the similar-looking swamp chestnut oak (Q. michauxii), implies that much of the slopes should indeed be considered Basic Mesic Forest, as the former oak is an obligate species on basic/circumneutral soils. A small area along Ebenezer Church Road at the southern end of the natural area is quite rocky, with the significantly rare glade milkvine (Matelea decipiens) being present on the roadbank. This area contains much eastern redcedar (Juniperus virginiana) and is probably a successional stage of the Basic Oak-Hickory Forest natural community, which is very rare in the A/P III study area.

OWNERSHIP: Multiple private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

This site has undergone considerable threats in the past decade. A sewerline was constructed through the middle of a rich wildflower slope on the north side of Crabtree Creek in the amphibolite area. Equestrian trails traverse the entire site, causing some erosion and making walking difficult in wet weather. The forests surrounding the rhododendron bluff have been cleared, and a quarry lies directly across the creek from the bluff. A proposed flood-control dam was scheduled to be constructed along Crabtree Creek in the natural area. However, these plans have been cancelled because of potential harm to Umstead State Park, farther upstream.

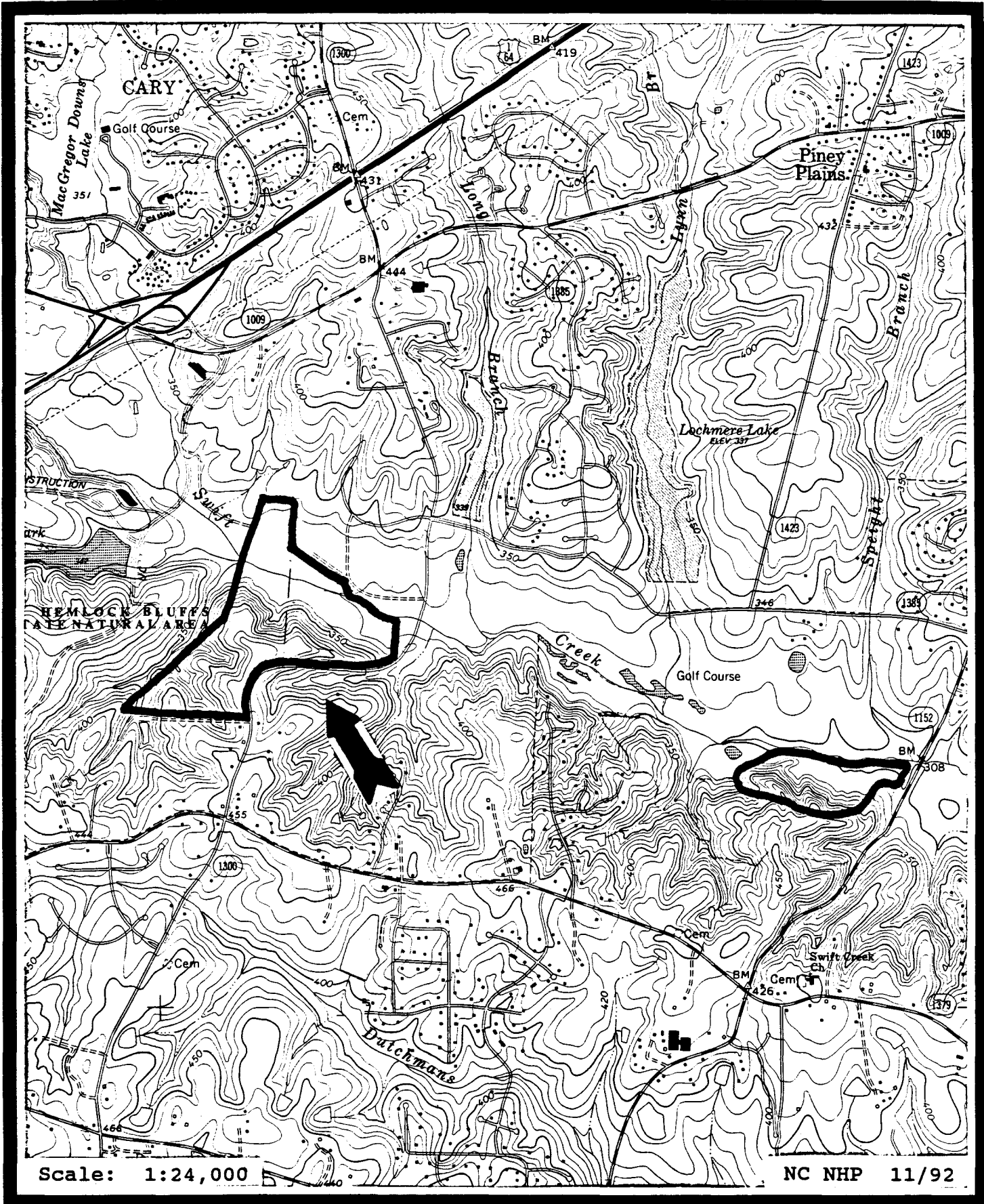
The site needs to be protected from further degradation considering the threats that already exist. One way to protect the natural area would be to include it within the acquisition plan boundaries of Umstead State Park. The landowners need to be informed of the significance of the site and of the various land protection options available.

COMMENTS: Further surveys of areas especially upstream along Richland Creek are recommended.

REFERENCES:

Dalton, B.R. 1985. Crabtree Creek Environs - Downstream from Ebenezer Church Road. Natural Area Reconnaissance. N.C. Natural Heritage Program.

LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.



Site Name: Hemlock Bluffs State Natural Area
 Site Code: WK4
 Quadrangle: Apex

SITE NAME: Hemlock Bluffs State Natural Area

SITE CODE: WK4

SIZE: 140 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Wake

QUADRANGLE: Apex

LOCATION: This site is in the eastern portion of Wake County in the Neuse River watershed in the Piedmont Province of North Carolina. It is located south of Cary, N.C. along Swift Creek, immediately upstream from SR 1300.

SIGNIFICANT FEATURES:

1. Sweet pinesap (Monotropsis odorata), a State Candidate plant species, is found in this natural area.
2. The site has good, though small, examples of Piedmont/Coastal Plain Heath Bluff, Mesic Mixed Hardwood Forest, and Piedmont Monadnock Forest community types.
3. This site has a highly disjunct population of Canadian hemlock (Tsuga canadensis) which occurs 200 miles from the normal range of hemlock in the Appalachian mountains.
4. A rich population of wildflowers is present on the slopes east of the hemlock bluffs.
5. This natural area has an excellent diversity of salamanders; these include the four-toed salamander (Hemidactylium scutatum)- a species of Special Concern.

GENERAL DESCRIPTION:

Hemlock Bluffs is widely known for its stand of Canada hemlock (Tsuga canadensis), occurring some 200 miles from the hemlock populations in Appalachian Mountains. This isolated occurrence is the result of past migrations of mountain species into the Piedmont during the glacial periods over 10,000 years ago. The bluff's cool microclimate allows the relict hemlocks to persist. The trees are located on 3-4 acres of the steep (80-foot high), north-facing slopes on the south side of Swift Creek. Several other plants with montane affinities are present at this site, including chestnut oak (Quercus montana), yellow Lady's slipper (Cypripedium calceolus var. pubescens), showy orchis (Orchis spectabilis), galax (Galax aphylla), and mountain laurel (Kalmia latifolia). Sweet pinesap (Monotropsis odorata), a State Candidate plant species, is also present.

"An in-depth study of the mosses (Anderson and Crosby 1967) at Hemlock Bluffs revealed even more disjunct plants. Of the 64 species of mosses collected on the bluff, five species are disjunct from the mountains and four are essentially montane with few known locations in the piedmont or coastal plain..." (LeGrand 1987).

The steepest part of the bluff is nearly vertical and consists of bare ground with patches of trees, shrubs, and herbs. On the less steep bluffs and in the ravines are mesic forests

dominated by American beech (Fagus grandifolia) and red oak (Quercus rubra). Wildflower diversity is high on the slopes and bluffs.

Other than the mesic hardwood forest communities and American beech-dominated slopes, the communities of the uplands and floodplain at this site are relatively young. A small area at the site contains a marginally developed Piedmont Monadnock Forest, dominated by chestnut oak. Other areas have a mixture of many oak and hickory species.

Significant animal species also occur at this site. Faunal research has been conducted at this site by the North Carolina State Museum of Natural History. A new species of crayfish in the genus Orconectes was reported for the creek. The bottomlands support a variety of turtle species, including the spotted turtle (Clemmys guttata). Other animals present at this site include the four-toed Salamander (Hemidactylium scutatum), a species of Special Concern, and the redback salamander (Plethodon cinereus). These amphibians breed in the semi-permanent pools and ditches on the Swift Creek floodplain and live in the surrounding forested bottomlands and slopes. The presence of such a diversity of salamanders, the overall quality of this site, and loss of similar habitats elsewhere make this the most important salamander habitat in Wake County.

OWNERSHIP: The state owns 84.7 acres of this site and the town of Cary owns about 50 acres. The portion of the site owned by the state is leased to the town of Cary for management.

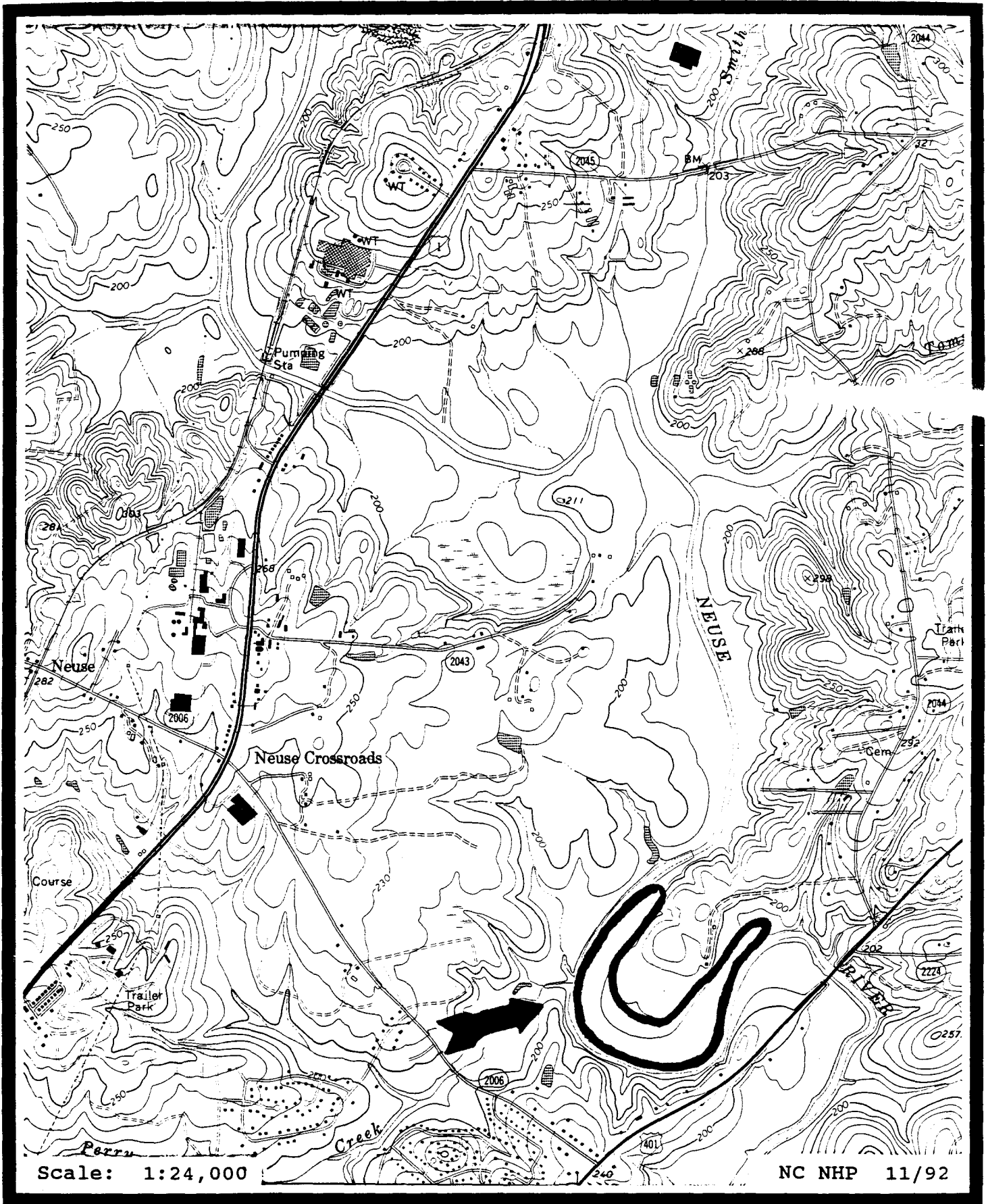
PROTECTION STATUS: The site is a North Carolina State Natural Area and is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The state-owned portion of the natural area is leased to the town of Cary for management. The site receives heavy public use. Hardened trails and wooden overlook platforms have been built at the site. Continuous protection against trampling, littering, and vandalism is needed. Public climbing on the cliffs should be avoided due to problems with erosion.

COMMENTS: The public-owned land north of the creek is to be developed for athletic fields and the area along SR 1300, south of the wildflower slopes, is to be developed for a visitor center. The Master Plan calls for increased monitoring and protection of the site by the town of Cary. These proposed construction plans are described in the Master Plan for the Hemlock Bluffs Nature Preserve (town of Cary Parks & Recreation Department 1987). Adjacent lands on the west side of the site have been developed.

REFERENCES:

- Anderson, L.E. and M.R. Crosby. 1967. The mosses of a relict hemlock stand in the eastern piedmont of North Carolina. *The Bryologist* 70:299-311.
- LeGrand, Jr., H.E. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.
- Roe, C. and J. Moore. 1984. Hemlock Bluffs Natural Area. Registry Report. N.C. Natural Heritage Program, Raleigh.
- Town of Cary Parks & Recreation Department. 1987. Master Plan For Hemlock Bluffs Nature Preserve & Lochmere Park.



Site Name: Horseshoe Farm Bottomland Forest
 Site Code: WK5
 Quadrangle: Wake Forest

SITE NAME: Horseshoe Farm Bottomland Forest

SITE CODE: WK5

SIZE: 65 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Wake Forest

LOCATION: This site is in the Neuse River watershed in northern Wake County in the Piedmont Province of North Carolina. It is on the north side of the Neuse River, just west of US 401; inside a horseshoe bend (meander) in the river.

SIGNIFICANT FEATURES: This is one of the better examples of natural levees in the eastern Piedmont. The undisturbed nature of the forest, with a climax forest of tall hardwoods, makes this a very scenic area, as well.

GENERAL DESCRIPTION:

This natural area is located in a horseshoe bend of the Neuse River and contains a mature, essentially non-disturbed hardwood forest. A well-developed natural levee and a few floodplain pools (dry during the site visit) are present. Several tiers of natural levees, with lower topography behind them, including a few floodplain pools, are present at this site. This area lies over the Rolesville Pluton, though no exposed granite is present. The soils are described as Congaree fine sandy loam. Three natural community types are represented at this site: Piedmont/Mountain Levee Forest, Piedmont/Mountain Bottomland Forest, and Floodplain Pool.

The Piedmont/Mountain Levee Forest at this site comprises perhaps 25-35% of the natural area. The natural levee is tiered in a few places. The levee is often 1-3 feet higher than the bottomland behind it, with slightly richer soil. The Piedmont/Mountain Bottomland Forest is found on the lower ground inward from the levee. It is not well-developed and is only about 100 yards wide in places. Several floodplain pools are present within the bottomland, though these were dry during the site visit in October.

The following description is not broken down by communities because the canopy trees are somewhat similar in the levee and bottomland forests. The floodplain is essentially undisturbed, featuring a mature hardwood forest with a good array of tree species. The canopy is often 80+ feet high, with many of the trees having a dbh of 2-3 feet. There is a surprising scarcity of oaks, which are often common in bottomlands. Yet, bitternut hickory (*Carya cordiformis*) is very common. Common canopy species include sweetgum (*Liquidambar styraciflua*), bitternut hickory, sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), and some water oak (*Quercus nigra*). River birch is common in the subcanopy along with box elder (*Acer negundo*), tuliptree (*Liriodendron tulipifera*), southern sugar maple (A.

floridanum), red maple (A. rubrum), and others. The shrub layer is of moderate to fairly light density, typical of Piedmont bottomlands. Bladdernut (Staphylea trifolia), is locally common. The herb layer is quite diverse, though much is weedy and non-native. Such exotics as Japanese grass (Microstegium vimineum), a weedy Oriental grass, are locally dominant.

OWNERSHIP: Single private ownership.

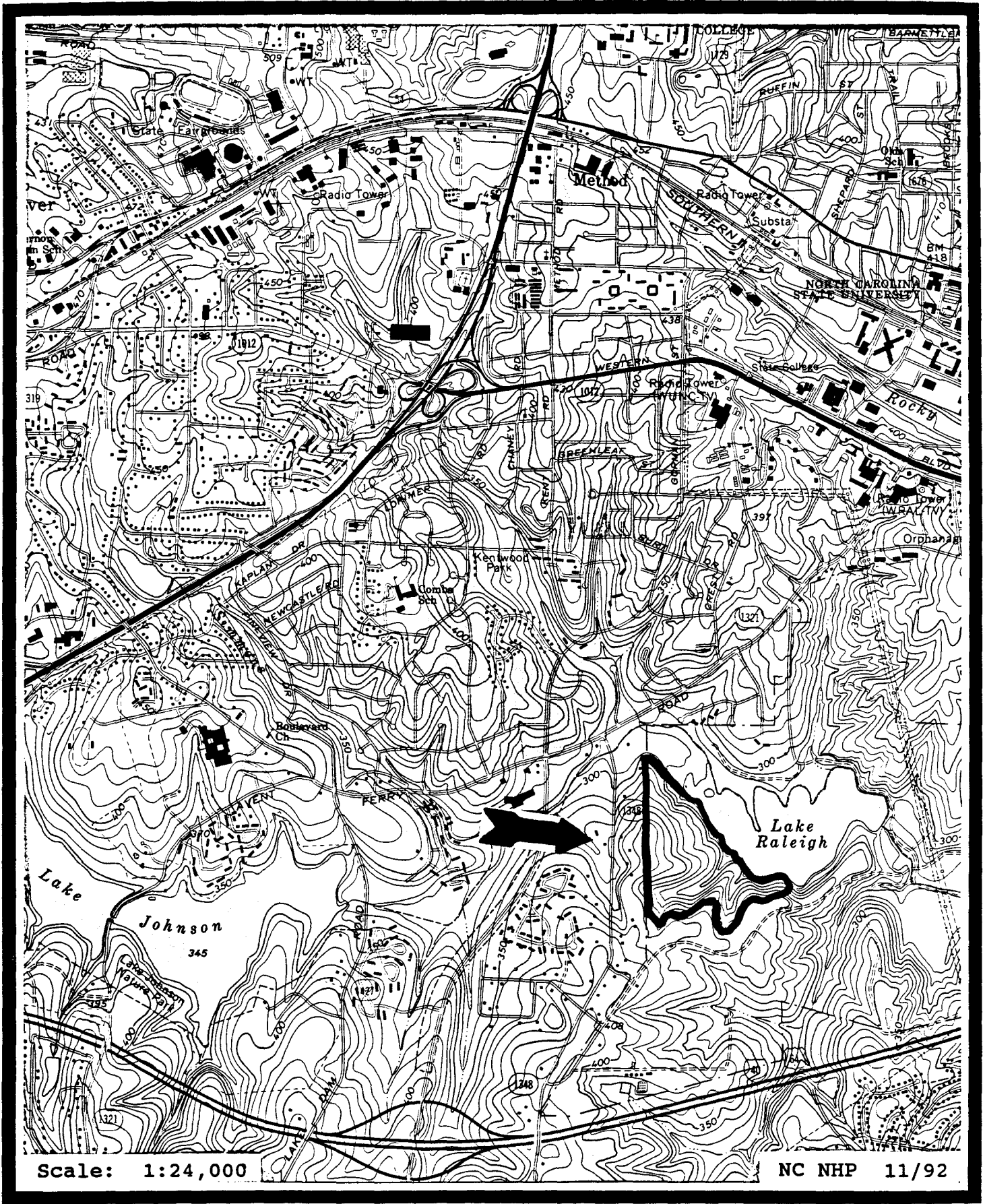
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The area is definitely deserving of protection and could be protected as a part of the Neuse River corridor. A hiking trail would be suitable for the area. There are really no management recommendations, other than no timber cutting should be allowed.

COMMENTS: A site visit in the spring may lead to a better understanding of the spring herbaceous flora. An early summer visit may reveal more information about breeding birds that visit the site.

REFERENCES:

LeGrand, H.E., Jr. 1991. Horseshoe Farm Bottomland Forest. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Lake Raleigh Hardwood Forest
 Site Code: WK6
 Quadrangle: Raleigh West

SITE NAME: Lake Raleigh Hardwood Forest

SITE CODE: WK6

SIZE: 55 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Raleigh West

LOCATION: This site is in the Neuse River watershed and is in the central portion of Wake County in the Piedmont Province of North Carolina. It is on the southwestern side of Lake Raleigh, along the southern edge of Raleigh, N.C.; immediately east of SR 1348 (Trailwood Road) and north of Crump Road.

SIGNIFICANT FEATURES:

1. This site contains an excellent example of a Mesic Mixed Hardwood Forest (Piedmont Subtype) natural community.
2. The diversity of herbaceous species is perhaps higher here than anywhere else of comparable size in Wake County.

GENERAL DESCRIPTION (from LeGrand 1987):

"The slopes on the southwestern side of Lake Raleigh contain an excellent example of mature Mesic Mixed Hardwood Forest (Piedmont Subtype); however, some portions could be considered as Dry-Mesic Oak-Hickory Forest. There is little sign of disturbance and few trails are present. The canopy species include hickories (Carya spp.), white oak (Quercus alba), northern red oak (Q. rubra), tuliptree (Liriodendron tulipifera), and American beech (Fagus grandifolia).

"The area possesses an extremely abundant and diverse shrub and herbaceous understory. In some ravines the herbaceous layer looks very similar to those found growing on basic parent material like amphibolite. The substrate here, however, is more acidic; felsic gneiss and schist underlie the forest. Uncommon herbs present on the slopes are yellow ladyslipper (Cypripedium calceolus), puttyroot (Aplectrum hyemale), monkshood (Aconitum uncinatum), mountain phlox (Phlox ovata), showy scullcap (Scutellaria serrata), and southern wood violet (Viola hirsutula). Dwarf crested iris (Iris cristata) is very common; common are Catesby's trillium (Trillium catesbaei), devil's bit (Chamaelirium luteum), and wild geranium (Geranium maculatum). [Also abundant are fern species. More than 10 species of ferns are present at this site.]

"Scarlet tanagers apparently nest in the forest, one of the few places close to the city of Raleigh where they occur. Prothonotary warblers are present, as well, though they probably nest in the bottomland at the head of the lake."

OWNERSHIP: This tract is owned by the state and is administered by North Carolina State University.

PROTECTION STATUS: No official protection. The master plan for the Centennial Campus, within which the natural area is located, indicates that most of the site will be set aside from development.

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

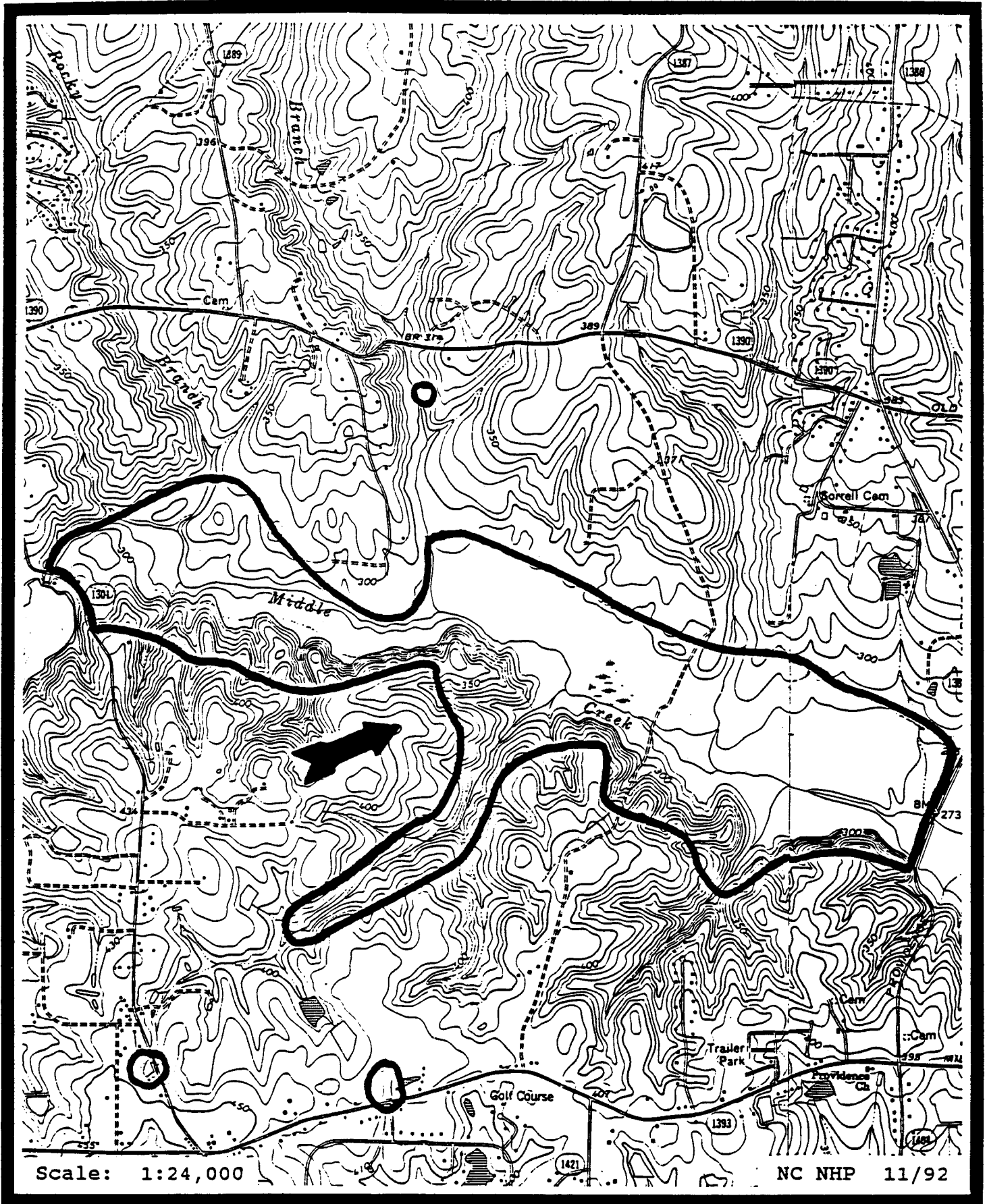
This tract is part of North Carolina State University's Centennial Campus. The university's development plans and Environmental Impact Statement (EIS) indicate there is an interest in conserving portions of this site; however, plans are not complete enough to assure protection. A residential area for the campus is proposed for the upper slopes of the extreme western portion of the site.

The city of Raleigh is planning a greenway along the shore of the lake; however, the EIS indicates that the trail should not be paved in sensitive portions of the natural area. Although the N.C. Natural Heritage Program has been involved in the protection of the natural area, the site should be considered in jeopardy.

COMMENTS: The proximity of this high quality natural area to the city of Raleigh and to the local universities makes it a valuable area for interpretive, educational, and research interests. This site would be an excellent research facility for the Botany and Zoology departments of N.C. State University.

REFERENCES:

- Dalton, B.R. 1985. Lake Raleigh Natural Area. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- LeGrand, H.E., Jr. 1985. Lake Raleigh Deciduous Forest. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- _____. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.



Site Name: Middle Creek Bluffs and Slopes
 Site Code: WK7
 Quadrangle: Apex, Lake Wheeler

SITE NAME: Middle Creek Bluffs and Slopes

SITE CODE: WK7

SIZE: 936 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake
Wheeler

QUADRANGLE: Apex, Lake

LOCATION: This site is in the Neuse River watershed and is in southwestern Wake County in the Piedmont Province of North Carolina. It is on the south side of Middle Creek and is a 2-3 mile stretch of floodplain with north-facing slope; between SR 1301 on the west and SR 1404 on the east; located about 5 miles northeast of Fuquay-Varina, N.C.; 4 miles east of Holly Springs, N.C.

SIGNIFICANT FEATURES:

1. An unusual mixture of montane plant species are present on the slopes and several Coastal Plain species occur in the adjacent floodplain.
2. Lewis' heartleaf (Hexastylis lewisii), a State Candidate, is present here.
3. Also present is the Neuse River waterdog (Necturus lewisi), an amphibian of Special Concern.

GENERAL DESCRIPTION (from LeGrand 1987):

"Middle Creek flows eastward through the southern portion of Wake County. Below Sunset Lake, the creek has a fairly wide floodplain (nearly 1/2 mile at SR 1404), with a series of steep north-facing bluffs on the south side of the creek. The bluff just west of SR 1404 contains a number of notable plant species for Wake County. Mountain laurel (Kalmia latifolia) is surprisingly scarce or absent; yet, galax (Galax aphylla) is abundant, along with sweetleaf (Symplocos tinctoria). Beaked hazelnut (Corylus cornuta) is ubiquitous on these slopes, but it is a rare shrub in the eastern Piedmont. Sweet pepperbush (Clethra alnifolia) is also abundant on the slopes and in the floodplain, presenting a most unusual mix of a "Coastal Plain" shrub with a "montane" shrub. Goat's-beard (Aruncus dioicus) is conspicuous on the slopes.

"Other slopes contain a more mesic forest with a typical array of spring-blooming wildflowers, such as Catesby's trillium (Trillium catesbaei). At the base of a gentle slope just east of Sunset Lake is a colony of Lewis' heartleaf (Hexastylis lewisii), a State Candidate species, found at scattered sites in the county but a rare species in terms of its range (southern Virginia and central North Carolina).

"The floodplain is rather typical in canopy composition; however, a few Coastal Plain elements are present: American snowbell (Styrax americana), inkberry (Ilex glabra), titi

(Cyrilla racemiflora), waxmyrtle (Myrica cerifera), and bayberry (M. heterophylla)...

"The Neuse River waterdog (Necturus lewisi) has been found in Middle Creek near SR 1301. The species is endemic to the Neuse and Tar River basins."

OWNERSHIP: Multiple private ownership; several tracts owned by the town of Cary.

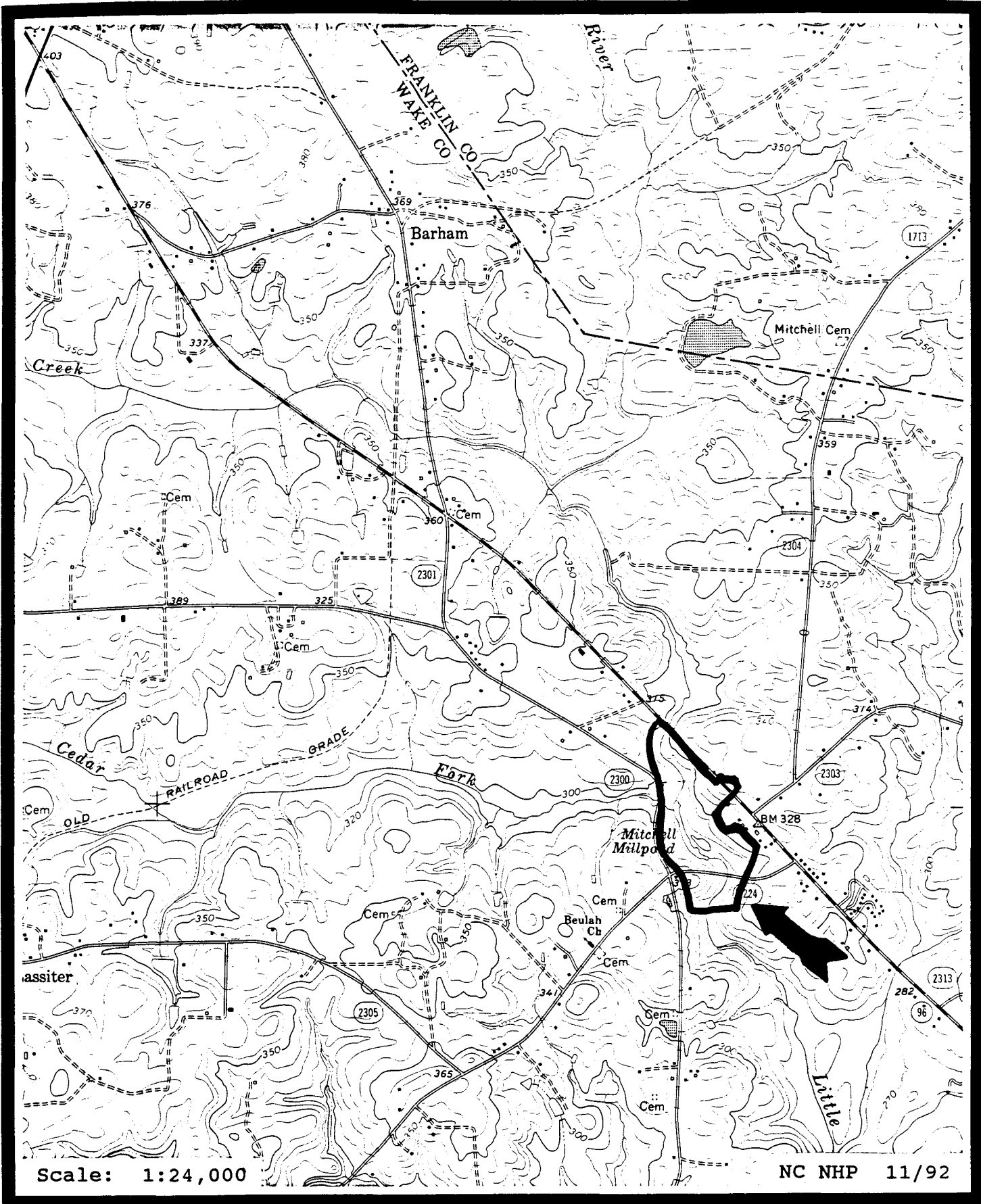
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This natural area is threatened by impending urban development. The slopes at the southeastern corner of the site are the most significant feature in this natural area and need protection from development. The town of Cary has built a wastewater treatment plant in the floodplain on the north side of the creek in the center of the natural area. Portions of the bottomland in the western end of the site have been logged in recent decades. It is recommended that this site be registered with the Natural Heritage Program.

COMMENTS: As with many, or most, of the privately-owned sites in Wake County, the natural area is severely threatened by development.

REFERENCES:

- Dalton, B.R. 1985. Middle Creek -- downstream from Sunset Lake. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.



Site Name: Mitchell's Millpond State Natural Area
 Site Code: WK8
 Quadrangle: Rolesville

SITE NAME: Mitchell's Millpond State Natural Area

SITE CODE: WK8

SIZE: 68 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Wake

QUADRANGLE: Rolesville

LOCATION: This site is in the Neuse River watershed and is in northeastern Wake County in the Piedmont Province of North Carolina. It is about 4 miles southeast of Rolesville, N.C.; lying between NC 96 and SR 2300. The Little River bisects the natural area.

SIGNIFICANT FEATURES:

1. This natural area contains classic examples of granitic flatrocks. Essentially all of the flora represented here are typical of Granitic Flatrock communities in the Piedmont.

2. One federally listed plant, nestronia (Nestronia umbellula), a Federal Candidate species, is present at this site.

2. Several rare plant species are found at this site: Small's portulaca (Portulaca smallii) and Piedmont quillwort (Isoetes piedmontana), State Threatened species; Oersted's campylopus (Campylopus oerstedianus), a State Candidate species; and granite flatsedge (Cyperus granitophilus), a significantly rare species.

3. The Neuse River waterdog (Necturus lewisi), a species of Special Concern, is present at this site.

GENERAL DESCRIPTION (from LeGrand 1987):

"Mitchell's Millpond is probably the largest expanse of granitic flatrocks in North Carolina. Over 10 flatrocks are present, covering perhaps 15-20 acres. The Little River bisects the outcrops, flowing over bare rock in some places. These flatrocks contain essentially all of the "endemic" flatrock flora found in the Wake-Franklin cluster of granitic outcrops.

"As at all granitic flatrocks, the earliest plant pioneers on the bare rock are mosses and lichens. Where some soil has accumulated, sandwort (Arenaria glabra), fameflower (Talinum teretifolium), and other vascular plants appear. Small's portulaca (Portulaca smallii), a State Threatened plant, is common at the natural area in sand and gravel at the edges of the rock. This rare flatrock endemic is probably more numerous here than anywhere else in North Carolina. Shallow pools contain Piedmont quillwort (Isoetes piedmontana), a State Threatened species, and damp gravelly places on the rocks contain bright red patches of stonecrop (Sedum smallii) in the spring. False pimpernel (Lindernia monticola) grows in damp places near the rocks, as well. A rare moss -- Oersted's campylopus (Campylopus oerstedianus), a State Candidate species -- grows on the flatrocks here, but it is not known anywhere else outside of Jamaica and Costa Rica.

"Virginia pine (Pinus virginiana) is scarce over most of Wake County, but it is common in the thin soil surrounding the rocks. As at all flatrocks, redcedar (Juniperus virginiana) is the pioneer tree species on the fringe of the rocks. In the damp soil along Little River grow several tree species characteristic of the Coastal Plain -- titi (Cyrilla racemiflora) and water ash (Fraxinus caroliniana). The rare shrub nestronia (Nestronia umbellula), a State Candidate species, grows in woodlands adjacent to one of the flatrocks." Another rare plant present in this natural area is the granite flatsedge (Cyperus granitophilus).

This natural area is also home to a rare animal endemic to North Carolina. The Neuse River waterdog (Necturus lewisi), a salamander species of Special Concern, has been found in the Little River in the natural area.

OWNERSHIP: A large portion of the site is owned by the state and is administered by the N.C. Division of Parks and Recreation. Several small flatrocks to the north of the NC 96 bridge are privately owned.

PROTECTION STATUS: The land owned by the state is a State Natural Area and is also a Registered Natural Heritage Area.

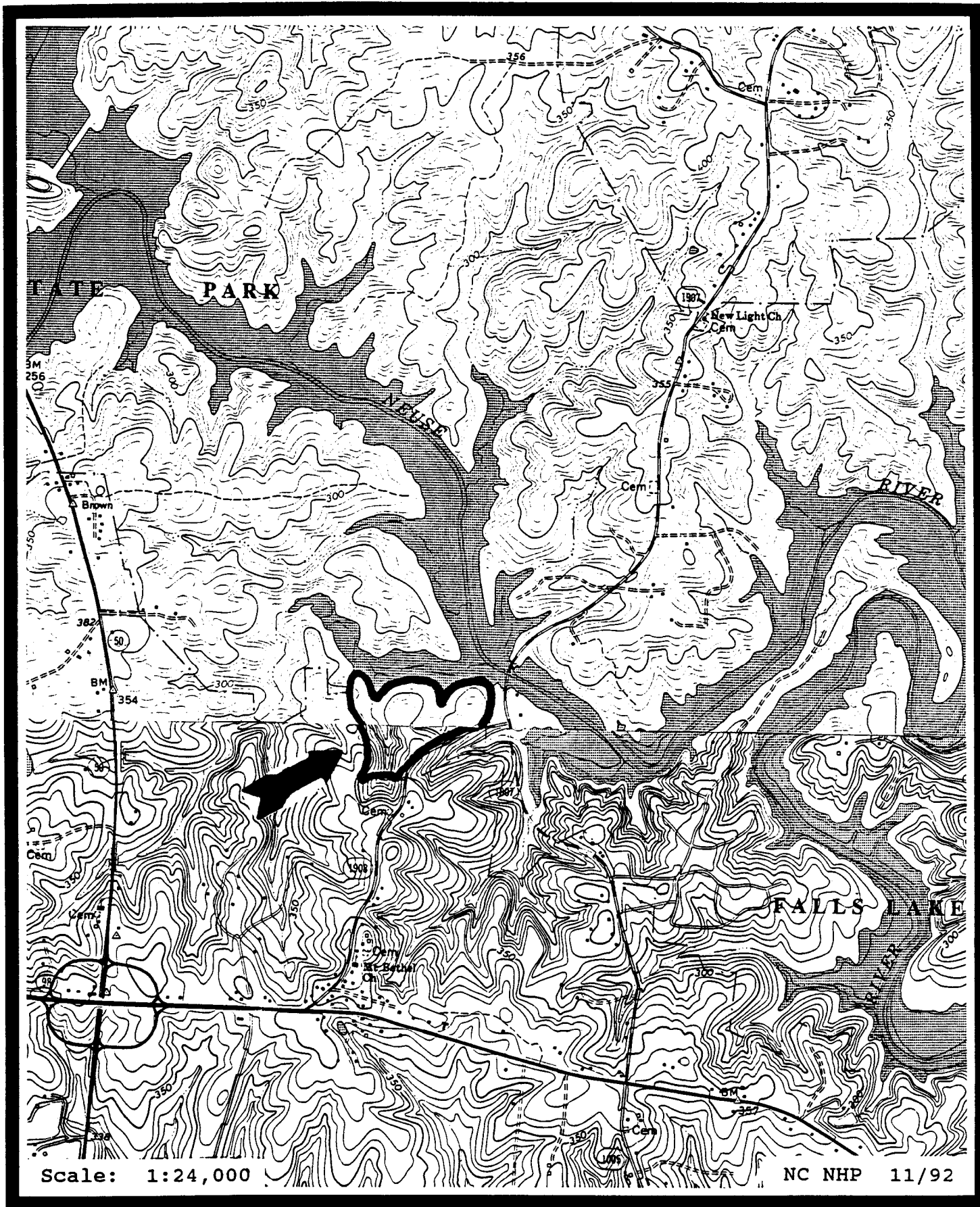
MANAGEMENT OR PROTECTION RECOMMENDATIONS: Parts of the site have been damaged by trampling and vehicles. Ongoing protection from vehicles and crowds is needed. The area is also plagued by littering. Periodically, garbage is removed from the area by State Park personnel. Protection of the upstream corridor is also necessary. The private lands (5-10 acres) along the Little River are an integral part of the entire natural area and need protection.

COMMENTS: This natural area is one of the premier educational facilities in the Piedmont Province of North Carolina. Because of its large acreage of flatrocks, large flora of flatrock endemics, and proximity to colleges and universities, it is a heavily studied area. A reservoir has been proposed for the Little River. Construction of this reservoir would impound the river below the mill dam; at high water stages, impoundment water might reach the mill dam.

REFERENCES:

- LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.
- Sugg, P., G. Woolard, and D. Boone. 1975. A study of Mitchell's Mill and its granite outcrop. Report to the North Carolina Division of Parks and RRA 442, Raleigh, N.C.

- Smith, E.L. 1976. Mitchell's mill pond -- floristic description of the granitic flatrock and the surrounding forest. N.C. Natural Heritage Program.
- Wells, T.R., Sr., and J.B. Taggart. 1979. Management plan -- Mitchell's mill pond natural area, Wake County, North Carolina. N.C. Department of Natural Resources and Community Development, Raleigh, N.C.



Site Name: Old Still Creek Forest
Site Code: WK9
Quadrangle: Creedmor, Bayleaf

SITE NAME: Old Still Creek Forest

SITE CODE: WK9

SIZE: 50 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake
Creedmoor

QUADRANGLE: Bayleaf,

LOCATION: This site is in the Neuse River watershed in northern Wake County in the Piedmont Province of North Carolina. It is on the south side of the impounded Neuse River (Falls Lake); on the west of the intersection of SR 1907 and SR 1908; about 1 mile north of NC 98.

SIGNIFICANT FEATURES:

1. This site contains a mature Mesic Mixed Hardwood Forest (Piedmont Subtype).
2. This natural area has a high diversity of wildflowers.

GENERAL DESCRIPTION (from Moore and LeGrand 1986):

"The Old Still Creek site contains a good quality example of a mature, mesic hardwood forest. Several other similar sites supporting this Piedmont natural community type were inundated by the [Falls Lake] reservoir. Along with various oak and hickory species [on the steep slopes and ravines above the lake] are numerous large American beech trees (Fagus grandifolia) and unusually shaggy-barked red maple (Acer rubrum). Umbrella tree (Magnolia tripetala) dominates the understory in the moist ravines. The area has not been timbered in recent decades. Over 100 plants of walking fern (Asplenium rhizophyllum) grow on a rock in a small creek bed, and twayblade orchids (Liparis lilifolia) cap a soapstone boulder.

"Among the rich herbaceous species on the slopes and ravines are numerous ferns: rattlesnake fern (Botrychium virginianum), maidenhair fern (Adiantum pedatum), southern lady fern (Athyrium filix-femina var. asplenioides), broad beech fern (Thelypteris hexagonoptera), and cinnamon fern (Osmunda cinnamomea). Showy species include wild geranium (Geranium maculatum), yellow ladyslipper (Cypripedium pubescens), featherbells (Stenanthium gramineum), bloodroot (Sanguinaria canadensis), mayapple (Podophyllum peltatum), Indian cucumber-root (Medeola virginiana), and devil's bit (Chamaelirium luteum)."

OWNERSHIP: This natural area is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

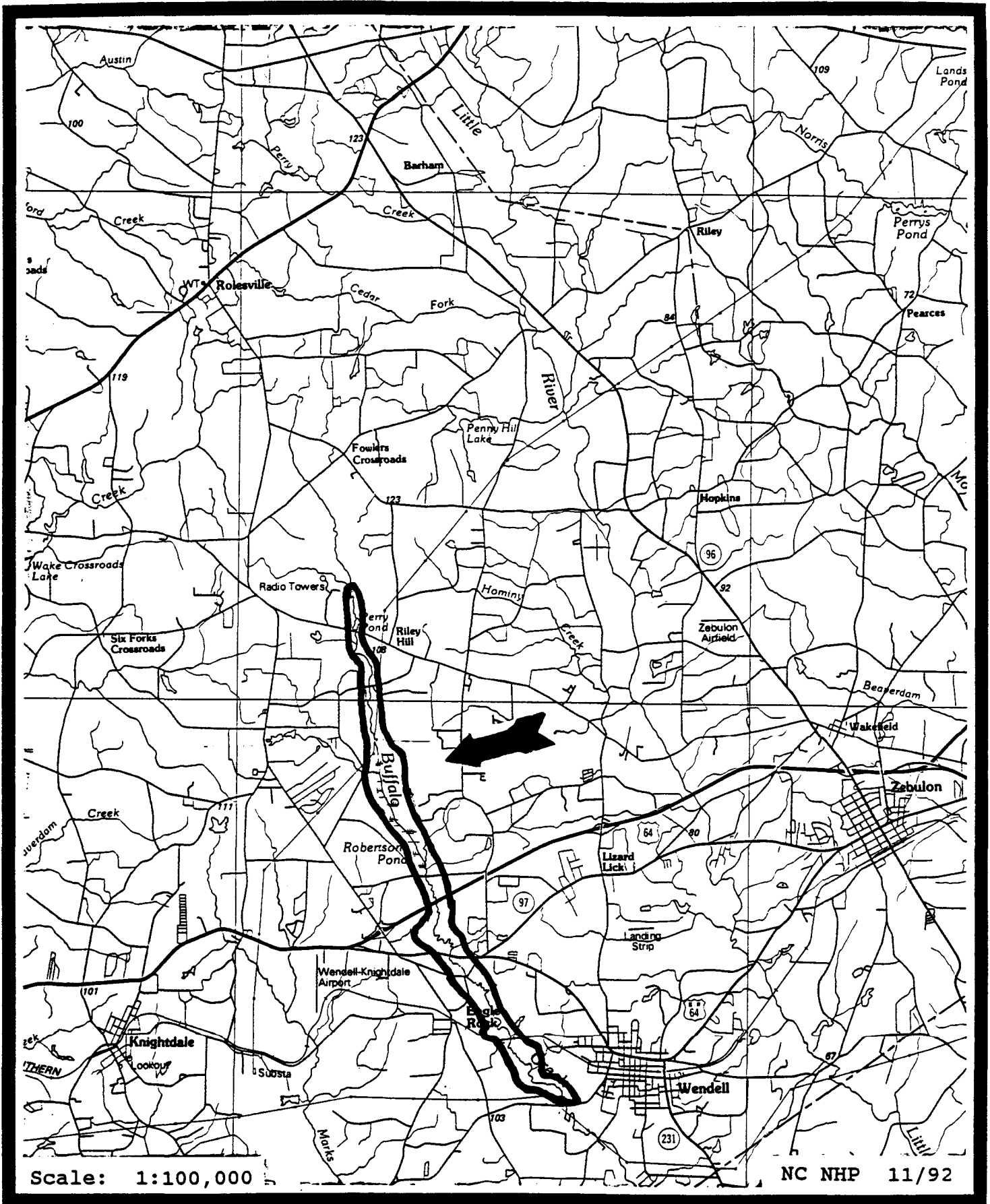
PROTECTION STATUS: This site is a Registered Natural Heritage Area. The registered site includes upland buffer land with old field pine stands.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Disturbances to the site included the inundation of the lower portions of the slopes. This natural area is used as a game land, and a hiking trail crosses the site. The site is managed by the N.C. Wildlife Resources Commission.

COMMENTS: This site was apparently a more significant one prior to the inundation of the lowest slopes by Falls Lake in the early 1980's.

REFERENCES:

- LeGrand, H.E., Jr. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.
- Moore, J. and H.E. LeGrand, Jr. 1986. Falls Lake Natural Areas. Registry Report. N.C. Natural Heritage Program.
- _____ and M. Olwell. 1977. Botanical survey and evaluation, Falls Lake. Report to U.S. Army Corps of Engineers, Wilmington.



Site Name: Robertson's Millpond and Buffalo Creek
 Site Code: WK10
 Quadrangle: Raleigh

SITE NAME: Robertson's Millpond and Buffalo Creek

SITE CODE: WK10

SIZE: 660 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Raleigh (1:100,000 scale)

LOCATION: This site is in the Neuse River watershed in eastern Wake County in the Piedmont Province of North Carolina. It extends a distance of over 7 miles starting 0.5 mile north of SR 2320 and ending south of SR 1007. The natural area includes the floodplain of the creek and the millpond located midway along the 7-mile stretch.

SIGNIFICANT FEATURES:

1. Robertson's Pond is one of the westernmost blackwater, baldcypress-dominated millponds (Coastal Plain Semipermanent Impoundment) in the state.

2. This is one of the few and most prolific locations in Wake County for baldcypress (Taxodium distichum), which is typically limited to the Coastal Plain. This tree dominates many areas along the 7-mile stretch and creates a nearly complete canopy at the old millpond.

3. Along the creek occurs the four-toed Salamander (Hemidactylium scutatum), a species of Special Concern.

4. Several fishes, amphibians, and reptiles with Coastal Plain affinities occur in the Piedmont at Buffalo Creek, including the eastern cottonmouth (Agkistrodon piscivorus).

5. The pond has a high wildlife value, including a large population of breeding birds.

GENERAL DESCRIPTION (from LeGrand 1987):

"Even though Buffalo Creek lies within the Piedmont, it shows many of the features of a Coastal Plain stream. It flows in a south-southeasterly direction into Johnston County, just west of Wendell. Along much of this creek, a baldcypress (Taxodium distichum) swamp is present, and the swamp extends for approximately 7 miles. Midway along this 7-mile stretch is Robertson's Pond, a man-made millpond [Coastal Plain Semipermanent Impoundment]... Above Robertson's Pond, the swamp is rather narrow, often only 50 yards wide. Cypress is common, as is sweetgum (Liquidambar styraciflua). Below Robertson's Pond, the cypress dominates the canopy, and the swamp widens also, so that at the US 64 Bypass crossing of the creek, the swamp is 300-400 yards wide. Other common trees of the swamp include red maple (Acer rubrum), tuliptree (Liriodendron tulipifera), water oak (Quercus nigra), and river birch (Betula nigra).

"This is one of just several locations in Wake County where baldcypress grows naturally. The creek also shows other Coastal Plain affinities in that the farthest extension inland of the ranges of the cottonmouth (Agkistrodon piscivorus) and the mud snake (Farancia abacura) in North Carolina occur at Buffalo Creek. The four-toed salamander (Hemidactylium scutatum) breeds in backwaters near the creek. The type locality for the sawcheek darter (Etheostoma serriferum) is at Wendell in the creek. Other typically Coastal Plain fish occurring in Buffalo Creek include the swamp darter (Etheostoma fusiforme), mud sunfish (Acantharchus pomotis), bluespotted sunfish (Enneacanthus gloriosus), banded pigmy sunfish (Elassoma zonatum), lined top-minnow (Fundulus lineolatus), tadpole madtom (Noturus gyrinus), and ironcolor shiner (Notropis chalybaeus).

"Robertson's Pond was created about 1900 by the damming of Buffalo Creek; the site was to be used for hydropower. Because bald cypress (Taxodium distichum) is common in the floodplain of the Buffalo River, and because it thrives well in permanently flooded sites, it is present throughout Robertson's Pond and forms a homogenous canopy over the dark waters of the pond. Thus, the pond very closely resembles similar cypress-dominated lakes and ponds in the Coastal Plain, such as Merchants Millpond in Gates County and Greenfield Lake in Wilmington. The swollen bases of the cypresses provide habitat for thickets of swamp rose (Rosa palustris), which grow in profusion at the site. Though the wild rose is by far the dominant shrub, Carolina water ash (Fraxinus caroliniana), button bush (Cephalanthus occidentalis), tag alder (Alder serrulata), titi (Cyrilla racemiflora), Virginia willow (Itea virginica), and fetter-bush (Leucothoe racemosa) are also anchored on the enlarged cypress buttresses.

"Robertson's Pond was heavily used in the 1950's and 1960's in a variety of wildlife studies, concentrating particularly on the Wood Duck. Eugene Hester and others at N.C. State University erected nest boxes and made numerous studies on the breeding biology and life history of the Wood Duck. Breeding bird censuses were conducted at the pond in 1966 and 1967; Browne (1966, 1967) found a very high density and species diversity of birds present. Prothonotary warblers [Protonotaria citrea] are very common, as are northern parula warblers [Parula americana]. The pond is also home to a wide variety of other animals, such as muskrats and raccoons. The two-toed amphiuma (Amphiuma means), an eel-like salamander essentially restricted to the Coastal Plain, has been collected here."

OWNERSHIP: Private ownership.

PROTECTION STATUS: The millpond is a Registered Natural Heritage Area.

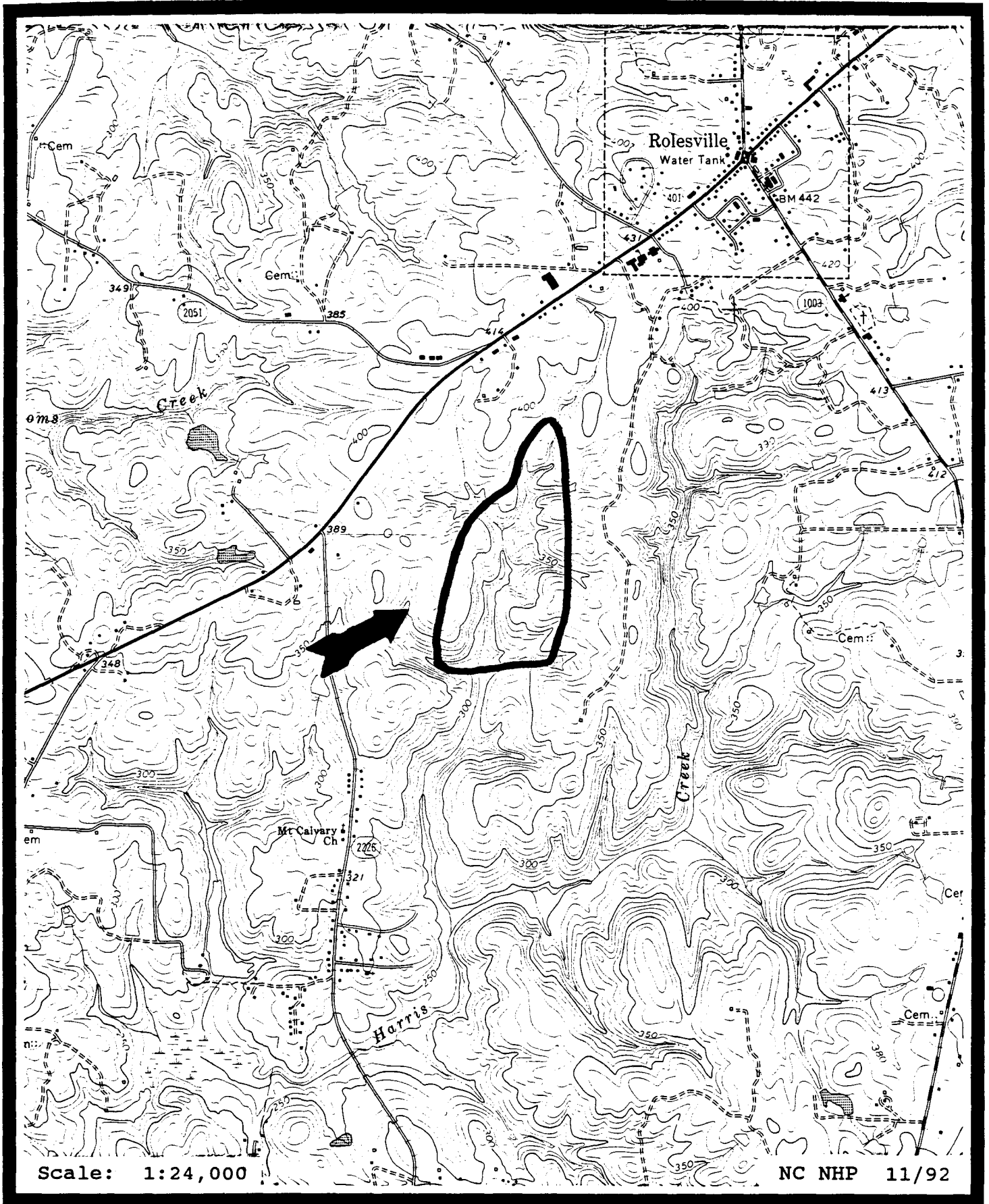
MANAGEMENT OR PROTECTION RECOMMENDATIONS: About six roads transect the swamp and many agricultural fields are located along the margins of the swamp. The highest quality cypress swamp

habitat at this site is located in the middle portion, between SR 2321 and US 64 Business (a 3-4 mile section). A sewerline has been proposed for a portion of the floodplain in the natural area. The clearing caused by this structure would damage the integrity of the site. The landowner(s) need to be encouraged to not develop this land and to adopt proper management practices.

COMMENTS: The Triangle Land Conservancy has been working on protecting this natural area; acquisition has been considered. Protection options have been discussed with the landowner who appears to have an interest in logging the baldcypress at the site. Long-term protection of the site is needed.

REFERENCES:

- Braswell, A. 1986. Letter to N.C. Natural Heritage Program.
Browne, M.M. 1966. Cypress Swamp. Audubon Field Notes 20:623.
_____. 1967. Cypress Pond. Audubon Field Notes 21:626.
Dalton, B.R. 1985. Buffalo Creek Cypress Swamp. Natural Area Reconnaissance. N.C. Natural Heritage Program.
LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.
Moore, J.H. 1982. Robertson's Pond. Registry Report. N.C. Natural Heritage Program.



Site Name: Southwest Rolesville Granitic Flatrocks
 Site Code: WK11
 Quadrangle: Rolesville

SITE NAME: Southwest Rolesville Granitic Flatrocks

SITE CODE: WK11

SIZE: 128 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Wake

QUADRANGLE: Rolesville

LOCATION: This site is in the Neuse River watershed in northeastern Wake County in the Piedmont Province of North Carolina. It is about 0.5 miles east of the intersection of US 401 and SR 2226; about 1.5 miles south-southeast of Rolesville, N.C.

SIGNIFICANT FEATURES:

1. There are 8-10 granitic flatrocks at this site, making it one of the largest clusters of outcrops in the eastern Piedmont.

2. A large colony of nestronia (Nestronia umbellula), a Federal Candidate species, is present at this site.

GENERAL DESCRIPTION:

The site is primarily composed of dry upland woods, mostly hardwoods with some pines and cedars, and abundant outcroppings of granite. Many boulders are located on slopes and along a creek that flows from north to south through the area. At least 8 to 10 flatrocks located at this site are 0.5-1 acre in size; these generally lie on the slopes above the creek.

"There are many xeric herbaceous species present, such as beargrass (Yucca filamentosa), prickly-pear cactus (Opuntia compressa), and fragrant sumac (Rhus aromatica) in the woods near the flatrocks. Because most of the rocks slope gently toward the creek flowing through the site, there are very few vernal pools, and stonecrop (Sedum smallii) is apparently present on just one flatrock. A site visit in April 1987 was too early to determine if the rare Small's portulaca (Portulaca smallii) was present, though it should occur here. Sandwort (Arenaria glabra) is very common on the flatrocks. On a dry ridge east of the main creek, there is a large colony of nestronia (Nestronia umbellula) containing several thousand stems of this rare shrub. This is one of the largest colonies known in North Carolina." (LeGrand 1987a)

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

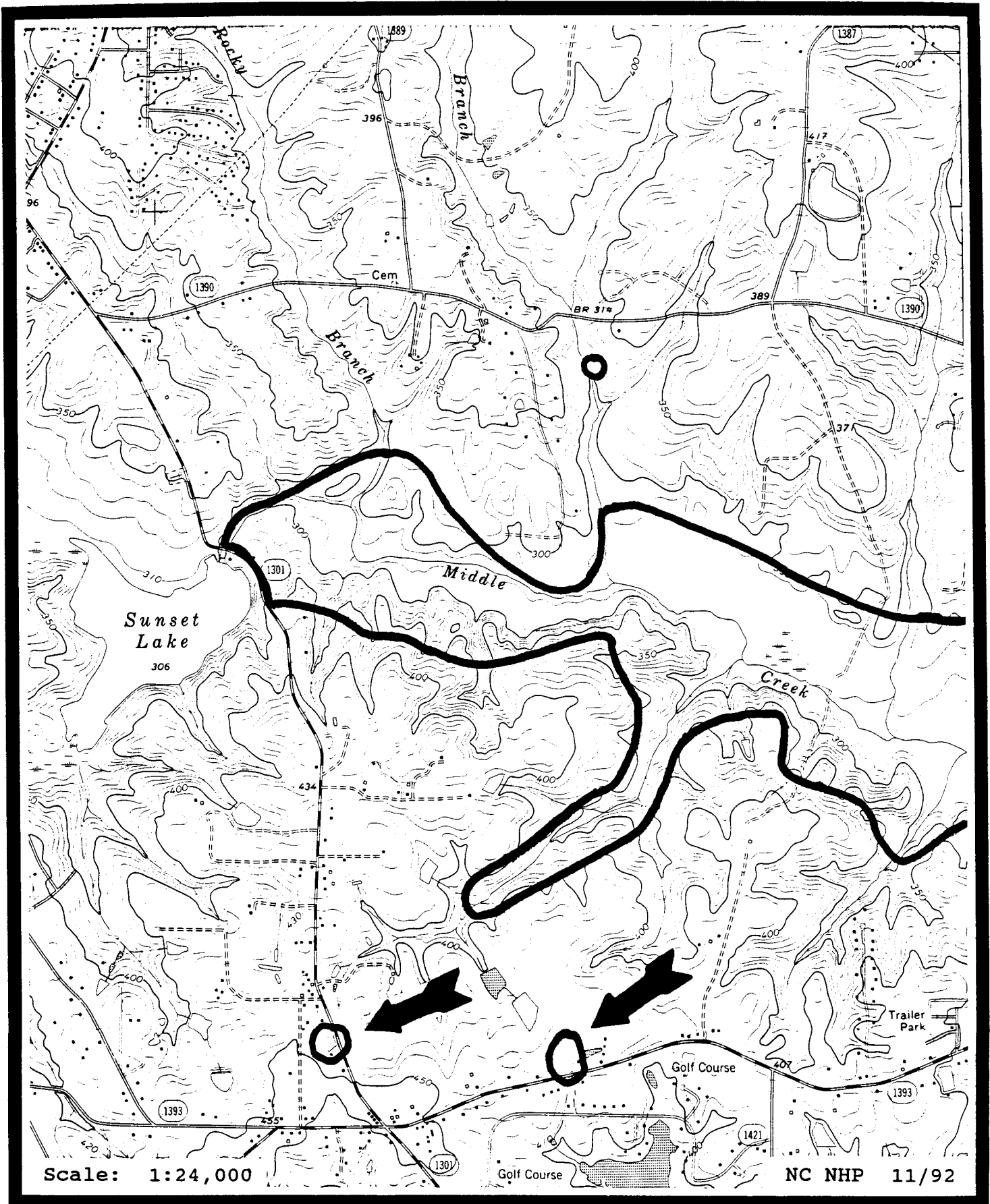
MANAGEMENT OR PROTECTION RECOMMENDATIONS: "The granite flatrocks and surrounding woodlands of the natural area are nearly devoid of garbage and other debris; they are among the most scenic flatrocks in Wake County. The town of Rolesville had planned to construct a wastewater treatment plant alongside Harris Creek,

about one mile south of the natural area, in 1988. A sewerline was proposed to bisect the natural area by running alongside the stream down the center of the area. However, the site for the proposed treatment plant has been moved to Harris Creek, about 0.3 mile east of the natural area. Sewerlines running to the proposed plant would presumably lie alongside Harris Creek and not alongside the creek in the natural area. It does not appear that the present site, east of the natural area, will impact the area." (LeGrand 1987b). The landowners need to be encouraged to adopt proper land management practices and not develop the site.

COMMENTS: With the sewerline construction in Rolesville in the early 1990's, the town is expected to undergo fairly rapid growth. Other threats, such as home construction, are likely in the next 10 years.

REFERENCES:

- LeGrand, H.E., Jr. 1987a. Southwest Rolesville Granite Flatrocks. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.
- _____. 1987b. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.



Site Name: Sunset Lake Salamander Ponds
 Site Code: WK12
 Quadrangle: Apex

SITE NAME: Sunset Lake Salamander Ponds

SITE CODE: WK12

SIZE: 20 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Apex

LOCATION: This site is in the Neuse River watershed in southwestern Wake County in the Piedmont Province of North Carolina. One pond (the older one) is west of SR 1301, about 0.3 mile northwest of the intersection of SR 1301 and SR 1393. The other pond (the younger one) is north of SR 1393, about 0.6 mile east of the intersection. This site also includes woods where salamanders presumably spend the warmer months, east of SR 1301.

SIGNIFICANT FEATURES: This natural area supports the only known Piedmont population in North Carolina of the tiger salamander (Ambystoma tigrinum), a State Threatened species.

GENERAL DESCRIPTION:

This natural area contains two ponds of differing ages and a woodland area. The soils in this area are of the Wehadkee and Bibb series. The adjacent land is mostly farmland with a few scattered residential sites.

The woodland in this natural area covers about 15 acres and is swampy. The canopy is scattered and is dominated by sweetgum (Liquidambar styraciflua), tuliptree (Liriodendron tulipifera), and red maple (Acer rubrum). The understory and shrub layers feature a mixture of Piedmont and Coastal Plain elements, including sweetbay (Magnolia virginiana), blaspheme-vine (Smilax laurifolia), and inkberry (Ilex glabra). Common in these layers are giant cane (Arundinaria gigantea) and sourwood (Oxydendrum arboreum). This site contains many pools with peatmoss (Sphagnum sp.).

One of the ponds (the older one) at this site is nearly filled in and is surrounded by fields and yards. The tiger salamander (Ambystoma tigrinum), a State Threatened species, has been found on the road (SR 1301) adjacent to this site and it is believed the salamanders migrate from the pond, across the road, to the woods on the east. This site had salamander eggs in the winter of 1990, but the pond is being filled in by landowners and the habitat is barely suitable for these salamanders.

The other pond (the younger one) covers about 5 acres and is the upper end of a small creek that was bisected by SR 1393. The flow of the water (to the south) is partially blocked by the road. Thus, the pond often contains about 3 feet of water. The pond is wooded with a nearly complete canopy of sweetgum in and along its margins. Located near these ponds is a swampy wooded area. Tiger salamander eggs were seen in this pond in the winter of 1990.

The tiger salamander lays its eggs in the ponds and moves to the nearby sandy woods in the warmer months of the year to burrow into the sand. The tiger salamander typically breeds in fish-free semipermanent ponds and forages in woods, usually sandy pinewoods.

OWNERSHIP: Private ownership.

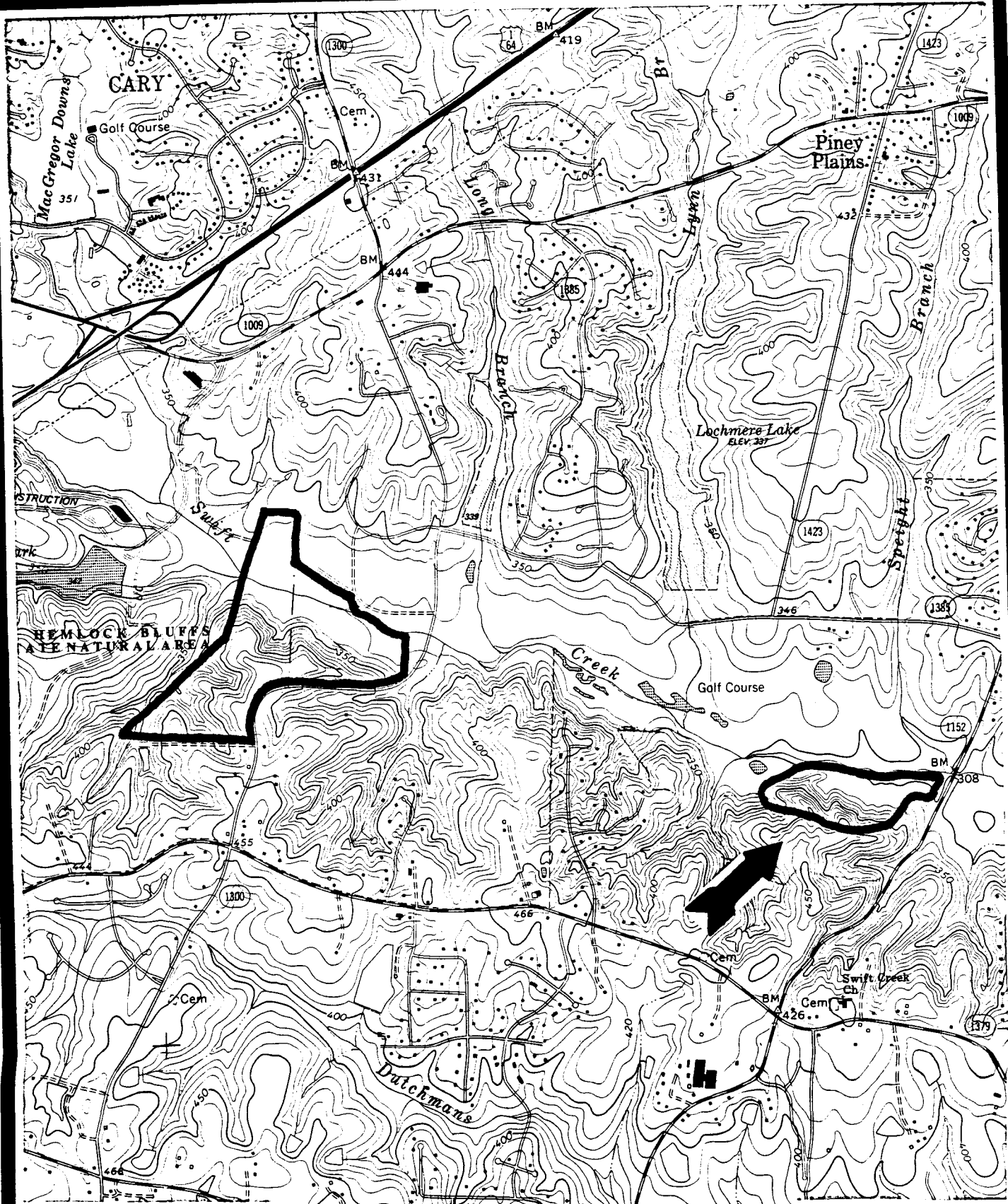
PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Logging and development is occurring in nearby areas. No further filling of the wetlands or ponds and no further cutting of the trees should occur in this natural area. Land registry or easements may be the best way to protect the area.

COMMENTS: This site has the potential to contain the four-toed salamander (Hemidactylium scutatum) and should be surveyed further for this species.

REFERENCES:

Perry, J., S. Hall, D. Hall, H.E. LeGrand, Jr., and B. Kirkman.
1990. Sunset Lake Salamander Ponds. Site Survey Report.
N.C. Natural Heritage Program.



Scale: 1:24,000

NC NHP 11/92

Site Name: Swift Creek Bluffs
 Site Code: WK13
 Quadrangle: Apex

SITE NAME: Swift Creek Bluffs

SITE CODE: WK13

SIZE: 32 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Wake

QUADRANGLE: Apex

LOCATION: This site is in the Neuse River watershed in western Wake County in the Piedmont Province of North Carolina. It is 2.5 miles west-southwest of Macedonia, N.C., on the south side of Swift Creek and immediately west of SR 1152.

SIGNIFICANT FEATURES:

1. This natural area supports three good quality natural communities: Piedmont/Low Mountain Alluvial Forest, unusual overcup oak (Quercus lyrata) patches in Floodplain Pools, and Mesic Mixed Hardwood Forest (Piedmont Subtype).

2. This site has a rich herbaceous flora, with several hundred plant species identified in just a 25-acre site.

GENERAL DESCRIPTION:

Swift Creek Bluffs are located just downstream from Hemlock Bluffs State Natural Area (Site WK4); however, the slopes here are not quite as steep as those at Hemlock Bluffs. The steep north to northeast-facing bluffs support a good quality Mesic Mixed Hardwood Forest (Piedmont Subtype) with a large continuous stand of mature American beech trees (Fagus grandifolia). Most of the trees here are in excess of 1-2 feet dbh. Shrubs of the bluffs include hydrangea (Hydrangea arborescens), styrax (Styrax grandifolia), witch-hazel (Hamamelis virginiana), and pagoda dogwood (Cornus alternifolia), a typical montane species. The herb layer is very diverse because of the mesic microclimate and the highly basic soil, compared to typical eastern Piedmont sites. Herb species present include baneberry (Actaea pachypoda), wild ginger (Asarum canadense), moonseed (Menispermum canadense), hepatica (Hepatica americana), blood root (Sanguinaria canadensis), black cohosh (Cimicifuga racemosa), showy orchis (Orchis spectabilis), yellow lady's slipper (Cypripedium calceolus), and several ferns and fern allies. Also present is a population of ginseng (Panax quinquefolius), uncommon in the state.

The floodplain on either side of the creek supports a good quality Piedmont/Low Mountain Alluvial Forest with a diverse mixture of canopy species. A 1-2 acre beech flat with trees in excess of 2 feet dbh is present at this site. Another portion of the floodplain contains a predominance of overcup oaks (Quercus lyrata) in poorly drained depressions near the base of the bluffs. Elsewhere in the bottomlands along the creek grows a mixture of hardwoods including American elm (Ulmus americana), bitternut hickory (Carya cordiformis), cherrybark oak (Quercus

pagoda), swamp chestnut oak (Q. michauxii), green ash (Fraxinus pennsylvanica), and sweetgum (Liquidambar styraciflua).

OWNERSHIP: A large portion of this site is owned by the Triangle Land Conservancy. The other portions are privately owned by individuals or development companies.

PROTECTION STATUS: The most significant portions of the site have been protected as a nature preserve by the Triangle Land Conservancy.

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

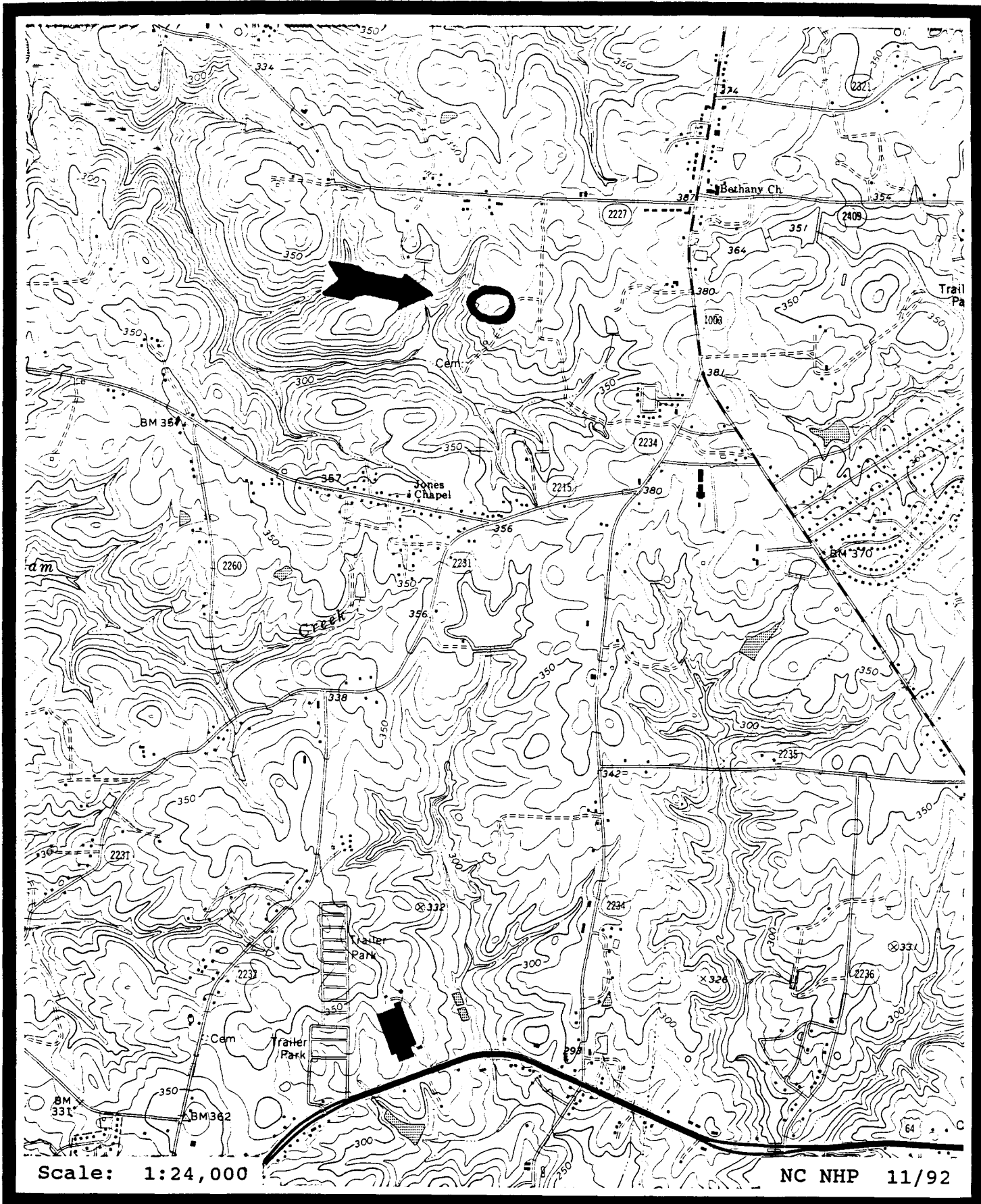
Development is encroaching on the southern side of the natural area. At the southeastern corner of the site, along SR 1152, a large tract of land has been subdivided, and a number of houses have been built at the top of the bluffs. At the northwestern edge of the site, in the floodplain, is the Lochmere golf course. Clearing for the golf course creek may cause increased windthrow on the site. This could have damaging effects on the plants on the adjacent slopes that require cool microclimates. The town of Cary has constructed a sewerline through the floodplain and an associated sewage lift station along SR 1152.

A greenway trail has been proposed to traverse the Swift Creek floodplain. Such a trail, likely to be paved, should not be constructed in the natural area. Not only could the trail further damage the natural area, but it could bring undesirable recreational uses to the site, such as biking.

COMMENTS: The Triangle Land Conservancy has constructed several dirt hiking trails through the preserve, and has built steps up the steep slopes to funnel visitation to the trails and away from the sensitive herbaceous vegetation. A small parking lot for the preserve has been proposed along SR 1152 near the sewage lift station. No additional acquisition is planned by The Triangle Land Conservancy along the bluffs, but acquisition or some other protection of the floodplain on the north side of Swift Creek will be needed to protect the preserve.

REFERENCES:

- Frost, C.C. 1982. Swift Creek Bluffs Natural Area. Site Survey Report. N.C. Natural Heritage Program.
- LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.
- Taggart, J.B. 1981. Swift Creek Bluffs Natural Area. Site Survey Report. N.C. Natural Heritage Program.



Site Name: Temple Rock
 Site Code: WK14
 Quadrangle: Knightdale

SITE NAME: Temple Rock

SITE CODE: WK14

SIZE: 5 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Knightdale

LOCATION: This site is in the Neuse River watershed in eastern Wake County in the Piedmont Province of North Carolina. It is at the end of a farm lane about 4 miles northeast of Knightdale, N.C.; about 0.5 mile west-southwest of the intersection of SR 1003 and SR 2227.

SIGNIFICANT FEATURES: Temple Rock is a granite flatrock, almost completely void of human disturbance, which contains good examples of primary succession on bare rock.

GENERAL DESCRIPTION:

"Temple Rock, an undisturbed exposure of the Rolesville Granite Batholith, is located near the Fall Line that separates the Piedmont and Inner Coastal Plain geomorphic regions. The outcrop slopes gently toward the west. The granite 'flatrock' exposures are surrounded by second-growth upland oaks and pines (*Pinus echinata*) and occasional eastern redcedar (*Juniperus virginiana*). The site is located in the Hodge Creek drainage.

"Primary and secondary vegetation succession are well represented at this site. Typical zonation of plants, determined by depth of soil and presence of moisture, can be seen here. As is characteristic for such granite exposures, sand and soil have accumulated in scattered depressions on the rock. Some depressions seasonally collect rainwater. The driest, most exposed depressions, where sand has collected support only patches of a red succulent-leaved plant, stonecrop (*Sedum smallii*). These red carpets of stonecrop take on a showy appearance in early spring when white star-shaped flowers appear. Where soils are deeper (usually toward the center of a vegetation mat) other mosses (e.g. *Polytrichum* spp.) are found together with another showy outcrop plant, sandwort (*Arenaria glabra*). In mid-April, the dime-sized white flowers of the sandwort are borne in profusion on 3 to 5 inch wiry stems. Later in summer other herbs (eggleaf rushfoil *Crotonopsis elliptica*, pineweed *Hypericum gentianoides*, and Adam's-needle *Yucca filamentosa*) can be seen blooming in the vegetation mats. Many of these plants are annuals that are restricted or closely correlated with granite rock exposures in the Carolinas and northern Georgia and Alabama." (Roe et al. 1984)

Growing on "islands" on the outcrop, where the deepest soils occur, are a variety of shrubs and trees. These include: redcedar, scattered loblolly and shortleaf pine (*Pinus taeda* and *P. echinata*), various oak species (*Quercus* spp.), shrubs such as sparkleberry (*Vaccinium arboreum*), highbush blueberry (V.

corymbosum), and red chokeberry (Sorbus arbutifolia), dense herbaceous mats of broom straw (Andropogon virginicus) and other grasses, green-brier (Smilax spp.), poison ivy (Rhus radicans), occasional blackberry canes (Rubus spp.), and coral honeysuckle (Lonicera sempervirens).

Other notable herbs at this site grow in the woods adjacent to the rock. These are bastard-toadflax (Comandra umbellata) and Carolina pink (Silene caroliniana). The latter is very scarce in North Carolina and occurs mainly in the Sandhills.

OWNERSHIP: Private ownership.

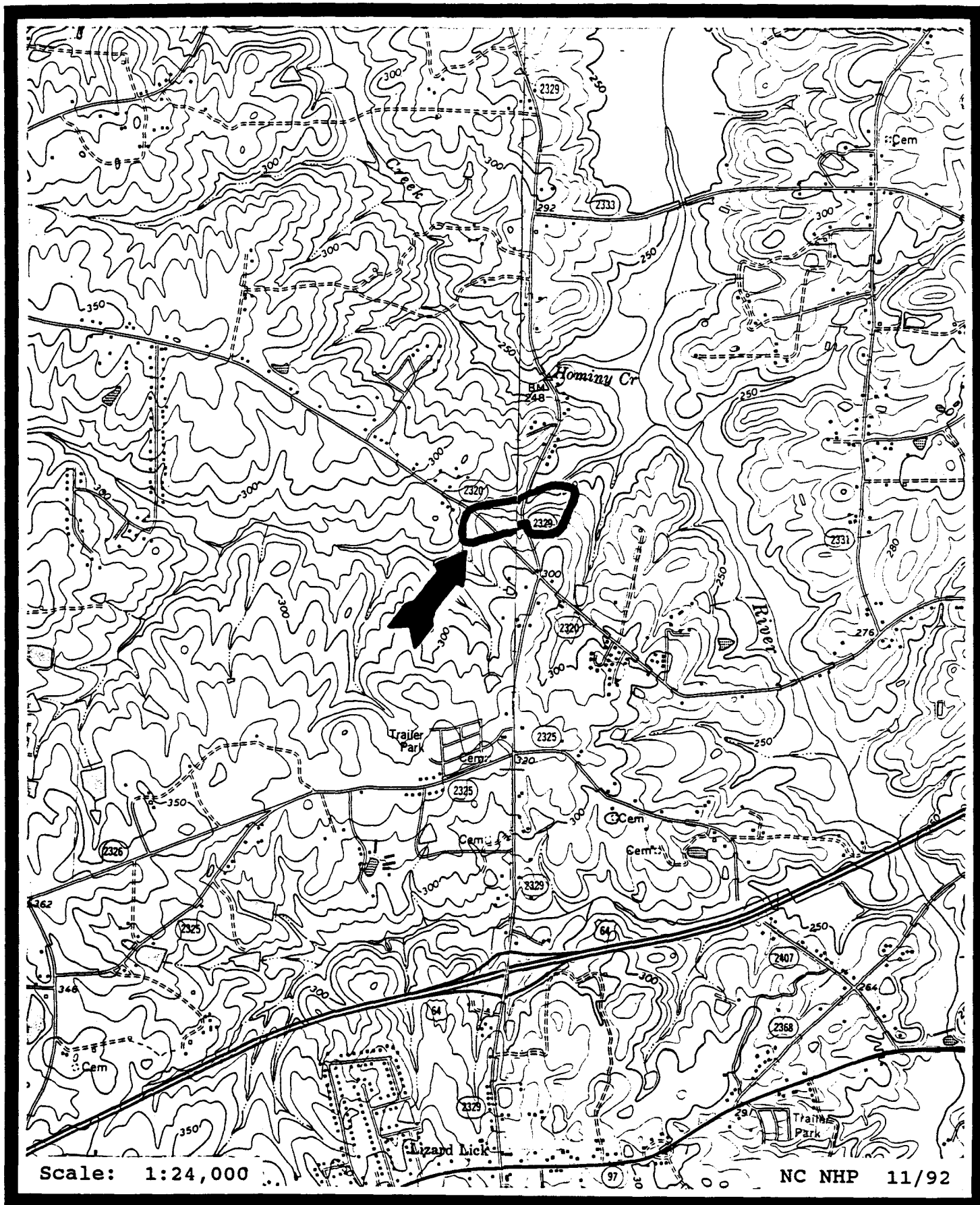
PROTECTION STATUS: The owner granted a conservation easement of 5 acres to The Nature Conservancy. The easement was conveyed to the Triangle Land Conservancy, who manages the site and conducts tours to the flatrock. Temple Rock is also a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The rock is in pristine condition, with essentially no trash, and most of the surrounding woods have not been recently disturbed. A small amount of logging took place several years ago, and though visible from the outcrop, has caused no impacts to the rocks. This is one of the most aesthetically pleasing flatrocks in the Piedmont. It does not contain, however, the extensive granitic flora present at several other Wake and Franklin sites, such as Mitchell's Millpond State Natural Area.

COMMENTS: One of the alternative alignments of the Northern Wake Expressway passes close to Temple Rock. Fortunately, the alternative selected by the N.C. Department of Transportation passes well to the south of the flatrock.

REFERENCES:

- Dalton, B.R. 1985. Temple Rock. Natural Area Reconnaissance. N.C. Natural Heritage Program.
- LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.
- Roe, C., J.H. Moore, and L. Mansberg. 1984. Temple Rock. Registry Report. N.C. Natural Heritage Program.



Site Name: The Rocks
Site Code: WK15
Quadrangle: Knightdale, Zebulon

SITE NAME: The Rocks

SITE CODE: WK15

SIZE: 10 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Wake
Zebulon

QUADRANGLE: Knightdale,

LOCATION: This site is in the Neuse River watershed in eastern Wake County in the Piedmont Province of North Carolina. It is about 4 miles north of Wendell, N.C. and 4 miles west of Zebulon, N.C.; about 0.1 mile north of the intersection of SR 2320 and SR 2329, extending from west of SR 2320 to east of SR 2329.

SIGNIFICANT FEATURES:

1. This site has one of the largest extents of granite flatrock in the county. It contains species typically restricted to Granitic Flatrock natural communities in the Piedmont.

2. Two rare species of plants typical of flatrocks are present at this site, Small's portulaca (Portulaca smallii), a State Threatened species, and granitic flatsedge (Cyperus granitophilus), a significantly rare species.

GENERAL DESCRIPTION (from LeGrand 1987):

"The Rocks are an exposure of the Rolesville Granite Batholith (Rolesville Pluton). This area contains good examples of primary and secondary succession on flatrocks. Besides the geological aspects, there are also many important botanical features. The granite outcrop contains species of plants that are restricted to Granitic Flatrocks in the Piedmont. These include sandwort (Arenaria glabra), stonecrop (Sedum smallii), fameflower (Talinum teretifolium), and Small's portulaca (Portulaca smallii).

"The Rocks have several dry pools that fill up with spring rains. Most of the outcrops are very dry and are covered with mosses and lichens. The vegetation surrounding the outcrops is mostly second-growth eastern redcedar (Juniperus virginiana), loblolly pine (Pinus taeda), and Virginia pine (Pinus virginiana), which is quite common despite being at the edge of the range. Communities on the flatrock are typical with stonecrop in dry pools and fameflower and other herbs in mats of moss. Most of the Small's portulaca occurs to the east of SR 2329, where the largest extent of flatrocks are found. Flatrock pimperl (Lindernia monticola), uncommon in the state and restricted to outcrops, occurs at the site between 2329 and 2320."

OWNERSHIP: Ten acres of this site were donated to the Triangle Land Conservancy. The rest of the site is privately owned.

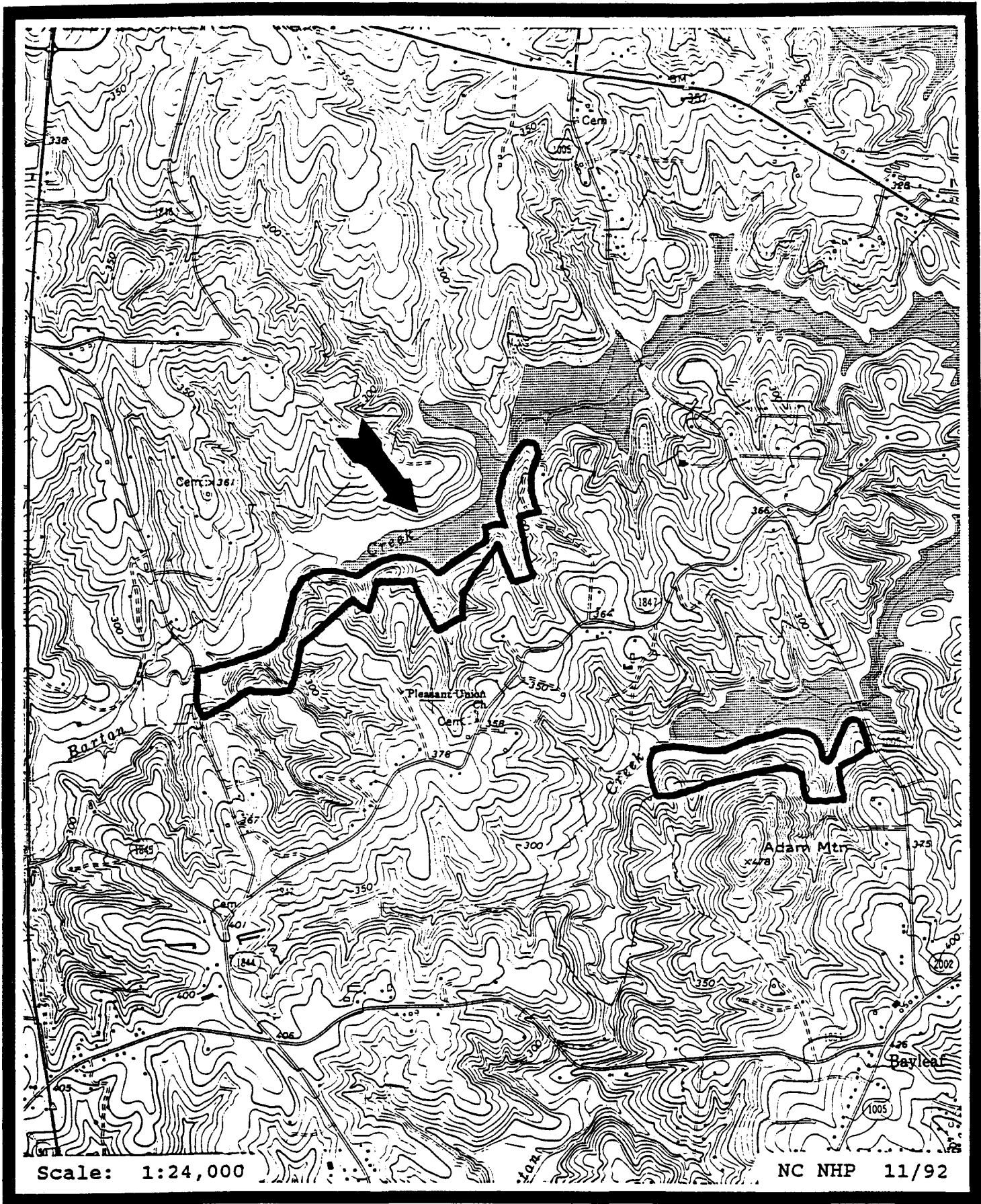
PROTECTION STATUS: Ten acres are a Triangle Land Conservancy Preserve and are also a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: The 10 acres owned by The Triangle Land Conservancy is periodically cleaned of trash that accumulates on the flatrocks. The rocks east of SR 2329, which are privately owned, are covered in trash and discarded items. This area has the most extensive outcropping of granite and contains most of the Small's portulaca in the natural area. The entire site lies adjacent to two roads and therefore littering will always remain a problem. A reservoir has been proposed for the Little River, west of Zebulon. If this reservoir is constructed and filled, this natural area may be destroyed by permanent flooding.

COMMENTS: Although the privately-owned outcrops could probably be acquired by Triangle Land Conservancy, the proposed reservoir would make any future protection efforts risky.

REFERENCES:

- Dalton, B.R. 1985. Rock Branch Rock. Natural Area Reconnaissance. N.C. Natural Heritage Program.
- LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.



Site Name: Upper Barton Creek Bluffs and Ravine
 Site Code: WK16
 Quadrangle: Bayleaf

SITE NAME: Upper Barton Creek Bluffs and Ravine

SITE CODE: WK16

SIZE: 89 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Bayleaf

LOCATION: This site is in the Neuse River watershed in northern Wake County in the Piedmont Province of North Carolina. It is south of Falls Lake; on the south side of Upper Barton Creek; east of SR 1844.

SIGNIFICANT FEATURES: The moist, north-facing bluffs and ravine along Upper Barton Creek support an extensive mature Basic Mesic Forest (Piedmont Subtype). This natural community contains a high diversity of herbaceous plant species, partially due to the presence of soapstone outcrops.

GENERAL DESCRIPTION (from Moore and LeGrand 1986):

"One passes through an area of mixed pines and scrub next to SR 1844 and patches of alluvial forest along the creek before reaching the extensive mesic hardwood forest on the slopes south of the creek. Soapstone outcrops occur along the bluffs. A characteristic mixture of oaks and hickories dominate the north-facing, 30-foot high bluffs, which are rich in diversity of herbaceous species. Large American beech trees (Fagus grandifolia) dominate the 100-foot long, west-facing section of slopes, but because it receives more direct light, west-facing slopes are somewhat drier than the ravines and the herb layer is more sparse. To the east of the west-facing slope, hardwood scrub dominates along the creek until the floodplain narrows at a massive soapstone outcrop on the west side of a small man-made pond.

"In addition to an abundance of typical mesic forest species, unusual species on the steep slopes and in the moist ravines include the yellow Pennsylvania violet (Viola eriocarpa), maidenhair fern (Adiantum pedatum), doll's eyes (Actaea pachypoda), Catesby's trillium (Trillium catesbaei), bladdernut (Staphylea trifolia), bugbane (Cimicifuga racemosa), and showy orchis (Orchis spectabilis)."

OWNERSHIP: This site is owned by the U.S. Army Corps of Engineers and is part of the Falls Lake Project.

PROTECTION STATUS: This site is a Registered Natural Heritage Area.

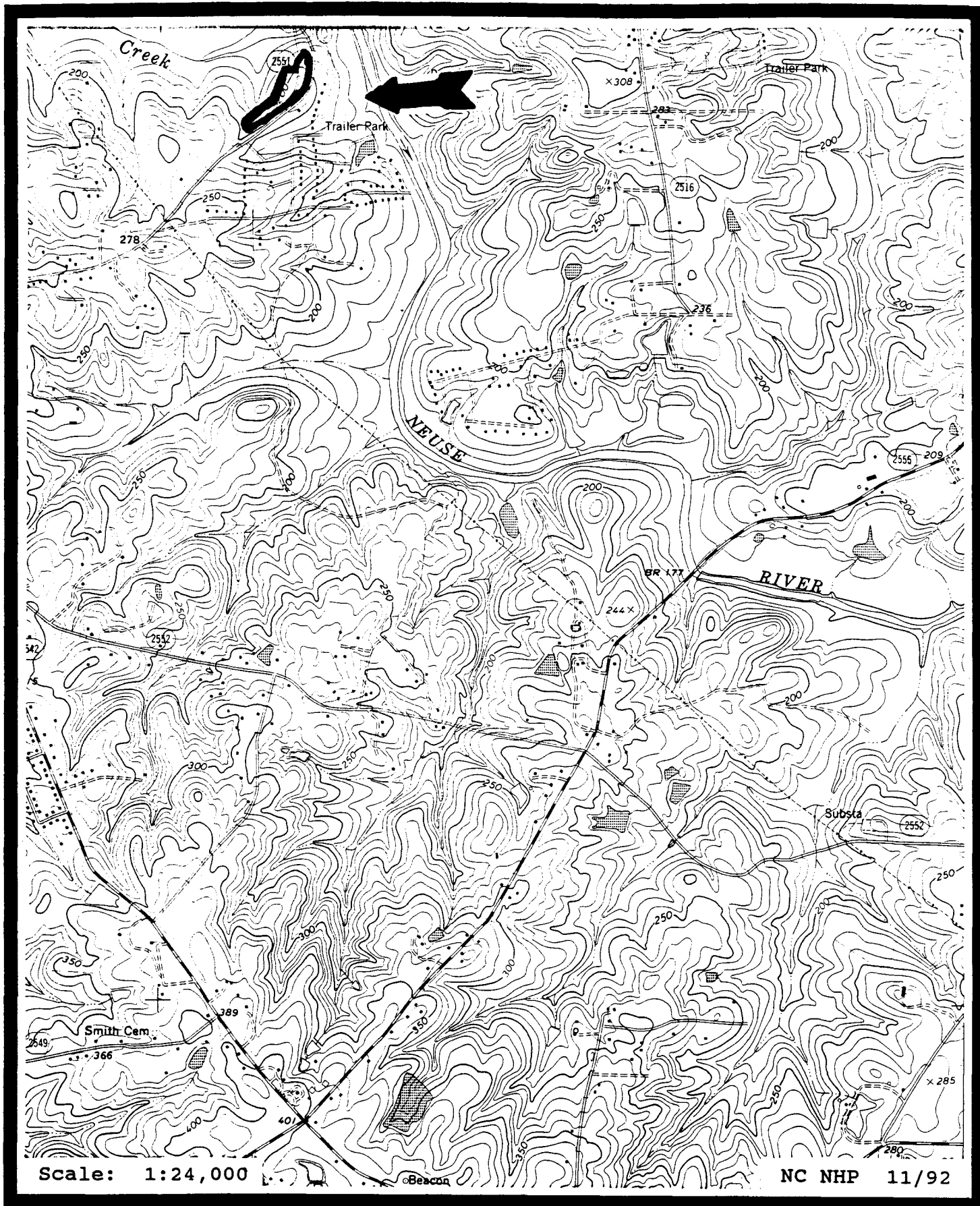
MANAGEMENT OR PROTECTION RECOMMENDATIONS: The N.C. Wildlife Resources Commission manages this natural area. Timber should not be harvested on the slopes and ravines at this site.

COMMENTS: None

REFERENCES:

LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.

Moore, J.H. and H.E. LeGrand, Jr. 1986. Falls Lake Natural Areas. Registry Report. N.C. Natural Heritage Program.
_____ and M. Olwell. 1977. Botanical survey and evaluation, Falls Lake. Report to the U.S. Army Corps of Engineers, Wilmington, N.C.



Site Name: Walnut Creek Sumac Site
 Site Code: WK17
 Quadrangle: Garner

SITE NAME: Walnut Creek Sumac Site

SITE CODE: WK17

SIZE: 7 acres

SITE SIGNIFICANCE: A (National)

COUNTY: Wake

QUADRANGLE: Garner

LOCATION: This site is in the Neuse River watershed in south-central Wake County in the Piedmont Province of North Carolina. It is about 6 miles east-southeast of Raleigh, N.C.; along the margins of SR 2551 (Barwell Road), about 0.2 mile south of Walnut Creek, on both sides of the road.

SIGNIFICANT FEATURES: This site has one of the best known populations of the Federally Endangered Michaux's sumac (Rhus michauxii) in the state. It is the only currently known site in Wake County, and is one of just three or four currently known populations in the state's Piedmont.

GENERAL DESCRIPTION (from LeGrand 1987):

"The roadbanks along Barwell Road south of Walnut Creek are somewhat dry and sandy, and three species of sumac grow on the banks. In addition to the widespread and common smooth sumac (Rhus glabra) and winged sumac (R. copallina), there is a rather large population of Michaux's sumac (R. michauxii). In addition, this site is one of the few in the state that contains both male and female plants, rather than just a colony of a single sex. The site is thus more likely to flourish and grow than other sites, and the seeds produced are available for the natural propagation of new colonies.

"Michaux's sumac is one of the rarest shrubs in the entire Southeast, and essentially the entire range is restricted to central North Carolina, with most populations being in the Sandhills region." It was previously known from South Carolina and Georgia as well, but was thought to be extirpated outside of North Carolina until a small population in Georgia was rediscovered a few years ago.

OWNERSHIP: The site is partially owned by the city of Raleigh and partially owned by the N.C. Department of Transportation.

PROTECTION STATUS: The city of Raleigh and the N.C. Department of Transportation have marked the sumac population for management and protection.

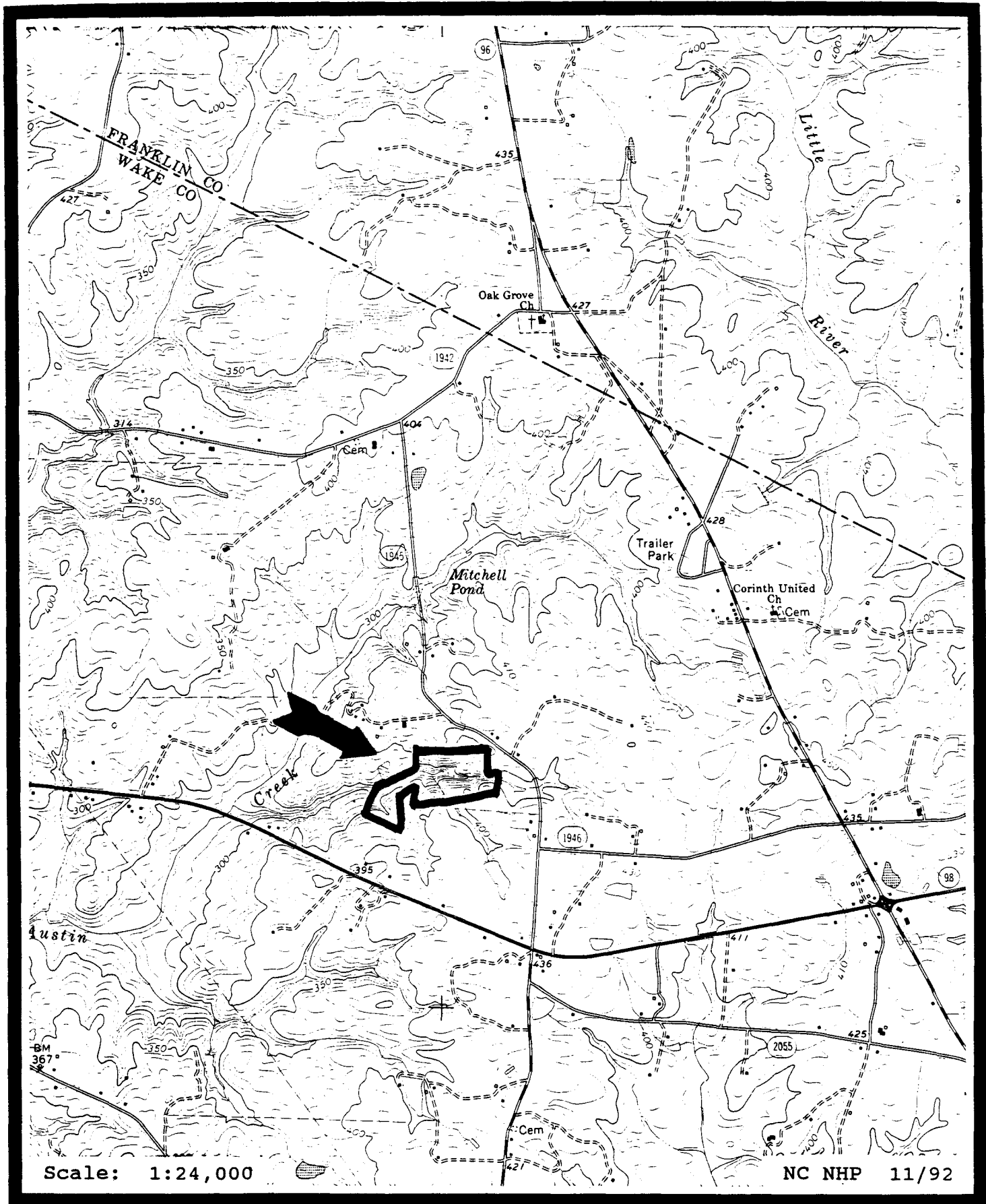
MANAGEMENT OR PROTECTION RECOMMENDATIONS: Although the population is healthy, part of it was destroyed by a housing project located just south of the city's property. Mowing and bush-hogging of the road shoulders by utility companies and the N.C. Department of Transportation have likely helped the population by retarding the growth of saplings of trees and of

taller shrubs. A major threat is the proposed widening of Barwell Road. It is recommended that this site be registered by the Natural Heritage Program or at least have a management agreement with the city of Raleigh.

COMMENTS: At least seven agencies and companies have been involved in the management of this site: the city of Raleigh, the N.C. Department of Transportation, the N.C. Natural Heritage Program, The Nature Conservancy, the Triangle Land Conservancy, Carolina Power and Light Company, and a tree-cutting company hired by CP&L.

REFERENCES:

LeGrand, H.E., Jr. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.



Site Name: Wild Cat Hollow
 Site Code: WK18
 Quadrangle: Rolesville

SITE NAME: Wild Cat Hollow

SITE CODE: WK18

SIZE: 30 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wake

QUADRANGLE: Rolesville

LOCATION: This site is in the Neuse River watershed in northeastern Wake County in the Piedmont Province of North Carolina. It is located about 3 miles east of Wake Forest, N.C.; along a tributary of Austin Creek; between NC 98 and SR 1945.

SIGNIFICANT FEATURES: This natural area contains small caves in openings of weathered granite boulders. These caves are extremely rare in the eastern half of North Carolina.

GENERAL DESCRIPTION:

Wild Cat Hollow is a dramatic exposure of granite boulders and outcrops formed by a tributary of Austin Creek. This portion of Wake County is underlain by igneous, granite rock known as the Rolesville Pluton. This massive granite body crops out on the land surface in many places in the form of granite flatrocks, such as at Mitchell's Millpond State Natural Area (Site WK8) and Temple Rock (Site WK14). Wild Cat Hollow is a unique occurrence of large, weathered granite boulders situated within small stream valleys; it is distinct from the gently sloping flatrocks on hillsides and along creeks in the vicinity. The eroding action of the cascading streams have removed soil from the top and side surfaces, leaving bare, somewhat rounded, boulders in the streams and partially exposed "cliffs" on the stream sides.

In places, the streams disappear where they flow under the boulders. Fissures in the boulders, over time, have been eroded by rainwater and water from the streams such that openings (caves) are present between the boulders. The openings are small, generally not much larger than 6 to 8 feet in any direction. In one or two caves, a stream flows along the base of the cave. Caves of this type appear to be rare in the Piedmont of North Carolina, though similar caves occur in Anson County where there is another extensive granite formation.

The sandy soils on the steep slopes beside the streams support a distinctive forest dominated by chestnut oak (Quercus montana) and American beech (Fagus grandifolia). Chestnut oak is typically found on dry, rocky ridge tops away from streams and rivers, whereas American beech prefers moist, sheltered hillsides above streams. Oaks are usually slow growing, and forests with numerous trees the size of the ones here have seldom been observed in Wake or Durham counties. Somewhat notable is that both species of polypody ferns (Polypodium polypodioides and P. virginianum) grow on the large boulders.

OWNERSHIP: Multiple private ownership.

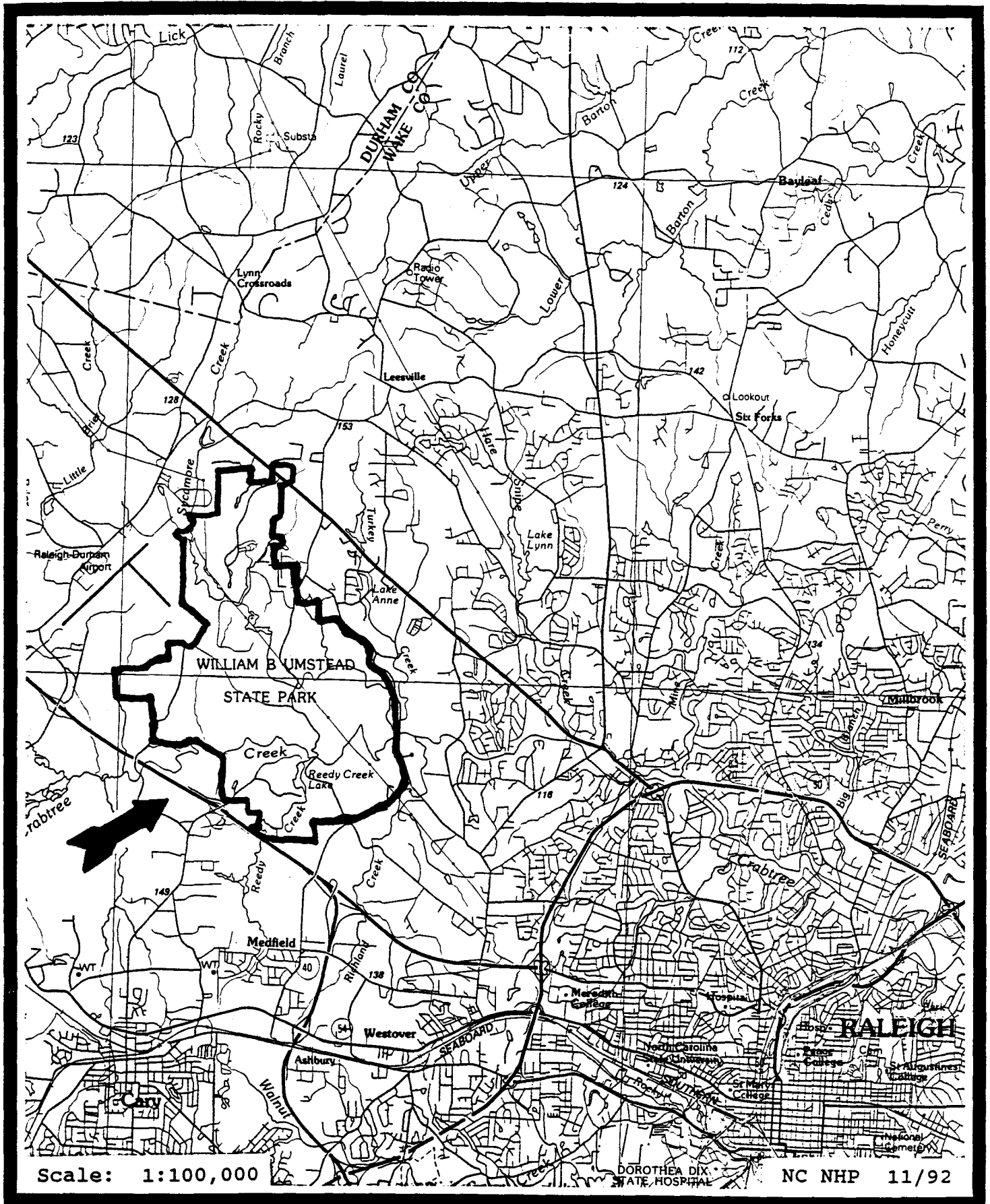
PROTECTION STATUS: Part of this site is a Registered Natural Heritage Area.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: A recently built home sits atop a ridge overlooking several of the boulders and caves. Residential development is also a possibility on the gentler slopes at the eastern end of the natural area. A powerline crosses the site and the opening contains weedy species such as Japanese honeysuckle and kudzu. Some erosion is taking place along motorbike trails that crisscross the site.

COMMENTS: Very little or no survey work on invertebrate species has been conducted inside the caves.

REFERENCES:

Moore, J.H., H.E. LeGrand, A. Carter, D. Carter, D. Howells, B. Kirkman, A. Braswell, N. Murdock, and M. Fritz. 1988. Wake Forest Granite Cave and Outcrops. Preliminary Site Reconnaissance Survey. N.C. Natural Heritage Program.



Site Name: William B. Umstead State Park
 Site Code: WK19
 Quadrangle: Raleigh

SITE NAME: William B. Umstead State Park

SITE CODE: WK19

SIZE: 5337 acres

SITE SIGNIFICANCE: B (State)

COUNTY: Wake

QUADRANGLE: Raleigh (1:100,000 scale)

LOCATION: This site is in the Neuse River watershed in Wake County in the Piedmont Province of North Carolina. It is about 8 miles northwest of downtown Raleigh, N.C.; it lies between US 70 on the north and I-40 on the south; the main entrance to the park is off US 70; the entrance to the Reedy Creek Park section is off of I-40.

SIGNIFICANT FEATURES:

1. This natural area has a large unbroken expanse (over 5000 acres) of pine and hardwood forests, which provides wildlife habitat especially for animals with large home ranges (hawks, owls, deer, turkeys, etc.) and animals of the forest interior (nesting warblers, etc.).

2. Eight species of rare plants are present (or were formerly present) in this natural area: Michaux's sumac (Rhus michauxii)- federally Endangered; nestronia (Nestronia umbellula)- a Federal Candidate; smooth blue aster (Aster laevis var. concinus), Carolina thistle (Cirsium carolinianum), and Lewis's heartleaf (Hexastylis lewisii)- all State Candidate species; and Piedmont gerardia (Agalinis decemloba), dwarf ginseng (Panax trifolius), and Indian physic (Porteranthus stipulatus)- significantly rare species.

3. This site contains several rare species of animals, all of which are of Special Concern: four-toed salamander (Hemidactylum scutatum), Neuse River waterdog (Necturus lewisi), and black vulture (Coragyps atratus).

4. Two significantly rare insects are present at this site: Thorey's grayback dragonfly (Tachopteryx thoreyi) and earwig scorpionfly (Merope tuber).

5. Five natural community types are represented at this site: Piedmont/Low Mountain Alluvial Forest, Mesic Mixed Hardwood Forest, Piedmont Monadnock Forest, Dry-Mesic Oak-Hickory Forest, and Piedmont/Coastal Plain Heath Bluff.

GENERAL DESCRIPTION:

William B. Umstead State Park contains over 5000 acres of nearly unbroken forest, located in the northwestern part of Wake County adjacent to the Raleigh-Durham Airport. This site contains two natural areas: William B. Umstead State Park Natural Area, the larger of the two natural areas, and Crabtree Creek Shrub Slopes. The State Park Natural Area is an old-growth beech-mixed hardwood forest on Crabtree Creek. The other natural

area consists mostly of hardwood forests with a high diversity of shrubs.

The southern half of the park contains the most rugged topography, particularly along Crabtree Creek, which flows eastward through the southern part of the park. A number of rugged slopes and bluffs occur along this creek. In general, many of the forests in these two natural areas consist of mixed pine-hardwoods, though some of the upland areas are still in pine forests. Much of this land was in cultivation in the early decades of this century, and furrows can still be seen on the ground in some of the pine forests. There are many stands of mature oak-hickory forests on the uplands, and most of the bottomlands contain alluvial forests. Five natural community types are represented in these natural areas: Piedmont/Low Mountain Alluvial Forest, Mesic Mixed Hardwood Forest, Piedmont Monadnock Forest, Dry-Mesic Oak-Hickory Forest, and Piedmont/Coastal Plain Heath Bluff.

"Umstead State Park has a wide variety of wildlife and plant species, mainly because of its large size, plus the fact that three lakes (Big, Sycamore, and Reedy Creek) and a powerline clearing add considerable diversity to the remainder of the forest. LeGrand (1971) found 90 bird species in the park in 1970 during the breeding season, of which about 70 probably nested in the park. The park is extensive enough that wild turkeys occur there, though they are rarely seen. An unpublished plant list of the park compiled by Nelson Chadwick in the 1970's listed over 700 species of vascular plants, a very impressive number.

"The park contains relatively few rare animals. The four-toed salamander (Hemidactylium scutatum) occurs in the northern portion of the park, and the earwig scorpionfly (Merope tuber) has been found in the Reedy Creek section south of Crabtree Creek. Most of the rare plants in the park were reported several decades ago and have not been verified in the 1980's: Michaux's sumac (Rhus michauxii), Carolina thistle (Cirsium carolinianum), and Lewis's heartleaf (Hexastylis lewisii). However, Indian physic (Porteranthus stipulatus) does occur near the eastern edge of the park on a steep bluff." (LeGrand 1987)

Other rare plant species present at this site include: smooth blue aster (Aster laevis var. concinus), nestronia (Nestronia umbellula), Piedmont gerardia (Agalinis decemloba), and dwarf ginseng (Panax trifolius). Other rare species of animals at this site include Neuse River waterdog (Necturus lewisi) and black vulture (Coragyps atratus). Another rare insect present at this site is Thorey's grayback dragonfly (Tachopteryx thoreyi).

OWNERSHIP: These natural areas are owned by the state and are administered by the N.C. Division of Parks and Recreation.

PROTECTION STATUS: This area is a State Park and also a National Natural Landmark; two portions of the Park are Registered Natural Heritage Areas.

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Threats include surrounding development and highway construction. ORV's and horses are threats to the natural areas within the park. There has been some pine beetle damage to trees in some spots. The diseased trees may need to be cut down. In 1988, a tornado bisected the larger natural area. Damage done by the tornado needs to be studied and an inventory of new species in the damage zone should be done.

COMMENTS: The natural areas are set aside for nature study. Foot trails are present in both areas.

REFERENCES:

- Division of Parks and Recreation. 1974. Master Plan -- William B. Umstead State Park. N.C. Department of Natural and Economic Resources.
- _____. 1979. Final Environmental Impact Statement -- William B. Umstead State Park. N.C. Department of Natural Resources and Community Development.
- LeGrand, H.E., Jr. 1971. 1970 Bird nesting study at William B. Umstead State Park, Wake County, N.C. Chat 35:67-70.
- _____. 1972. 1970 Habitat relations study of the nesting birds of William B. Umstead State Park. Chat 36:1-3.
- _____. 1987. Inventory of the natural areas of Wake County, North Carolina. Report to the Triangle Land Conservancy, N.C. Natural Heritage Program, and Wake County Parks and Recreation Commission.

WARREN COUNTY NATURAL AREAS

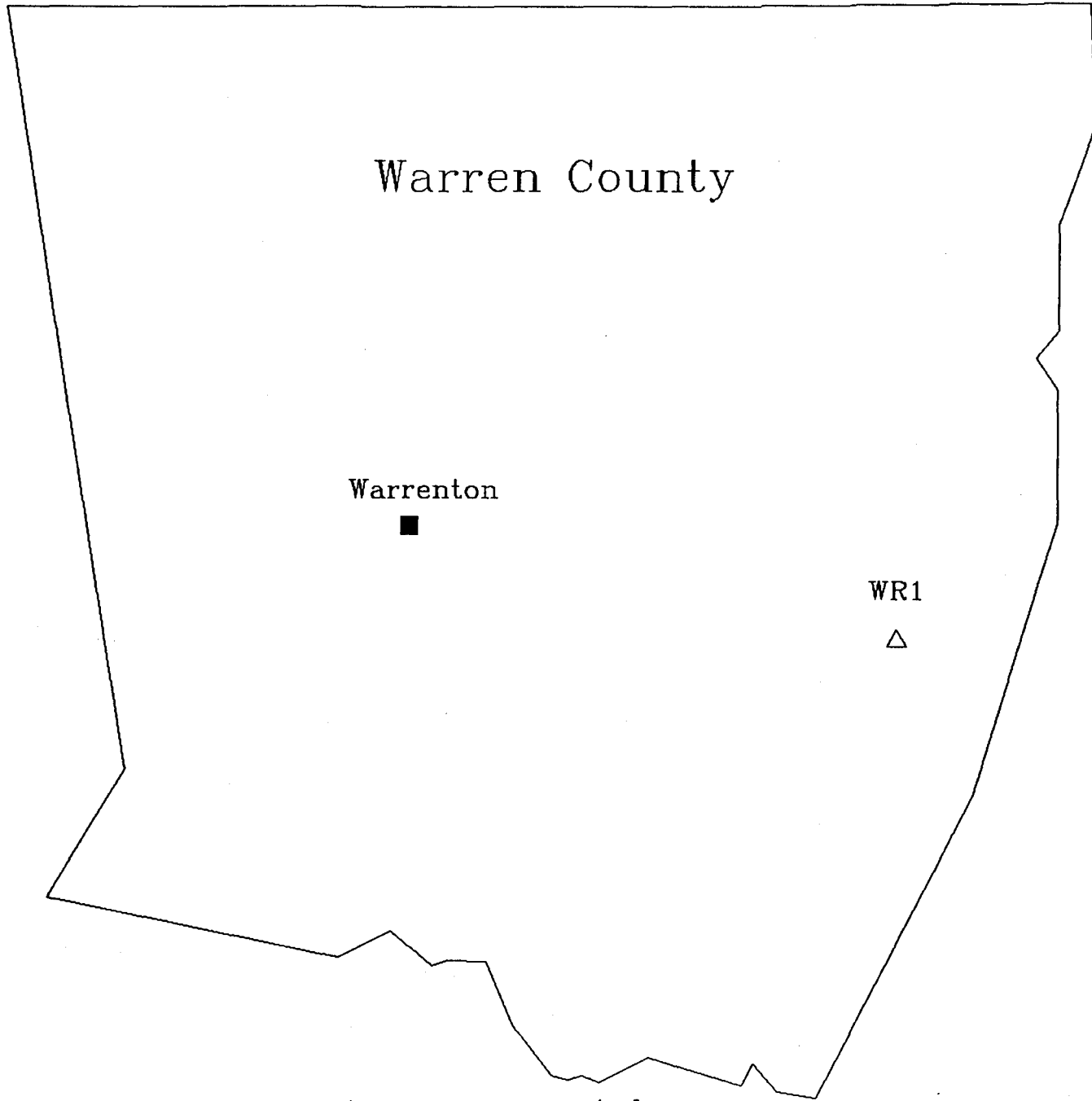
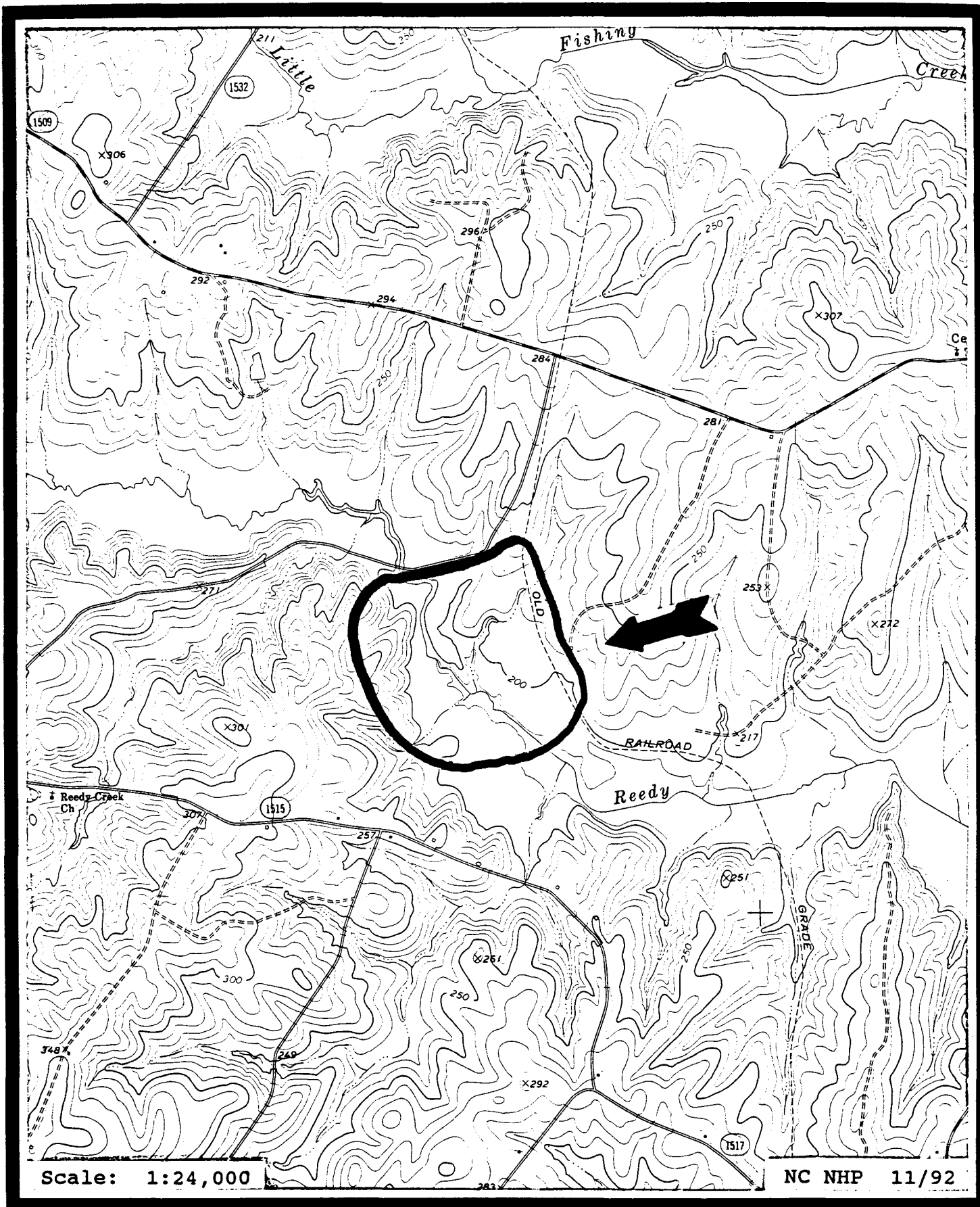


Figure 20. Significant natural areas in the A/P III study area portion of Warren County



Site Name: Reedy Creek Hardwood Forests
 Site Code: WR1
 Quadrangle: Hollister

SITE NAME: Reedy Creek Hardwood Forests

SITE CODE: WR1

SIZE: 190 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Warren

QUADRANGLE: Hollister

LOCATION: This site is in the Tar River watershed in southeastern Warren County in the Piedmont Province of North Carolina. It is on both sides of Reedy Creek south of SR 1512; north of SR 1515.

SIGNIFICANT FEATURES: This site contains a very extensive mature Piedmont/Mountain Bottomland Forest.

GENERAL DESCRIPTION:

This natural area contains a very extensive and mature Piedmont/Mountain Bottomland Forest along the floodplain of Reedy Creek. Two other natural community types are also present in this natural area: Piedmont/Mountain Swamp Forest and Piedmont/Mountain Levee Forest. The canopies of these forests are composed of large, mature trees, some with dbh's up to 4-5 feet. In one area of this forest where the soil is poorly drained, the forest is a Piedmont/Mountain Swamp Forest with a canopy composed mostly of swamp cottonwood (Populus heterophylla), rare in the Piedmont, and overcup oak (Quercus lyrata). In other areas along the creek where drainage is good, the forest is a Piedmont/Mountain Bottomland Forest with a canopy dominated more by swamp chestnut oak (Q. michauxii), Shumard's oak (Q. shumardii), cherrybark oak (Q. pagoda), shagbark hickory (Carya ovata), and American beech (Fagus grandifolia).

The shrub layers in these forests are fairly distinct and are characterized by tall individuals of common pawpaw (Asimina triloba), spicebush (Lindera benzoin), and American hornbeam (Carpinus caroliniana). The herb layers are covered 75-100% by sedges (Carex spp.), trout lily (Erythronium umbilicatum), Virginia springbeauty (Claytonia virginiana), Atamasco lily (Zephyranthes atamasco), wild geranium (Geranium maculatum), and others.

OWNERSHIP: Presumed privately owned; leased to deer hunting club.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: Much of the surrounding land is owned by timber corporations and has been converted to large-scale loblolly pine plantations. Few stands of hardwoods remain in the area. Logging is a potential threat and the landowner should be encouraged not to clearcut the site.

COMMENTS: A logging trail winds through this natural area, and SR 1512 runs along the northern side of the tract. Other than its use by the local deer hunting club during hunting season, this site appears to be little used. The natural area has not been visited by biologists in perhaps five years. Whether or not it still exists in a viable condition is unknown.

REFERENCES:

Lynch, J.M. 1985. Reedy Creek. Site Survey Summary. N.C. Natural Heritage Program.

WAYNE COUNTY NATURAL AREAS

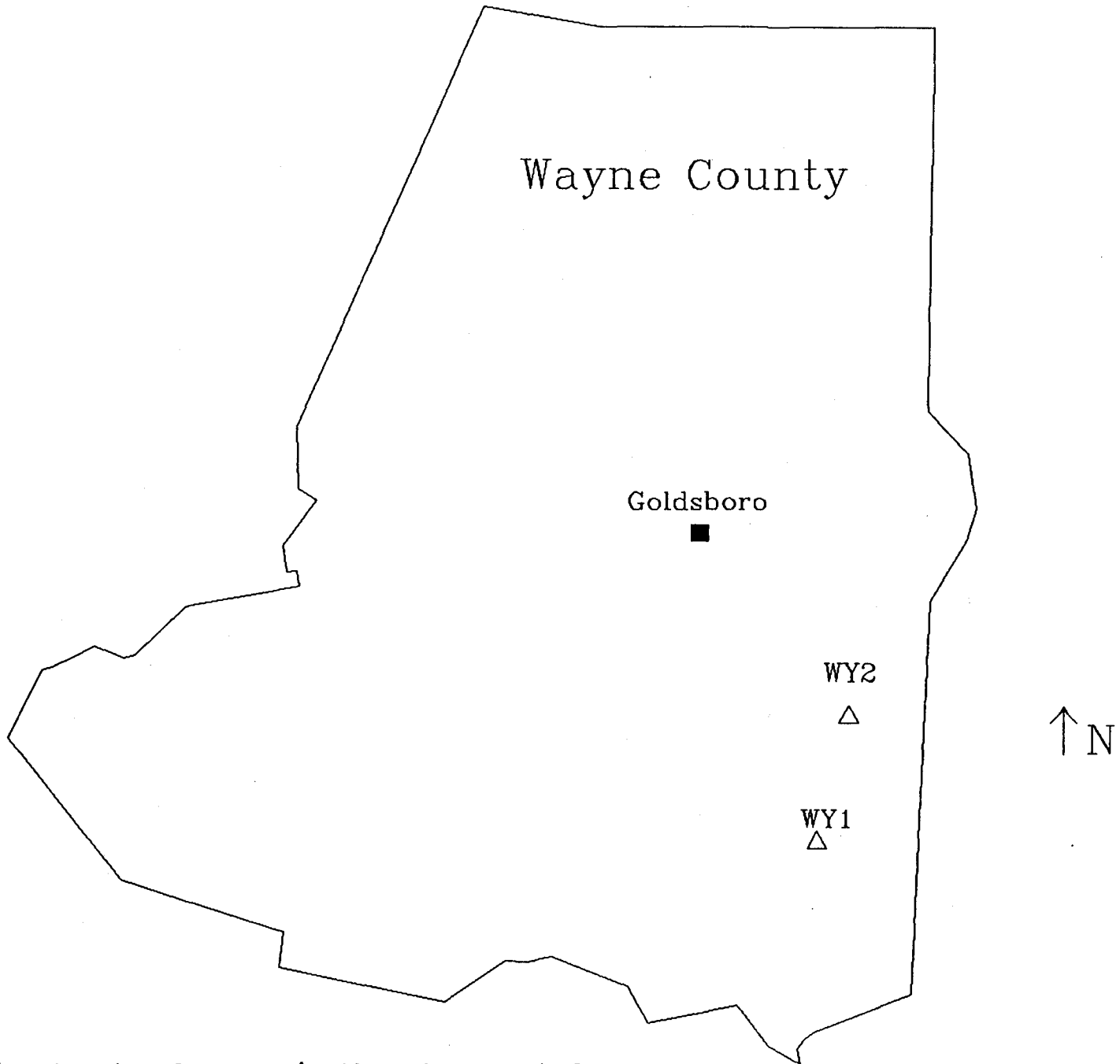
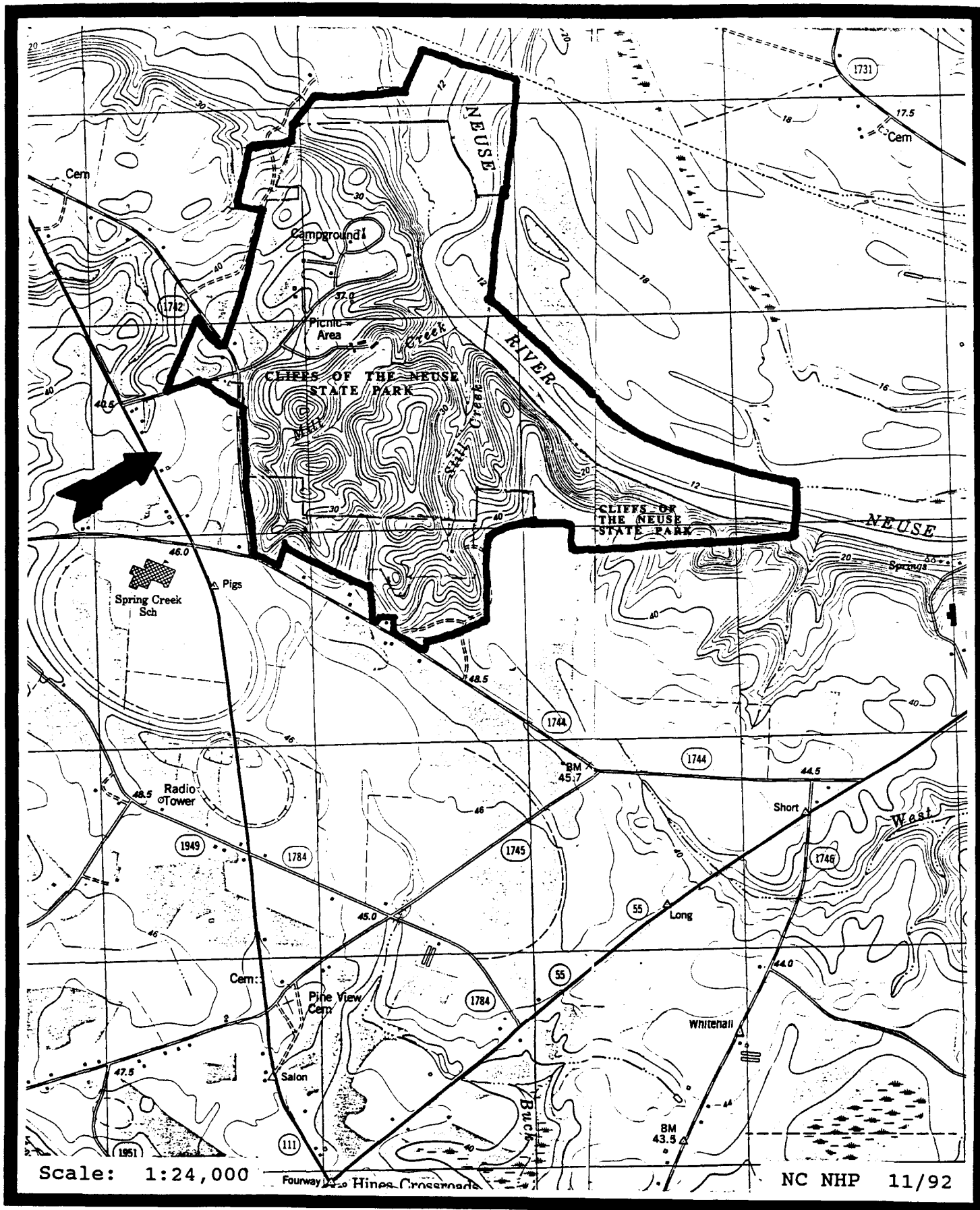


Figure 21. Significant natural areas in the A/P III study area portion of Wayne County



Site Name: Cliffs of the Neuse State Park
 Site Code: WY1
 Quadrangle: Seven Springs, Williams

SITE NAME: Cliffs of the Neuse State Park

SITE CODE: WY1

SIZE: 750 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wayne

QUADRANGLE: Seven Springs, Williams

LOCATION: This site is in the Neuse River watershed in southeastern Wayne County in the Coastal Plain Province of North Carolina. It is about 13 miles southeast of Goldsboro, N.C. on NC 111 near Seven Springs, N.C.

SIGNIFICANT FEATURES:

1. This natural area contains one of the most extensive examples of a Piedmont/Coastal Plain Acidic Cliff natural community in the Coastal Plain.

2. This site supports good quality examples of Sand and Mud Bar, Cypress-Gum Swamp (Brownwater Subtype), Coastal Plain Bottomland Hardwoods (Brownwater Subtype), Mesic Mixed Hardwood Forest (Coastal Plain Subtype, Bluff/Slope Variant), Dry Oak-Hickory Forest, and Dry-Mesic Oak--Hickory Forest natural communities.

3. The cliffs at this site are highly significant geologically as they contain a large section of the strata of Coastal Plain sediments. This natural area is also an important fossil site.

GENERAL DESCRIPTION:

The most striking feature of this state park is the nearly 100-foot high sedimentary cliff along the southern side of the Neuse River. The cliff is composed of layers of sand and gravel and is primarily of Cretaceous age. It is of great geologic significance as one of the best cross-sections of the sediments that make up the Coastal Plain, and as a fossil site. Away from the cliff the topography consists primarily of slopes dissected by ravines and of the floodplain of the Neuse River. The floodplain has representatives of typical fluvial landforms such as sloughs, ridges, and natural levees. Soils range from sandy to clayey and are primarily of the Ultisol order.

The diverse environments of the park support seven natural community types. The most unusual is the Piedmont/Coastal Plain Acidic Cliff, which is perhaps the largest and best developed example in the Coastal Plain. Much of the cliff is bare sediment, with only scattered small plants. Around the edges there is greater cover of herbs, shrubs, and trees, and the vegetation grades into that of the adjacent forests.

The dissected uplands range from dry to moist, according to slope aspect and degree of sheltering. The dissected terrain

provided protection from the natural fires that once swept the Coastal Plain and allowed hardwood forests to persist.

Upper slopes support Dry Oak--Hickory Forest, dominated by white oak (Quercus alba), southern red oak (Q. falcata), post oak (Q. stellata), and pines (Pinus taeda, P. echinata). The driest parts contain some species typical of the Xeric Sandhill Scrub community type, such as longleaf pine (Pinus palustris) and turkey oak (Q. laevis). Moister areas support Dry-Mesic Oak--Hickory Forest, dominated by white oak, black oak (Q. velutina), red oak (Q. rubra), hickories (Carya spp.), and loblolly pine. North-facing slopes and lower slopes contain Mesic Mixed Hardwood Forest (Coastal Plain Subtype) characterized by American beech (Fagus grandifolia), red oak, white oak, and sweetgum (Liquidambar styraciflua). The hardwood forests range from young to mature.

The most extensive floodplain natural community present is Coastal Plain Bottomland Hardwoods (Brownwater Subtype). The forest is dominated by sweetgum, loblolly pine, overcup oak (Q. lyrata), and other bottomland hardwoods. Some areas formerly occupied by Bottomland Hardwoods were farmed and now support successional loblolly pine stands. Smaller areas of Cypress-Gum Swamp (Brownwater Subtype) occur in sloughs and small backswamp basins. They are dominated by baldcypress (Taxodium distichum) and swamp tupelo (Nyssa biflora). Most of these forests are young to mature, but some very large trees occur.

OWNERSHIP: This natural area is owned by the state and is administered by the N.C. Division of Parks and Recreation.

PROTECTION STATUS: This site is a Registered Natural Heritage Area and much of it is a State Park.

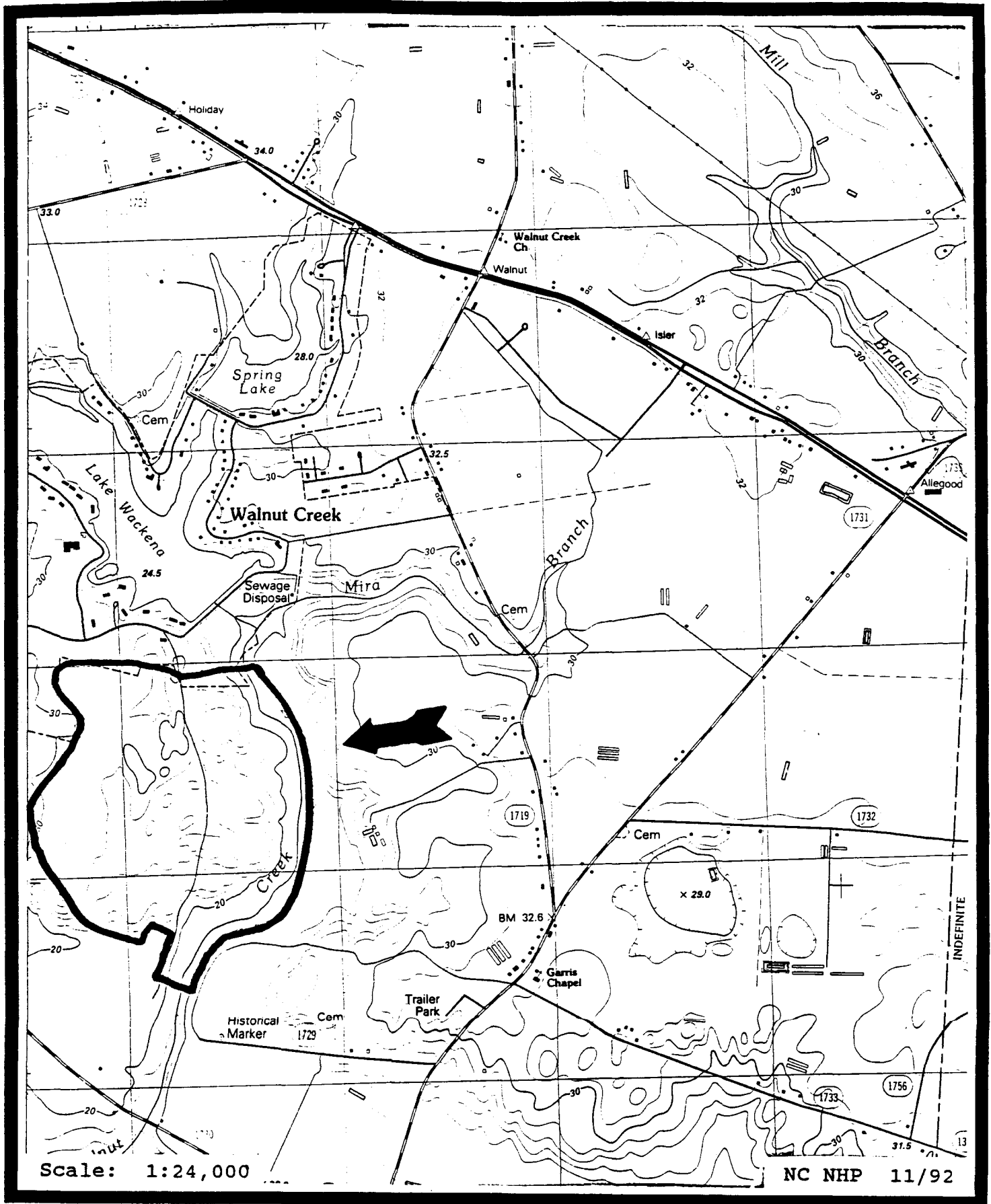
MANAGEMENT OR PROTECTION RECOMMENDATIONS: The most significant natural areas within this site are registered with the N.C. Natural Heritage Program. The most significant areas should be dedicated.

COMMENTS: None

REFERENCES:

- Bruton, V.C. 1968. Floristic survey and vegetational analysis of Cliffs of the Neuse State Park in North Carolina. M.S. Thesis, Botany Dept., North Carolina State University.
- Deyle, R.E. and E.L. Smith. 1976. Cliffs of the Neuse Natural Area, eastern section. Report to Div. of Parks and Recreation, Raleigh, N.C.
- Division of Parks and Recreation. 1977. Cliffs of the Neuse Master Plan. Master Planning Unit, Div. of Parks and Recreation, Raleigh, N.C.
- Ferenczi, I. 1958. The geology of "The Cliffs of the Neuse State Park" and its surrounding area. Report to Div. of Parks and Recreation

Wilson, J. 1975. Cliffs of the Neuse Natural Area. Report to
Report to Div. of Parks and Recreation, Raleigh, N.C.



Site Name: Walnut Creek Sandhills
 Site Code: WY2
 Quadrangle: La Grange

SITE NAME: Walnut Creek Sandhills

SITE CODE: WY2

SIZE: 340 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wayne

QUADRANGLE: LaGrange

LOCATION: This site is in the Neuse River watershed in eastern Wayne County in the Coastal Plain Province of North Carolina. It is just south of Lake Wackena and the Walnut Creek subdivision; about 2 miles south of US 70 and 1 mile west of SR 1719, on the west side of Walnut Creek.

SIGNIFICANT FEATURES:

1. This is the best example of a longleaf pine community in Wayne County and is one of the northernmost well-developed examples remaining in the state.

2. The habitat appears suitable for red-cockaded woodpeckers (Picoides borealis), a Federally Endangered species.

GENERAL DESCRIPTION:

This natural area is composed of gently rolling sandhills dominated by longleaf pine (Pinus palustris) and xerophytic oaks. The oaks at this site are quite thick in some areas, but most of the natural area has a fairly open canopy. The plant diversity at this site is quite good and many characteristic sandhill plants are present. This natural area supports good wildlife habitat. The geology is of the Black Creek Formation. The soils are of Lakeland sand, Wagram loamy sand, Troup sand, Kenansville loamy sand (west edge of the area), and Johnston loam (along Walnut Creek).

This natural area supports four community types: Pine/Scrub Oak Sandhill, Xeric Sandhill Scrub, Dry Oak-Hickory Forest, and Coastal Plain Semipermanent Impoundment. These communities are in good condition and have mature canopies and well-developed herb layers. The Pine/Scrub Oak Sandhill is a good quality forest and has a high plant diversity. It covers most of the sandhill area, except for the slopes to the creek and the higher, drier sites. It is dominated by longleaf pine, turkey oak (Quercus laevis), and dwarf post oak (Q. margarettae). Mature longleaf pine is found throughout the area along with many sandhill plants such as cluster-spike indigo-bush (Amorpha herbacea), dwarf huckleberry (Gaylussacia dumosa), waxmyrtle (Myrica cerifera), wiregrass (Aristida stricta), and woolly chaffhead (Carphephorus bellidifolius). Among the less common plants are swamp milkweed (Asclepias humistrata), and Carolina indigo (Indigofera caroliniana).

The Xeric Sandhill Scrub community is found on the highest ridges and flats. It contains some areas of bare sand with less litter and a semi-open canopy. It is dominated by turkey oak, longleaf pine, and wiregrass. This community has many of the

same common species as the Pine/Scrub Oak Sandhill community. The Dry Oak-Hickory Forest occurs on the slopes and low areas in the southern part of the natural area near Walnut Creek. It has a closed canopy with a number of tree species which do not occur in the rest of the natural area. These trees include sassafras (Sassafras albidum), southern red oak (Q. falcata), sweetgum (Liquidambar styraciflua), flowering dogwood (Cornus florida), and chinquapin (Castanea pumila).

The Coastal Plain Semipermanent Impoundment is located on Walnut Creek and is a beaver pond. Several of the plant species present there are inkberry (Ilex glabra), titi (Cyrilla racemiflora), southern lady fern (Athyrium filix-femina var. asplenioides), slender spikegrass (Chasmanthium laxum), cinnamon fern (Osmunda cinnamomea), and Virginia chainfern (Woodwardia virginica).

Numerous bird species are present in this natural area, many of which occur at the Semipermanent Impoundment. Some examples of these bird species are: yellow-billed cuckoo (Coccyzus americanus), great crested flycatcher (Myiarchus crinitus), pine warbler (Dendroica pinus), and prothonotary warbler (Protonotaria citrea). Other wildlife present at this site are: beaver (Castor canadensis), red fox (Vulpes), white-tailed deer (Odocoileus virginianus), ground skink (Scincella lateralis), southern toad (Bufo terrestris), bullfrog (Rana catesbeiana), six-lined racerunner (Cnemidophorus sexlineatus), and various turtle species.

OWNERSHIP: Multiple private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: This area is highly threatened. New housing in the area is starting to encroach into the edges of this natural area. The land adjacent to this site has been developed for housing, a reservoir, a golf course, and agricultural fields. The Walnut Creek subdivision is located in a botanically significant area. Many of the vacant lots west of Lake Wackena contain unusual plants for this area, such as live oak (Q. virginiana) and pond pine (P. serotina). If some of these lots were left undeveloped, these plants could be preserved. The sandhill area needs to be burned to preserve its high quality, but considering the development nearby, such burning is extremely unlikely to occur. Protection would be best achieved through acquisition or conservation easement.

COMMENTS: This site has large longleaf pines and therefore has potential for red-cockaded woodpeckers.

REFERENCES:

Nordman, C. and H. LeGrand. 1991. Walnut Creek Sandhills. Site Survey Report. N.C. Natural Heritage Program.

WILSON COUNTY NATURAL AREAS

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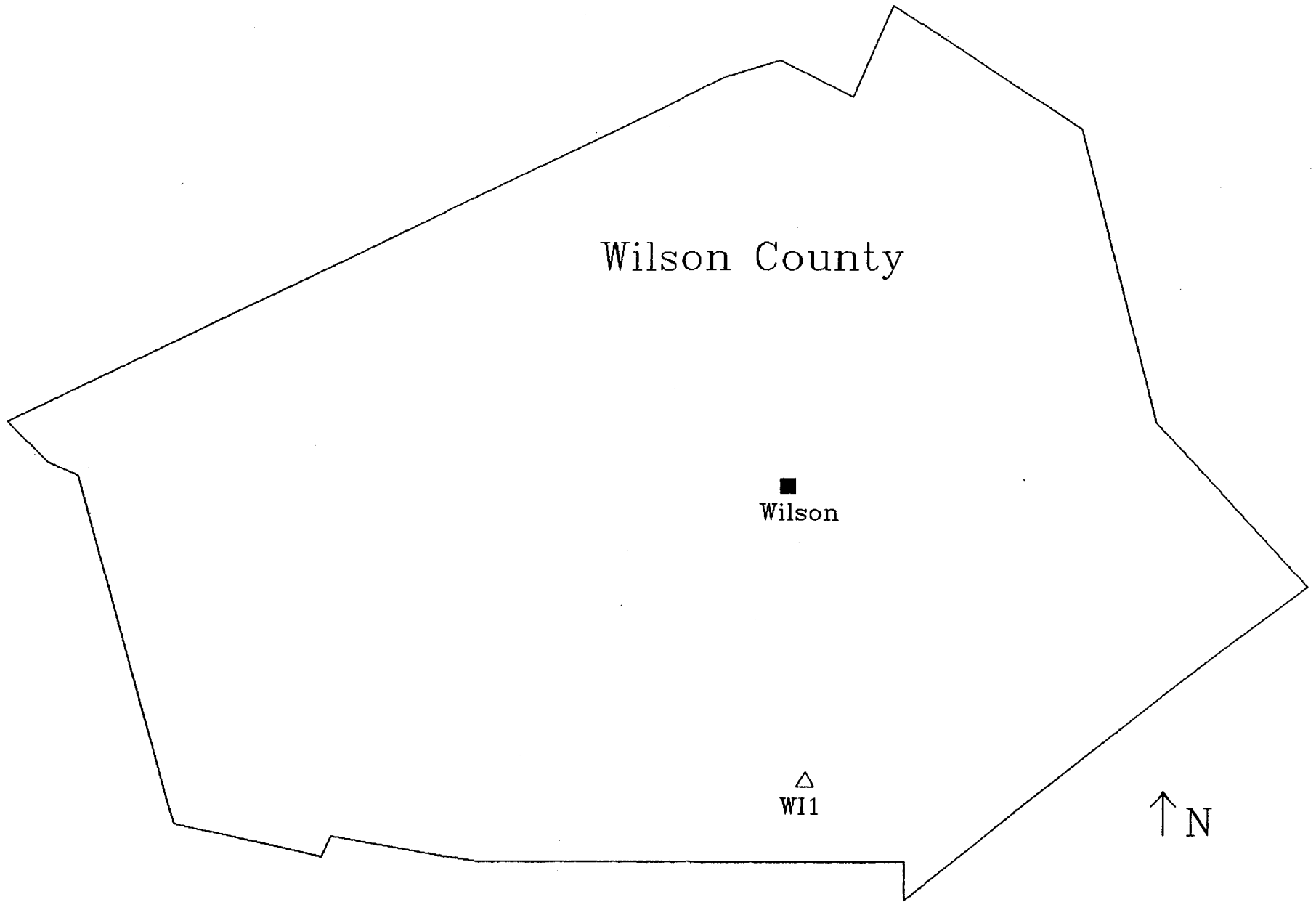
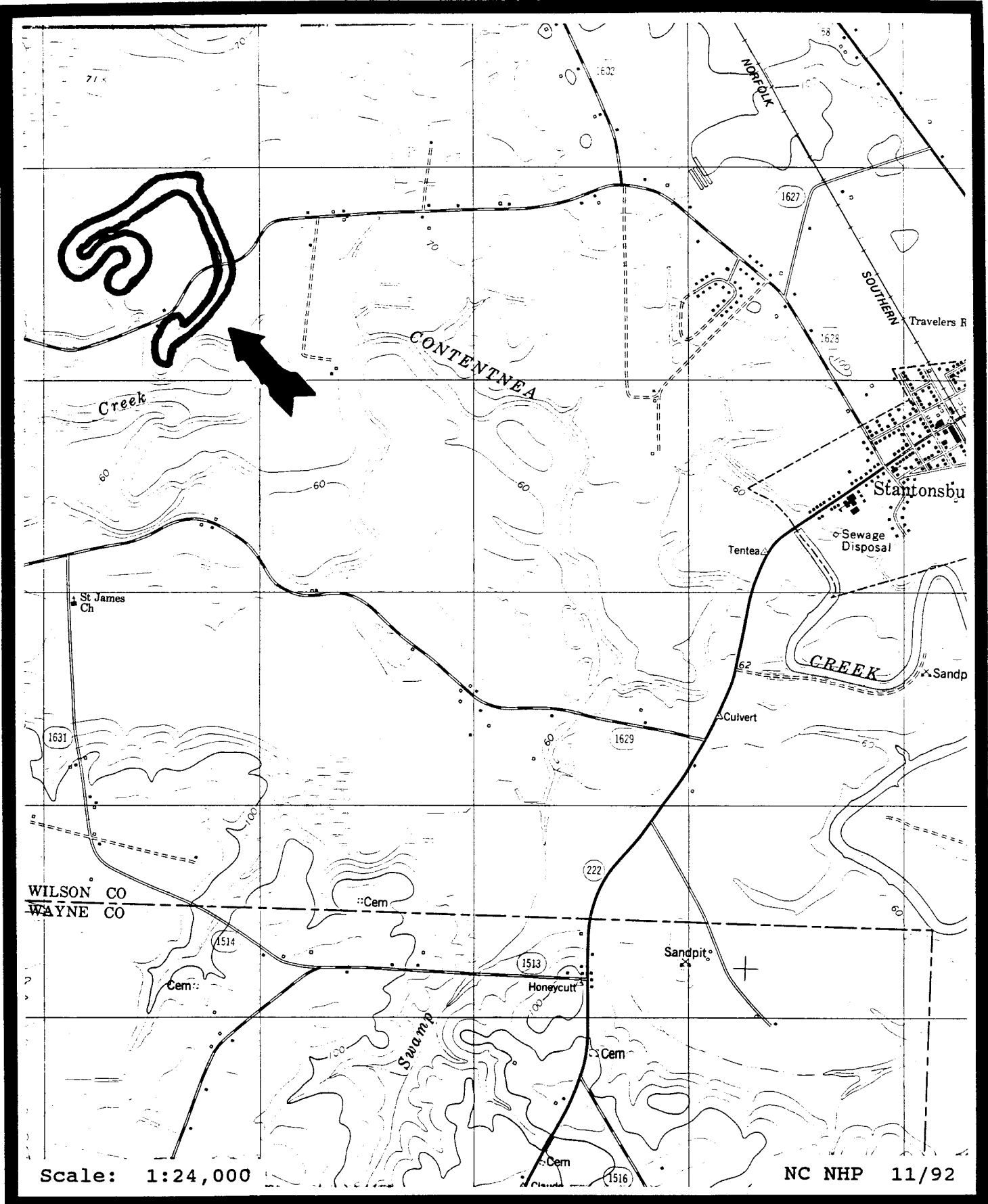


Figure 22. Significant natural areas in the A/P III study area portion of Wilson County



Site Name: Stantonsburg Oxbow Lake
 Site Code: WI1
 Quadrangle: Stantonsburg

SITE NAME: Stantonsburg Oxbow Lake

SITE CODE: WI1

SIZE: 33 acres

SITE SIGNIFICANCE: C (Regional)

COUNTY: Wilson

QUADRANGLE: Stantonsburg

LOCATION: This site is in the Neuse River watershed in Wilson County in the Coastal Plain Province of North Carolina. It is about 2 miles west of Stantonsburg, N.C. at the SR 1628 bridge; just north of the confluence of Black Creek and Contentnea Creek.

SIGNIFICANT FEATURES: This site contains a good quality Oxbow Lake, which is a rare natural community type.

GENERAL DESCRIPTION:

This site contains a true Oxbow Lake nearly 1 mile long with standing water a few feet deep. It was formerly a bend in Contentnea Creek, but the bend was later cut-off, leaving the oxbow lake disconnected from the creek. The site belongs to the Yorktown Formation and has Wehadkee and Chewacla loam soils. The lands adjacent to this oxbow appear to be clearcut. The oxbow itself appears to be in good condition and its drainage has not been altered.

The Oxbow Lake natural community present at this site is dominated by water tupelo (*Nyssa aquatica*). Other tree species present are river birch (*Betula nigra*), various willows (*Salix* sp.), water oak (*Quercus nigra*), willow oak (*Q. phellos*), and sweetgum (*Liquidambar styraciflua*). This natural area also contains outstanding wildlife habitat. Several species of birds were reported for this site as well as many dragonflies.

OWNERSHIP: Private ownership.

PROTECTION STATUS: None

MANAGEMENT OR PROTECTION RECOMMENDATIONS: It is recommended that this site not be drained. Logging should be limited or avoided in this natural area. This natural community would be suitable as a Wildlife Resources Commission game land or would be suitable as a registry agreement.

COMMENTS: The site was not surveyed thoroughly and it is recommended that a more comprehensive survey be done.

REFERENCES:

Nordman, C. 1991. Big Oxbow by Contentnea Creek. Site Survey Report. N.C. Natural Heritage Program.

APPENDIX: Site Survey Report Form

SITE SURVEY REPORT

-- N.C. Natural Heritage Program
 P.O. Box 27687 / Raleigh NC 27611

Date: 4/22 & 5/3/91
 Quad Name: Four Oaks
 County: Johnston Co.

Name of Site: Black Creek Bluff & sandhill
 Surveyors: Carl Nordman
 Location & Directions: wooded longleaf area on hill approx. 1/2 mile west of SR 1162 on SR 1308. Site is about 2 miles northwest of Four Oaks.

Size: ca. 120 acres Province: Coastal Plain Watershed: Black Creek → Neuse River
 Owners and address: Not known (CEI) 03020201

Owner contacted & attitude: No

General Landscape Description:

SR 1308 goes through the pine/scrub oak sandhill section of this site. The highest point is just south of the road. From here it gently slopes to the north to the very steep bluff. *Kalmia latifolia*, *Galax*, and *Trailing Arbutus* are found on the bluff. Below the bluff is a flat bottomland area, much of which is permanently wet. The site has an entire range of moisture.

Physical Description: conditions and also diverse natural communities.

Aspect:	Slope:	Topog. Position:	Hydrology:	Moisture:
<input checked="" type="checkbox"/> N	<input type="checkbox"/> flat	<input checked="" type="checkbox"/> crest	<input checked="" type="checkbox"/> terrestrial	<input type="checkbox"/> inundated
<input type="checkbox"/> E	<input checked="" type="checkbox"/> 0-5	<input checked="" type="checkbox"/> upper slope	<input checked="" type="checkbox"/> palustrine	<input checked="" type="checkbox"/> seasonally flooded
<input type="checkbox"/> S	<input type="checkbox"/> 5-10	<input checked="" type="checkbox"/> mid slope	<input type="checkbox"/> estuarine	<input checked="" type="checkbox"/> frequently flooded
<input type="checkbox"/> W	<input checked="" type="checkbox"/> 10-35	<input checked="" type="checkbox"/> lower slope	<input type="checkbox"/> riverine	<input type="checkbox"/> seasonally wet
<input type="checkbox"/> flat	<input checked="" type="checkbox"/> 35 +	<input type="checkbox"/> upland flat	<input type="checkbox"/> lacustrine	<input type="checkbox"/> wet mesic
<input type="checkbox"/> all	<input type="checkbox"/> vertical	<input checked="" type="checkbox"/> alluvial flat	<input type="checkbox"/> subterranean	<input type="checkbox"/> mesic
		<input type="checkbox"/> nonalluvial flat	<input type="checkbox"/> marine	<input checked="" type="checkbox"/> dry mesic
Elevation: <u>210' - 120'</u>				<input checked="" type="checkbox"/> xeric (dry)

Geology:

CAPE FEAR FORMATION

Soils (series if known, correlated with Natural Communities, p.2, if possible):

Comments on Physical Description:

Sand hill area is extremely dry, but below the bluffs above Black Creek Springs feed small tributaries to the Black Creek. The bluff is very steep, near vertical in some places.

Biological Description:

Natural Communities. List communities and for each describe:

- A) name of community (see Schafale & Weakley) & size,
- B) vegetation structure,
- C) dominants & important spp. by strata,
- D) position in landscape & relation to other communities,
- E) quality & condition,
- F) size

CT-1 PINE / SCRUB OAK SANDHILL

An open forest with sparse herb layer and mainly ericaceous shrubs. Canopy layer consists of dry site oaks, *Carya pallida*, and a mix of Longleaf and loblolly pines.

Subcanopy is dominated by *Q. marilandica* (Blackjack Oak). This is a high quality Longleaf site for Johnston Co. The number and age of trees (to ~350 yrs.) and the good seedling regeneration are significant.

CT-2 PIEDMONT / COASTAL PLAIN HEATH BLUFF

The bluff extends beyond the area surveyed. *Pussycats*, *Galax*, and *Trailing Arbutus* dominate the herb layer. *Simplocos* and *Witch-hazel* are the dominant shrubs and *Kalmia latifolia* is also dominant and impenetrable in areas. Above the bluff the PINE / SCRUB OAK SANDHILL community and below the bluff is CT-3. The bluff is in good condition. It is narrow but extends about 1 mile along Black Creek, most of which was not surveyed.

CT-3 COASTAL PLAIN BOTTOMLAND HARDWOODS (B ^{water sibly})

Canopy composed of bottomland hardwoods; *Q. michauxii*, *Q. nigra*, *Acer*, *Nyssa* sp., *Liquidambar*, *Liriodendron*, etc. Herb layer is diverse, many vines are also present. The condition is not pristine, there is evidence of logging, and the average tree size is not very large. This community covers a large area, much of it was not explored however.

Special Status Species present (attach forms):

Potential for other Special Status Species:

Other noteworthy species or features present:

50-60 large Longleaf pines with good reproduction & as many small trees and seedlings. Many boxfaced stumps and evidence of turpentine on several of the Longleaf pine trees.

Site Integrity: high good fair poor

Average DBH of canopy trees: 10-20"

Maximum DBH of canopy trees: 25"

Fire regime (natural, suppression, date of most recent, etc.):

The longleaf area has been selectively logged, a fire regime is recommended to keep the *Acer rubrum* & sweetgum out, and encourage longleaf regeneration.

logged (when, describe):

selectively 10-20 yrs ago. (I believe, not sure) the canopy is relatively open.

even-aged canopy (successional stand from pasture or clearcut):

non-native or weedy spp. present (list and describe):

Lonocera japonica in floodplain. *Acer rubrum* & sweetgum seedlings in sandhill are

ditched/draind (describe):

stream channelized:

dredging/filling:

understory cleared:

grazing:

ORV damage (describe):

other (describe):

Adjacent land use (describe):

Old fields, forestry (loblolly pine plantations)

Significance of site: (high quality and/or rare communities, rare spp., etc.):

Discussion:

The high quality longleaf pines in the Pine/scrub Oak sandhill community, and the good condition of the adjacent bluff, make this an important site. Seedling regeneration of longleaf is excellent, this is not a site where longleaf is being lost, it is healthy and competing well.

national
 state
 regional
 county
 local
 low

Protection Considerations and Management Needs: (discuss recommended protection for natural area, and management needed to maintain or improve quality of site, such as fire, ORV exclusion, fencing, blocking drainage, etc.)

Fire may be necessary as part of a management plan for the Longleaf pine area. Selective logging may also be effective at maintaining open habitat for seedlings. ORV exclusion would be logical, no evidence of ORV use was seen. This is an important site to have a landowner agreement. I hope this will be practical, two residences are within the site along SR 1308. These may be owners.

Documentation

Survey boundaries (describe why your survey stopped where it did):

To the south area became wetter with no longleaf, old fields were found to the East and West.

Priority for further survey (why, for what, at what season):

East and west along the bluff may turn up more interesting plants. Survey later in year for sandhill herbs.

Specimens collected (plants, animals, soil, rock - of what and state repository):

Photographs (of what):

Others knowledgeable about site:

TOPO MAP ATTACHED

Sketch of site or part of site attached (as needed or appropriate, to show access, rare spp., relative positions of communities, etc., particularly if cannot be well-portrayed on attached topo map).

PLANT SPECIES LIST (page 2)

SHRUBS:

VINES:

D = Stratal Dominant

* = Special Status Species

	CT-								CT-							
	1	2	3						1	2	3					
<i>Alnus serrulata</i>			✓						<i>Gelsemium sempervirens</i>	✓						
<i>Arundinaria gigantea</i>			✓						<i>Lonicera japonica</i>			✓				
<i>Clethra alnifolia</i>			✓						<i>Parthenocissus quinquef.</i>			✓				
<i>Cyrilla racemiflora</i>			✓						<i>Smilax glauca</i>		✓					
<i>Kalmia latifolia</i>	✓	✓							<i>Smilax laurifolia</i>			✓				
<i>Magnolia virginica</i>	✓		✓						<i>Smilax rotundifolia</i>			✓				
<i>Persea palustris</i>			✓						<i>Toxicodendron radicans</i>	✓		✓				
<i>Quercus margareta</i>	✓								<i>Vitis rotundifolia</i>	✓		✓				
<i>Rhododendron atlanticum</i>	✓								<i>Toxicodendron pubescens</i>	✓						
<i>Rhododendron nudiflorum</i>		✓														
<i>Lyonia mariana</i>	✓															
<i>Gaylussacia dumosa</i>	✓															
<i>Vaccinium arborium</i>	✓	✓														
<i>Vaccinium stamineum</i>	✓															
<i>Cephalanthus occidentalis</i>			✓													
<i>Vaccinium tenellum</i>	✓															
<i>Hamamelis virginiana</i>	✓															
<i>Xanthorhiza simplicissima</i>	✓															
<i>Symplocos tinctoria</i>	✓															
									EPIPHYTES:							
									<i>Polypodium polypodioides</i>			✓				

WILSON

DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

DEPARTMENT OF NATURAL RESOURCES
RALEIGH, N.C.

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